E- Syllabus of Subjects
Highlighting
Dissertation/ project work/Internship

Science College, Kokrajhar
Assam-783370

BODOLAND UNIVERSITY

B.Sc. Syllabus in Chemistry under Choice Based Credit System (CBCS)

Bodoland University
Kokrajhar–783370, Assam, India

B.Sc. with Chemistry Honours

Sl. No.	CORE COURSE (14)	Ability Enhancement Compulsory Course (AECC) (2)	Skill Enhancement Course (SEC) (2)	Discipline Specific Elective (DSE) (4)	Generic Elective (GE) (4)
I	**Inorganic Chemistry-I** (4+2) **Physical Chemistry-I** (4+2)	(English/Hindi/ MIL Communication)			GE-1 (*Chemistry-1*)
II	**Organic Chemistry-I** (4+2) **Physical Chemistry-II** (4+2)	Environmental Science			GE-2 (*Chemistry-2*)
III	**Inorganic Chemistry-II** (4+2) **Organic Chemistry-II** (4+2) **Physical Chemistry-III** (4+2)		SEC-1 (Basic Analytical Chemistry)		GE-3 (*Chemistry-3*)
IV	**Inorganic Chemistry-III** (4+2) **Organic Chemistry-III** (4+2) **Physical Chemistry-IV** (4+2)		SEC-2 (Fuel Chemistry**)**		GE-4 (*Chemistry-4*)
V	**Organic Chemistry-IV** (4+2)			DSE-1 (Analytical Methods in Chemistry)	
	Physical Chemistry-V (4+2)			DSE-2 (Instrumental Methods of Chemical Analysis)	
VI	**Inorganic Chemistry-IV** (4+2)			DSE-3 (Applications of Computers in Chemistry)	
	Organic Chemistry-V (4+2)			DSE-4 (Dissertation)	

- **Chemistry Generic Elective (GE) papers for the honours students of other Departments/Disciplines (like Physics, Mathematics, Botany, Zoology, etc.).**
  GE-1: *Chemistry-1*, **GE-2**: *Chemistry-2*, **GE-3**: *Chemistry-3*, **GE-4**: *Chemistry-4.*

- **Chemistry honours students have to choose GE papers from other Departments/Disciplines. However, at least two GE Mathematics papers are compulsory for admission in M.Sc. Chemistry in Bodoland University.**

Curriculum Structures for B.Sc. Chemistry Honours
No. of papers =14+12=26
Total Credits = 140, Total Marks = 2400

SEMESTER-I						
Paper Code	**Course**	**L+T+P**	**Credit**	**End Sem Marks**	**Internal Marks**	**Total Marks**
CHY-101H	CC 1: Inorganic Chemistry-I	4+0+2	6	60(L)+20(P)	20	100
CHY-102H	CC 2: Physical Chemistry-I	4+0+2	6	60(L)+20(P)	20	100
Paper	GE-1	4+0+2	6	60(L)+20(P)	20	100
COMM-104HR	AECC-1: (English /Hindi/MIL Communication)	2	2	50(L)	-	50
Total		**20**	**20**	**290**	**60**	**350**

SEMESTER-II						
Paper Code	**Course**	**L+T+P**	**Credit**	**End Sem Marks**	**Internal Marks**	**Total Marks**
CHY-201H	CC 3: Organic Chemistry-I	4+0+2	6	60(L)+20(P)	20	100
CHY -202H	CC 4: Physical Chemistry-II	4+0+2	6	60(L)+20(P)	20	100
Paper	GE-2	4+0+2	6	60(L)+20(P)	20	100
ENV-204HR	AECC-2: Environmental Science	2	2	50(L)	-	50
Total			**20**	**290**	**60**	**350**

SEMESTER-III						
Paper Code	**Course**	**L+T+P**	**Credit**	**End Sem Marks**	**Internal Marks**	**Total Marks**
CHY-301H	CC 5: Inorganic Chemistry-II	4+0+2	6	60(L)+20(P)	20	100
CHY-302H	CC 6: Organic Chemistry-II	4+0+2	6	60(L)+20(P)	20	100
CHY-303H	CC 7: Physical Chemistry-III	4+0+2	6	60(L)+20(P)	20	100
CHY-304HR	SEC-1: Basic Analytical Chemistry	2	2	50(L)	-	50
Paper	GE-3	4+0+2	6	60(L)+20(P)	20	100
Total			**26**	**370**	**80**	**450**

SEMESTER-IV						
Paper Code	**Course**	**L+T+P**	**Credit**	**End Sem Marks**	**Internal Marks**	**Total Marks**
CHY-401H	CC 8: Inorganic Chemistry-III	4+0+2	6	60(L)+20(P)	20	100
CHY-402H	CC 9: Organic Chemistry-III	4+0+2	6	60(L)+20(P)	20	100
CHY-403H	CC 10: Physical Chemistry-IV	4+0+2	6	60(L)+20(P)	20	100
CHY-404HR	SEC-2: Fuel Chemistry	2	2	50(L)	-	50
Paper	GE-4	4+0+2	6	60(L)+20(P)	20	100
Total			**26**	**370**	**80**	**450**

SEMESTER-V						
Paper Code	**Course**	**L+T+P**	**Credit**	**End Sem Marks**	**Internal Marks**	**Total Marks**
CHY-501H	CC 11: Organic Chemistry-IV	4+0+2	6	60(L)+20(P)	20	100
CHY-502H	CC 12: Physical Chemistry-V	4+0+2	6	60(L)+20(P)	20	100
CHY-HR	DSE-1: Analytical Methods in Chemistry	4+0+2	6	60(L)+20(P)	20	100
CHY-HR	DSE-2: Instrumental Methods of Chemical Analysis	4+0+2	6	60(L)+20(P)	20	100
Total			**24**	**320**	**80**	**400**

SEMESTER-VI						
Paper Code	**Course**	**L+T+P**	**Credit**	**End Sem Marks**	**Internal Marks**	**Total Marks**
CHY-601H	CC 13: Inorganic Chemistry-IV	4+0+2	6	60(L)+20(P)	20	100
CHY-602H	CC 14: Organic Chemistry-V	4+0+2	6	60(L)+20(P)	20	100
CHY-H	DSE-3: Applications of Computers in Chemistry	4+0+2	6	60(L)+20(P)	20	100
CHY-H	DSE-4: (Project/Dissertation)	6	6	80	20	100
Total			**24**	**320**	**80**	**400**

B.Sc. HONOURS IN CHEMISTRY (*CORE COURSES*)

SEMESTER I

CHEMISTRY-CC 1: INORGANIC CHEMISTRY-I
(Credits: Theory-04, Practicals-02)
Theory: 60 Lectures

Atomic Structure:
Bohr's theory, its limitations and atomic spectrum of hydrogen atom. Wave mechanics: de Broglie equation, Heisenberg's Uncertainty Principle and its significance, Schrödinger's wave equation, significance of ψ and ψ^2. Quantum numbers and their significance. Normalized and orthogonal wave functions. Sign of wave functions. Radial and angular wave functions for hydrogen atom. Radial and angular distribution curves. Shapes of *s, p, d* and *f* orbitals. Contour boundary and probability diagrams.
Pauli's Exclusion Principle, Hund's rule of maximum multiplicity, Aufbau's principle and its limitations, Variation of orbital energy with atomic number.

(14 Lectures)

Periodicity of Elements:
s, p, d, f block elements, the long form of periodic table. Detailed discussion of the following properties of the elements, with reference to *s* and *p*-block.

(a) Effective nuclear charge, shielding or screening effect, Slater rules, variation of effective nuclear charge in periodic table.
(b) Atomic radii (van der Waals)
(c) Ionic and crystal radii.
(d) Covalent radii (octahedral and tetrahedral)
(e) Ionization enthalpy, Successive ionization enthalpies and factors affecting ionization energy. Applications of ionization enthalpy.
(f) Electron gain enthalpy, trends of electron gain enthalpy.
(g) Electronegativity, Pauling's/ Mulliken's/ Allred Rachow's/ and Mulliken-Jaffé's electronegativity scales. Variation of electronegativity with bond order, partial charge, hybridization, group electronegativity. Sanderson's electron density ratio.

(16 Lectures)

Chemical Bonding:
(i) *Ionic bond:* General characteristics, types of ions, size effects, radius ratio rule and its limitations. Packing of ions in crystals. Born-Landé equation with derivation and importance of Kapustinskii expression for lattice energy. Madelung constant, Born-Haber cycle and its application, Solvation energy.
(ii) *Covalent bond:* Lewis structure, Valence Bond theory (Heitler-London approach).Energetics of hybridization, equivalent and non-equivalent hybrid orbitals. Bent's rule, Resonance and resonance energy, Molecular orbital theory. Molecular orbital diagrams of diatomic and simple polyatomic molecules N_2, O_2, C_2, B_2, F_2, CO, NO, and their ions; HCl, BeF_2, CO_2, (idea of s-p mixing and orbital interaction to be given). Formal charge, Valence shell electron pair repulsion theory (VSEPR), shapes of simple molecules and ions containing lone pairs and bond pairs of electrons, multiple bonding (σ and π bond approach)

and bond lengths.
Covalent character in ionic compounds, polarizing power and polarizability. Fajan's rules and consequences of polarization.
Ionic character in covalent compounds: Bond moment and dipole moment. Percentage ionic character from dipole moment and electronegativity difference.
(iii) *Metallic Bond:* Qualitative idea of valence bond and band theories. Semiconductors and insulators, defects in solids.
(iv) *Weak Chemical Forces:* van der Waals forces, ion-dipole forces, dipole-dipole interactions, induced dipole interactions, Instantaneous dipole-induced dipole interactions. Repulsive forces, Hydrogen bonding (theories of hydrogen bonding, valence bond treatment) Effects of chemical force, melting and boiling points, solubility energetics of dissolution process.

(26 Lectures)

Oxidation-Reduction:
Redox equations, Standard Electrode Potential and its application to inorganic reactions. Principles involved in volumetric analysis to be carried out in class.

(4 Lectures)

Reference Books:

- Lee, J.D. *Concise Inorganic Chemistry* ELBS, 1991.
- Douglas, B.E. and McDaniel, D.H. *Concepts & Models of Inorganic Chemistry* Oxford, 1970
- Atkins, P.W. & Paula, J. *Physical Chemistry*, 10th Ed., Oxford University Press, 2014.
- Day, M.C. and Selbin, J. *Theoretical Inorganic Chemistry*, ACS Publications, 1962.
- Rodger, G.E. *Inorganic and Solid State Chemistry*, Cengage Learning India Edition, 2002.

CHEMISTRY LAB- CC 1 LAB: 60 Lectures

(A) Titrimetric Analysis

(i) Calibration and use of apparatus
(ii) Preparation of solutions of different Molarity/Normality of titrants

(B) Acid-Base Titrations

(i) Estimation of carbonate and hydroxide present together in mixture.
(ii) Estimation of carbonate and bicarbonate present together in a mixture.
(iii) Estimation of free alkali present in different soaps/detergents

(C) Oxidation-Reduction Titrimetry

(i) Estimation of Fe (II) and oxalic acid using standardized $KMnO_4$ solution.
(ii) Estimation of oxalic acid and sodium oxalate in a given mixture.
(iii) Estimation of Fe(II) with $K_2Cr_2O_7$ using internal (diphenylamine, anthranilic acid) and external indicator.

Reference text:

1. Mendham, J., A. I. Vogel's *Quantitative Chemical Analysis 6th Ed.*, Pearson, 2009.

CHEMISTRY–CC 2: PHYSICAL CHEMISTRY-I
(Credits: Theory-04, Practicals-02)
Theory: 60 Lectures

Gaseous state:

Kinetic molecular model of a gas: postulates and derivation of the kinetic gas equation; collision frequency; collision diameter; mean free path and viscosity of gases, including their temperature and pressure dependence, relation between mean free path and coefficient of viscosity, calculation of σ from η; variation of viscosity with temperature and pressure.

Maxwell distribution and its use in evaluating molecular velocities (average, root mean square and most probable) and average kinetic energy, law of equipartition of energy, degrees of freedom and molecular basis of heat capacities.

Behaviour of real gases: Deviations from ideal gas behaviour, compressibility factor, *Z*, and its variation with pressure for different gases. Causes of deviation from ideal behaviour. van der Waals equation of state, its derivation and application in explaining real gas behaviour, mention of other equations of state (Berthelot, Dietrici); virial equation of state; van der Waals equation expressed in virial form and calculation of Boyle temperature. Isotherms of real gases and their comparison with van der Waals isotherms, continuity of states, critical state, relation between critical constants and van der Waals constants, law of corresponding states.

(18 Lectures)

Liquid state:

Qualitative treatment of the structure of the liquid state; Radial distribution function; physical properties of liquids; vapour pressure, surface tension and coefficient of viscosity, and their determination. Effect of addition of various solutes on surface tension and viscosity. Explanation of cleansing action of detergents. Temperature variation of viscosity of liquids and comparison with that of gases.

Qualitative discussion of structure of water.

(6 Lectures)

Solid state:

Nature of the solid state, law of constancy of interfacial angles, law of rational indices, Miller indices, elementary ideas of symmetry, symmetry elements and symmetry operations, qualitative idea of point and space groups, seven crystal systems and fourteen Bravais lattices; X-ray diffraction, Bragg's law, a simple account of rotating crystal method and powder pattern method. Analysis of powder diffraction patterns of NaCl, CsCl and KCl. Defects in crystals. Glasses and liquid crystals.

(16 Lectures)

Ionic equilibria:
Strong, moderate and weak electrolytes, degree of ionization, factors affecting degree of ionization, ionization constant and ionic product of water. Ionization of weak acids and bases, pH scale, common ion effect; dissociation constants of mono-, di-and triprotic acids

(exact treatment).

Salt hydrolysis-calculation of hydrolysis constant, degree of hydrolysis and pH for different salts. Buffer solutions; derivation of Henderson equation and its applications; buffer capacity, buffer range, buffer action and applications of buffers in analytical chemistry and biochemical processes in the human body.

Solubility and solubility product of sparingly soluble salts – applications of solubility product principle. Qualitative treatment of acid – base titration curves (calculation of pH at various stages). Theory of acid–base indicators; selection of indicators and their limitations.

Multistage equilibria in polyelectrolyte systems; hydrolysis and hydrolysis constants.

(20 Lectures)

Reference Books:

- Atkins, P. W. & Paula, J. de *Atkin's Physical Chemistry* 10th Ed., Oxford University Press (2014).
- Ball, D. W. *Physical Chemistry* Thomson Press, India (2007).
- Castellan, G. W. *Physical Chemistry* 4th Ed. Narosa (2004).
- Mortimer, R. G. *Physical Chemistry* 3rd Ed. Elsevier: NOIDA, UP (2009).
- Engel, T. & Reid, P. *Physical Chemistry* 3rd Ed. Pearson (2013).

CHEMISTRY LAB-CC 2 LAB: 60 Lectures

1. **Surface tension measurements.**
   a. Determine the surface tension by (i) drop number (ii) drop weight method.
   b. Study the variation of surface tension of detergent solutions with concentration.
2. **Viscosity measurement using Ostwald's viscometer**.
   a. Determination of viscosity of aqueous solutions of (i) polymer (ii) ethanol and (iii) sugar at room temperature.
   b. Study the variation of viscosity of sucrose solution with the concentration of solute.
3. **Indexing of a given powder diffraction pattern of a cubic crystalline system.**
4. **pH metry**
   a. Study the effect on pH of addition of HCl/NaOH to solutions of acetic acid, sodium acetate and their mixtures.
   b. Preparation of buffer solutions of different pH
      i. Sodium acetate-acetic acid
      ii. Ammonium chloride-ammonium hydroxide
   c. pH metric titration of (i) strong acid vs. strong base, (ii) weak acid vs. strong base.
   d. Determination of dissociation constant of a weak acid.

Reference Books

- Khosla, B. D.; Garg, V. C. &Gulati, A. *Senior Practical Physical Chemistry*, R. Chand & Co.: New Delhi (2011).
- Garland, C. W.; Nibler, J. W. & Shoemaker, D. P. *Experiments in Physical Chemistry8th Ed*.; McGraw-Hill: New York (2003).
- Halpern, A. M. & McBane, G. C. *Experimental Physical Chemistry 3rd Ed.;* W.H. Freeman & Co.: New York (2003).

SEMESTER II

CHEMISTRY-CC 3: ORGANIC CHEMISTRY-I
(Credits: Theory-04, Practicals-02)
Theory: 60 Lectures

Basics of Organic Chemistry

Organic Compounds: Classification, and Nomenclature, Hybridization, Shapes of molecules, Influence of hybridization on bond properties.

Electronic Displacements: Inductive, electromeric, resonance and mesomeric effects, hyperconjugation and their applications; Dipole moment; Organic acids and bases; their relative strength.

Homolytic and Heterolytic fission with suitable examples. Curly arrow rules, formal charges; Electrophiles and Nucleophiles; Nucleophlicity and basicity; Types, shape and their relative stability of carbocations, carbanions, free radicals and carbenes.

Introduction to types of organic reactions and their mechanism: Addition, Elimination and Substitution reactions.

(6 Lectures)

Stereochemistry:

Fischer Projection, Newmann and Sawhorse Projection formulae and their interconversions; Geometrical isomerism: cis–trans and, syn-anti isomerism E/Z notations with C.I.P rules.

Optical Isomerism: Optical Activity, Specific Rotation, Chirality/Asymmetry, Enantiomers, Molecules with two or more chiral-centres, Distereoisomers, meso structures, Racemic mixture and resolution. Relative and absolute configuration: D/L and R/S designations.

(18 Lectures)

Chemistry of Aliphatic Hydrocarbons

A. Carbon-Carbon sigma bonds

Chemistry of alkanes: Formation of alkanes, Wurtz Reaction, Wurtz-Fittig Reactions, Free radical substitutions: Halogenation -relative reactivity and selectivity.

B. Carbon-Carbon pi bonds:

Formation of alkenes and alkynes by elimination reactions, Mechanism of E1, E2, E1cb reactions. Saytzeff and Hofmann eliminations.

Reactions of alkenes: Electrophilic additions their mechanisms (Markownikoff/ Anti-Markownikoff addition), mechanism of oxymercuration-demercuration, hydroboration-oxidation, ozonolysis, reduction (catalytic and chemical), syn and anti-hydroxylation (oxidation). 1,2-and 1,4-addition reactions in conjugated dienes and, Diels-Alder reaction; Allylic and benzylic bromination and mechanism, e.g. propene, 1-butene, toluene, ethyl benzene.

Reactions of alkynes: Acidity, Electrophilic and Nucleophilic additions. Hydration to form carbonyl compounds, Alkylation of terminal alkynes.

C. Cycloalkanes and Conformational Analysis

Types of cycloalkanes and their relative stability, Baeyer strain theory, Conformation analysis of alkanes: Relative stability: Energy diagrams of cyclohexane: Chair, Boat and Twist boat forms; Relative stability with energy diagrams.

(24 Lectures)

Aromatic Hydrocarbons

Aromaticity: Hückel's rule, aromatic character of arenes, cyclic carbocations/carbanions and heterocyclic compounds with suitable examples. Electrophilic aromatic substitution: halogenation, nitration, sulphonation and Friedel-Craft's alkylation/acylation with their mechanism. Directing effects of the groups.

(12 Lectures)

Reference Books:

- Morrison, R. N. & Boyd, R. N. *Organic Chemistry*, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
- Finar, I. L. *Organic Chemistry (Volume 1)*, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
- Finar, I. L. *Organic Chemistry (Volume 2: Stereochemistry and the Chemistry of Natural Products)*, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
- Eliel, E. L. & Wilen, S. H. *Stereochemistry of Organic Compounds*, Wiley: London, 1994.
- Kalsi, P. S. *Stereochemistry Conformation and Mechanism*, New Age International, 2005.
- McMurry, J.E. *Fundamentals of Organic Chemistry*, 7th Ed. Cengage Learning India Edition, 2013.

CHEMISTRY LAB-CC 3 LAB: 60 Lectures

1. Checking the calibration of the thermometer

2. Purification of organic compounds by crystallization using the following solvents:

a. Water
b. Alcohol
c. Alcohol-Water

3. Determination of the melting points of above compounds and unknown organic compounds (Kjeldhal method and electrically heated melting point apparatus)
4. Effect of impurities on the melting point – mixed melting point of two unknown organic compounds

5. Determination of boiling point of liquid compounds. (boiling point lower than and more than 100 °C by distillation and capillary method)

6. Chromatography

a. Separation of a mixture of two amino acids by ascending and horizontal paper chromatography
b. Separation of a mixture of two sugars by ascending paper chromatography
c. Separation of a mixture of o- and p-nitrophenol or o- and p-aminophenol by thin layer chromatography (TLC)

Reference Books

- Mann, F.G. & Saunders, B.C. *Practical Organic Chemistry*, Pearson Education (2009).
- Furniss, B.S.; Hannaford, A.J.; Smith, P.W.G.; Tatchell, A.R. *Practical Organic Chemistry*, *5th Ed.*, Pearson (2012).

CHEMISTRY –CC 4: PHYSICAL CHEMISTRY-II
(Credits: Theory-04, Practicals-02)
Theory: 60 Lectures

Chemical Thermodynamics:

Intensive and extensive variables; state and path functions; isolated, closed and open systems; zeroth law of thermodynamics.

First law: Concept of heat, *q*, work, *w*, internal energy, *U*, and statement of first law; enthalpy, *H* , relation between heat capacities, calculations of *q*, *w*, *U* and *H* for reversible, irreversible and free expansion of gases (ideal and van der Waals) under isothermal and adiabatic conditions.

Thermochemistry: Heats of reactions: standard states; enthalpy of formation of molecules and ions and enthalpy of combustion and its applications; calculation of bond energy, bond dissociation energy and resonance energy from thermochemical data, effect of temperature (Kirchhoff's equations) and pressure on enthalpy of reactions. Adiabatic flame temperature, explosion temperature.

Second Law: Concept of entropy; thermodynamic scale of temperature, statement of the second law of thermodynamics; molecular and statistical interpretation of entropy. Calculation of entropy change for reversible and irreversible processes.

Third Law: Statement of third law, concept of residual entropy, calculation of absolute entropy of molecules.

Free Energy Functions: Gibbs and Helmholtz energy; variation of S, G, A with T, V, P; Free energy change and spontaneity. Relation between Joule-Thomson coefficient and other thermodynamic parameters; inversion temperature; Gibbs-Helmholtz equation; Maxwell relations; thermodynamic equation of state.

(36 Lectures)

Systems of Variable Composition:

Partial molar quantities, dependence of thermodynamic parameters on composition; Gibbs-Duhem equation, chemical potential of ideal mixtures, change in thermodynamic functions in mixing of ideal gases. **(8 Lectures)**

Chemical Equilibrium:

Criteria of thermodynamic equilibrium, degree of advancement of reaction, chemical equilibria in ideal gases, concept of fugacity. Thermodynamic derivation of relation between Gibbs free energy of reaction and reaction quotient. Coupling of exoergic and endoergic reactions. Equilibrium constants and their quantitative dependence on temperature, pressure and concentration. Free energy of mixing and spontaneity; thermodynamic derivation of relations between the various equilibrium constants K_P, K_c and K_x. Le Chatelier principle (quantitative treatment); equilibrium between ideal gases and a pure condensed phase.

(8 Lectures)

Solutions and Colligative Properties:

Dilute solutions; lowering of vapour pressure, Raoult's and Henry's Laws and their applications. Excess thermodynamic functions.

Thermodynamic derivation using chemical potential to derive relations between the four colligative properties [(i) relative lowering of vapour pressure, (ii) elevation of boiling point, (iii) Depression of freezing point, (iv) osmotic pressure] and amount of solute. Applications in calculating molar masses of normal, dissociated and associated solutes in solution.

(8 Lectures)

Reference Books

- Peter, A. & Paula, J. de. *Physical Chemistry* 10th Ed., Oxford University Press (2014).
- Castellan, G. W. *Physical Chemistry 4th Ed.*,Narosa (2004).
- Engel, T. & Reid, P. *Physical Chemistry 3rd Ed.,* Prentice-Hall (2012).
- McQuarrie, D. A. & Simon, J. D. *Molecular Thermodynamics* Viva Books Pvt. Ltd.: New Delhi (2004).
- Assael, M. J.; Goodwin, A. R. H.; Stamatoudis, M.; Wakeham, W. A. & Will, S. *Commonly Asked Questions in Thermodynamics.* CRC Press: NY (2011).
- Levine, I .N. *Physical Chemistry* 6th Ed., Tata McGraw Hill (2010).
- Metz, C.R. *2000 solved problems in chemistry,* Schaum Series (2006).

CHEMISTRY LAB- CC 4 LAB: 60 Lectures

Thermochemistry

(a) Determination of heat capacity of a calorimeter for different volumes using change of enthalpy data of a known system (method of back calculation of heat capacity of calorimeter from known enthalpy of solution or enthalpy of neutralization).

(b) Determination of heat capacity of the calorimeter and enthalpy of neutralization of hydrochloric acid with sodium hydroxide.

(c) Calculation of the enthalpy of ionization of ethanoic acid.

(d) Determination of heat capacity of the calorimeter and integral enthalpy (endothermic and exothermic) solution of salts.

(e) Determination of basicity/proticity of a polyprotic acid by the thermochemical method in

terms of the changes of temperatures observed in the graph of temperature versus time for different additions of a base. Also calculate the enthalpy of neutralization of the first step.

(f) Determination of enthalpy of hydration of copper sulphate.

(g) Study of the solubility of benzoic acid in water and determination of ΔH.

Any other experiment carried out in the class.

Reference Books

- Khosla, B. D.; Garg, V. C. &Gulati, A., *Senior Practical Physical Chemistry*, R. Chand & Co.: New Delhi (2011).
- Athawale, V. D. & Mathur, P. *Experimental Physical Chemistry* New Age International: New Delhi (2001).

SEMESTER III

CHEMISTRY-CC 5: INORGANIC CHEMISTRY-II
(Credits: Theory-04, Practicals-02)
Theory: 60 Lectures

General Principles of Metallurgy

Chief modes of occurrence of metals based on standard electrode potentials. Ellingham diagrams for reduction of metal oxides using carbon and carbon monoxide as reducing agent. Electrolytic Reduction, Hydrometallurgy. Methods of purification of metals: Electrolytic Kroll process, Parting process, van Arkel-de Boer process and Mond's process, Zone refining.

(6 Lectures)

Acids and Bases

Brönsted-Lowry concept of acid-base reactions, solvated proton, relative strength of acids, types of acid-base reactions, levelling solvents, Lewis acid-base concept, Classification of Lewis acids, Hard and Soft Acids and Bases (HSAB). Application of HSAB principle.

(8 Lectures)

Chemistry of *s* and *p* Block Elements:

Inert pair effect, Relative stability of different oxidation states, diagonal relationship and anomalous behaviour of first member of each group. Allotropy and catenation. Complex formation tendency of *s* and *p* block elements.

Hydrides and their classification ionic, covalent and interstitial. Basic beryllium acetate and nitrate.

Study of the following compounds with emphasis on structure, bonding, preparation, properties and uses.

Boric acid and borates, boron nitrides, borohydrides (diborane) carboranes and graphitic compounds, silanes, Oxides and oxoacids of nitrogen, Phosphorus and chlorine. Peroxo acids of sulphur, interhalogen compounds, polyhalide ions, pseudohalogens and basic properties of halogens.

(30 Lectures)

Noble Gases:

Occurrence and uses, rationalization of inertness of noble gases, Clathrates; preparation and properties of XeF_2, XeF_4 and XeF_6; Nature of bonding in noble gas compounds (Valence bond treatment and MO treatment for XeF_2). Molecular shapes of noble gas compounds (VSEPR theory).

(8 Lectures)

Inorganic Polymers:

Types of inorganic polymers, comparison with organic polymers, synthesis, structural aspects and applications of silicones and siloxanes. Borazines, silicates and phosphazenes, and polysulphates.

(8 Lectures)

Reference Books:

- Lee, J.D. *Concise Inorganic Chemistry*, ELBS, 1991.
- Douglas, B.E; Mc Daniel, D.H. & Alexander, J.J. *Concepts & Models of Inorganic Chemistry 3rd Ed.*, John Wiley Sons, N.Y. 1994.
- Greenwood, N.N. & Earnshaw. *Chemistry of the Elements*, Butterworth-Heinemann. 1997.
- Cotton, F.A. & Wilkinson, G. *Advanced Inorganic Chemistry*, Wiley, VCH, 1999.
- Rodger, G.E. *Inorganic and Solid State Chemistry*, Cengage Learning India Edition, 2002.
- Miessler, G. L. & Donald, A. Tarr. *Inorganic Chemistry* 4th Ed., Pearson, 2010.
- Atkin, P. *Shriver & Atkins' Inorganic Chemistry* 5th Ed. Oxford University Press (2010).

CHEMISTRY LAB-CC 5 LAB: 60 Lectures

(A) Iodo / Iodimetric Titrations

(i) Estimation of Cu(II) and $K_2Cr_2O_7$ using sodium thiosulphate solution (Iodimetrically).
(ii) Estimation of (i) arsenite and (ii) antimony in tartar-emetic iodimetrically
(iii) Estimation of available chlorine in bleaching powder iodometrically.

(B) Inorganic preparations

(i) Cuprous Chloride, Cu_2Cl_2

(ii) Preparation of Manganese(III) phosphate, $MnPO_4.H_2O$

(iii) Preparation of Aluminium potassium sulphate $KAl(SO_4)_2.12H_2O$ (Potash alum) or Chrome alum.

Reference Books:

- Mendham, J., *A. I. Vogel's Quantitative Chemical Analysis 6th Ed.*, Pearson, 2009.

CHEMISTRY-CC 6: ORGANIC CHEMISTRY-II
(Credits: Theory-04, Practicals-02)
Theory: 60 Lectures

Chemistry of Halogenated Hydrocarbons:

Alkyl halides: Methods of preparation, nucleophilic substitution reactions – S_N1, S_N2 and S_Ni mechanisms with stereochemical aspects and effect of solvent etc.; nucleophilic substitution vs. elimination.

Aryl halides: Preparation, including preparation from diazonium salts. Nucleophilic

aromatic substitution; SNAr, Benzyne mechanism.

Relative reactivity of alkyl, allyl/benzyl, vinyl and aryl halides towards nucleophilic substitution reactions.

Organometallic compounds of Mg and Li – Use in synthesis of organic compounds.

(16 Lectures)

Alcohols, Phenols, Ethers and Epoxides:

Alcohols: preparation, properties and relative reactivity of 1°, 2°, 3° alcohols, Bouvaelt-Blanc Reduction; Preparation and properties of glycols: Oxidation by periodic acid and lead tetraacetate, Pinacol-Pinacolone rearrangement.

Phenols: Preparation and properties; Acidity and factors effecting it, Ring substitution reactions, Reimer–Tiemann and Kolbe's–Schmidt Reactions, Fries and Claisen rearrangements with mechanism;

Ethers and Epoxides: Preparation and reactions with acids. Reactions of epoxides with alcohols, ammonia derivatives and $LiAlH_4$.

(**16 Lectures)**

Carbonyl Compounds:

Structure, reactivity and preparation; Nucleophilic additions, Nucleophilic addition-elimination reactions with ammonia derivatives with mechanism; Mechanisms of Aldol and Benzoin condensation, Knoevenagel condensation, Claisen-Schmidt, Perkin, Cannizzaro and Wittig reaction, Beckmann and Benzil-Benzilic acid rearrangements, haloform reaction and Baeyer Villiger oxidation, α-substitution reactions, oxidations and reductions (Clemmensen, Wolff-Kishner, $LiAlH_4$, NaBH4, MPV, PDC and PGC).

Addition reactions of unsaturated carbonyl compounds: Michael addition.

Active methylene compounds: Keto-enol tautomerism. Preparation and synthetic applications of diethyl malonate and ethyl acetoacetate.

(**14 Lectures)**

Carboxylic Acids and their Derivatives:

Preparation, physical properties and reactions of monocarboxylic acids: Typical reactions of dicarboxylic acids, hydroxy acids and unsaturated acids: succinic/phthalic, lactic, malic, tartaric, citric, maleic and fumaric acids.

Preparation and reactions of acid chlorides, anhydrides, esters and amides; Comparative study of nucleophilic sustitution at acyl group -Mechanism of acidic and alkaline hydrolysis of esters, Claisen condensation, Dieckmann and Reformatsky reactions, Hofmann-bromamide degradation and Curtius rearrangement.

(10 Lectures)

Sulphur containing compounds:

Preparation and reactions of thiols, thioethers and sulphonic acids.

(4 Lectures)

Reference Books:

- Morrison, R. T. & Boyd, R. N. *Organic Chemistry*, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
- Finar, I. L. *Organic Chemistry* (*Volume 1*), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
- Graham Solomons, T.W. *Organic Chemistry*, John Wiley & Sons, Inc.
- McMurry, J.E. *Fundamentals of Organic Chemistry*, 7th Ed. Cengage Learning India Edition, 2013.

CHEMISTRY LAB- CC 6 LAB: 60 Lectures

1. Functional group tests for alcohols, phenols, carbonyl and carboxylic acid group.
2. Organic preparations:
   - i. Acetylation of one of the following compounds: amines (aniline, *o*-, *m*-, *p*-toluidines and *o*-, *m*-, *p*-anisidine) and phenols (β-naphthol, vanillin, salicylic acid) by any one method:
     a. Using conventional method.
     b. Using green approach
   - ii. Benzolyation of one of the following amines (aniline, *o*-, *m*-, *p*- toluidines and *o*-, *m*-, *p*-anisidine) and one of the following phenols (β-naphthol, resorcinol, p-cresol) by Schotten-Baumann reaction.
   - iii. Oxidation of ethanol/ isopropanol (Iodoform reaction).
   - iv. Bromination of any one of the following:
     a. Acetanilide by conventional methods
     b. Acetanilide using green approach (Bromate-bromide method)
   - v. Nitration of any one of the following:
     a. Acetanilide/nitrobenzene by conventional method
     b. Salicylic acid by green approach (using ceric ammonium nitrate).
   - vi. Selective reduction of *meta* dinitrobenzene to *m*-nitroaniline.
   - vii. Reduction of *p*-nitrobenzaldehyde by sodium borohydride.
   - viii. Hydrolysis of amides and esters.
   - ix. Semicarbazone of any one of the following compounds: acetone, ethyl methyl ketone, cyclohexanone, benzaldehyde.
   - x. *S*-Benzyl isothiouronium salt of one each of water soluble and water insoluble acids(benzoic acid, oxalic acid, phenyl acetic acid and phthalic acid).
   - xi. Aldol condensation using either conventional or green method.
   - xii. Benzil-Benzilic acid rearrangement.

The above derivatives should be prepared using 0.5-1g of the organic compound. The solid samples must be collected and may be used for recrystallization, melting point and TLC.

Reference Books

- Mann, F.G. & Saunders, B.C. *Practical Organic Chemistry*, Pearson Education (2009).
- Furniss, B.S., Hannaford, A.J., Smith, P.W.G. &Tatchell, A.R. *Practical Organic Chemistry, 5th Ed.* Pearson (2012).
- Ahluwalia, V.K. &Aggarwal, R. *Comprehensive Practical Organic Chemistry: Preparation and Quantitative Analysis,* University Press (2000).
- Ahluwalia, V.K. & Dhingra, S. *Comprehensive Practical Organic Chemistry: Qualitative Analysis*, University Press (2000).

CHEMISTRY-CC 7: PHYSICAL CHEMISTRY-III
(Credits: Theory-04, Practicals-02)
Theory: 60 Lectures

Phase Equilibria:
Concept of phases, components and degrees of freedom, derivation of Gibbs Phase Rule for nonreactive and reactive systems; Clausius-Clapeyron equation and its applications to solid-liquid, liquid-vapour and solid-vapour equilibria, phase diagram for one component systems, with applications.

Phase diagrams for systems of solid-liquid equilibria involving eutectic, congruent and incongruent melting points, solid solutions.

Three component systems, water-chloroform-acetic acid system, triangular plots.

Binary solutions: Gibbs-Duhem-Margules equation, its derivation and applications to fractional distillation of binary miscible liquids (ideal and non-ideal), azeotropes, lever rule, partial miscibility of liquids, CST, miscible pairs, steam distillation.

Nernst distribution law: its derivation and applications.

(28 Lectures)

Chemical Kinetics
Order and molecularity of a reaction, rate laws in terms of the advancement of a reaction, differential and integrated form of rate expressions up to second order reactions, experimental methods of the determination of rate laws, kinetics of complex reactions (integrated rate expressions up to first order only): (i) Opposing reactions (ii) parallel reactions and (iii) consecutive reactions and their differential rate equations (steady-state approximation in reaction mechanisms) (iv) chain reactions.

Temperature dependence of reaction rates; Arrhenius equation; activation energy. Collision theory of reaction rates, Lindemann mechanism, qualitative treatment of the theory of absolute reaction rates. **(18 Lectures)**

Catalysis:
Types of catalyst, specificity and selectivity, mechanisms of catalyzed reactions at solid surfaces; effect of particle size and efficiency of nanoparticles as catalysts. Enzyme catalysis, Michaelis-Menten mechanism, acid-base catalysis. **(8 Lectures)**

Surface chemistry:

Physical adsorption, chemisorption, adsorption isotherms, nature of adsorbed state.

(6 Lectures)

Reference Books:

- Peter Atkins & Julio De Paula, *Physical Chemistry* 10th Ed., Oxford University Press (2014).
- Castellan, G. W. *Physical Chemistry*, 4th Ed., Narosa (2004).
- McQuarrie, D. A. & Simon, J. D., *Molecular Thermodynamics*, Viva Books Pvt. Ltd.: New Delhi (2004).
- Engel, T. & Reid, P. *Physical Chemistry 3rd Ed.*, Prentice-Hall (2012).
- Assael, M. J.; Goodwin, A. R. H.; Stamatoudis, M.; Wakeham, W. A. & Will, S.

Commonly Asked Questions in Thermodynamics. CRC Press: NY (2011).
- Zundhal, S.S. *Chemistry Concepts and Applications* Cengage India (2011).
- Ball, D. W. *Physical Chemistry* Cengage India (2012).
- Mortimer, R. G. *Physical Chemistry 3rd Ed.*, Elsevier: NOIDA, UP (2009).
- Levine, I. N. *Physical Chemistry 6th Ed.*, Tata McGraw-Hill (2011).
- Metz, C. R. *Physical Chemistry 2nd Ed.*, Tata McGraw-Hill (2009).

CHEMISTRY PRACTICAL-CC 7 LAB: 60 Lectures

I. Determination of critical solution temperature and composition of the phenol-water system and to study the effect of impurities on it.
II. Phase equilibria: Construction of the phase diagram using cooling curves or ignition tube method:
    a. simple eutectic and
    b. congruently melting systems.
III. Distribution of acetic/ benzoic acid between water and cyclohexane.
IV. Study the equilibrium of at least one of the following reactions by the distribution method:

(i) $I_2(aq) + I^- \rightarrow I_3^-(aq)^{2+}$

(ii) $Cu^{2+}(aq) + nNH_3 \rightarrow Cu(NH_3)_n$

V. Study the kinetics of the following reactions.
1. Initial rate method: Iodide-persulphate reaction
2. Integrated rate method:
    a. Acid hydrolysis of methyl acetate with hydrochloric acid.
    b. Saponification of ethyl acetate.
3. Compare the strengths of HCl and H_2SO_4 by studying kinetics of hydrolysis of methyl acetate.

VI. Adsorption

I. Verify the Freundlich and Langmuir isotherms for adsorption of acetic acid on activated charcoal.

Reference Books:

- Khosla, B. D.; Garg, V. C. & Gulati, A. *Senior Practical Physical Chemistry*, R. Chand & Co.: New Delhi (2011).
- Garland, C. W.; Nibler, J. W. & Shoemaker, D. P. *Experiments in Physical Chemistry 8th Ed.*; McGraw-Hill: New York (2003).
- Halpern, A. M. & McBane, G. C. *Experimental Physical Chemistry 3rd Ed.;* W.H. Freeman & Co.: New York (2003).

SEMESTER IV

CHEMISTRY-CC 8: INORGANIC CHEMISTRY-III
(Credits: Theory-04, Practicals-02)
Theory: 60 Lectures

Coordination Chemistry:

Werner's theory, valence bond theory (inner and outer orbital complexes), electroneutrality principle and back bonding. Crystal field theory, measurement of 10 Dq (o), CFSE in weak and strong fields, pairing energies, factors affecting the magnitude of 10 Dq (o,t). Octahedral vs. tetrahedral coordination, tetragonal distortions from octahedral geometry Jahn-Teller theorem, square planar geometry. Qualitative aspect of Ligand field and MO Theory.

IUPAC nomenclature of coordination compounds, isomerism in coordination compounds. Stereochemistry of complexes with 4 and 6 coordination numbers. Chelate effect, polynuclear complexes, Labile and inert complexes.

(26 Lectures)

Transition Elements:

General group trends with special reference to electronic configuration, colour, variable valency, magnetic and catalytic properties, ability to form complexes. Stability of various oxidation states and e.m.f. (Latimer & Bsworth diagrams). Difference between the first, second and third transition series.

Chemistry of Ti, V, Cr Mn, Fe and Co in various oxidation states (excluding their metallurgy).

(18 Lectures)

Lanthanoids and Actinoids:

Electronic configuration, oxidation states, colour, spectral and magnetic properties, lanthanide contraction, separation of lanthanides (ion-exchange method only).

(6 Lectures)

Bioinorganic Chemistry:

Metal ions present in biological systems, classification of elements according to their action in biological system. Geochemical effect on the distribution of metals. Sodium / K-pump, carbonic anhydrase and carboxypeptidase. Excess and deficiency of some trace metals. Toxicity of metal ions (Hg, Pb, Cd and As), reasons for toxicity, Use of chelating agents in medicine.

Iron and its application in bio-systems, Haemoglobin; Storage and transfer of iron.

(10 Lectures)

Reference Books:

- Purcell, K.F & Kotz, J.C. *Inorganic Chemistry* W.B. Saunders Co, 1977.
- Huheey, J.E., *Inorganic Chemistry*, Prentice Hall, 1993.
- Lippard, S.J. & Berg, J.M. *Principles of Bioinorganic Chemistry* Panima Publishing

Company 1994.
- Cotton, F.A. & Wilkinson, G, *Advanced Inorganic Chemistry* Wiley-VCH, 1999.
- Basolo, F, and Pearson, R.C. *Mechanisms of Inorganic Chemistry*, John Wiley & Sons, NY, 1967.
- Greenwood, N.N. &Earnshaw A. *Chemistry of the Elements*, Butterworth-Heinemann, 1997.

CHEMISTRY-CC 8 LAB: 60 Lectures

Gravimetric Analysis:

i. Estimation of nickel (II) using Dimethylglyoxime (DMG).
ii. Estimation of copper as CuSCN.
iii. Estimation of iron as Fe_2O_3 by precipitating iron as $Fe(OH)_3$.
iv. Estimation of Al (III) by precipitating with oxine and weighing as $Al(oxine)_3$ (aluminium oxinate).

Inorganic Preparations:

i. Tetraamminecopper (II) sulphate, $[Cu(NH_3)_4]SO_4.H_2O$
ii. *Cis* and *trans* $K[Cr(C_2O_4)_2.(H_2O)_2]$ Potassium dioxalatodiaquachromate (III)
iii. Tetraamminecarbonatocobalt (III) ion
iv. Potassium tris(oxalate)ferrate(III)

Chromatography of metal ions

Principles involved in chromatographic separations. Paper chromatographic separation of following metal ions:

i. Ni (II) and Co (II)
ii. Fe (III) and Al (III)

Reference Book:

- Mendham, J., *A. I. Vogel's Quantitative Chemical Analysis 6th Ed.*, Pearson, 2009.

CHEMISTRY-CC 9: ORGANIC CHEMISTRY-III
(Credits: Theory-04, Practicals-02)
Theory: 60 Lectures

Nitrogen Containing Functional Groups

Preparation and important reactions of nitro and compounds, nitriles and isonitriles.
Amines: Effect of substituent and solvent on basicity; Preparation and properties: Gabriel phthalimide synthesis, Carbylamine reaction, Mannich reaction, Hoffmann's exhaustive methylation, Hofmann-elimination reaction; Distinction between 1°, 2° and 3° amines with Hinsberg reagent and nitrous acid.
Diazonium Salts: Preparation and their synthetic applications.

(18 Lectures)

Polynuclear Hydrocarbons

Reactions of naphthalene phenanthrene and anthracene Structure, Preparation and structure elucidation and important derivatives of naphthalene and anthracene; Polynuclear hydrocarbons.

(8 Lectures)

Heterocyclic Compounds

Classification and nomenclature, Structure, aromaticity in 5-numbered and 6-membered rings containing one heteroatom; Synthesis, reactions and mechanism of substitution reactions of: Furan, Pyrrole (Paal-Knorr synthesis, Knorr pyrrole synthesis, Hantzsch synthesis), Thiophene, Pyridine (Hantzsch synthesis), Pyrimidine, Structure elucidation of indole, Fischer indole synthesis and Madelung synthesis), Structure elucidation of quinoline and isoquinoline, Skraup synthesis, Friedlander's synthesis, Knorr quinoline synthesis, Doebner-Miller synthesis, Bischler-Napieralski reaction, Pictet-Spengler reaction, Pomeranz-Fritsch reaction

Derivatives of furan: Furfural and furoic acid.

(22 Lectures)

Alkaloids

Natural occurrence, General structural features, Isolation and their physiological action.

Hoffmann's exhaustive methylation, Emde's modification, Structure elucidation and synthesis of Hygrine and Nicotine. Medicinal importance of Nicotine, Hygrine, Quinine, Morphine, Cocaine, and Reserpine.

(6 Lectures)

Terpenes

Occurrence, classification, isoprene rule; Elucidation of stucture and synthesis of Citral, Neral and α-terpineol.

(6 Lectures)

Reference Books:

- Morrison, R. T. & Boyd, R. N. *Organic Chemistry*, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
- Finar, I. L. *Organic Chemistry* (*Volume 1*), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
- Finar, I. L. *Organic Chemistry* (*Volume 2: Stereochemistry and the Chemistry of Natural Products*), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
- Acheson, R.M. *Introduction to the Chemistry of Heterocyclic compounds,* John Welly & Sons (1976).
- Graham Solomons, T.W. *Organic Chemistry*, John Wiley & Sons, Inc.
- McMurry, J.E. *Fundamentals of Organic Chemistry*, 7th Ed. Cengage Learning India Edition, 2013.
- Kalsi, P. S. *Textbook of Organic Chemistry 1st Ed.*, New Age International (P) Ltd. Pub.
- Clayden, J.; Greeves, N.; Warren, S.; Wothers, P.; *Organic Chemistry*, Oxford University Press.
- Singh, J.; Ali, S.M. & Singh, J. *Natural Product Chemistry*, Prajati Parakashan (2010).

CHEMISTRY PRACTICAL-CC 9 LAB
60 Lectures

1. Detection of extra elements.
2. Functional group test for nitro, amine and amide groups.
3. Qualitative analysis of unknown organic compounds containing simple functional groups (alcohols, carboxylic acids, phenols and carbonyl compounds)

Reference Books

- Mann, F.G. & Saunders, B.C. *Practical Organic Chemistry*, Pearson Education (2009).
- Furniss, B.S.; Hannaford, A.J.; Smith, P.W.G.; Tatchell, A.R. *Practical Organic Chemistry, 5th Ed.*, Pearson (2012).
- Ahluwalia, V.K. & Aggarwal, R. *Comprehensive Practical Organic Chemistry: Preparation and Quantitative Analysis,* University Press (2000).
- Ahluwalia, V.K. & Dhingra, S. *Comprehensive Practical Organic Chemistry: Qualitative Analysis,* University Press (2000).

CHEMISTRY-CC 10: PHYSICAL CHEMISTRY-IV
(Credits: Theory-04, Practicals-02)
Theory: 60 Lectures

Conductance

Arrhenius theory of electrolytic dissociation. Conductivity, equivalent and molar conductivity and their variation with dilution for weak and strong electrolytes. Molar conductivity at infinite dilution. Kohlrausch law of independent migration of ions. Debye-Hückel-Onsager equation, Wien effect, Debye-Falkenhagen effect, Walden's rules.

Ionic velocities, mobilities and their determinations, transference numbers and their relation to ionic mobilities, determination of transference numbers using Hittorf and Moving Boundary methods. Applications of conductance measurement: (i) degree of dissociation of weak electrolytes, (ii) ionic product of water (iii) solubility and solubility product of sparingly soluble salts, (iv) conductometric titrations, and (v) hydrolysis constants of salts.

(20 Lectures)

Electrochemistry

Quantitative aspects of Faraday's laws of electrolysis, rules of oxidation/reduction of ions based on half-cell potentials, applications of electrolysis in metallurgy and industry.

Chemical cells, reversible and irreversible cells with examples. Electromotive force of a cell and its measurement, Nernst equation; Standard electrode (reduction) potential and its application to different kinds of half-cells. Application of EMF measurements in determining
(i) free energy, enthalpy and entropy of a cell reaction, (ii) equilibrium constants, and (iii) pH values, using hydrogen, quinone-hydroquinone, glass and SbO/Sb_2O_3 electrodes. Concentration cells with and without transference, liquid junction potential; determination of activity coefficients and transference numbers.Qualitative discussion of potentiometric titrations (acid-base, redox, precipitation).

(28 Lectures)

Electrical & Magnetic Properties of Atoms and Molecules

Basic ideas of electrostatics, Electrostatics of dielectric media, Clausius-Mosotti equation, Lorenz-Laurentz equation, Dipole moment and molecular polarizabilities and their

measurements. Diamagnetism, paramagnetism, magnetic susceptibility and its measurement, molecular interpretation.

(12 Lectures)

Reference Books:

- Atkins, P.W & Paula, J.D. *Physical Chemistry*, 10th Ed., Oxford University Press (2014).
- Castellan, G. W. *Physical Chemistry 4th Ed.,* Narosa (2004).
- Mortimer, R. G. *Physical Chemistry 3rd Ed.,* Elsevier: NOIDA, UP (2009).
- Barrow, G. M., *Physical Chemistry 5th Ed.,* Tata McGraw Hill: New Delhi (2006).
- Engel, T. & Reid, P. *Physical Chemistry 3rd Ed.,* Prentice-Hall (2012).
- Rogers, D. W. *Concise Physical Chemistry* Wiley (2010).
- Silbey, R. J.; Alberty, R. A. &Bawendi, M. G. *Physical Chemistry 4th Ed.,* John Wiley & Sons, Inc. (2005).

CHEMISTRY PRACTICAL-CC 10 LAB: 60 Lectures

Conductometry

I. Determination of cell constant

II. Determination of equivalent conductance, degree of dissociation and dissociation constant of a weak acid.

III. Perform the following conductometric titrations:
   i. Strong acid vs. strong base
   ii. Weak acid vs. strong base
   iii. Mixture of strong acid and weak acid vs. strong base
   iv. Strong acid vs. weak base

Potentiometry

I Perform the following potentiometric titrations:
   i. Strong acid vs. strong base
   ii. Weak acid vs. strong base
   iii. Dibasic acid vs. strong base
   iv. Potassium dichromate vs. Mohr's salt

Reference Books:

- Khosla, B. D.; Garg, V. C. &Gulati, A. *Senior Practical Physical Chemistry,* R. Chand & Co.: New Delhi (2011).
- Garland, C. W.; Nibler, J. W. & Shoemaker, D. P. *Experiments in Physical Chemistry8th Ed.;* McGraw-Hill: New York (2003).
- Halpern, A. M. & McBane, G. C. *Experimental Physical Chemistry 3rd Ed.;* W.H. Freeman & Co.: New York (2003).

SEMESTER V

CHEMISTRY-CC 11: ORGANIC CHEMISTRY-IV
(Credits: Theory-04, Practicals-02)
Theory: 60 Lectures

Nucleic Acids

Components of nucleic acids, Nucleosides and nucleotides;

Structure, synthesis and reactions of: Adenine, Guanine, Cytosine, Uracil and Thymine; Structure of polynucleotides.

(9 Lectures)

Amino Acids, Peptides and Proteins

Amino acids, Peptides and their classification.

α-Amino Acids - Synthesis, ionic properties and reactions. Zwitterions, pK_a values, isoelectric point and electrophoresis.

Study of peptides: determination of their primary structures-end group analysis, methods of peptide synthesis. Synthesis of peptides using N-protecting, C-protecting and C-activating groups -Solid-phase synthesis. **(16 Lectures)**

Enzymes

Introduction, classification and characteristics of enzymes. Salient features of active site of enzymes.
Mechanism of enzyme action (taking trypsin as example), factors affecting enzyme action, coenzymes and cofactors and their role in biological reactions, specificity of enzyme action (including stereospecificity), enzyme inhibitors and their importance, phenomenon of inhibition (competitive, uncompetitive and non-competitive inhibition including allosteric inhibition).

(**8 Lectures**)

Lipids

Introduction to oils and fats; common fatty acids present in oils and fats, Hydrogenation of fats and oils, Saponification value, acid value, iodine number. Reversion and rancidity.

(8 Lectures)

Concept of Energy in Biosystems

Cells obtain energy by the oxidation of foodstuff (organic molecules). Introduction to metabolism (catabolism, anabolism).
ATP: The universal currency of cellular energy, ATP hydrolysis and free energy change.
Agents for transfer of electrons in biological redox systems: NAD^+, FAD.
Conversion of food to energy: Outline of catabolic pathways of carbohydrate- glycolysis, fermentation, Krebs cycle.
Overview of catabolic pathways of fat and protein.
Interrelationship in the metabolic pathways of protein, fat and carbohydrate.
Caloric value of food, standard caloric content of food types.

(7 Lectures)

Pharmaceutical Compounds: Structure and Importance

Classification, structure and therapeutic uses of antipyretics: Paracetamol (with synthesis), Analgesics: Ibuprofen (with synthesis), Antimalarials: Chloroquine (with synthesis). An elementary treatment of Antibiotics and detailed study of chloramphenicol, Medicinal values of curcumin (haldi), azadirachtin (neem), vitamin C and antacid (ranitidine).

(12 Lectures)

Reference Books:

- Berg, J.M., Tymoczko, J.L. & Stryer, L. (2006) *Biochemistr*y. 6th Ed. W.H. Freeman and Co.
- Nelson, D.L., Cox, M.M. & Lehninger, A.L. (2009) *Principles of Biochemistry. IV Edition.* W.H. Freeman and Co.
- Murray, R.K., Granner, D.K., Mayes, P.A. & Rodwell, V.W. (2009) *Harper's Illustrated Biochemistry.* XXVIII edition. Lange Medical Books/ McGraw-Hill.

CHEMISTRY PRACTICAL-CC 11 LAB

60 Lectures

1. Estimation of glycine by Sorenson's formalin method.
2. Study of the titration curve of glycine.
3. Estimation of proteins by Lowry's method.
4. Study of the action of salivary amylase on starch at optimum conditions.
5. Effect of temperature on the action of salivary amylase.
6. Saponification value of an oil or a fat.
7. Determination of Iodine number of an oil/ fat.
8. Isolation and characterization of DNA from onion/ cauliflower/peas.

Reference Books:

- Manual of Biochemistry Workshop, 2012, Department of Chemistry, University of Delhi.
- Arthur, I. V. *Quantitative Organic Analysis,* Pearson.

CHEMISTRY-CC 12: PHYSICAL CHEMISTRY-V
(Credits: Theory-04, Practicals-02)
Theory: 60 Lectures

Quantum Chemistry

Postulates of quantum mechanics, quantum mechanical operators, Schrödinger equation and its application to free particle and "particle-in-a-box" (rigorous treatment), quantization of energy levels, zero-point energy and Heisenberg Uncertainty principle; wave functions, probability distribution functions, nodal properties, Extension to two and three dimensional boxes, separation of variables, degeneracy.

Qualitative treatment of simple harmonic oscillator model of vibrational motion: Setting up of Schrödinger equation and discussion of solution and wave functions. Vibrational energy of diatomic molecules and zero-point energy.

Angular momentum: Commutation rules, quantization of square of total angular momentum

and z-component.

Rigid rotator model of rotation of diatomic molecule. Schrödinger equation, transformation to spherical polar coordinates.Separation of variables. Spherical harmonics. Discussion of solution.

Qualitative treatment of hydrogen atom and hydrogen-like ions: setting up of Schrödinger equation in spherical polar coordinates, radial part, quantization of energy (only final energy expression). Average and most probable distances of electron from nucleus.

Setting up of Schrödinger equation for many-electron atoms (He, Li). Need for approximation methods. Statement of variation theorem and application to simple systems (particle-in-a-box, harmonic oscillator, hydrogen atom).

Chemical bonding: Covalent bonding, valence bond and molecular orbital approaches, LCAO-MO treatment of H_2^+. Bonding and antibonding orbitals. Qualitative extension to H_2. Comparison of LCAO-MO and VB treatments of H_2 (only wave functions, detailed solution not required) and their limitations. Refinements of the two approaches (Configuration Interaction for MO, ionic terms in VB).Qualitative description of LCAO-MO treatment of homonuclear and heteronuclear diatomic molecules (HF, LiH). Localised and non-localised molecular orbitals treatment of triatomic (BeH_2, H_2O) molecules. Qualitative MO theory and its application to AH_2 type molecules.

(24 Lectures)

Molecular Spectroscopy:
Interaction of electromagnetic radiation with molecules and various types of spectra; Born-Oppenheimer approximation.

Rotation spectroscopy: Selection rules, intensities of spectral lines, determination of bond lengths of diatomic and linear triatomic molecules, isotopic substitution.

Vibrational spectroscopy: Classical equation of vibration, computation of force constant, amplitude of diatomic molecular vibrations, anharmonicity, Morse potential, dissociation energies, fundamental frequencies, overtones, hot bands, degrees of freedom for polyatomic molecules, modes of vibration, concept of group frequencies. Vibration-rotation spectroscopy: diatomic vibrating rotator, P, Q, R branches.

Raman spectroscopy: Qualitative treatment of Rotational Raman effect; Effect of nuclear spin, Vibrational Raman spectra, Stokes and anti-Stokes lines; their intensity difference, rule of mutual exclusion.

Electronic spectroscopy: Franck-Condon principle, electronic transitions, singlet and triplet states, fluorescence and phosphorescence, dissociation and pre-dissociation, calculation of electronic transitions of polyenes using free electron model.

Nuclear Magnetic Resonance (NMR) spectroscopy: Principles of NMR spectroscopy, Larmor precession, chemical shift and low resolution spectra, different scales, spin-spin coupling and high resolution spectra, interpretation of PMR spectra of organic molecules.

Electron Spin Resonance (ESR) spectroscopy: Its principle, hyperfine structure, ESR of simple radicals.

(24 Lectures)

Photochemistry

Characteristics of electromagnetic radiation, Lambert-Beer's law and its limitations, physical significance of absorption coefficients. Laws, of photochemistry, quantum yield, actinometry, examples of low and high quantum yields, photochemical equilibrium and the differential rate of photochemical reactions, photosensitised reactions, quenching. Role of photochemical reactions in biochemical processes, photostationary states, chemiluminescence.

(12 Lectures)

Reference Books:

- Banwell, C. N. & McCash, E. M. *Fundamentals of Molecular Spectroscopy* 4th Ed. Tata McGraw-Hill: New Delhi (2006).
- Chandra, A. K. *Introductory Quantum Chemistry* Tata McGraw-Hill (2001).
- House, J. E. *Fundamentals of Quantum Chemistry* 2nd Ed. Elsevier: USA (2004).
- Kakkar, R. *Atomic & Molecular Spectroscopy*: *Concepts & Applications*, Cambridge University Press (2015).
- Lowe, J. P. & Peterson, K. *Quantum Chemistry*, Academic Press (2005).

CHEMISTRY PRACTICAL-CC 12
LAB 60 Lectures

UV/Visible spectroscopy

I. Study the 200-500 nm absorbance spectra of $KMnO_4$ and $K_2Cr_2O_7$ (in 0.1 M H_2SO_4) and determine the λ_{max} values. Calculate the energies of the two transitions in different units (J molecule^{-1}, kJ mol^{-1}, cm^{-1}, eV).
II. Study the pH-dependence of the UV-Vis spectrum (200-500 nm) of $K_2Cr_2O_7$.
III. Record the 200-350 nm UV spectra of the given compounds (acetone, acetaldehyde, 2-propanol, acetic acid) in water. Comment on the effect of structure on the UV spectra of organic compounds.

Colorimetry

I. Verify Lambert-Beer's law and determine the concentration of $CuSO_4$/$KMnO_4$/$K_2Cr_2O_7$ in a solution of unknown concentration
II. Determine the concentrations of $KMnO_4$ and $K_2Cr_2O_7$ in a mixture.
III. Study the kinetics of iodination of propanone in acidic medium.
IV. Determine the amount of iron present in a sample using 1,10-phenathroline.
V. Determine the dissociation constant of an indicator (phenolphthalein).
VI. Study the kinetics of interaction of crystal violet/ phenolphthalein with sodium hydroxide.
VII. Analysis of the given vibration-rotation spectrum of HCl(g).

Reference Books

- Khosla, B. D.; Garg, V. C. & Gulati, A., *Senior Practical Physical Chemistry*, R. Chand & Co.: New Delhi (2011).
- Garland, C. W.; Nibler, J. W. & Shoemaker, D. P. *Experiments in Physical Chemistry 8th Ed.;* McGraw-Hill: New York (2003).
- Halpern, A. M. & McBane, G. C. *Experimental Physical Chemistry 3rd Ed.;* W.H. Freeman & Co.: New York (2003).

SEMESTER VI

CHEMISTRY-CC 13: INORGANIC CHEMISTRY-IV
(Credits: Theory-04, Practicals-02)
Theory: 60 Lectures

Theoretical Principles in Qualitative Analysis (H_2S Scheme)

Basic principles involved in analysis of cations and anions and solubility products, common ion effect. Principles involved in separation of cations into groups and choice of group reagents. Interfering anions (fluoride, borate, oxalate and phosphate) and need to remove them after Group II.

(10 Lectures)

Organometallic Compounds

Definition and classification of organometallic compounds on the basis of bond type.Concept of hapticity of organic ligands.

Metal carbonyls: 18 electron rule, electron count of mononuclear, polynuclear and substituted metal carbonyls of 3d series. General methods of preparation (direct combination, reductive carbonylation, thermal and photochemical decomposition) of mono and binuclear carbonyls of 3d series. Structures of mononuclear and binuclear carbonyls of Cr, Mn, Fe, Co and Ni using VBT. π-acceptor behaviour of CO (MO diagram of CO to be discussed), synergic effect and use of IR data to explain extent of back bonding.

Zeise's salt: Preparation and structure, evidences of synergic effect and comparison of synergic effect with that in carbonyls.

Metal Alkyls: Important structural features of methyl lithium (tetramer) and trialkyl aluminium (dimer), concept of multicentre bonding in these compounds. Role of triethylaluminium in polymerisation of ethene (Ziegler – Natta Catalyst). Species present in ether solution of Grignard reagent and their structures, Schlenk equilibrium.

Ferrocene: Preparation and reactions (acetylation, alkylation, metallation, Mannich Condensation). Structure and aromaticity.Comparison of aromaticity and reactivity with that of benzene.

(22 Lectures)

Reaction Kinetics and Mechanism

Introduction to inorganic reaction mechanisms. Substitution reactions in square planar complexes, Trans- effect, theories of trans effect, Mechanism of nucleophilic substitution in square planar complexes, Thermodynamic and Kinetic stability, Kinetics of octahedral substitution, Ligand field effects and reaction rates, Mechanism of substitution in octahedral complexes.

(18 Lectures)

Catalysis by Organometallic Compounds

Study of the following industrial processes and their mechanism:

1. Alkene hydrogenation (Wilkinsons Catalyst)
2. Hydroformylation (Co salts)
3. Wacker Process
4. Synthetic gasoline (Fischer Tropsch reaction)
5. Synthesis gas by metal carbonyl complexes.

(10 Lectures)

Reference Books:

- Svehla, G. *Vogel's Qualitative Inorganic Analysis*, 7th Edition, Prentice Hall, 1996.
- Cotton, F.A.G.; Wilkinson & Gaus, P.L. *Basic Inorganic Chemistry 3rd Ed.;* Wiley India,
- Huheey, J. E.; Keiter, E.A. & Keiter, R.L. *Inorganic Chemistry, Principles of Structure and Reactivity 4th Ed.*, Harper Collins 1993, Pearson,2006.
- Sharpe, A.G. *Inorganic Chemistry*, 4th Indian Reprint (Pearson Education) 2005
- Douglas, B. E.; McDaniel, D.H. & Alexander, J.J. *Concepts and Models in Inorganic Chemistry 3rd Ed.*, John Wiley and Sons, NY, 1994.
- Greenwood, N.N. &Earnshaw, A. *Chemistry of the Elements, Elsevier 2nd Ed,* 1997 (Ziegler Natta Catalyst and Equilibria in Grignard Solution).
- Lee, J.D. *Concise Inorganic Chemistry 5th Ed.*, John Wiley and sons 2008.
- Powell, P. *Principles of Organometallic Chemistry*, Chapman and Hall, 1988.
- Shriver, D.D. & P. Atkins, *Inorganic Chemistry 2nd Ed.*, Oxford University Press, 1994.
- Basolo, F. & Pearson, R. *Mechanisms of Inorganic Reactions: Study of Metal Complexes in Solution 2nd Ed.*, John Wiley & Sons Inc; NY.
- Purcell, K.F. & Kotz, J.C., *Inorganic Chemistry*, W.B. Saunders Co. 1977
- Miessler, G. L. & Tarr, D.A. *Inorganic Chemistry 4th Ed.*, Pearson, 2010.
- Collman, J. P. *et al. Principles and Applications of Organotransition Metal Chemistry*. Mill Valley, CA: University Science Books, 1987.
- Crabtree, R. H. *The Organometallic Chemistry of the Transition Metals*. *j* New York, NY: John Wiley, 2000.
- Spessard, G. O. & Miessler, G.L. *Organometallic Chemistry*. Upper Saddle River, NJ: Prentice-Hall, 1996.

CHEMISTRY PRACTICAL-CC 13 LAB

60 Lectures

Qualitative semimicro analysis of mixtures containing 3 anions and 3 cations. Emphasis should be given to the understanding of the chemistry of different reactions. The following radicals are suggested:

CO_3^{2-}, NO_2^-, S^{2-}, SO_3^{2-},$S_2O_3^{2-}$, CH_3COO^-, F^-,Cl^-, Br^-, I^-, NO_3^-, BO_3^{3-}, $C_2O_4^{2-}$, PO_4^{3-}, NH_4^+, K^+, Pb^{2+}, Cu^{2+}, Cd^{2+}, Bi^{3+}, Sn^{2+}, Sb^{3+}, Fe^{3+}, Al^{3+}, Cr^{3+}, Zn^{2+}, Mn^{2+}, Co^{2+}, Ni^{2+}, Ba^{2+}, Sr^{2+}, Ca^{2+}, Mg^{2+}

Mixtures should preferably contain one interfering anion, **or** insoluble component ($BaSO_4$, $SrSO_4$, $PbSO_4$, CaF_2 or Al_2O_3) or combination of anions e.g. CO_3^{2-} and SO_3^{2-}, NO_2^- and NO_3^-, Cl^- and Br^-, Cl^- and I^-, $Br^-$and I^-, NO_3^- and Br^-, NO_3^- and I^-.

Spot tests should be done whenever possible.

i. Measurement of 10 Dq by spectrophotometric method
ii. Verification of spectrochemical series.
iii. Controlled synthesis of two copper oxalate hydrate complexes: kinetic vs thermodynamic factors.
iv. Preparation of acetylacetanato complexes of Cu^{2+}/Fe^{3+}. Find the λ_{max} of the complex.
v. Synthesis of ammine complexes of Ni(II) and its ligand exchange reactions (e.g.

bidentate ligands like acetylacetone, DMG, glycine) by substitution method.

Reference Books

- Vogel's *Qualitative Inorganic Analysis*, Revised by G. Svehla. Pearson Education, 2002.
- Marr & Rockett *Practical Inorganic Chemistry*. John Wiley & Sons 1972.

CHEMISTRY-CC 14: ORGANIC CHEMISTRY-V
(Credits: Theory-04, Practicals-02)
Theory: 60 Lectures

Organic Spectroscopy

General principles Introduction to absorption and emission spectroscopy.

UV Spectroscopy: Types of electronic transitions, λ_{max}, Chromophores and Auxochromes, Bathochromic and Hypsochromic shifts, Intensity of absorption; Application of Woodward Rules for calculation of λmax for the following systems: α,β unsaturated aldehydes, ketones, carboxylic acids and esters; Conjugated dienes: alicyclic, homoannular and heteroannular; Extended conjugated systems (aldehydes, ketones and dienes); distinction between cis and trans isomers.

IR Spectroscopy: Fundamental and non-fundamental molecular vibrations; IR absorption positions of O, N and S containing functional groups; Effect of H-bonding, conjugation, resonance and ring size on IR absorptions; Fingerprint region and its significance; application in functional group analysis.

NMR Spectroscopy: Basic principles of Proton Magnetic Resonance, chemical shift and factors influencing it; Spin – Spin coupling and coupling constant; Anisotropic effects in alkene, alkyne, aldehydes and aromatics, Interpretation of NMR spectra of simple compounds.

Applications of IR, UV and NMR for identification of simple organic molecules.

(24 Lectures)

Carbohydrates

Occurrence, classification and their biological importance.

Monosaccharides: Constitution and absolute configuration of glucose and fructose, epimers and anomers, mutarotation, determination of ring size of glucose and fructose, Haworth projections and conformational structures; Interconversions of aldoses and ketoses; Killiani-Fischer synthesis and Ruff degradation;
Disaccharides – Structure elucidation of maltose, lactose and sucrose.
Polysaccharides – Elementary treatment of starch, cellulose and glycogen.

(16 Lectures)

Dyes

Classification, Colour and constitution; Mordant and Vat Dyes; Chemistry of dyeing;

Synthesis and applications of: Azo dyes – Methyl Orange and Congo Red (mechanism of Diazo Coupling); Triphenyl Methane Dyes -Malachite Green, Rosaniline and Crystal Violet; Phthalein Dyes – Phenolphthalein and Fluorescein; Natural dyes –structure elucidation and synthesis of Alizarin and Indigotin; Edible Dyes with examples.

(8 Lectures)

Polymers

Introduction and classification including di-block, tri-block and amphiphilic polymers; Number average molecular weight, Weight average molecular weight, Degree of polymerization, Polydispersity Index.

Polymerisation reactions -Addition and condensation -Mechanism of cationic, anionic and free radical addition polymerization; Metallocene-based Ziegler-Natta polymerisation of alkenes; Preparation and applications of plastics – thermosetting (phenol-formaldehyde, Polyurethanes) and thermosoftening (PVC, polythene).

Fabrics – natural and synthetic (acrylic, polyamido, polyester); Rubbers – natural and synthetic: Buna-S, Chloroprene and Neoprene; Vulcanization; Polymer additives; Introduction to liquid crystal polymers; Biodegradable and conducting polymers with examples.

(12 Lectures)

Reference Books:

- Kalsi, P. S. *Textbook of Organic Chemistry 1st Ed.*, New Age International (P) Ltd. Pub.
- Morrison, R. T. & Boyd, R. N. *Organic Chemistry*, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
- Billmeyer, F. W. *Textbook of Polymer Science*, John Wiley & Sons, Inc.
- Gowariker, V. R.; Viswanathan, N. V. & Sreedhar, J. *Polymer Science*, New Age International (P) Ltd. Pub.
- Finar, I. L. *Organic Chemistry* (*Volume 2: Stereochemistry and the Chemistry of Natural Products*), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
- Graham Solomons, T.W. *Organic Chemistry*, John Wiley & Sons, Inc.
- McMurry, J.E. *Fundamentals of Organic Chemistry*, 7th Ed. Cengage Learning India Edition, 2013.
- Clayden, J.; Greeves, N.; Warren, S.; Wothers, P.; *Organic Chemistry,* Oxford University Press.
- Singh, J.; Ali, S.M. & Singh, J. *Natural Product Chemistry*, Prajati Prakashan (2010).
- Kemp, W. *Organic Spectroscopy*, Palgrave.
- Pavia, D. L. *et al. Introduction to Spectroscopy* 5th Ed. Cengage Learning India Ed. (2015).

CHEMISTRY PRACTICAL-CC 14 LAB

60 Lectures

1. Extraction of caffeine from tea leaves.
2. Preparation of sodium polyacrylate.
3. Preparation of urea formaldehyde.
4. Analysis of Carbohydrate: aldoses and ketoses, reducing and non-reducing sugars.
5. Qualitative analysis of unknown organic compounds containing monofunctional groups (carbohydrates, aryl halides, aromatic hydrocarbons, nitro compounds, amines and amides) and simple bifunctional groups, for e.g. salicylic acid, cinnamic acid, nitrophenols, etc.
6. Identification of simple organic compounds by IR spectroscopy and NMR spectroscopy (Spectra to be provided).
7. Preparation of methyl orange.

Reference Books:

- Vogel, A.I. *Quantitative Organic Analysis,* Part 3, Pearson (2012).
- Mann, F.G. & Saunders, B.C. *Practical Organic Chemistry,* Pearson Education (2009).
- Furniss, B.S.; Hannaford, A.J.; Smith, P.W.G.; Tatchell, A.R. *Practical Organic Chemistry, 5th Ed.,* Pearson (2012).
- Ahluwalia, V.K. &Aggarwal, R. *Comprehensive Practical Organic Chemistry: Preparation and Quantitative Analysis,* University Press (2000).
- Ahluwalia, V.K. & Dhingra, S. *Comprehensive Practical Organic Chemistry: Qualitative Analysis,* University Press (2000).

Skill Enhancement Course (Credit: 02 each)

(*SEC-1 & SEC-2 for the students of Chemistry Honours*)

SEC-1:
BASIC ANALYTICAL CHEMISTRY (Credits: 02)
30 Lectures

Introduction: Introduction to Analytical Chemistry and its interdisciplinary nature. Conceptof sampling. Importance of accuracy, precision and sources of error in analytical measurements. Presentation of experimental data and results, from the point of view of significant figures.

Analysis of soil: Composition of soil, Concept of pH and pH measurement, Complexometric titrations, Chelation, Chelating agents, use of indicators.

a. Determination of pH of soil samples.
b. Estimation of Calcium and Magnesium ions as Calcium carbonate by complexometric titration.

Analysis of water: Definition of pure water, sources responsible for contaminating water, water sampling methods, water purification methods.

a. Determination of pH, acidity and alkalinity of a water sample.
b. Determination of dissolved oxygen (DO) of a water sample.

Analysis of food products: Nutritional value of foods, idea about food processing and food preservations and adulteration.

a. Identification of adulterants in some common food items like coffee powder, asafoetida, chilli powder, turmeric powder, coriander powder and pulses, etc.
b. Analysis of preservatives and colouring matter.

Chromatography: Definition, general introduction on principles of chromatography, paper chromatography, TLC etc.

a. Paper chromatographic separation of mixture of metal ion (Fe^{3+} and Al^{3+}).
b. To compare paint samples by TLC method. **Ion-exchange:** Column, ion-exchange chromatography etc.
   Determination of ion exchange capacity of anion / cation exchange resin (using batch procedure if use of column is not feasible).

Analysis of cosmetics: Major and minor constituents and their function

a. Analysis of deodorants and antiperspirants, Al, Zn, boric acid, chloride, sulphate.
b. Determination of constituents of talcum powder: Magnesium oxide, Calcium oxide, Zinc oxide and Calcium carbonate by complexometric titration.

Suggested Applications (Any one):

a. To study the uses of phenolphthalein in trap cases.
b. To analyse arson accelerants.
c. To carry out analysis of gasoline.

Suggested Instrumental demonstrations:

a. Estimation of macro nutrients: Potassium, Calcium, Magnesium in soil samples by flame photometry.
b. Spectrophotometric determination of Iron in Vitamin /Dietary Tablets.
c. Spectrophotometric Identification and Determination of Caffeine and Benzoic Acid in Soft Drinks.

Reference Books:

2. Willard, H.H., Merritt, L.L., Dean, J. & Settoe, F.A. *Instrumental Methods of Analysis*, 7th Ed. Wadsworth Publishing Company Ltd., Belmont, California, USA, 1988.
3. Skoog, D.A., Holler, F.J. & Crouch, S. *Principles of Instrumental Analysis*, Cengage Learning India Edition, 2007.
4. Skoog, D.A.; West, D.M. & Holler, F.J. *Analytical Chemistry: An Introduction 6th Ed.*, Saunders College Publishing, Fort Worth, Philadelphia (1994).
5. Harris, D. C. *Quantitative Chemical Analysis*, 9th ed. Macmillan Education, 2016.
6. Dean, J. A. *Analytical Chemistry Handbook*, McGraw Hill, 2004.
7. Day, R. A. & Underwood, A. L. *Quantitative Analysis*, Prentice Hall of India, 1992.
8. Freifelder, D.M. *Physical Biochemistry 2nd Ed.,* W.H. Freeman & Co., N.Y. USA (1982).
9. Cooper, T.G. *The Tools of Biochemistry*, John Wiley & Sons, N.Y. USA. 16 (1977).
10. Vogel, A. I. *Vogel's Qualitative Inorganic Analysis 7th Ed.,* Prentice Hall, 1996.
11. Mendham, J., *A. I. Vogel's Quantitative Chemical Analysis 6th Ed.,* Pearson, 2009.
12. Robinson, J.W. *Undergraduate Instrumental Analysis 5th Ed.,* Marcel Dekker, Inc., New York (1995).
13. Christian, G.D. *Analytical Chemistry*, 6th Ed. John Wiley & Sons, New York, 2004.

SEC-2
FUEL CHEMISTRY (Credits: 02)
30 Lectures

Review of energy sources (renewable and non-renewable). Classification of fuels and their calorific value.

Coal: Uses of coal (fuel and nonfuel) in various industries, its composition, carbonization of coal. Coal gas, producer gas and water gas-composition and uses. Fractionation of coal tar, uses of coal tar bases chemicals, requisites of a good metallurgical coke, Coal gasification (Hydro gasification and Catalytic gasification), Coal liquefaction and Solvent Refining.

Petroleum and Petrochemical Industry: Composition of crude petroleum, Refining and different types of petroleum products and their applications.

Fractional Distillation (Principle and process), Cracking (Thermal and catalytic cracking), Reforming Petroleum and non-petroleum fuels (LPG, CNG, LNG, bio-gas, fuels derived from biomass), fuel from waste, synthetic fuels (gaseous and liquids), clean fuels. Petrochemicals: Vinyl acetate, Propylene oxide, Isoprene, Butadiene, Toluene and its derivatives Xylene.

Lubricants: Classification of lubricants, lubricating oils (conducting and non-conducting) Solid and semisolid lubricants, synthetic lubricants.

Properties of lubricants (viscosity index, cloud point, pour point) and their determination.

Reference Books:

- Stocchi, E. *Industrial Chemistry*, Vol-I, Ellis Horwood Ltd. UK (1990).
- Jain, P.C. & Jain, M. *Engineering Chemistry* Dhanpat Rai& Sons, Delhi.
- Sharma, B.K. & Gaur, H. *Industrial Chemistry,* Goel Publishing House, Meerut (1996).

CHEMISTRY-DSE 1-4 (*For the students of Chemistry Honours*)

CHEMISTRY-DSE-1: ANALYTICAL METHODS IN CHEMISTRY
(Credits: Theory-04, Practicals-02)
Theory: 60 Lectures

Qualitative and quantitative aspects of analysis:

Sampling, evaluation of analytical data, errors, accuracy and precision, methods of their expression, normal law of distribution if indeterminate errors, statistical test of data; F, Q and t test, rejection of data, and confidence intervals.

(5 Lectures)

Optical methods of analysis:

Origin of spectra, interaction of radiation with matter, fundamental laws of spectroscopy and selection rules, validity of Beer-Lambert's law.

UV-Visible Spectrometry: Basic principles of instrumentation (choice of source, monochromator and detector) for single and double beam instrument;

Basic principles of quantitative analysis: estimation of metal ions from aqueous solution, geometrical isomers, keto-enol tautomers. Determination of composition of metal complexes using Job's method of continuous variation and mole ratio method.

Infrared Spectrometry: Basic principles of instrumentation (choice of source, monochromator & detector) for single and double beam instrument; sampling techniques.

Structural illustration through interpretation of data, Effect and importance of isotope substitution.

Flame Atomic Absorption and Emission Spectrometry: Basic principles of instrumentation (choice of source, monochromator, detector, choice of flame and Burner designs. Techniques of atomization and sample introduction; Method of background correction, sources of chemical interferences and their method of removal. Techniques for the quantitative estimation of trace level of metal ions from water samples.

(25 Lectures)

Thermal methods of analysis:

Theory of thermogravimetry (TG), basic principle of instrumentation.

Techniques for quantitative estimation of Ca and Mg from their mixture.

(5 Lectures)

Electroanalytical methods:

Classification of electroanalytical methods, basic principle of pH metric, potentiometric and conductometric titrations. Techniques used for the determination of equivalence points.

Techniques used for the determination of pK_a values.

(10 Lectures)

Separation techniques:

Solvent extraction: Classification, principle and efficiency of the technique.

Mechanism of extraction: extraction by solvation and chelation.

Technique of extraction: batch, continuous and counter current extractions.

Qualitative and quantitative aspects of solvent extraction: extraction of metal ions from aqueous solution, extraction of organic species from the aqueous and non-aqueous media.

Chromatography: Classification, principle and efficiency of the technique.

Mechanism of separation: adsorption, partition & ion exchange.

Development of chromatograms: frontal, elution and displacement methods.

Qualitative and quantitative aspects of chromatographic methods of analysis: IC, GLC, GPC, TLC and HPLC.

Stereoisomeric separation and analysis: Measurement of optical rotation, calculation of Enantiomeric excess (ee)/diastereomeric excess (de) ratios and determination of enantiomeric composition using NMR, Chiral solvents and chiral shift reagents. Chiralchromatographic techniques using chiral columns (GC and HPLC).

Role of computers in instrumental methods of analysis.

(15 Lectures)

Reference Books:

- Mendham, J., *A. I. Vogel's Quantitative Chemical Analysis 6th Ed.*, Pearson, 2009.
- Willard, H.H. *et al.*: *Instrumental Methods of Analysis*, 7th Ed. Wardsworth Publishing Company, Belmont, California, USA, 1988.
- Christian, G.D. *Analytical Chemistry*, 6th Ed. John Wiley & Sons, New York, 2004.
- Harris, D.C.: *Exploring Chemical Analysis*, 9th Ed. New York, W.H. Freeman, 2016.
- Khopkar, S.M. *Basic Concepts of Analytical Chemistry*. New Age International Publisher, 2009.
- Skoog, D.A. Holler F.J. & Nieman, T.A. *Principles of Instrumental Analysis*, Cengage Learning India Ed.
- Mikes, O. *Laboratory Hand Book of Chromatographic & Allied Methods*, Elles Harwood Series on Analytical Chemistry, John Wiley & Sons, 1979.
- Ditts, R.V. Analytical Chemistry; Methods of separation, van Nostrand, 1974.

PRACTICALS- DSE-1 LAB: ANALYTICAL METHODS IN CHEMISTRY (60 Lectures)

I. Separation Techniques

1. Chromatography:

(a) Separation of mixtures

(i) Paper chromatographic separation of Fe^{3+}, Al^{3+}, and Cr^{3+}.

(ii) Separation and identification of the monosaccharides present in the given mixture (glucose & fructose) by paper chromatography. Reporting the R_f values.

(b) Separate a mixture of Sudan yellow and Sudan Red by TLC technique and identify them on the basis of their R_f values.

(c) Chromatographic separation of the active ingredients of plants, flowers and juices by TLC.

II. Solvent Extractions:

(i) To separate a mixture of Ni^{2+} & Fe^{2+} by complexation with DMG and extracting the Ni^{2+}-DMG complex in chloroform, and determine its concentration by spectrophotometry.

(ii) Solvent extraction of zisconium with amberliti LA-1, separation from a mixture of irons and gallium.

3. Determine the pH of the given aerated drinks fruit juices, shampoos and soaps.

4. Determination of Na, Ca, Li in cola drinks and fruit juices using fame photometric techniques.

5. Analysis of soil:

(i) Determination of pH of soil.

(ii) Total soluble salt

(iii) Estimation of calcium, magnesium, phosphate,

nitrate 6. Ion exchange:

(i) Determination of exchange capacity of cation exchange resins and anion exchange resins.

(ii) Separation of metal ions from their binary mixture.

(iii) Separation of amino acids from organic acids by ion exchange chromatography.

III Spectrophotometry

1. Determination of pK_a values of indicator using spectrophotometry.

2 Structural characterization of compounds by infrared spectroscopy.
3 Determination of dissolved oxygen in water.
4 Determination of chemical oxygen demand (COD).
5 Determination of Biological oxygen demand (BOD).
6 Determine the composition of the Ferric-salicylate/ ferric-thiocyanate complex by Job's method.

Reference Books:

- Mendham, J., *A. I. Vogel's Quantitative Chemical Analysis 6th Ed.,* Pearson, 2009.
- Willard, H.H. *et al.*: *Instrumental Methods of Analysis*, 7th Ed. Wardsworth Publishing Company, Belmont, California, USA, 1988.
- Christian, G.D. *Analytical Chemistry*, 6th Ed. John Wiley & Sons, New York, 2004.
- Harris, D.C. *Exploring Chemical Analysis*, 9 th Ed. New York, W.H. Freeman, 2016.
- Khopkar, S.M. *Basic Concepts of Analytical Chemistry*. New Age International Publisher, 2009.
- Skoog, D.A. Holler F.J. and Nieman, T.A. *Principles of Instrumental Analysis*, Cengage Learning India Edition.
- Mikes, O. & Chalmes, R.A. *Laboratory Handbook of Chromatographic & Allied Methods*, Elles Harwood Ltd. London.
- Ditts, R.V. *Analytical Chemistry: Methods of separation.* Van Nostrand, New York, 1974.

CHEMISTRY-DSE-2: INSTRUMENTAL METHODS OF CHEMICAL ANALYSIS

(Credits: Theory-04, Practicals-02)

Theory: 60 Lectures

Introduction to spectroscopic methods of analysis:
Recap of the spectroscopic methods covered in detail in the core chemistry syllabus: Treatment of analytical data, including error analysis. Classification of analytical methods and the types of instrumental methods. Consideration of electromagnetic radiation.

(4 Lectures)

Molecular spectroscopy:

Infrared spectroscopy:
Interactions with molecules: absorption and scattering. Means of excitation (light sources), separation of spectrum (wavelength dispersion, time resolution), detection of the signal (heat,

differential detection), interpretation of spectrum (qualitative, mixtures, resolution), advantages of Fourier Transform (FTIR). Samples and results expected. Applications: Issues of quality assurance and quality control, Special problems for portable instrumentation and rapid detection.

UV-Visible/ Near IR – emission, absorption, fluorescence and photoaccoustic. Excitation sources (lasers, time resolution), wavelength dispersion (gratings, prisms, interference filters, laser, placement of sample relative to dispersion, resolution), Detection of signal (photocells, photomultipliers, diode arrays, sensitivity and S/N), Single and Double Beam instruments, Interpretation (quantification, mixtures, absorption vs. fluorescence and the use of time, photoaccoustic, fluorescent tags). **(16 Lectures)**

Separation techniques

Chromatography: Gas chromatography, liquid chromatography, supercritical fluids, Importance of column technology (packing, capillaries), Separation based on increasing number of factors (volatility, solubility, interactions with stationary phase, size, electrical field), Detection: simple vs. specific (gas and liquid), Detection as a means of further analysis (use of tags and coupling to IR and MS), Electrophoresis (plates and capillary) and use with DNA analysis.

Immunoassays and DNA techniques.

Mass spectroscopy: Making the gaseous molecule into an ion (electron impact, chemical ionization), Making liquids and solids into ions (electrospray, electrical discharge, laser desorption, fast atom bombardment), Separation of ions on basis of mass to charge ratio, Magnetic, Time of flight, Electric quadrupole. Resolution, time and multiple separations, Detection and interpretation (how this is linked to excitation).

(16 Lectures)

Elemental analysis:

Mass spectrometry (electrical discharges).

Atomic spectroscopy: Atomic absorption, Atomic emission, and Atomic fluorescence.

Excitation and getting sample into gas phase (flames, electrical discharges, plasmas), Wavelength separation and resolution (dependence on technique), Detection of radiation (simultaneous/scanning, signal noise), Interpretation (errors due to molecular and ionic species, matrix effects, other interferences).

(8 Lectures)

NMR spectroscopy: **P**rinciple, Instrumentation, Factors affecting chemical shift, Spin-coupling, Applications. **(4 Lectures)**

Electroanalytical Methods: Potentiometry & Voltammetry

(4 Lectures)

Radiochemical Methods

(4 Lectures)

X-ray analysis and electron spectroscopy (surface analysis)

(4 Lectures)

Reference books:

- D.A. Skoog, F.J. Holler & S. Crouch (ISBN 0-495-01201-7) *Principles of Instrumental Analysis*, Cengage Learning India Edition, 2007.
- Willard, Merritt, Dean, Settle, *Instrumental Methods of Analysis*, 7th ed, IBH Book House, New Delhi.

- Atkins, P.W & Paula, J.D. *Physical Chemistry*, 10th Ed., Oxford University Press (2014).
- Kakkar, R. *Atomic and Molecular Spectroscopy: Concepts and Applications.* Cambridge University Press, 2015.
- Castellan, G. W. *Physical Chemistry 4th Ed.*, Narosa (2004).
- Banwell, C. N. & McCash, E. M. *Fundamentals of Molecular Spectroscopy* 4th Ed. Tata McGraw-Hill: New Delhi (2006).
- Smith, B.C. *Infrared Spectral Interpretations: A Systematic Approach.* CRC Press, 1998.
- Moore, W.J., *Physical Chemistry* Orient Blackswan, 1999.

PRACTICALS-DSE-2 LAB: INSTRUMENTAL METHODS OF CHEMICAL ANALYSIS (60 Lectures)

1. Safety Practices in the Chemistry Laboratory
2. Determination of the isoelectric pH of a protein.
3. Titration curve of an amino acid.
4. Determination of the void volume of a gel filtration column.
5. Determination of a Mixture of Cobalt and Nickel (UV/Vis spec.)
6. Study of Electronic Transitions in Organic Molecules (i.e., acetone in water)
7. IR Absorption Spectra (Study of Aldehydes and Ketones)
8. Determination of Calcium, Iron, and Copper in Food by Atomic Absorption
9. Quantitative Analysis of Mixtures by Gas Chromatography (i.e., chloroform and carbon tetrachloride)
10. Separation of Carbohydrates by HPLC
11. Determination of Caffeine in Beverages by HPLC
12. Potentiometric Titration of a Chloride-Iodide Mixture
13. Cyclic Voltammetry of the Ferrocyanide/Ferricyanide Couple
14. Nuclear Magnetic Resonance
15. Use of fluorescence to do “presumptive tests” to identify blood or other body fluids.
16. Use of “presumptive tests” for anthrax or cocaine
17. Collection, preservation, and control of blood evidence being used for DNA testing
18. Use of capillary electrophoresis with laser fluorescence detection for nuclear DNA (Y chromosome only or multiple chromosome)
19. Use of sequencing for the analysis of mitochondrial DNA
20. Laboratory analysis to confirm anthrax or cocaine
21. Detection in the field and confirmation in the laboratory of flammable accelerants or explosives
22. Detection of illegal drugs or steroids in athletes
23. Detection of pollutants or illegal dumping
24. Fibre analysis

At least 10 experiments to be performed.

Reference Books:

- Skoog, D.A. Holler F.J. & Nieman, T.A. *Principles of Instrumental Analysis*, Cengage Learning India Ed.
- Willard, H.H., Merritt, L.L., Dean, J. & Settoe, F.A. *Instrumental Methods of Analysis*, 7th Ed. Wadsworth Publishing Company Ltd., Belmont, California, USA, 1988.

CHEMISTRY-DSE-3: APPLICATIONS OF COMPUTERS IN CHEMISTRY

(Credits: Theory-04, Practicals-02)

Theory: 60 Lectures

Basics:

Constants, variables, bits, bytes, binary and ASCII formats, arithmetic expressions, hierarchy of operations, inbuilt functions. Elements of the BASIC language. BASIC keywords and commands. Logical and relative operators. Strings and graphics. Compiled versus interpreted languages. Debugging. Simple programs using these concepts. Matrix addition and multiplication. Statistical analysis.

Numerical methods:

Roots of equations: Numerical methods for roots of equations: Quadratic formula, iterative method, Newton-Raphson method, Binary bisection and Regula-Falsi.

Differential calculus: Numerical differentiation.

Integral calculus: Numerical integration (Trapezoidal and Simpson's rule), probability distributions and mean values.

Simultaneous equations: Matrix manipulation: addition, multiplication. Gauss-Siedal method.

Interpolation, extrapolation and curve fitting: Handling of experimental data.

Conceptual background of molecular modelling: Potential energy surfaces. Elementary ideas of molecular mechanics and practical MO methods.

Reference Books:

- Harris, D. C. *Quantitative Chemical Analysis*. 6th Ed., Freeman (2007) Chapters 3-5.
- Levie, R. de, *How to use Excel in analytical chemistry and in general scientific data analysis*, Cambridge Univ. Press (2001) 487 pages.
- Noggle, J. H. *Physical chemistry on a Microcomputer*. Little Brown & Co. (1985).
- Venit, S.M. *Programming in BASIC: Problem solving with structure and style.* Jaico Publishing House: Delhi (1996).

PRACTICAL-DSE-3 LAB: APPLICATIONS OF COMPUTERS IN CHEMISTRY

60 Lectures

Computer programs based on numerical methods for

1. Roots of equations: (e.g. volume of van der Waals gas and comparison with ideal gas, pH of a weak acid).
2. Numerical differentiation (e.g., change in pressure for small change in volume of a van der Waals gas, potentiometric titrations).

3. Numerical integration (e.g. entropy/ enthalpy change from heat capacity data), probability distributions (gas kinetic theory) and mean values.

4. Matrix operations. Application of Gauss-Siedel method in colourimetry.
5. Simple exercises using molecular visualization software.

Reference Books:

- McQuarrie, D. A. *Mathematics for Physical Chemistry* University Science Books (2008).
- Mortimer, R. *Mathematics for Physical Chemistry*. 3rd Ed. Elsevier (2005).
- Steiner, E. *The Chemical Maths Book* Oxford University Press (1996).
- Yates, P. *Chemical Calculations*. 2nd Ed. CRC Press (2007).
- Harris, D. C. *Quantitative Chemical Analysis*. 6th Ed., Freeman (2007) Chapters 3-5.
- Levie, R. de, *How to use Excel in analytical chemistry and in general scientific data analysis*, Cambridge Univ. Press (2001) 487 pages.
- Noggle, J. H. *Physical Chemistry on a Microcomputer*. Little Brown & Co. (1985).
- Venit, S.M. *Programming in BASIC: Problem solving with structure and style.* Jaico Publishing House: Delhi (1996).

CHEMISTRY-DSE-4: DISSERTATION (Credits: 06)

Each student will submit a dissertation on an assigned topic under the guidance of a faculty member.

Generic Elective Papers for other Departments/Disciplines
(GE-1 to GE-4)
(Credit: 06 each)

GE-1: Chemistry-1
(*ATOMIC STRUCTURE, BONDING, GENERAL ORGANIC CHEMISTRY & ALIPHATIC HYDROCARBONS*)
(Credits: Theory-04, Practicals-02)
Theory: 60 Lectures

Section A: Inorganic Chemistry-1 **(30 Periods)**

Atomic Structure: *Review of: Bohr's theory and its limitations, dual behaviour of matter and radiation, de Broglie's relation, Heisenberg Uncertainty principle. Hydrogen atom spectra. Need of a new approach to Atomic structure.*

What is Quantum mechanics? Time independent Schrodinger equation and meaning of various terms in it. Significance of ψ and ψ^2, Schrödinger equation for hydrogen atom. Radial and angular parts of the hydrogenic wave functions (atomic orbitals) and their variations for 1*s*, 2*s*, 2*p*, 3*s*, 3*p* and 3*d* orbitals (Only graphical representation). Radial and angular nodes and their significance. Radial distribution functions and the concept of the most probable distance with special reference to 1*s* and 2*s* atomic orbitals. Significance of quantum numbers, orbital angular momentum and quantum numbers m_l and m_s. Shapes of *s*, *p* and *d* atomic orbitals, nodal planes. Discovery of spin, spin quantum number (*s*) and magnetic spin quantum number (m_s).

Rules for filling electrons in various orbitals, Electronic configurations of the atoms. Stability of half-filled and completely filled orbitals, concept of exchange energy. Relative energies of atomic orbitals, Anomalous electronic configurations.

(14 Lectures)

Chemical Bonding and Molecular Structure

Ionic Bonding: General characteristics of ionic bonding. Energy considerations in ionic bonding, lattice energy and solvation energy and their importance in the context of stability and solubility of ionic compounds. Statement of Born-Landé equation for calculation of lattice energy, Born-Haber cycle and its applications, polarizing power and polarizability. Fajan's rules, ionic character in covalent compounds, bond moment, dipole moment and percentage ionic character.

Covalent bonding: VB Approach: Shapes of some inorganic molecules and ions on the basis of VSEPR and hybridization with suitable examples of linear, trigonal planar, square planar, tetrahedral, trigonal bipyramidal and octahedral arrangements.

Concept of resonance and resonating structures in various inorganic and organic compounds.

MO Approach: Rules for the LCAO method, bonding and antibonding MOs and their characteristics for *s-s*, *s-p* and *p-p* combinations of atomic orbitals, nonbonding combination of

orbitals, MO treatment of homonuclear diatomic molecules of 1st and 2nd periods (including idea of *s-p* mixing) and heteronuclear diatomic molecules such as CO, NO and NO^+. Comparison of VB and MO approaches.

(16 Lectures)

Section B: Organic Chemistry-1 **(30 Periods)**

Fundamentals of Organic Chemistry

Physical Effects, Electronic Displacements: Inductive Effect, Electromeric Effect, Resonance and Hyperconjugation. Cleavage of Bonds: Homolysis and Heterolysis.

Structure, shape and reactivity of organic molecules: Nucleophiles and electrophiles. Reactive Intermediates: Carbocations, Carbanions and free radicals.

Strength of organic acids and bases: Comparative study with emphasis on factors affecting pK values. Aromaticity: Benzenoids and Hückel's rule.

(8 Lectures)

Stereochemistry

Conformations with respect to ethane, butane and cyclohexane. Interconversion of Wedge Formula, Newmann, Sawhorse and Fischer representations. Concept of chirality (upto two carbon atoms). Configuration: Geometrical and Optical isomerism; Enantiomerism, Diastereomerism and Meso compounds). Threo and erythro; D and L; *cis-trans* nomenclature; CIP Rules: R/S (for upto 2 chiral carbon atoms) and E/Z Nomenclature (for upto two C=C systems).

(10 Lectures)

Aliphatic Hydrocarbons

Functional group approach for the following reactions (preparations & reactions) to be studied in context to their structure.

Alkanes: (Upto 5 Carbons). *Preparation:* Catalytic hydrogenation, Wurtz reaction, Kolbe's synthesis, from Grignard reagent. *Reactions:* Free radical Substitution: Halogenation.

Alkenes: (Upto 5 Carbons) *Preparation:* Elimination reactions: Dehydration of alkenes and dehydrohalogenation of alkyl halides (Saytzeff's rule); cis alkenes (Partial catalytic hydrogenation) and trans alkenes (Birch reduction). *Reactions:* cis-addition (alk. KMnO4) and trans-addition (bromine), Addition of HX (Markownikoff's and anti-Markownikoff's addition), Hydration, Ozonolysis, oxymecuration-demercuration, Hydroboration-oxidation.

Alkynes: (Upto 5 Carbons) *Preparation:* Acetylene from $CaC_2$and conversion into higher alkynes; by dehalogenation of tetra halides and dehydrohalogenation of vicinal-dihalides. *Reactions:* formation of metal acetylides, addition of bromine and alkaline $KMnO_4$,ozonolysis and oxidation with hot alk. $KMnO_4$.

(12 Lectures)

Reference Books:

- Lee, J.D. *Concise Inorganic Chemistry* ELBS, 1991.
- Cotton, F.A., Wilkinson, G. & Gaus, P.L. *Basic Inorganic Chemistry*, 3rd ed., Wiley.
- Douglas, B.E., McDaniel, D.H. & Alexander, J.J. *Concepts and Models in Inorganic Chemistry*, John Wiley & Sons.

- Huheey, J.E., Keiter, E.A., Keiter, R.L. & Medhi, O.K. *Inorganic Chemistry: Principles of Structure and Reactivity*, Pearson Education India, 2006.
- Graham Solomon, T.W., Fryhle, C.B. & Dnyder, S.A. *Organic Chemistry*, John Wiley & Sons (2014).
- McMurry, J.E. *Fundamentals of Organic Chemistry*, 7th Ed. Cengage Learning India Edition, 2013.
- Sykes, P. *A Guidebook to Mechanism in Organic Chemistry*, Orient Longman, New Delhi (1988).
- Eliel, E.L. *Stereochemistry of Carbon Compounds*, Tata McGraw Hill education, 2000.
- Finar, I.L. *Organic Chemistry* (Vol. I & II), E.L.B.S.
- Morrison, R.T. & Boyd, R.N. *Organic Chemistry*, Pearson, 2010.
- Bahl, A. & Bahl, B.S. *Advanced Organic Chemistry*, S. Chand, 2010.

GE-1 LAB: Chemistry-1 LAB

60 Lectures

Section A: Inorganic Chemistry - Volumetric Analysis

1. Estimation of sodium carbonate and sodium hydrogen carbonate present in a mixture.

2. Estimation of oxalic acid by titrating it with $KMnO_4$.

3. Estimation of water of crystallization in Mohr's salt by titrating with $KMnO_4$.

4. Estimation of Fe (II) ions by titrating it with $K_2Cr_2O_7$ using internal indicator.

5. Estimation of Cu (II) ions iodometrically using $Na_2S_2O_3$.

Section B: Organic Chemistry

1. Detection of extra elements (N, S, Cl, Br, I) in organic compounds (containing upto two extra elements)

2. Separation of mixtures by Chromatography: Measure the R_f value in each case (combination of two compounds to be given)

(a) Identify and separate the components of a given mixture of two amino acids (glycine, aspartic acid, glutamic acid, tyrosine or any other amino acid) by paper chromatography
(b) Identify and separate the sugars present in the given mixture by paper chromatography.

Reference Books:

- Svehla, G. *Vogel's Qualitative Inorganic Analysis*, Pearson Education, 2012.
- Mendham, J. *Vogel's Quantitative Chemical Analysis*, Pearson, 2009.
- Vogel, A.I., Tatchell, A.R., Furnis, B.S., Hannaford, A.J. & Smith, P.W.G., *Textbook of Practical Organic Chemistry*, Prentice-Hall, 5th edition, 1996.
- Mann, F.G. & Saunders, B.C. *Practical Organic Chemistry* Orient-Longman, 1960.

GE-2: Chemistry-2

(*CHEMICAL ENERGETICS, EQUILIBRIA & FUNCTIONAL ORGANIC CHEMISTRY-I*)

(Credits: Theory-04, Practicals-2) Theory: 60 Lectures

Section A: Physical Chemistry-1 **(30 Lectures)**

Chemical Energetics

Review of thermodynamics and the Laws of Thermodynamics.

Important principles and definitions of thermochemistry. Concept of standard state and standard enthalpies of formations, integral and differential enthalpies of solution and dilution. Calculation of bond energy, bond dissociation energy and resonance energy from thermochemical data. Variation of enthalpy of a reaction with temperature – Kirchhoff's equation.

Statement of Third Law of thermodynamics and calculation of absolute entropies of substances.

(10 Lectures)

Chemical Equilibrium:

Free energy change in a chemical reaction.Thermodynamic derivation of the law of chemical equilibrium.Distinction between G and G^{o}, Le Chatelier's principle. Relationships between K_p, K_c and K_x for reactions involving ideal gases.

(8 Lectures)

Ionic Equilibria:

Strong, moderate and weak electrolytes, degree of ionization, factors affecting degree of ionization, ionization constant and ionic product of water. Ionization of weak acids and bases, pH scale, common ion effect. Salt hydrolysis-calculation of hydrolysis constant, degree of hydrolysis and pH for different salts. Buffer solutions. Solubility and solubility product of sparingly soluble salts – applications of solubility product principle.

(12 Lectures)

Section B: Organic Chemistry-2 **(30 Lectures)**

Functional group approach for the following reactions (preparations & reactions) to be studied in context to their structure.

Aromatic hydrocarbons

Preparation (Case benzene): from phenol, by decarboxylation, from acetylene, from benzene sulphonic acid.

Reactions: (Case benzene): Electrophilic substitution: nitration, halogenation and sulphonation. Friedel-Craft's reaction (alkylation and acylation) (upto 4 carbons on benzene).Side chain oxidation of alkyl benzenes (upto 4 carbons on benzene).

(8 Lectures)

Alkyl and Aryl Halides

Alkyl Halides (Upto 5 Carbons) Types of Nucleophilic Substitution (S_N1, S_N2 and S_Ni)reactions.

Preparation: from alkenes *and* alcohols.

Reactions: hydrolysis, nitrite & nitro formation, nitrile & isonitrile formation. Williamson's ether synthesis: Elimination vs substitution.

Aryl Halides *Preparation:* (Chloro, bromo and iodo-benzene case): from phenol, Sandmeyer & Gattermann reactions.

Reactions (Chlorobenzene): Aromatic nucleophilic substitution (replacement by –OH group)and effect of nitro substituent. Benzyne Mechanism: KNH_2/NH_3 (or $NaNH_2/NH_3$).

Reactivity and Relative strength of C-Halogen bond in alkyl, allyl, benzyl, vinyl and aryl halides.

(8 Lectures)

Alcohols, Phenols and Ethers (Upto 5 Carbons)

Alcohols: *Preparation:* Preparation of 1^o, 2^o and 3^oalcohols: using Grignard reagent, Esterhydrolysis, Reduction of aldehydes, ketones, carboxylic acid and esters.

Reactions: With sodium, HX (Lucas test), esterification, oxidation (with PCC, alk. $KMnO_4$, acidic dichromate, conc. HNO_3). Oppeneauer oxidation *Diols:* (Upto 6 Carbons) oxidation of diols. Pinacol-Pinacolone rearrangement.

Phenols: (Phenol case) *Preparation:* Cumene hydroperoxide method, from diazonium salts. *Reactions:* Electrophilic substitution: Nitration, halogenation and sulphonation. Reimer-Tiemann Reaction, Gattermann-Koch Reaction, Houben–Hoesch Condensation, Schotten – Baumann Reaction.

Ethers (aliphatic and aromatic): Cleavage of ethers with HI.

Aldehydes and ketones (aliphatic and aromatic): (Formaldehye, acetaldehyde, acetone andbenzaldehyde).

Preparation: from acid chlorides and from nitriles.

Reactions – Reaction with HCN, ROH, $NaHSO_3$, NH_2-G derivatives. Iodoform test. Aldol

Condensation, Cannizzaro's reaction, Wittig reaction, Benzoin condensation. Clemensen reduction and Wolff Kishner reduction. Meerwein-Pondorff Verley reduction.

(14 Lectures)

Reference Books:

- Graham Solomon, T.W., Fryhle, C.B. & Dnyder, S.A. *Organic Chemistry,* John Wiley & Sons (2014).
- McMurry, J.E. *Fundamentals of Organic Chemistry*, 7th Ed. Cengage Learning India Edition, 2013.
- Sykes, P. *A Guidebook to Mechanism in Organic Chemistry,* Orient Longman, New Delhi (1988).
- Finar, I.L. *Organic Chemistry* (Vol. I & II), E.L.B.S.
- Morrison, R.T. & Boyd, R.N. *Organic Chemistry,* Pearson, 2010.
- Bahl, A. & Bahl, B.S. *Advanced Organic Chemistry,* S. Chand, 2010.
- Barrow, G.M. *Physical Chemistry* Tata McGraw-Hill (2007).
- Castellan, G.W. *Physical Chemistry* 4th Ed. Narosa (2004).
- Kotz, J.C., Treichel, P.M. & Townsend, J.R. *General Chemistry* Cengage Learning India Pvt. Ltd., New Delhi (2009).
- Mahan, B.H. *University Chemistry* 3rd Ed. Narosa (1998).
- Petrucci, R.H. *General Chemistry* 5th Ed. Macmillan Publishing Co.: New York (1985).

GE-2 LAB: Chemistry-2 LAB

60 Lectures

Section A: Physical Chemistry

Thermochemistry

1. Determination of heat capacity of calorimeter for different volumes.
2. Determination of enthalpy of neutralization of hydrochloric acid with sodium hydroxide.
3. Determination of enthalpy of ionization of acetic acid.
4. Determination of integral enthalpy of solution of salts (KNO_3, NH_4Cl).
5. Determination of enthalpy of hydration of copper sulphate.
6. Study of the solubility of benzoic acid in water and determination of ΔH.

Ionic equilibria

pH measurements

Measurement of pH of different solutions like aerated drinks, fruit juices, shampoos and soaps (use dilute solutions of soaps and shampoos to prevent damage to the glass electrode) using pH-meter.

a) Preparation of buffer solutions:

(i) Sodium acetate-acetic acid

(ii) Ammonium chloride-ammonium hydroxide

Measurement of the pH of buffer solutions and comparison of the values with theoretical

values.

Section B: Organic Chemistry

1. Purification of organic compounds by crystallization (from water and alcohol) and distillation.
2. Criteria of Purity: Determination of melting and boiling points.
3. Preparations: Mechanism of various reactions involved to be discussed. Recrystallization, determination of melting point and calculation of quantitative yields to be done.

(a) Bromination of Phenol/Aniline
(b) Benzoylation of amines/phenols
(c) Oxime and 2,4-dinitrophenylhydrazone of aldehyde/ketone.

Reference Books

- Vogel, A.I., Tatchell, A.R., Furnis, B.S., Hannaford, A.J. & Smith, P.W.G., *Text book of Practical Organic Chemistry*, Prentice-Hall, 5th edition, 1996.
- Mann, F.G. & Saunders, B.C. *Practical Organic Chemistry* Orient-Longman, 1960.
- Khosla, B. D.; Garg, V. C. & Gulati, A. *Senior Practical Physical Chemistry*, R. Chand & Co.: New Delhi (2011).

GE-3: Chemistry-3

(*SOLUTIONS, PHASE EQUILIBRIA, CONDUCTANCE, ELECTROCHEMISTRY & FUNCTIONAL GROUP ORGANIC CHEMISTRY-II*)

(Credits: Theory-04, Practicals-02)

Theory: 60 Lectures

Section A: Physical Chemistry-2 **(30 Lectures)**

Solutions

Thermodynamics of ideal solutions: Ideal solutions and Raoult's law, deviations from Raoult's law – non-ideal solutions. Vapour pressure-composition and temperature-composition curves of ideal and non-ideal solutions. Distillation of solutions. Lever rule. Azeotropes.

Partial miscibility of liquids: Critical solution temperature; effect of impurity on partial miscibility of liquids. Immiscibility of liquids- Principle of steam distillation. Nernst distribution law and its applications, solvent extraction.

(8 Lectures)

Phase Equilibria

Phases, components and degrees of freedom of a system, criteria of phase equilibrium. Gibbs Phase Rule and its thermodynamic derivation. Derivation of Clausius – Clapeyron equation and its importance in phase equilibria. Phase diagrams of one-component systems (water and sulphur) and two component systems involving eutectics, congruent and incongruent melting points (lead-silver, $FeCl_3$-H_2O and Na-K only).

(8 Lectures)

Conductance

Conductivity, equivalent and molar conductivity and their variation with dilution for weak and strong electrolytes. Kohlrausch law of independent migration of ions.

Transference number and its experimental determination using Hittorf and Moving boundary methods. Ionic mobility. Applications of conductance measurements: determination of degree of ionization of weak electrolyte, solubility and solubility products of sparingly soluble salts, ionic product of water, hydrolysis constant of a salt. Conductometric titrations (only acid-base).

(6 Lectures)

Electrochemistry

Reversible and irreversible cells. Concept of EMF of a cell. Measurement of EMF of a cell. Nernst equation and its importance. Types of electrodes. Standard electrode potential. Electrochemical series. Thermodynamics of a reversible cell, calculation of thermodynamic properties: *G*, *H* and *S* from EMF data.

Calculation of equilibrium constant from EMF data. Concentration cells with transference and without transference. Liquid junction potential and salt bridge.

pH determination using hydrogen electrode and quinhydrone electrode.

Potentiometric titrations -qualitative treatment (acid-base and oxidation-reduction only).

(8 Lectures)

Section B: Organic Chemistry-3 **(30 Lectures)**

Functional group approach for the following reactions (preparations & reactions) to be studied in context to their structure.

Carboxylic acids and their derivatives

Carboxylic acids (aliphatic and aromatic)

Preparation: Acidic and Alkaline hydrolysis of esters.

Reactions: Hell–Vohlard - Zelinsky Reaction.

Carboxylic acid derivatives (aliphatic): (Upto 5 carbons)

Preparation: Acid chlorides, Anhydrides, Esters and Amides from acids and their interconversion.

Reactions: Comparative study of nucleophilicity of acyl derivatives. Reformatsky Reaction, Perkin condensation. **(6 Lectures)**

Amines and Diazonium Salts

Amines (Aliphatic and Aromatic): (Upto 5 carbons)

Preparation: from alkyl halides, Gabriel's Phthalimide synthesis, Hofmann Bromamide reaction.

Reactions: Hofmann vs. Saytzeff elimination, Carbylamine test, Hinsberg test, with HNO_2,Schotten–Baumann Reaction. Electrophilic substitution (case aniline): nitration, bromination, sulphonation.

Diazonium salts: *Preparation:* from aromatic amines.

Reactions: conversion to benzene, phenol, dyes. **(6 Lectures)**

Molecules of Life:

Amino Acids, Peptides and Proteins:

Preparation of Amino Acids: Strecker synthesis using Gabriel's phthalimide synthesis. Zwitterion, Isoelectric point and Electrophoresis.

Overview of Primary, Secondary, Tertiary and Quaternary Structure of proteins.

(3 Lectures)

Carbohydrates: Classification, and General Properties, Glucose and Fructose (open chain and cyclic structure), Determination of configuration of monosaccharides, absolute configuration of Glucose and Fructose, Mutarotation, ascending and descending in monosaccharides. Structure of disaccharides (sucrose, cellobiose, maltose, lactose) and polysaccharides (starch and cellulose) excluding their structure elucidation.

(4 Lectures)

Enzymes:

Mechanism of enzyme action, factors affecting enzyme action, Coenzymes and cofactors and their role in biological reactions, Specificity of enzyme action (including stereospecificity), Enzyme inhibitors and their importance.

(3 Lectures)

Nucleic Acids:

Components of Nucleic acids: Adenine, guanine, thymine and cytosine (structure only), other components of nucleic acids, Nucleosides and nucleotides (nomenclature), Structure of polynucleotides; Structure of DNA (Watson-Crick model) and RNA (types of RNA).

(4 Lectures)

Lipids:

Introduction to lipids, classification.

Oils and fats: Common fatty acids present in oils and fats, Omega fatty acids, Trans fats, Hydrogenation, Saponification value, Iodine number.

(2 Lectures)

Concept of Energy in Biosystems:

Calorific value of food. Standard caloric content of carbohydrates, proteins and fats. ATP: the universal currency of cellular energy.

(2 Lectures)

Reference Books:

- Barrow, G.M. *Physical Chemistry* Tata McGraw-Hill (2007).
- Castellan, G.W. *Physical Chemistry* 4th Ed. Narosa (2004).
- Kotz, J.C., Treichel, P.M. & Townsend, J.R. *General Chemistry*, Cengage Learning India Pvt. Ltd.: New Delhi (2009).
- Mahan, B.H. *University Chemistry*, 3rd Ed. Narosa (1998).
- Petrucci, R.H. *General Chemistry*, 5th Ed., Macmillan Publishing Co.: New York (1985).
- Morrison, R. T. & Boyd, R. N. *Organic Chemistry*, Dorling Kindersley (India) Pvt.

Ltd. (Pearson Education).
- Finar, I. L. *Organic Chemistry* (*Volume 1*), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
- Finar, I. L. *Organic Chemistry* (*Volume 2)*, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
- Nelson, D. L. & Cox, M. M. *Lehninger's Principles of Biochemistry 7th Ed.*, W. H. Freeman.
- Berg, J.M., Tymoczko, J.L. & Stryer, L. *Biochemistry*, W.H. Freeman, 2002.

GE-3 LAB: Chemistry-3 LAB

60 Lectures

Section A: Physical Chemistry

Distribution

Study of the equilibrium of one of the following reactions by the distribution method:

$I_2(aq) + I^-(aq) \rightleftharpoons I_3^-(aq)$

$Cu^{2+}(aq) + xNH_2(aq) \rightleftharpoons [Cu(NH_3)_x]^{2+}$

Phase equilibria

a) Construction of the phase diagram of a binary system (simple eutectic) using cooling curves.
b) Determination of the critical solution temperature and composition of the phenol water system and study of the effect of impurities on it.
c) Study of the variation of mutual solubility temperature with concentration for the phenol water system and determination of the critical solubility temperature.

Conductance

1. Determination of cell constant
2. Determination of equivalent conductance, degree of dissociation and dissociation constant of a weak acid.
3. Perform the following conductometric titrations:
    a. Strong acid vs. strong base
    b. Weak acid vs. strong base

Potentiometry

1. Perform the following potentiometric titrations:

i. Strong acid vs. strong base
ii. Weak acid vs. strong base
iii. Potassium dichromate vs. Mohr's salt

Section B: Organic Chemistry

I. Systematic Qualitative Organic Analysis of Organic Compounds possessing

monofunctional groups (-COOH, phenolic, aldehydic, ketonic, amide, nitro, amines) and preparation of one derivative.

II.

1. Separation of amino acids by paper chromatography
2. Determination of the concentration of glycine solution by formylation method.
3. Titration curve of glycine
4. Action of salivary amylase on starch
5. Effect of temperature on the action of salivary amylase on starch.
6. Differentiation between a reducing and a non-reducing sugar.

Reference Books:

- Vogel, A.I., Tatchell, A.R., Furnis, B.S., Hannaford, A.J. & Smith, P.W.G., *Text book of Practical Organic Chemistry*, Prentice-Hall, 5th edition, 1996.
- Mann, F.G. & Saunders, B.C. *Practical Organic Chemistry* Orient-Longman, 1960.
- Khosla, B. D.; Garg, V. C. & Gulati, A. *Senior Practical Physical Chemistry,* R. Chand & Co.: New Delhi (2011).
- Ahluwalia, V.K. & Aggarwal, R. *Comprehensive Practical Organic Chemistry,* Universities Press.

GE-4: Chemistry-4

(*TRANSITION METAL & COORDINATION CHEMISTRY, STATES OF MATTER & CHEMICAL KINETICS*)

(Credits: Theory-04, Practicals-02)

Theory: 60 Lectures

Section A: Inorganic Chemistry-2 **(30 Lectures)**

Transition Elements (3*d* series)

General group trends with special reference to electronic configuration, variable valency, colour, magnetic and catalytic properties, ability to form complexes and stability of various oxidation states (Latimer diagrams) for Mn, Fe and Cu.

Lanthanoids and actinoids: Electronic configurations, oxidation states, colour, magnetic properties, lanthanide contraction, separation of lanthanides (ion exchange method only).

(12 Lectures)

Coordination Chemistry

Valence Bond Theory (VBT): Inner and outer orbital complexes of Cr, Fe, Co, Ni and Cu (coordination numbers 4 and 6). Structural and stereoisomerism in complexes with coordination numbers 4 and 6.

Drawbacks of VBT. IUPAC system of nomenclature.

(8 Lectures)

Crystal Field Theory
Crystal field effect, octahedral symmetry. Crystal field stabilization energy (CFSE), Crystal field effects for weak and strong fields. Tetrahedral symmetry. Factors affecting the magnitude of D. Spectrochemical series. Comparison of CFSE for O_h and T_d complexes, Tetragonal distortion of octahedral geometry.

Jahn-Teller distortion, Square planar coordination.

(10 Lectures)

Section B: Physical Chemistry-3 **(30 Lectures)**

Kinetic Theory of Gases
Postulates of Kinetic Theory of Gases and derivation of the kinetic gas equation.

Deviation of real gases from ideal behaviour, compressibility factor, causes of deviation. van der Waals equation of state for real gases. Boyle temperature (derivation not required). Critical phenomena, critical constants and their calculation from van der Waals equation. Andrews isotherms of CO_2.

Maxwell Boltzmann distribution laws of molecular velocities and molecular energies (graphic representation – derivation not required) and their importance.
Temperature dependence of these distributions. Most probable, average and root mean square velocities (no derivation). Collision cross section, collision number, collision frequency, collision diameter and mean free path of molecules. Viscosity of gases and effect of temperature and pressure on coefficient of viscosity (qualitative treatment only).

(8 Lectures)

Liquids
Surface tension and its determination using stalagmometer. Viscosity of a liquid and determination of coefficient of viscosity using Ostwald viscometer. Effect of temperature on surface tension and coefficient of viscosity of a liquid (qualitative treatment only).

(6 Lectures)

Solids
Forms of solids. Symmetry elements, unit cells, crystal systems, Bravais lattice types and identification of lattice planes. Laws of Crystallography - Law of constancy of interfacial angles, Law of rational indices. Miller indices. X–Ray diffraction by crystals, Bragg's law. Structures of NaCl, KCl and CsCl (qualitative treatment only).Defects in crystals. Glasses and liquid crystals.

(8 Lectures)

Chemical Kinetics
The concept of reaction rates. Effect of temperature, pressure, catalyst and other factors on reaction rates. Order and molecularity of a reaction. Derivation of integrated rate equations for zero, first and second order reactions (both for equal and unequal concentrations of reactants). Half–life of a reaction. General methods for determination of order of a reaction. Concept of activation energy and its calculation from Arrhenius equation.

Theories of Reaction Rates: Collision theory and Activated Complex theory of bimolecular reactions. Comparison of the two theories (qualitative treatment only).

(8 Lectures)

Reference Books:

- Barrow, G.M. *Physical Chemistry* Tata McGraw-Hill (2007).
- Castellan, G.W. *Physical Chemistry* 4th Ed. Narosa (2004).
- Kotz, J.C., Treichel, P.M. & Townsend, J.R. *General Chemistry* Cengage Learning India Pvt. Ltd., New Delhi (2009).
- Mahan, B.H. *University Chemistry* 3rd Ed. Narosa (1998).
- Petrucci, R.H. *General Chemistry* 5th Ed. Macmillan Publishing Co.: New York (1985).
- Cotton, F.A. & Wilkinson, G. *Basic Inorganic Chemistry,* Wiley.
- Shriver, D.F. & Atkins, P.W. *Inorganic Chemistry,* Oxford University Press.
- Wulfsberg, G. *Inorganic Chemistry,* Viva Books Pvt. Ltd.
- Rodgers, G.E. *Inorganic & Solid State Chemistry,* Cengage Learning India Ltd., 2008.

GE-4 LAB: Chemistry-4 LAB

60 Lectures

Section A: Inorganic Chemistry

Semi-micro qualitative analysis (using H_2S or other methods) of mixtures - not more than four ionic species (two anions and two cations, excluding insoluble salts) out of the following:

Cations : NH_4^+, Pb^{2+}, Bi^{3+}, Cu^{2+}, Cd^{2+}, Fe^{3+}, Al^{3+}, Co^{2+}, Ni^{2+}, Mn^{2+}, Zn^{2+}, Ba^{2+}, Sr^{2+}, Ca^{2+}, K^+

Anions : CO_3^{2-}, S^{2-}, SO_3^{2-}, $S_2O_3^{2-}$, NO_3^-, CH_3COO^-, Cl^-, Br^-, I^-, NO_3^-, SO_4^{2-}, PO_4^{3-}, BO_3^{3-}, $C_2O_4^{2-}$, F^-

(Spot tests should be carried out wherever feasible)

1. Estimate the amount of nickel present in a given solution as bis (dimethyl glyoximato) nickel (II) or aluminium as oximate in a given solution gravimetrically.
2. Estimation of (i) Mg^{2+} or (ii) Zn^{2+} by complexometric titrations using EDTA.
3. Estimation of total hardness of a given sample of water by complexometric titration.

Section B: Physical Chemistry

(I) Surface tension measurement (use of organic solvents excluded).

a) Determination of the surface tension of a liquid or a dilute solution using a stalagmometer.
b) Study of the variation of surface tension of a detergent solution with concentration.

(II) Viscosity measurement (use of organic solvents excluded).

a) Determination of the relative and absolute viscosity of a liquid or dilute solution using an Ostwald's viscometer.
b) Study of the variation of viscosity of an aqueous solution with concentration of

solute.

(III) Chemical Kinetics

Study the kinetics of the following reactions.

3. Initial rate method: Iodide-persulphate reaction
4. Integrated rate method:
   c. Acid hydrolysis of methyl acetate with hydrochloric acid.
   d. Saponification of ethyl acetate.
   e. Compare the strengths of HCl and H_2SO_4 by studying kinetics of hydrolysis of methyl acetate.

Reference Books:

- Svehla, G. *Vogel's Qualitative Inorganic Analysis*, Pearson Education, 2012.
- Mendham, J. *Vogel's Quantitative Chemical Analysis*, Pearson, 2009.
- Khosla, B. D.; Garg, V. C. &Gulati, A. *Senior Practical Physical Chemistry*, R. Chand & Co.: New Delhi (2011).

BODOLAND UNIVERSITY

SYLLABUS FOR

B.Sc. CHEMISTRY (CBCS)

(Regular Course)

Bodoland University
Kokrajhar–783 370, Assam, India

B.Sc. (Regular Course)

Sem.	CORE COURSE (12)	Ability Enhancement Compulsory Course (AECC) (2)	Skill Enhancement Course (SEC) (4)	Discipline Specific Elective (DSE) (6)
I	DSC-1 A	(English/Hindi/MIL Communication)		
	DSC-2 A (Chemistry-1)			
	DSC-3 A			
II	DSC-1 B	Environmental Science		
	DSC-2 B (Chemistry-2)			
	DSC-3 B			
III	DSC-1 C		SEC-1 (Basic Analytical Chemistry)	
	DSC-2 C (Chemistry-3)			
	DSC-3 C			
IV	DSC-1 D		SEC-2 (Fuel Chemistry)	
	DSC-2 D (Chemistry-4)			
	DSC-3 D			
V			SEC-3 (Chemical Technology & Society)	DSE-1 A
				DSE-2 A (Analytical Methods in Chemistry)
				DSE-3 A
VI			SEC-4 (Chemistry of Cosmetics & Perfumes)	DSE-1 B
				DSE-2 B (Instrumental Methods of Chemical Analysis)
				DSE-3 B

Curriculum Structures for B.Sc. (Regular Course)
(*Physics, Chemistry, Mathematics, Botany and Zoology*)
No. of papers =12+12=24, Total Credits= 120
Total Marks=2100

SEMESTER-I						
Paper Code	**Course**	**L+T+P**	**Credit**	**End Sem Marks**	**Internal Marks**	**Total Marks**
Paper-101R	DSC-1A	4+0+2 5+1+0	6	60(L)+20(P) 60(L)+20(T)	20	100
CHY-102R	DSC-2A: Chemistry-1	4+0+2	6	60(L)+20(P)	20	100
Paper-103R	DSC-3A	4+0+2 5+1+0	6	60(L)+20(P) 60(L)+20(T)	20	100
COMM-104HR	AECC-1: (English /Hindi/MIL Communication)	2	2	50(L)	-	50
Total			**20**	**290**	**60**	**350**

SEMESTER-II						
Paper Code	**Course**	**L+T+P**	**Credit**	**End Sem Marks**	**Internal Marks**	**Total Marks**
Paper-201R	DSC-1B	4+0+2 5+1+0	6	60(L)+20(P) 60(L)+20(T)	20	100
CHY -202R	DSC-2B: Chemistry-2	4+0+2	6	60(L)+20(P)	20	100
Paper-203R	DSC-3B	4+0+2 5+1+0	6	60(L)+20(P) 60(L)+20(T)	20	100
ENV-204HR	AECC-2: Environmental Science	2	2	50(L)	-	50
Total			**20**	**290**	**60**	**350**

SEMESTER-III						
Paper Code	**Course**	**L+T+P**	**Credit**	**End Sem Marks**	**Internal Marks**	**Total Marks**
Paper-301R	DSC-1C	4+0+2 5+1+0	6	60(L)+20(P) 60(L)+20(T)	20	100
CHY -302R	DSC-2C: Chemistry-3	4+0+2	6	60(L)+20(P)	20	100
Paper-303R	DSC-3C	4+0+2 5+1+0	6	60(L)+20(P) 60(L)+20(T)	20	100
CHY-304HR	SEC-1: Basic Analytical Chemistry	2	2	50(L)	-	50
Total			**20**	**290**	**60**	**350**

SEMESTER-IV						
Paper Code	**Course**	**L+T+P**	**Credit**	**End Sem Marks**	**Internal Marks**	**Total Marks**
Paper-401R	DSC-1D	4+0+2 5+1+0	6	60(L)+20(P) 60(L)+20(T)	20	100
CHY -402R	DSC-2D: Chemistry-4	4+0+2	6	60(L)+20(P)	20	100
Paper-403R	DSC-3D	4+0+2 5+1+0	6	60(L)+20(P) 60(L)+20(T)	20	100
CHY-404HR	SEC-2: Fuel Chemistry	2	2	50(L)	-	50
Total			**20**	**290**	**60**	**350**

SEMESTER-V						
Paper Code	**Course**	**L+T+P**	**Credit**	**End Sem Marks**	**Internal Marks**	**Total Marks**
Paper-501R	DSE-1A	4+0+2 5+1+0	6	60(L)+20(P) 60(L)+20(T)	20	100
CHY-HR	DSE-2A: Analytical Methods in Chemistry	4+0+2	6	60(L)+20(P)	20	100
Paper-503R	DSE-3A	4+0+2 5+1+0	6	60(L)+20(P) 60(L)+20(T)	20	100
CHY-504R	SEC-3: Chemical Technology & Society	2	2	50(L)	-	50
Total			**20**	**290**	**60**	**350**

SEMESTER-VI						
Paper Code	**Course**	**L+T+P**	**Credit**	**End Sem Marks**	**Internal Marks**	**Total Marks**
Paper-601R	DSE-1B	4+0+2 5+1+0	6	60(L)+20(P) 60(L)+20(T)	20	100
CHY-HR	DSE-2B: Instrumental Methods of Chemical Analysis	4+0+2	6	60(L)+20(P)	20	100
Paper-603R	DSE-3B	4+0+2 5+1+0	6	60(L)+20(P) 60(L)+20(T)	20	100
CHY-604R	SEC-4: Chemistry of Cosmetics & Perfumes	2	2	50(L)	-	50
Total			**20**	**290**	**60**	**350**

SEMESTER-I

DSC-2A: Chemistry-1

(*ATOMIC STRUCTURE, BONDING, GENERAL ORGANIC CHEMISTRY &ALIPHATIC HYDROCARBONS*)
(Credits: Theory-04, Practicals-02)
Theory: 60 Lectures

Section A: Inorganic Chemistry-1 **(30 Periods)**

Atomic Structure: *Review of: Bohr's theory and its limitations, dual behaviour of matter and radiation, de Broglie's relation, Heisenberg Uncertainty principle. Hydrogen atom spectra. Need of a new approach to Atomic structure.*

What is Quantum mechanics? Time independent Schrodinger equation and meaning of various terms in it. Significance of ψ and ψ^2, Schrödinger equation for hydrogen atom. Radial and angular parts of the hydrogenic wave functions (atomic orbitals) and their variations for 1*s*, 2*s*, 2*p*, 3*s*, 3*p* and 3*d* orbitals (Only graphical representation). Radial and angular nodes and their significance. Radial distribution functions and the concept of the most probable distance with special reference to 1*s* and 2*s* atomic orbitals. Significance of quantum numbers, orbital angular momentum and quantum numbers m_l and m_s. Shapes of *s*, *p* and *d* atomic orbitals, nodal planes. Discovery of spin, spin quantum number (*s*) and magnetic spin quantum number (m_s).
Rules for filling electrons in various orbitals, Electronic configurations of the atoms. Stability of half-filled and completely filled orbitals, concept of exchange energy. Relative energies of atomic orbitals, Anomalous electronic configurations. **(14 Lectures)**

Chemical Bonding and Molecular Structure
Ionic Bonding: General characteristics of ionic bonding. Energy considerations in ionic bonding, lattice energy and solvation energy and their importance in the context of stability and solubility of ionic compounds. Statement of Born-Landé equation for calculation of lattice energy, Born-Haber cycle and its applications, polarizing power and polarizability. Fajan's rules, ionic character in covalent compounds, bond moment, dipole moment and percentage ionic character.

Covalent bonding: VB Approach: Shapes of some inorganic molecules and ions on the basis of VSEPR and hybridization with suitable examples of linear, trigonal planar, square planar, tetrahedral, trigonal bipyramidal and octahedral arrangements.

Concept of resonance and resonating structures in various inorganic and organic compounds.

MO Approach: Rules for the LCAO method, bonding and antibonding MOs and their characteristics for *s-s*, *s-p* and *p-p* combinations of atomic orbitals, nonbonding combination of orbitals, MO treatment of homonuclear diatomic molecules of 1stand 2ndperiods(including idea of *s-p* mixing) and heteronuclear diatomic molecules such as CO, NO and NO^+. Comparison of VB and MO approaches. **(16 Lectures)**

Section B: Organic Chemistry-1 **(30 Periods)**

Fundamentals of Organic Chemistry

Physical Effects, Electronic Displacements: Inductive Effect, Electromeric Effect, Resonance and Hyperconjugation. Cleavage of Bonds: Homolysis and Heterolysis.
Structure, shape and reactivity of organic molecules: Nucleophiles and electrophiles. Reactive Intermediates: Carbocations, Carbanions and free radicals.
Strength of organic acids and bases: Comparative study with emphasis on factors affecting pK values. Aromaticity: Benzenoids and Hückel's rule. **(8 Lectures)**

Stereochemistry

Conformations with respect to ethane, butane and cyclohexane. Interconversion of Wedge Formula, Newmann, Sawhorse and Fischer representations. Concept of chirality (upto two carbon atoms). Configuration: Geometrical and Optical isomerism; Enantiomerism, Diastereomerism and Meso compounds). Threo and erythro; D and L; *cis-trans* nomenclature; CIP Rules: R/S (for upto 2 chiral carbon atoms) and E/Z Nomenclature (for upto two C=C systems). **(10 Lectures)**

Aliphatic Hydrocarbons

Functional group approach for the following reactions (preparations & reactions) to be studied in context to their structure.

Alkanes: (Upto 5 Carbons). *Preparation:* Catalytic hydrogenation, Wurtz reaction, Kolbe's synthesis, from Grignard reagent. *Reactions:* Free radical Substitution: Halogenation.

Alkenes: (Upto 5 Carbons) *Preparation:* Elimination reactions: Dehydration of alkenes and dehydrohalogenation of alkyl halides (Saytzeff's rule); cis alkenes (Partial catalytic hydrogenation) and trans alkenes (Birch reduction). *Reactions:* cis-addition (alk. $KMnO_4$) and trans-addition (bromine), Addition of HX (Markownikoff's and anti-Markownikoff's addition), Hydration, Ozonolysis, oxymecuration-demercuration, Hydroboration-oxidation.

Alkynes: (Upto 5 Carbons) *Preparation:* Acetylene from $CaC_2$and conversion into higher alkynes; by dehalogenation of tetra halides and dehydrohalogenation of vicinal-dihalides.

Reactions: formation of metal acetylides, addition of bromine and alkaline $KMnO_4$,ozonolysis and oxidation with hot alk. $KMnO_4$. **(12 Lectures)**

Reference Books:

- Lee, J.D. *Concise Inorganic Chemistry* ELBS, 1991.
- Cotton, F.A., Wilkinson, G. & Gaus, P.L. *Basic Inorganic Chemistry*, 3rd ed., Wiley.
- Douglas, B.E., McDaniel, D.H. & Alexander, J.J. *Concepts and Models in Inorganic Chemistry*, John Wiley & Sons.
- Huheey, J.E., Keiter, E.A., Keiter, R.L. & Medhi, O.K. *Inorganic Chemistry: Principles of Structure and Reactivity*, Pearson Education India, 2006.
- Graham Solomon, T.W., Fryhle, C.B. & Dnyder, S.A. *Organic Chemistry*, John Wiley & Sons (2014).
- McMurry, J.E. *Fundamentals of Organic Chemistry*, 7th Ed. Cengage Learning

India Edition, 2013.
- Sykes, P. *A Guidebook to Mechanism in Organic Chemistry*, Orient Longman, New Delhi (1988).
- Eliel, E.L. *Stereochemistry of Carbon Compounds*, Tata McGraw Hill education, 2000.
- Finar, I.L. *Organic Chemistry* (Vol. I & II), E.L.B.S.
- Morrison, R.T. & Boyd, R.N. *Organic Chemistry*, Pearson, 2010.
- Bahl, A. & Bahl, B.S. *Advanced Organic Chemistry*, S. Chand, 2010.

DSC-2A LAB: Chemistry-1 LAB

60 Lectures

Section A: Inorganic Chemistry - Volumetric Analysis

1. Estimation of sodium carbonate and sodium hydrogen carbonate present in a mixture.
2. Estimation of oxalic acid by titrating it with $KMnO_4$.
3. Estimation of water of crystallization in Mohr's salt by titrating with $KMnO_4$.
4. Estimation of Fe (II) ions by titrating it with $K_2Cr_2O_7$ using internal indicator.
5. Estimation of Cu (II) ions iodometrically using $Na_2S_2O_3$.

Section B: Organic Chemistry

1. Detection of extra elements (N, S, Cl, Br, I) in organic compounds (containing upto two extra elements).
2. Separation of mixtures by Chromatography: Measure the R_f value in each case (combination of two compounds to be given)
3. Identify and separate the components of a given mixture of two amino acids (glycine, aspartic acid, glutamic acid, tyrosine or any other amino acid) by paper chromatography.
4. Identify and separate the sugars present in the given mixture by paper chromatography.

Reference Books:

- Svehla, G. *Vogel's Qualitative Inorganic Analysis*, Pearson Education, 2012.
- Mendham, J. *Vogel's Quantitative Chemical Analysis*, Pearson, 2009.
- Vogel, A.I., Tatchell, A.R., Furnis, B.S., Hannaford, A.J. & Smith, P.W.G., *Textbook of Practical Organic Chemistry*, Prentice-Hall, 5th edition, 1996.
- Mann, F.G. & Saunders, B.C. *Practical Organic Chemistry* Orient-Longman, 1960.

SEMESTER-II

DSC-2B: Chemistry-2

(*CHEMICAL ENERGETICS, EQUILIBRIA & FUNCTIONAL ORGANIC CHEMISTRY-I*)

(Credits: Theory-04, Practicals-2)

Theory: 60 Lectures

Section A: Physical Chemistry-1 **(30 Lectures)**

Chemical Energetics

Review of thermodynamics and the Laws of Thermodynamics.

Important principles and definitions of thermochemistry. Concept of standard state and standard enthalpies of formations, integral and differential enthalpies of solution and dilution. Calculation of bond energy, bond dissociation energy and resonance energy from thermochemical data. Variation of enthalpy of a reaction with temperature – Kirchhoff's equation.

Statement of Third Law of thermodynamics and calculation of absolute entropies of substances. **(10 Lectures)**

Chemical Equilibrium:

Free energy change in a chemical reaction. Thermodynamic derivation of the law of chemical equilibrium. Distinction between G and G^{o}, Le Chatelier's principle. Relationships between K_p, K_c and K_x for reactions involving ideal gases. **(8 Lectures)**

Ionic Equilibria:

Strong, moderate and weak electrolytes, degree of ionization, factors affecting degree of ionization, ionization constant and ionic product of water. Ionization of weak acids and bases, pH scale, common ion effect. Salt hydrolysis-calculation of hydrolysis constant, degree of hydrolysis and pH for different salts. Buffer solutions. Solubility and solubility product of sparingly soluble salts – applications of solubility product principle.

(12 Lectures)

Section B: Organic Chemistry-2 **(30 Lectures)**

Functional group approach for the following reactions (preparations & reactions) to be studied in context to their structure.

Aromatic hydrocarbons

Preparation (Case benzene): from phenol, by decarboxylation, from acetylene, from benzene sulphonic acid.

Reactions: (Case benzene): Electrophilic substitution: nitration, halogenation and sulphonation. Friedel-Craft's reaction (alkylation and acylation) (upto 4 carbons on benzene). Side chain oxidation of alkyl benzenes (upto 4 carbons on benzene). **(8 Lectures)**

Alkyl and Aryl Halides

Alkyl Halides (Upto 5 Carbons) Types of Nucleophilic Substitution (S_N1, S_N2 and S_Ni) reactions.

Preparation: from alkenes and alcohols.
Reactions: hydrolysis, nitrite & nitro formation, nitrile & isonitrile formation. Williamson's ether synthesis: Elimination vs substitution.

Aryl Halides *Preparation:* (Chloro, bromo and iodo-benzene case): from phenol, Sandmeyer & Gattermann reactions.
Reactions (Chlorobenzene): Aromatic nucleophilic substitution (replacement by –OH group)and effect of nitro substituent. Benzyne Mechanism: KNH_2/NH_3 (or $NaNH_2/NH_3$). Reactivity and Relative strength of C-Halogen bond in alkyl, allyl, benzyl, vinyl and aryl halides. **(8 Lectures)**

Alcohols, Phenols and Ethers (Upto 5 Carbons)
Alcohols: *Preparation:* Preparation of 1°, 2° and 3° alcohols: using Grignard reagent, Ester hydrolysis, Reduction of aldehydes, ketones, carboxylic acid and esters.
Reactions: With sodium, HX (Lucas test), esterification, oxidation (with PCC, alk. $KMnO_4$, acidic dichromate, conc. HNO_3). Oppeneauer oxidation Diols: (Upto 6 Carbons) oxidation of diols. Pinacol-Pinacolone rearrangement.
Phenols: (Phenol case) *Preparation:* Cumene hydroperoxide method, from diazonium salts. *Reactions:* Electrophilic substitution: Nitration, halogenation and sulphonation. Reimer-Tiemann Reaction, Gattermann-Koch Reaction, Houben–Hoesch Condensation, Schotten – Baumann Reaction.
Ethers (aliphatic and aromatic): Cleavage of ethers with HI.
Aldehydes and ketones (aliphatic and aromatic): (Formaldehye, acetaldehyde, acetone and benzaldehyde).
Preparation: from acid chlorides and from nitriles.
Reactions – Reaction with HCN, ROH, $NaHSO_3$, NH_2-G derivatives. Iodoform test. Aldol Condensation, Cannizzaro's reaction, Wittig reaction, Benzoin condensation. Clemensen reduction and Wolff Kishner reduction. Meerwein-Pondorff Verley reduction.
(14 Lectures)

Reference Books:

- Graham Solomon, T.W., Fryhle, C.B. & Dnyder, S.A. *Organic Chemistry*, John Wiley & Sons (2014).
- McMurry, J.E. *Fundamentals of Organic Chemistry*, 7th Ed. Cengage Learning India Edition, 2013.
- Sykes, P. *A Guidebook to Mechanism in Organic Chemistry*, Orient Longman, New Delhi (1988).
- Finar, I.L. *Organic Chemistry* (Vol. I & II), E.L.B.S.
- Morrison, R.T. & Boyd, R.N. *Organic Chemistry*, Pearson, 2010.
- Bahl, A. & Bahl, B.S. *Advanced Organic Chemistry*, S. Chand, 2010.
- Barrow, G.M. *Physical Chemistry* Tata McGraw-Hill (2007).
- Castellan, G.W. *Physical Chemistry* 4th Ed. Narosa (2004).
- Kotz, J.C., Treichel, P.M. & Townsend, J.R. *General Chemistry* Cengage Learning India Pvt. Ltd., New Delhi (2009).
- Mahan, B.H. *University Chemistry* 3rd Ed. Narosa (1998).
- Petrucci, R.H. *General Chemistry* 5th Ed. Macmillan Publishing Co.: New York (1985).

DSC-2B LAB: Chemistry-2 LAB

60 Lectures

Section A: Physical Chemistry

Thermochemistry

1. Determination of heat capacity of calorimeter for different volumes.
2. Determination of enthalpy of neutralization of hydrochloric acid with sodium hydroxide.
3. Determination of enthalpy of ionization of acetic acid.
4. Determination of integral enthalpy of solution of salts (KNO_3, NH_4Cl).
5. Determination of enthalpy of hydration of copper sulphate.
6. Study of the solubility of benzoic acid in water and determination of ΔH.

Ionic equilibria

pH measurements

Measurement of pH of different solutions like aerated drinks, fruit juices, shampoos and soaps (use dilute solutions of soaps and shampoos to prevent damage to the glass electrode) using pH-meter.

a) Preparation of buffer solutions:
b) Sodium acetate-acetic acid
c) Ammonium chloride-ammonium hydroxide

Measurement of the pH of buffer solutions and comparison of the values with theoretical values.

Section B: Organic Chemistry

1. Purification of organic compounds by crystallization (from water and alcohol) and distillation.
2. Criteria of Purity: Determination of melting and boiling points.
3. Preparations: Mechanism of various reactions involved to be discussed. Recrystallization, determination of melting point and calculation of quantitative yields to be done.
   (a) Bromination of Phenol/Aniline
   (b) Benzoylation of amines/phenols
   (c) Oxime and 2,4-dinitrophenylhydrazone of aldehyde/ketone.

Reference Books

- Vogel, A.I., Tatchell, A.R., Furnis, B.S., Hannaford, A.J. & Smith, P.W.G., *Text Book of Practical Organic Chemistry*, Prentice-Hall, 5th edition, 1996.
- Mann, F.G. & Saunders, B.C. *Practical Organic Chemistry* Orient-Longman, 1960.
- Khosla, B. D.; Garg, V. C. & Gulati, A. *Senior Practical Physical Chemistry*, R. Chand & Co.: New Delhi (2011).

SEMESTER-III

DSC-2C: Chemistry-3

(*SOLUTIONS, PHASE EQUILIBRIA, CONDUCTANCE, ELECTROCHEMISTRY & FUNCTIONAL GROUP ORGANIC CHEMISTRY-II*)

(Credits: Theory-04, Practicals-02)

Theory: 60 Lectures

Section A: Physical Chemistry-2 **(30 Lectures)**

Solutions

Thermodynamics of ideal solutions: Ideal solutions and Raoult's law, deviations from Raoult's law – non-ideal solutions. Vapour pressure-composition and temperature-composition curves of ideal and non-ideal solutions. Distillation of solutions. Lever rule. Azeotropes.

Partial miscibility of liquids: Critical solution temperature; effect of impurity on partial miscibility of liquids. Immiscibility of liquids-Principle of steam distillation. Nernst distribution law and its applications, solvent extraction. **(8 Lectures)**

Phase Equilibria

Phases, components and degrees of freedom of a system, criteria of phase equilibrium. Gibbs Phase Rule and its thermodynamic derivation. Derivation of Clausius–Clapeyron equation and its importance in phase equilibria. Phase diagrams of one-component systems (water and sulphur) and two component systems involving eutectics, congruent and incongruent melting points (lead-silver, $FeCl_3$-H_2O and Na-K only). **(8 Lectures)**

Conductance

Conductivity, equivalent and molar conductivity and their variation with dilution for weak and strong electrolytes. Kohlrausch law of independent migration of ions.

Transference number and its experimental determination using Hittorf and Moving boundary methods. Ionic mobility. Applications of conductance measurements: determination of degree of ionization of weak electrolyte, solubility and solubility products of sparingly soluble salts, ionic product of water, hydrolysis constant of a salt. Conductometric titrations (only acid-base). **(6 Lectures)**

Electrochemistry

Reversible and irreversible cells. Concept of EMF of a cell. Measurement of EMF of a cell. Nernst equation and its importance. Types of electrodes. Standard electrode potential. Electrochemical series. Thermodynamics of a reversible cell, calculation of thermodynamic properties: G, H and S from EMF data.

Calculation of equilibrium constant from EMF data. Concentration cells with transference and without transference. Liquid junction potential and salt bridge.

pH determination using hydrogen electrode and quinhydrone electrode.

Potentiometric titrations -qualitative treatment (acid-base and oxidation-reduction only).

(8 Lectures)

Section B: Organic Chemistry-3 **(30 Lectures)**

Functional group approach for the following reactions (preparations & reactions) to be studied in context to their structure.

Carboxylic acids and their derivatives

Carboxylic acids (aliphatic and aromatic)

Preparation: Acidic and Alkaline hydrolysis of esters.

Reactions: Hell–Vohlard - Zelinsky Reaction.

Carboxylic acid derivatives (aliphatic): (Upto 5 carbons)

Preparation: Acid chlorides, Anhydrides, Esters and Amides from acids and theirinterconversion.

Reactions: Comparative study of nucleophilicity of acyl derivatives. Reformatsky Reaction,Perkin condensation. **(6 Lectures)**

Amines and Diazonium Salts

Amines (Aliphatic and Aromatic): (Upto 5 carbons)

Preparation: from alkyl halides, Gabriel's Phthalimide synthesis, Hofmann Bromamide reaction.

Reactions: Hofmann vs. Saytzeff elimination, Carbylamine test, Hinsberg test, with HNO_2, Schotten–Baumann Reaction. Electrophilic substitution (case aniline): nitration, bromination, sulphonation.

Diazonium salts: *Preparation:* from aromatic amines.

Reactions: conversion to benzene, phenol, dyes. **(6 Lectures)**

Molecules of Life:

Amino Acids, Peptides and Proteins:

Preparation of Amino Acids: Strecker synthesis using Gabriel's phthalimide synthesis. Zwitterion, Isoelectric point and Electrophoresis.

Overview of Primary, Secondary, Tertiary and Quaternary Structure of proteins.

(3 Lectures)

Carbohydrates: Classification, and General Properties, Glucose and Fructose (open chain and cyclic structure), Determination of configuration of monosaccharides, absolute configuration of Glucose and Fructose, Mutarotation, ascending and descending in monosaccharides. Structure of disacharrides (sucrose, cellobiose, maltose, lactose) and polysacharrides (starch and cellulose) excluding their structure elucidation.

(4 Lectures)

Enzymes:

Mechanism of enzyme action, factors affecting enzyme action, Coenzymes and cofactors and their role in biological reactions, Specificity of enzyme action (including stereospecificity), Enzyme inhibitors and their importance. **(3 Lectures)**

Nucleic Acids:

Components of Nucleic acids: Adenine, guanine, thymine and cytosine (structure only), other components of nucleic acids, Nucleosides and nucleotides (nomenclature), Structure of polynucleotides; Structure of DNA (Watson-Crick model) and RNA (types

of RNA). **(4 Lectures)**

Lipids:
Introduction to lipids, classification.
Oils and fats: Common fatty acids present in oils and fats, Omega fatty acids, Trans fats, Hydrogenation, Saponification value, Iodine number.

(2 Lectures)

Concept of Energy in Biosystems:
Calorific value of food. Standard caloric content of carbohydrates, proteins and fats. ATP: the universal currency of cellular energy.

(2 Lectures)

Reference Books:

- Barrow, G.M. *Physical Chemistry* Tata McGraw-Hill (2007).
- Castellan, G.W. *Physical Chemistry* 4th Ed. Narosa (2004).
- Kotz, J.C., Treichel, P.M. & Townsend, J.R. *General Chemistry*, Cengage Learning India Pvt. Ltd.: New Delhi (2009).
- Mahan, B.H. *University Chemistry*, 3rd Ed. Narosa (1998).
- Petrucci, R.H. *General Chemistry*, 5th Ed., Macmillan Publishing Co.: New York (1985).
- Morrison, R. T. & Boyd, R. N. *Organic Chemistry*, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
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- Finar, I. L. *Organic Chemistry* (*Volume 2)*, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
- Nelson, D. L. & Cox, M. M. *Lehninger's Principles of Biochemistry 7th Ed.*, W. H. Freeman.
- Berg, J.M., Tymoczko, J.L. &Stryer, L. *Biochemistry*, W.H. Freeman, 2002.

DSC-2C LAB: Chemistry-3 LAB

60 Lectures

Section A: Physical Chemistry

Distribution

Study of the equilibrium of one of the following reactions by the distribution method:

(i) $I_2\,(aq) + I^- \rightarrow I_3^-\,(aq)$

(ii) $Cu^{2+}\,(aq) + n NH_3 \rightarrow [Cu(NH_3)_n]^{2+}$

Phase equilibria

(i) Construction of the phase diagram of a binary system (simple eutectic) using cooling curves.
(ii) Determination of the critical solution temperature and composition of the phenol water system and study of the effect of impurities on it.
(iii) Study of the variation of mutual solubility temperature with concentration for

the phenol water system and determination of the critical solubility temperature.

Conductance

(i) Determination of cell constant
(ii) Determination of equivalent conductance, degree of dissociation and dissociation constant of a weak acid.
(iii) Perform the following conductometric titrations:
  (a) Strong acid vs. strong base
  (b) Weak acid vs. strong base

Potentiometry

Perform the following potentiometric titrations:

(a) Strong acid vs. strong base
(b) Weak acid vs. strong base
(c) Potassium dichromate vs. Mohr's salt

Section B: Organic Chemistry

I. Systematic Qualitative Organic Analysis of Organic Compounds possessing monofunctional groups (-COOH, phenolic, aldehydic, ketonic, amide, nitro, amines) and preparation of one derivative.

II.

(a) Separation of amino acids by paper chromatography
(b) Determination of the concentration of glycine solution by formylation method.
(c) Titration curve of glycine
(d) Action of salivary amylase on starch
(e) Effect of temperature on the action of salivary amylase on starch.
(f) Differentiation between a reducing and a non-reducing sugar.

Reference Books:

- Vogel, A.I., Tatchell, A.R., Furnis, B.S., Hannaford, A.J. & Smith, P.W.G., *Text book of Practical Organic Chemistry*, Prentice-Hall, 5th edition, 1996.
- Mann, F.G. & Saunders, B.C. *Practical Organic Chemistry* Orient-Longman, 1960.
- Khosla, B. D.; Garg, V. C. & Gulati, A. *Senior Practical Physical Chemistry,* R. Chand & Co.: New Delhi (2011).
- Ahluwalia, V.K. & Aggarwal, R. *Comprehensive Practical Organic Chemistry,* Universities Press.

SEC-1
BASIC ANALYTICAL CHEMISTRY
(Credits: 02) 30 Lectures

Introduction: Introduction to Analytical Chemistry and its interdisciplinary nature. Concept of sampling. Importance of accuracy, precision and sources of error in analytical measurements. Presentation of experimental data and results, from the point of view of significant figures.

Analysis of soil: Composition of soil, Concept of pH and pH measurement, Complexometric titrations, Chelation, Chelating agents, use of indicators.

Determination of pH of soil samples.

Estimation of Calcium and Magnesium ions as Calcium carbonate by complexometric titration.

Analysis of water: Definition of pure water, sources responsible for contaminating water, water sampling methods, water purification methods.

Determination of pH, acidity and alkalinity of a water sample.

Determination of dissolved oxygen (DO) of a water sample.

Analysis of food products: Nutritional value of foods, idea about food processing and food preservations and adulteration.

Identification of adulterants in some common food items like coffee powder, asafoetida, chilli powder, turmeric powder, coriander powder and pulses, etc.

Analysis of preservatives and colouring matter.

Chromatography: Definition, general introduction on principles of chromatography, paper chromatography, TLC etc.

Paper chromatographic separation of mixture of metal ion (Fe^{3+} and Al^{3+}).

To compare paint samples by TLC method.

Ion-exchange: Column, ion-exchange chromatography etc.

Determination of ion exchange capacity of anion / cation exchange resin (using batch procedure if use of column is not feasible).

Analysis of cosmetics: Major and minor constituents and their function

Analysis of deodorants and antiperspirants, Al, Zn, boric acid, chloride, sulphate.

Determination of constituents of talcum powder: Magnesium oxide, Calcium oxide, Zinc oxide and Calcium carbonate by complexometric titration.

Suggested Applications (Any one):

To study the use of phenolphthalein in trap cases.

To analyze arson accelerants.

To carry out analysis of gasoline.

Suggested Instrumental demonstrations:

Estimation of macro nutrients: Potassium, Calcium, Magnesium in soil samples by

flame photometry.

Spectrophotometric determination of Iron in Vitamin /Dietary Tablets.
Spectrophotometric Identification and Determination of Caffeine and Benzoic Acid in Soft Drinks.

Reference Books:

1. Willard, H.H., Merritt, L.L., Dean, J. & Settoe, F.A. *Instrumental Methods of Analysis*, 7th Ed. Wadsworth Publishing Company Ltd., Belmont, California, USA,1988.
2. S koog, D.A., Holler, F.J. & Crouch, S. *Principles of Instrumental Analysis*, Cengage Learning India Edition, 2007.
3. Skoog, D.A.; West, D.M. & Holler, F.J. *Analytical Chemistry: An Introduction 6th Ed.*, Saunders College Publishing, Fort Worth, Philadelphia (1994).
4. Harris, D. C. *Quantitative Chemical Analysis*, 9th ed. Macmillan Education, 2016.
5. Dean, J. A. *Analytical Chemistry Handbook*, McGraw Hill, 2004.
6. Day, R. A. & Underwood, A. L. *Quantitative Analysis*, Prentice Hall of India, 1992.
7. Freifelder, D.M. *Physical Biochemistry 2nd Ed.*, W.H. Freeman & Co., N.Y. USA (1982).
8. Cooper, T.G. *The Tools of Biochemistry*, John Wiley & Sons, N.Y. USA. 16 (1977).
9. Vogel, A. I. *Vogel's Qualitative Inorganic Analysis 7 th Ed.*, Prentice Hall, 1996.
10. Mendham, J., *A. I. Vogel's Quantitative Chemical Analysis 6th Ed.*, Pearson, 2009.
11. Robinson, J.W. *Undergraduate Instrumental Analysis 5 th Ed.*, Marcel Dekker, Inc., New York (1995).
12. Christian, G.D. *Analytical Chemistry*, 6th Ed. John Wiley & Sons, New York, 2004.

SEMESTER-IV

DSC-2D: Chemistry-4

(*TRANSITION METAL & COORDINATION CHEMISTRY, STATES OFMATTER & CHEMICAL KINETICS*)

(Credits: Theory-04, Practicals-02)

Theory: 60 Lectures

Section A: Inorganic Chemistry-2 **(30 Lectures)**

Transition Elements (3*d* series)

General group trends with special reference to electronic configuration, variable valency, colour, magnetic and catalytic properties, ability to form complexes and stability of various oxidation states (Latimer diagrams) for Mn, Fe and Cu.

Lanthanoids and actinoids: Electronic configurations, oxidation states, colour, magnetic properties, lanthanide contraction, separation of lanthanides (ion exchange method only).

(12 Lectures)

Coordination Chemistry

Valence Bond Theory (VBT): Inner and outer orbital complexes of Cr, Fe, Co, Ni and Cu (coordination numbers 4 and 6). Structural and stereoisomerism in complexes with coordination numbers 4 and 6.

Drawbacks of VBT. IUPAC system of nomenclature. **(8 Lectures)**

Crystal Field Theory

Crystal field effect, octahedral symmetry. Crystal field stabilization energy (CFSE), Crystal field effects for weak and strong fields. Tetrahedral symmetry. Factors affecting the magnitude of D. Spectrochemical series. Comparison of CFSE for O_h and T_d complexes, Tetragonal distortion of octahedral geometry.

Jahn-Teller distortion, Square planar coordination. **(10 Lectures)**

Section B: Physical Chemistry-3 **(30 Lectures)**

Kinetic Theory of Gases

Postulates of Kinetic Theory of Gases and derivation of the kinetic gas equation.

Deviation of real gases from ideal behaviour, compressibility factor, causes of deviation. van der Waals equation of state for real gases. Boyle temperature (derivation not required). Critical phenomena, critical constants and their calculation from van der Waals equation. Andrews isotherms of CO_2.

Maxwell Boltzmann distribution laws of molecular velocities and molecular energies (graphic representation – derivation not required) and their importance.

Temperature dependence of these distributions. Most probable, average and root mean square velocities (no derivation). Collision cross section, collision number, collision frequency, collision diameter and mean free path of molecules. Viscosity of gases and effect of temperature and pressure on coefficient of viscosity (qualitative treatment only).

(8 Lectures)

Liquids

Surface tension and its determination using stalagmometer. Viscosity of a liquid and

determination of coefficient of viscosity using Ostwald viscometer. Effect of temperature on surface tension and coefficient of viscosity of a liquid (qualitative treatment only).

(6 Lectures)

Solids

Forms of solids. Symmetry elements, unit cells, crystal systems, Bravais lattice types and identification of lattice planes. Laws of Crystallography - Law of constancy of interfacial angles, Law of rational indices. Miller indices. X–Ray diffraction by crystals, Bragg's law. Structures of NaCl, KCl and CsCl (qualitative treatment only). Defects in crystals. Glasses and liquid crystals. **(8 Lectures)**

Chemical Kinetics

The concept of reaction rates. Effect of temperature, pressure, catalyst and other factors on reaction rates. Order and molecularity of a reaction. Derivation of integrated rate equations for zero, first and second order reactions (both for equal and unequal concentrations of reactants). Half–life of a reaction. General methods for determination of order of a reaction. Concept of activation energy and its calculation from Arrhenius equation.

Theories of Reaction Rates: Collision theory and Activated Complex theory of bimolecular reactions. Comparison of the two theories (qualitative treatment only). **(8 Lectures)**

Reference Books:

- Barrow, G.M. *Physical Chemistry* Tata McGraw-Hill (2007).
- Castellan, G.W. *Physical Chemistry* 4th Ed. Narosa (2004).
- Kotz, J.C., Treichel, P.M. & Townsend, J.R. *General Chemistry* Cengage Learning India Pvt. Ltd., New Delhi (2009).
- Mahan, B.H. *University Chemistry* 3rd Ed. Narosa (1998).
- Petrucci, R.H. *General Chemistry* 5th Ed. Macmillan Publishing Co.: New York (1985).
- Cotton, F.A. & Wilkinson, G. *Basic Inorganic Chemistry,* Wiley.
- Shriver, D.F. & Atkins, P.W. *Inorganic Chemistry*, Oxford University Press.
- Wulfsberg, G. *Inorganic Chemistry*, Viva Books Pvt. Ltd.
- Rodgers, G.E. *Inorganic & Solid State Chemistry,* Cengage Learning India Ltd., 2008.

DSC-2D LAB: Chemistry-4 LAB

60 Lectures

Section A: Inorganic Chemistry

Semi-micro qualitative analysis (using H_2S or other methods) of mixtures - not more than four ionic species (two anions and two cations, excluding insoluble salts) out of the following:

Cations : NH_4^+, Pb^{2+}, Bi^{3+}, Cu^{2+}, Cd^{2+}, Fe^{3+}, Al^{3+}, Co^{2+}, Ni^{2+}, Mn^{2+}, Zn^{2+}, Ba^{2+}, Sr^{2+}, Ca^{2+}, K^+

Anions : CO_3^{2-}, S^{2-}, SO^{2-}, $S_2O_3^{2-}$, NO_3^-, CH_3COO^-, Cl^-, Br^-, I^-, SO_4^{2-}, PO_4^{3-}, BO_3^{3-},$C_2O_4^{2-}$, F^- *(Spot tests should be carried out wherever feasible).*

1. Estimate the amount of nickel present in a given solution as bis (dimethyl glyoximato) nickel (II) or aluminium as oximate in a given solution gravimetrically.

2. Estimation of (i) Mg^{2+} or (ii) Zn^{2+} by complexometric titrations using EDTA.
3. Estimation of total hardness of a given sample of water by complexometric titration.

Section B: Physical Chemistry

Surface tension measurement (use of organic solvents excluded).

1. Determination of the surface tension of a liquid or a dilute solution using a stalagmometer.
2. Study of the variation of surface tension of a detergent solution with concentration.

Viscosity measurement (use of organic solvents excluded).

1. Determination of the relative and absolute viscosity of a liquid or dilute solution using an Ostwald's viscometer.
2. Study of the variation of viscosity of an aqueous solution with concentration of solute.

Chemical Kinetics

Study the kinetics of the following reactions.

1. Initial rate method: Iodide-persulphate reaction
2. Integrated rate method:
    a. Acid hydrolysis of methyl acetate with hydrochloric acid.
    b. Saponification of ethyl acetate.
    c. Compare the strengths of HCl and H_2SO_4 by studying kinetics of hydrolysis of methyl acetate.

Reference Books:

- Svehla, G. *Vogel's Qualitative Inorganic Analysis*, Pearson Education, 2012.
- Mendham, J. *Vogel's Quantitative Chemical Analysis*, Pearson, 2009.
- Khosla, B. D.; Garg, V. C. & Gulati, A. *Senior Practical Physical Chemistry*, R. Chand & Co.: New Delhi (2011).

SEC-2
FUEL CHEMISTRY
(Credits: 02)
30 Lectures

Review of energy sources (renewable and non-renewable). Classification of fuels and their calorific value.

Coal: Uses of coal (fuel and nonfuel) in various industries, its composition, carbonization of coal. Coal gas, producer gas and water gas—composition and uses. Fractionation of coal tar, uses of coal tar bases chemicals, requisites of a good metallurgical coke, Coal gasification (Hydro gasification and Catalytic gasification), Coal liquefaction and Solvent Refining.

Petroleum and Petrochemical Industry: Composition of crude petroleum, Refining and different types of petroleum products and their applications.

Fractional Distillation (Principle and process), Cracking (Thermal and catalytic cracking), Reforming Petroleum and non-petroleum fuels (LPG, CNG, LNG, bio-gas, fuels derived

from biomass), fuel from waste, synthetic fuels (gaseous and liquids), clean fuels. Petrochemicals: Vinyl acetate, Propylene oxide, Isoprene, Butadiene, Toluene and its derivatives Xylene.

Lubricants: Classification of lubricants, lubricating oils (conducting and non-conducting)Solid and semisolid lubricants, synthetic lubricants.

Properties of lubricants (viscosity index, cloud point, pore point) and their determination.

Reference Books:

- Stocchi, E. *Industrial Chemistry*, Vol-I, Ellis Horwood Ltd. UK (1990).
- Jain, P.C. & Jain, M. *Engineering Chemistry* Dhanpat Rai & Sons, Delhi.
- Sharma, B.K. & Gaur, H. *Industrial Chemistry*, Goel Publishing House, Meerut (1996).

SEMESTER-V

CHEMISTRY-DSE-2A-1: ANALYTICAL METHODS IN CHEMISTRY
(Credits: Theory-04, Practicals-02)
Theory: 60 Lectures

Qualitative and quantitative aspects of analysis:
Sampling, evaluation of analytical data, errors, accuracy and precision, methods of their expression, normal law of distribution if indeterminate errors, statistical test of data; F, Q and t test, rejection of data, and confidence intervals. **(5 Lectures)**

Optical methods of analysis:
Origin of spectra, interaction of radiation with matter, fundamental laws of spectroscopy and selection rules, validity of Beer-Lambert's law.
UV-Visible Spectrometry: Basic principles of instrumentation (choice of source, monochromator and detector) for single and double beam instrument.
Basic principles of quantitative analysis: estimation of metal ions from aqueous solution, geometrical isomers, keto-enol tautomers. Determination of composition of metal complexes using Job's method of continuous variation and mole ratio method.
Infrared Spectrometry: Basic principles of instrumentation (choice of source, monochromator & detector) for single and double beam instrument; sampling techniques.
Structural illustration through interpretation of data, Effect and importance of isotope substitution.
Flame Atomic Absorption and Emission Spectrometry: Basic principles of instrumentation (choice of source, monochromator, detector, choice of flame and Burner designs. Techniques of atomization and sample introduction; Method of background correction, sources of chemical interferences and their method of removal. Techniques for the quantitative estimation of trace level of metal ions from water samples. **(25 Lectures)**

Thermal methods of analysis:
Theory of thermogravimetry (TG), basic principle of instrumentation.
Techniques for quantitative estimation of Ca and Mg from their mixture. **(5 Lectures)**

Electroanalytical methods:
Classification of electroanalytical methods, basic principle of pH metric, potentiometric and conductometric titrations. Techniques used for the determination of equivalence points. Techniques used for the determination of pKa values. **(10 Lectures)**

Separation techniques:
Solvent extraction: Classification, principle and efficiency of the technique.
Mechanism of extraction: extraction by solvation and chelation.
Technique of extraction: batch, continuous and counter current extractions.
Qualitative and quantitative aspects of solvent extraction: extraction of metal ions from aqueous solution, extraction of organic species from the aqueous and non-aqueous media.
Chromatography: Classification, principle and efficiency of the technique.

Mechanism of separation: adsorption, partition & ion exchange.
Development of chromatograms: frontal, elution and displacement methods.
Qualitative and quantitative aspects of chromatographic methods of analysis: IC, GLC, GPC, TLC and HPLC.
Stereoisomeric separation and analysis: Measurement of optical rotation, calculation of Enantiomeric excess (ee)/diastereomeric excess (de) ratios and determination of enantiomeric composition using NMR, Chiral solvents and chiral shift reagents. Chiral chromatographic techniques using chiral columns (GC and HPLC).
Role of computers in instrumental methods of analysis. **(15 Lectures)**

Reference Books:

- Jeffery, G.H., Bassett, J., Mendham, J. & Denney, R.C. *Vogel's Textbook of Quantitative Chemical Analysis*, John Wiley & Sons, 1989.
- Willard, H.H., Merritt, L.L., Dean, J. & Settoe, F.A. *Instrumental Methods of Analysis*, 7th Ed. Wadsworth Publishing Company Ltd., Belmont, California, USA,1988.
- Christian, G.D; *Analytical Chemistry*, 6th Ed. John Wiley & Sons, New York, 2004.
- Harris, D. C. *Exploring Chemical Analysis*, Ed. New York, W.H. Freeman, 2001.
- Khopkar, S.M. *Basic Concepts of Analytical Chemistry*. New Age, InternationalPublisher, 2009.
- Skoog, D.A. Holler F.J. & Nieman, T.A. *Principles of Instrumental Analysis*, Cengage Learning India Ed.
- Mikes, O. *Laboratory Hand Book of Chromatographic & Allied Methods*, Elles Harwood Series on Analytical Chemistry, John Wiley & Sons, 1979.
- Ditts, R.V. *Analytical Chemistry; Methods of Separation*, van Nostrand, 1974.

DSE-2A-1 LAB: ANALYTICAL METHODS IN CHEMISTRY
60 Lectures

I. Separation Techniques Chromatography:

(a) Separation of mixtures
(i) Paper chromatographic separation of Fe^{3+}, Al^{3+}, and Cr^{3+}.
(ii) Separation and identification of the monosaccharides present in the given mixture(glucose & fructose) by paper chromatography. Reporting the R_f values.
(b) Separate a mixture of Sudan yellow and Sudan Red by TLC technique and identify them on the basis of their R_f values.
(c) Chromatographic separation of the active ingredients of plants, flowers and juices by TLC.

II. Solvent Extractions:

(i) To separate a mixture of Ni^{2+} & Fe^{2+} by complexation with DMG and extracting the Ni^{2+}-DMG complex in chloroform, and determine its concentration by spectrophotometry.
(ii) Solvent extraction of zisconium with amberliti LA-1, separation from a mixture of irons and gallium.

(iii) Determine the pH of the given aerated drinks fruit juices, shampoos and soaps.
(iv) Determination of Na, Ca, Li in cola drinks and fruit juices using flame photometric techniques.

Analysis of soil:

(i) Determination of pH of soil.
(ii) Total soluble salt
(iii) Estimation of calcium, magnesium, phosphate, nitrate

Ion exchange:

(i) Determination of exchange capacity of cation exchange resins and anion exchange resins.
(ii) Separation of metal ions from their binary mixture.
(iii) Separation of amino acids from organic acids by ion exchange chromatography.

Spectrophotometry

a. Determination of pKa values of indicator using spectrophotometry.
b. Structural characterization of compounds by infrared spectroscopy.
c. Determination of dissolved oxygen in water.
d. Determination of chemical oxygen demand (COD).
e. Determination of Biological oxygen demand (BOD).
f. Determine the composition of the Ferric-salicylate/ferric-thiocyanate complex by Job's method.

Reference Books:

- Jeffery, G.H., Bassett, J., Mendham, J. & Denney, R.C. *Vogel's Textbook of Quantitative Chemical Analysis*, John Wiley & Sons, 1989.
- Willard, H.H., Merritt, L.L., Dean, J. & Settoe, F.A. *Instrumental Methods of Analysis*, 7th Ed. Wadsworth Publishing Company Ltd., Belmont, California, USA,1988.
- Christian, Gary D; Analytical Chemistry, 6th Ed. John Wiley & Sons, New York, 2004.
- Harris, Daniel C: Exploring Chemical Analysis, Ed. New York, W.H. Freeman, 2001.
- Khopkar, S.M. Basic Concepts of Analytical Chemistry. New Age, International Publisher, 2009.
- Skoog, D.A. Holler F.J. & Nieman, T.A. *Principles of Instrumental Analysis*, Cengage Learning India Ed.
- Mikes, O. *Laboratory Hand Book of Chromatographic & Allied Methods*, Elles Harwood Series on Analytical Chemistry, John Wiley & Sons, 1979.

SEC-3
CHEMICAL TECHNOLOGY & SOCIETY
(Credits: 02)
Theory: 30 Lectures

Chemical Technology

Basic principles of distillation, solvent extraction, solid-liquid leaching and liquid-liquid extraction, separation by absorption and adsorption. An introduction into the scope of different types of equipment needed in chemical technology, including reactors, distillation columns, extruders, pumps, mills, emulgators. Scaling up operations in chemical industry. Introduction to clean technology.

Society

Exploration of societal and technological issues from a chemical perspective. Chemical and scientific literacy as a means to better understand topics like air and water (and the trace materials found in them that are referred to as pollutants); energy from natural sources (i.e. solar and renewable forms), from fossil fuels and from nuclear fission; materials like plastics and polymers and their natural analogues, proteins and nucleic acids, and molecular reactivity and interconversions from simple examples like combustion to complex instances like genetic engineering and the manufacture of drugs.

Reference Book:

- John W. Hill, Terry W. McCreary & Doris K. Kolb, *Chemistry for changing times* 13th Ed, Prentice-Hall (2012).

SEMESTER-VI

CHEMISTRY-DSE-2A-2: INSTRUMENTAL METHODS OF CHEMICAL ANALYSIS
(Credits: Theory-04, Practicals-02)
Theory: 60 Lectures

Introduction to spectroscopic methods of analysis:
Recap of the spectroscopic methods covered in detail in the core chemistry syllabus: Treatment of analytical data, including error analysis. Classification of analytical methods and the types of instrumental methods. Consideration of electromagnetic radiation. **(4 Lectures)**

Molecular spectroscopy:
Infrared spectroscopy:
Interactions with molecules: absorption and scattering. Means of excitation (light sources), separation of spectrum (wavelength dispersion, time resolution), detection of the signal (heat, differential detection), interpretation of spectrum (qualitative, mixtures, resolution), advantages of Fourier Transform (FTIR). Samples and results expected. Applications: Issues of quality assurance and quality control, Special problems for portable instrumentation and rapid detection.
UV-Visible/Near IR – emission, absorption, fluorescence and photoaccoustic. Excitation sources (lasers, time resolution), wavelength dispersion (gratings, prisms, interference filters, laser, placement of sample relative to dispersion, resolution), Detection of signal (photocells, photomultipliers, diode arrays, sensitivity and S/N), Single and Double Beam instruments, Interpretation (quantification, mixtures, absorption vs. fluorescence and the use of time, photoaccoustic, fluorescent tags).
(16 Lectures)

Separation techniques
Chromatography: Gas chromatography, liquid chromatography, supercritical fluids, Importance of column technology (packing, capillaries), Separation based on increasing number of factors (volatility, solubility, interactions with stationary phase, size, electrical field), Detection: simple vs. specific (gas and liquid), Detection as a means of further analysis(use of tags and coupling to IR and MS), Electrophoresis (plates and capillary) and use with DNA analysis.

Immunoassays and DNA techniques
Mass spectroscopy: Making the gaseous molecule into an ion (electron impact, chemical ionization), Making liquids and solids into ions (electrospray, electrical discharge, laser desorption, fast atom bombardment), Separation of ions on basis of mass to charge ratio, Magnetic, Time of flight, Electric quadrupole. Resolution, time and multiple separations, Detection and interpretation (how this is linked to excitation).
(16 Lectures)

Elemental analysis:
Mass spectrometry (electrical discharges).

Atomic spectroscopy: Atomic absorption, Atomic emission, and Atomic fluorescence. Excitation and getting sample into gas phase (flames, electrical discharges, plasmas), Wavelength separation and resolution (dependence on technique), Detection of radiation (simultaneous/scanning, signal noise), Interpretation (errors due to molecular and ionic species, matrix effects, other interferences). **(8 Lectures)**

NMR spectroscopy: **P**rinciple, Instrumentation, Factors affecting chemical shift, Spin coupling, Applications. **(4 Lectures)**

Electroanalytical Methods: Potentiometry & Voltammetry **(4 Lectures)**

Radiochemical Methods **(4 Lectures)**

X-ray analysis and electron spectroscopy (surface analysis) **(4 Lectures)**

Reference books:

- Skoog, D.A. Holler F.J. & Nieman, T.A. *Principles of Instrumental Analysis*, Cengage Learning India Ed.
- Willard, H.H., Merritt, L.L., Dean, J. & Settoe, F.A. *Instrumental Methods of Analysis*, 7th Ed. Wadsworth Publishing Company Ltd., Belmont, California, USA, 1988.
- P.W. Atkins: Physical Chemistry.
- G.W. Castellan: Physical Chemistry.
- C.N. Banwell: Fundamentals of Molecular Spectroscopy.
- Brian Smith: Infrared Spectral Interpretations: A Systematic Approach.
- W.J. Moore: Physical Chemistry.

DSE-2A-2 LAB: INSTRUMENTAL METHODS OF CHEMICAL ANALYSIS
60 Lectures

1. Safety Practices in the Chemistry Laboratory
2. Determination of the isoelectric pH of a protein.
3. Titration curve of an amino acid.
4. Determination of the void volume of a gel filtration column.
5. Determination of a Mixture of Cobalt and Nickel (UV/Vis spec.)
6. Study of Electronic Transitions in Organic Molecules (i.e., acetone in water)
7. IR Absorption Spectra (Study of Aldehydes and Ketones)
8. Determination of Calcium, Iron, and Copper in Food by Atomic Absorption
9. Quantitative Analysis of Mixtures by Gas Chromatography (i.e., chloroform and carbon tetrachloride)
10. Separation of Carbohydrates by HPLC
11. Determination of Caffeine in Beverages by HPLC
12. Potentiometric Titration of a Chloride-Iodide Mixture
13. Cyclic Voltammetry of the Ferrocyanide/Ferricyanide Couple
14. Nuclear Magnetic Resonance
15. Use of fluorescence to do “presumptive tests” to identify blood or other body fluids.
16. Use of “presumptive tests” for anthrax or cocaine
17. Collection, preservation, and control of blood evidence being used for DNA testing

18. Use of capillary electrophoresis with laser fluorescence detection for nuclear DNA (Y chromosome only or multiple chromosome)
19. Use of sequencing for the analysis of mitochondrial DNA
20. Laboratory analysis to confirm anthrax or cocaine
21. Detection in the field and confirmation in the laboratory of flammable accelerants or explosives.
22. Detection of illegal drugs or steroids in athletes
23. Detection of pollutants or illegal dumping
24. Fibre analysis

(At least 10 experiments to be performed).

Reference Books:

- Skoog, D.A. Holler F.J. & Nieman, T.A. *Principles of Instrumental Analysis*, Cengage Learning India Ed.
- Willard, H.H., Merritt, L.L., Dean, J. & Settoe, F.A. *Instrumental Methods of Analysis*, 7th Ed. Wadsworth Publishing Company Ltd., Belmont, California, USA, 1988.

SEC-4
CHEMISTRY OF COSMETICS & PERFUMES
(Credits: 02) 30 Lectures

A general study including preparation and uses of the following: Hair dye, hair spray, shampoo, suntan lotions, face powder, lipsticks, talcum powder, nail enamel, creams (cold, vanishing and shaving creams), antiperspirants and artificial flavours. Essential oils and their importance in cosmetic industries with reference to Eugenol, Geraniol, sandalwood oil, eucalyptus, rose oil, 2-phenyl ethyl alcohol, Jasmone, Civetone, Muscone.

Practicals

1. Preparation of talcum powder.
2. Preparation of shampoo.
3. Preparation of enamels.
4. Preparation of hair remover.
5. Preparation of face cream.
6. Preparation of nail polish and nail polish remover.

Reference Books:

- Stocchi, E. *Industrial Chemistry*, Vol-I, Ellis Horwood Ltd. UK (1990).
- Jain, P.C. & Jain, M. *Engineering Chemistry* Dhanpat Rai & Sons, Delhi.
- Sharma, B.K. & Gaur, H. *Industrial Chemistry,* Goel Publishing House, Meerut (1996).

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SYLLABUS

Curriculum Structures for UG syllabus for

Information Technology (Honours)

SUBJECT: INFORMATION TECHNOLOGY

Bodol and University

Debargaon, KoKrajhar (b.T.C.)

Bodoland University
Curriculum Structures for UG syllabus For Information Technology (Honours), No. of papers =14+12=26, Total Credits= 140
Total Marks = 2400

SL. NO.	CORE COURSE (14)	ABILITY ENHANCEMENT COURSE (AECC) (2)	SKILL ENHANCEMENT COURSE (SEC) (2)	ELECTIVE: DISCIPLINE SPECIFIC DSE (4)	ELECTIVE: GENERIC (GE) (4)
1	C1 :Computer Fundamental and Programming in C (4+4 lab) C2: : Discrete Structures (5+1 lab)	(English/Hindi /MIL Communication)			GE 1: Information Communication Technologies Hardware
2	C3: Data Structure through C (4+4 lab) C4 :Computer Oriented Numerical Methods (5+1 Lab/Tutorial	Environmental Science			GE 2: Digital Logic
3	C5: Digital Logic & ICT (4+4 lab) C6: Object Oriented Programming using C++ C7: database Management System (4+4 lab)		SEC 1: Core Java Programming		GE3: Introduction to Programming in C
4	C8: Data Communication & Networking (4+4 lab) C9: Operating System (4+4 lab) C10: Computer Organization and Architecture (5+1lab/ Tutorial)		SEC 2: Digital Image Processing using MATLAB		GE4: Introduction to Database System.

5	C11: Software Engineering (4+4 lab)			DSE 1: a) Microprocessor / b) Theory of Computation (5+1 lab/Tutorial)	
	C12: Web Technologies (4+4 lab			DSE 2: a) Web Application Design using PHP Programming/ b) Data Mining & Warehousing	
6	C13: System Administration (4+4 lab)			DSE 3: (a)Compiler Design/ (b)System Analysis and Designing	
	C14: Computer Graphics (4+4 lab)			DSE 4: DISSERTATION/PROJECT WORK	

SEM-I						
Paper Code	**Course**	**L+T+P**	**Credit**	End Sem	Int.	Total
IT-101H	C-1	4+0+2 5+1+0	6	60(L)+20(P) 60(L)+20(T)	20 20	100
IT-102H	C-2	4+0+2 5+1+0	6	60(L)+20(P) 60(L)+20(T)	20	100
Phy-GE-103H	GE-1	4+0+2 5+1+0	6	60(L)+20(P) 60(L)+20(T)	20 20	100
COMM-104HR	AECC-1:**English/ Hindi/MIL (Communication)**	2	2	50(L)		50
Total-			**20**	**290**	**60**	**350**

SEM-II						
Paper Code	**Course**	**L+T+P**	**Credit**	End Sem	Int	Total
IT -201H	C-3	4+0+2 5+1+0	6	60(L)+20(P) 60(L)+20(T)	20	100
IT-202H	C-4	4+0+2 5+1+0	6	60(L)+20(P) 60(L)+20(T)	20	100
Phy-GE-203H	GE-2	4+0+2 5+1+0	6	60(L)+20(P) 60(L)+20(T)	20	100
ENV -204HR	AECC-2: **Environmental Science**	2	2	50(L)		50
Total-			**20**	**290**	**60**	**350**

SEM-III						
Paper Code	**Course**	**L+T+P**	**Credit**	End Sem	Int	Total
IT -301H	C-5	4+0+2 5+1+0	6	60(L)+20(P) 60(L)+20(T)	20	100
IT -302H	C-6	4+0+2 5+1+0	6	60(L)+20(P) 60(L)+20(T)	20	100
IT -303H	C-7	4+0+2 5+1+0	6	60(L)+20(P) 60(L)+20(T)	20	100
IT –SEC1-304HR	SEC-1	2	2	50(L)		50
Math –GE-305H	GE-3	4+0+2 5+1+0	6	60(L)+20(P) 60(L)+20(T)	20	100
Total-			**26**	**370**	**80**	**450**

SEM-IV						
Paper Code	**Course**	**L+T+P**	**Credit**	End Sem	Int	Total
IT -401H	C-8	4+0+2 5+1+0	6	60(L)+20(P) 60(L)+20(T)	20	100
IT -402H	C-9	4+0+2 5+1+0	6	60(L)+20(P) 60(L)+20(T)	20	100
IT -403H	C-10	4+0+2 5+1+0	6	60(L)+20(P) 60(L)+20(T)	20	100
IT –SEC2-404HR	SEC-2	2	2	50(L)		50
Math-GE-405H	GE-4	4+0+2 5+1+0	6	60(L)+20(P) 60(L)+20(T)	20	100
Total-			**26**	**370**	**80**	**450**

SEM-V						
Paper Code	**Course**	**L+T+P**	**Credit**	End Sem	Int	Total
IT -501H	C-11	4+0+2 5+1+0	6	60(L)+20(P) 60(L)+20(T)	20	100
IT -502H	C-12	4+0+2 5+1+0	6	60(L)+20(P) 60(L)+20(T)	20	100
IT –DSE1-503H	DSE-1	4+0+2 5+1+0	6	60(L)+20(P) 60(L)+20(T)	20	100
IT –DSE2-504H	DSE-2	4+0+2 5+1+0	6	60(L)+20(P) 60(L)+20(T)	20	100
Total-			**24**	**320**	**80**	**400**

SEM-VI						
Paper Code	**Course**	**L+T+P**	**Credit**	End Sem	Int	Total
IT -601H	C-13	4+0+2 5+1+0	6	60(L)+20(P) 60(L)+20(T)	20	100
IT -602H	C-14	4+0+2 5+1+0	6	60(L)+20(P) 60(L)+20(T)	20	100
IT –DSE3-603H	DSE-3	4+0+2 5+1+0	6	60(L)+20(P) 60(L)+20(T)	20	100
IT –DSE4-604H	DSE-4 (Project/Dissertation)	4+0+2 5+1+0	6	60(L)+20(P) 60(L)+20(T)	20	100
Total-			**24**	**320**	**80**	**400**

1. Where there is a practical there will be no tutorial or vice-versa.
2. Institute should evolve a system/policy about ECA/ General Interest/Hobby/Sports/NCC/NSS/related courses on its own.
3. **Skill Enhancement Courses (SEC)**: These courses are to be chosen from a pool of courses designed to provide value-based and/or skill-based knowledge and should contain both theory and lab/hands-on/training/field work. The main purpose of these courses is to provide students life-skills in hands-on mode so as to increase their employability. The list provided under this category are suggestive in nature and each Institution/College has complete freedom to suggest their own papers under this category based on their expertise, specialization, requirements, scope and need. However, in this case approval of Academic section of the University is mandatory.

1st SEMESTER

IT-101 C-1: COMPUTER FUNDAMENTALS AND PROGRAMMING IN C
Theory: 60 Lectures

Unit 1: Fundamentals (15 Lectures)

Major components of a Digital Computer (A brief introduction of CPU, Main memory, Secondary memory devices and I/O devices) Keyboard, monitor, mouse, printers, Secondary storage devices (floppy disks, hard disks and optical disks), backup system and why it is needed ? Bootstrapping a Computer. Representation of numbers (only a brief introduction to be given) and characters in computer. ASCII. EDCDIC and Gray codes. Interpreter, Assembler, Linker and Loader. Definitionand concepts of algorithm and its different implementations-pseudo code, flowchart and Computer programs.

Number System: Binary, Hexadecimal, Octal, BCD, and conversions of number systems. Representation of signed integers, Sign and magnitude, 1‘s complement and 2‘s complement representation. Arithmetic operations using 2‘s complement representation and conditions for overflow/underflow and its detection.

Unit 2:Introduction to C (25 Lectures)

Elementary data types , variables, constants and identifiers. Integer, character floating point and string constants . variable declarations. Syntax and semantics. Reserved word. Initialization of variable during declarations Constant data types. Expression in C, precedence and associativity of C operators, unary, binary and ternary operators. C arithmetic operators, assignment operators, relational operators, logical operators and bit –wise operators . L-value and R-value. Side effects of operators. Expression statement. Conditional Statement-if, if-else, switch. Iterative Statement-white, do-while, for. Other

Statement –break , continue, goto, return, null Statement, block Statement. Function: function declaration. Calling a function. Parameters –Call by value, Call by reference and its absence in C. Recursion and how it works. Cast and sizeof operator. Automatic type Conversion.

Simple programs like programs to compute an arithmetic expression, unit conversion, the sum of a series (like trigonometric series), GCD, factorial (both recursive and non-recursive version), fibonacci number (both recursive and non-recursive version), generation of prime numbers, reversing digits of an integer, finding the square root of a number, prime factors of an integer, base conversion of numbers, test if three points form a triangle and classify triangles as right angled, isosceles, equilateral etc., roots of a quadratic equation, generation of simple patterns of characters on screen.

Unit 3:Arrays and pointers (15 Lectures)

Storage classes : Automatic, External, Static, Register. Scope and lifetime of variables. Arrays and pointers and corresponding operators. Pointer arithmetic. Programs using arrays and pointers like sum, average, minimum, maximum of an array of numbers. Add and delete an element of an array. Merge two sorted arrays. String manipulation programs like string concatenation, palindrome, reverse, copy etc. Matrix manipulation like Sum of rows, columns, and diagonal elements of a matrix, transpose of a matrix.

Searching and Sorting

Linear search, binary search. Selection sort and bubble sort.

Unit 4:Structures and Files **(5** Lectures)

Structure – declaration and use. Structure member resolution and structure pointer member resolution operators. Programs to show the use of structure. Standard C library.

Files in C—opening, closing, reading and writing of files. Seeking forward and backward. Simple examples of file handling programs.

REFERNCE BOOKS

1. Programming with C, B.S. Gottfried, Tata Mc-Graw Hill.
2. Programming in ANSI C, E.Balagurusamy, Tata McGraw – Hill
3. The C Programming Language, B.W. Kernighan and D.M.Ritchie, PHI
4. Computer Fundamentals, Anita Goel, Pearson, 2010.

IT LAB-101 (C-I): COMPUTER FUNDAMENTALS AND PROGRAMMING IN C
Lab Practical: 60 Lectures

At least 20 programming assignments have to be done by each student from the following list. The assignments should be selected in such a way that all the features of C language are included.

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1. Write a program to convert a given temperature value from Fahrenheit scale to Centigrade scale and vice versa.
2. Write a program to display ASCII value of a character.
3. Write a program to check whether a number is perfect or not.
4. Write a program to find out the biggest of three numbers using nested if.
5. A company insures its drivers if either of the following conditions are satisfied

   Driver is married.

   Driver is an unmarried, male and above 30 years of age.

   Driver is unmarried, female and above 25 years of age.

Write a program to decide if a driver is to be insured using logical operators.

6. Write a program to read a list of positive integers terminated by -1 and display the odd and even numbers separately and also their respective counts.
7. Write a program to read values of n and x and print the value of y using switch case where

a. y=n+x when n=1

b. y=1+x/n when n=2

c. y= n+3x when n=3

d. y=1+nx when n>3 or n<1.

8. Write a program to n values of sales and then calculate the commission on sales amount where the commission is calculated as follows:

a. If sales <= Rs.500, commission is 5%.

b. If sales > 500 but <= 2000, commission is Rs 35 plus 10% above Rs 500.

c. If sales > 2000 but <= 5000,commission is Rs 185 plus 12% above Rs.2000.

d. If sales > 5000 ,commission is 12.5%.

9. Write a program to find out minimum, maximum, sum and average of n numbers without using array.
10. Program to find mean and standard deviation (SD) for a set of n numbers without using array.
11. Write a program to find out the roots of a quadratic equation. Use proper testing to find checks for real and complex roots.

12. Write a program to print the digits of a number in words. (eg. if a number 841 is entered through the keyboard your program should print ―Eight Four One‖.)

13. Write a program to print the PASCAL Triangle up to the n-th row where n is an input to the program.

14. Write a function to return the HCF of two positive integers. Write a main function to read two positive integers and print their HCF and LCM by using the above function.

15. Write a program to convert a decimal number into binary number using function.

16. Write a program to display the result of sine series using function.

17. Write a program to find the sum of the following series
1+x-x^3/3!+x^5/5!-x^7/7!+ .....corrected up to the 3 decimal place.

18. Write a program to read n numbers in a sorted array and insert a given element in a particular position

19. Write functions to compute the factorial of a number using both recursive and non-recursive procedure.

20. Write a program to print the values of ncr and npr for given positive integers n r > 0. Use a function fact(n) to return the factorial of a non-negative integer.n.
ncr=n!/r!*(n-r)! npr=n!/(n-r)!

21. Write a program to display the first n Fibonacci numbers using function.

22. Write a program to display the prime numbers within a given range. Write a function to check whether a given integer is prime or not and use it.

23. Write a program to Multiply two matrices using function

22. Write a program to display the prime numbers within a given range. Write a function to check whether a given integer is prime or not and use it.

23. Write a program to Multiply two matrices using function

24. Write a program to display the upper Triangle and lower Triangle of a given square matrix using function.

25. Write a function to check if a given square matrix is symmetric or not. Write a main function to implement it.

26. Write a program to read a m X n matrix and calculate the Row sum and Column Sum of the matrix

27. Write a function to read in an integer and print the representation of the number using the sign and magnitude representation scheme using 8 bits. The program should check for overflow/under flow conditions. The left most bit is to be used as the sign bit.

28. Write a program to merge two sorted arrays.

29. Write a program to implement selection sort using function.

30. Write a program to count the number of vowels in a string.

31. Write a program to concatenate two strings using function (without using library function).

32. Write a program to convert a string from upper case to lower case and vice versa.

33. Write a program to swap two numbers using function (pass the pointers).

34. Write a program to sort n number of strings in ascending order using pointer.

35. Write a program using pointers to copy a string to another string variable (without using library function).

36. Declare a structure of a student with details like roll number, student name and total marks. Using this, declare an array with 50 elements. Write a program to read details of n students and print the list of students who have scored 75 marks and above.

37. Create a structure to store the following information of employees.
a. Employee‘s number, name, pay and date of joining.
It has been decided to increase the pay as per the following rules:
Pay <= Rs.3000 : 20% increase
Pay <= Rs.6000 but > Rs.3000 :15% increase
Pay > Rs.6000 : no increase
Write a program to implement the above structure.

38. Write a program to read a text file and count the number of vowels in the text file.

39. Write a program to copy a text file to another file.

IT-102 (C-2): DISCRETE STRUCTURE
Theory: 60 Lectures

Unit 1: Introduction: (15 Lectures)

Sets - finite and Infinite sets, uncountably Infinite Sets; functions, relations, Properties of Binary Relations, Closure, Partial Ordering Relations; counting - Pigeonhole Principle, Permutation and Combination; Mathematical Induction, Principle of Inclusion and Exclusion.

Unit 2: Growth of Functions: (8 Lectures)

Asymptotic Notations, Summation formulas and properties, Bounding Summations, approximation by Integrals

Unit 3: Recurrences (10 Lectures)

Recurrence Relations, generating functions, Linear Recurrence Relations with constant coefficients and their solution, Substitution Method, Recurrence Trees, Master Theorem

Unit 4: Graph Theory (15 Lectures)

Basic Terminology, Models and Types, multigraphs and weighted graphs, Graph Representaion, Graph Isomorphism, Connectivity, Euler and Hamiltonian Paths and Circuits, Planar Graphs, Graph Coloring, Trees, Basic Terminology and properties of Trees, Introduction to Spanning Trees

5. Prepositional Logic (12 Lectures)

Logical Connectives, Well-formed Formulas, Tautologies, Equivalences, Inference Theory

Recommended Books:

1. C.L. Liu , D.P. Mahopatra, Elements of Discrete mathematics, 2nd Edition , Tata McGraw Hill, 1985,
2. Kenneth Rosen, Discrete Mathematics and Its Applications, Sixth Edition ,McGraw Hill 2006
3. T.H. Coremen, C.E. Leiserson, R. L. Rivest, Introduction to algorithms, 3rd edition Prentice Hall on India, 2009
4. M. O. Albertson and J. P. Hutchinson, Discrete Mathematics with Algorithms , John wiley Publication, 1988
5. J. L. Hein, Discrete Structures, Logic, and Computability, 3rd Edition, Jones and Bartlett Publishers, 2009
6. D.J. Hunter, Essentials of Discrete Mathematics, Jones and Bartlett Publishers, 2008

IT LAB-102 (C 2): DISCRETE STRUCTURES

Lab Practical: 15 Lectures

1. C programs to implement the Kruskal's algorithm to generate a minimum cost spanning tree.
2. C programs to implement the Prim's algorithm to generate a minimum cost spanning tree.
3. C program to implement Euler Circuit problem.
4. C program to implement Hamiltonian Cycle.
5. C Program to Evaluate Truth Value of Conjuction.
6. C program to Evaluate Truth Value of Disjuction.
7. Write a c program to print the union of two sets.
8. Write a c program to print the intersection of two sets.
9. Write a c program to print the Permutation of character string of two sets.
10. Write a c program to print the combination of a number of two sets.
11. Write a c program to find and print all the elements in the Cartesian product of two sets.
12. Write a c program to print the subtraction of two sets.
13. Write a c program to print the power of two sets.
14. Write a c program to print the proper subset of sets.
15. Write a c program to print the symmetric difference of two sets.

2nd SEMESTER

IT-201 (C-3): DATA STRUCTURE THROUGH C
Theory: 60 Lectures

Unit 1:Arrays (5 Lectures)
Single and Multi-dimensional Arrays, Sparse Matrices (Array and Linked Representation)

Unit 2:Stacks (5 Lectures)
Implementing single / multiple stack/s in an Array; Prefix, Infix and Postfix expressions, Utility and conversion of these expressions from one to another; Applications of stack; Limitations of Array representation of stack

Unit 3:Linked Lists (10 Lectures)
Singly, Doubly and Circular Lists (Array and Linked representation); Normal and Circular representation of Stack in Lists; Self Organizing Lists; Skip Lists

Unit 4;Queues (5 Lectures)
Array and Linked representation of Queue, De-queue, Priority Queues

Unit 5:Recursion (5 lectures)
Developing Recursive Definition of Simple Problems and their implementation; Advantages and Limitations of Recursion; Understanding what goes behind Recursion (Internal Stack Implementation)

Unit 6:Trees (20 Lectures)
Introduction to Tree as a data structure; Binary Trees (Insertion, Deletion , Recursive and Iterative Traversals on Binary Search Trees); Threaded Binary Trees (Insertion, Deletion, Traversals); Height-Balanced Trees (Various operations on AVL Trees).

Unit 7:Searching and Sorting (5 Lectures)
Linear Search, Binary Search, Comparison of Linear and Binary Search, Selection Sort, Insertion Sort, Insertion Sort, Shell Sort, Comparison of Sorting Techniques

Unit 8:Hashing (5 Lectures)
Introduction to Hashing, Deleting from Hash Table, Efficiency of Rehash Methods, Hash Table Reordering, Resolving collusion by Open Addressing, Coalesced Hashing, Separate Chaining, Dynamic and Extendible Hashing, Choosing a Hash Function, Perfect Hashing Function

Reference Books:

1. Adam Drozdek, "Data Structures and algorithm in C++", Third Edition, Cengage Learning, 2012.
2. SartajSahni, Data Structures, "Algorithms and applications in C++", Second Edition, Universities Press, 2011.
3. Aaron M. Tenenbaum, Moshe J. Augenstein, YedidyahLangsam, "Data Structures Using C and C++:, Second edition, PHI, 2009.
4. Robert L. Kruse, "Data Structures and Program Design in C++", Pearson,1999.
5. D.S Malik, Data Structure using C++,Second edition, Cengage Learning, 2010.

6. Mark Allen Weiss, "Data Structures and Algorithms Analysis in Java", Pearson Education, 3rd edition, 2011
7. Aaron M. Tenenbaum, Moshe J. Augenstein, YedidyahLangsam, "Data Structures Using Java, 2003.
8. Robert Lafore, "Data Structures and Algorithms in Java, 2/E", Pearson/ Macmillan Computer Pub,2003
9. John Hubbard, "Data Structures with JAVA", McGraw Hill Education (India) Private Limited; 2 edition, 2009
10. Goodrich, M. and Tamassia, R. "Data Structures and Algorithms Analysis in Java", 4th Edition, Wiley,2013

IT LAB-201 (C-3): DATA STRUCTURES

Lab Practical: 60 Lectures

1. Write a program to search an element from a list. Give user the option to perform Linear or Binary search. Use Template functions.
2. WAP using templates to sort a list of elements. Give user the option to perform sorting using Insertion sort, Bubble sort or Selection sort.
3. Implement Linked List using templates. Include functions for insertion, deletion and search of a number, reverse the list and concatenate two linked lists (include a function and also overload operator +).
4. Implement Doubly Linked List using templates. Include functions for insertion, deletion and search of a number, reverse the list.
5. Implement Circular Linked List using templates. Include functions for insertion, deletion and search of a number, reverse the list.
6. Perform Stack operations using Linked List implementation.
7. Perform Stack operations using Array implementation. Use Templates.
8. Perform Queues operations using Circular Array implementation. Use Templates.
9. Create and perform different operations on Double-ended Queues using Linked List implementation.
10. WAP to scan a polynomial using linked list and add two polynomial.
11. WAP to calculate factorial and to compute the factors of a given no. (i)using recursion, (ii) using iteration
12. (ii) WAP to display fibonacci series (i)using recursion, (ii) using iteration
13. WAP to calculate GCD of 2 number (i) with recursion (ii) without recursion
14. WAP to create a Binary Search Tree and include following operations in tree:
    (a) Insertion (Recursive and Iterative Implementation)
    (b) Deletion by copying
    (c) Deletion by Merging
    (d) Search a no. in BST
    (e) Display its preorder, postorder and inorder traversals Recursively
    (f) Display its preorder, postorder and inorder traversals Iteratively
    (g) Display its level-by-level traversals
    (h) Count the non-leaf nodes and leaf nodes
    (i) Display height of tree

(j) Create a mirror image of tree
(k) Check whether two BSTs are equal or not

15. WAP to convert the Sparse Matrix into non-zero form and vice-versa.
16. WAP to reverse the order of the elements in the stack using additional stack.
17. WAP to reverse the order of the elements in the stack using additional Queue.
18. WAP to implement Diagonal Matrix using one-dimensional array.
19. WAP to implement Lower Triangular Matrix using one-dimensional array.
20. WAP to implement Upper Triangular Matrix using one-dimensional array.
21. WAP to implement Symmetric Matrix using one-dimensional array.
22. WAP to create a Threaded Binary Tree as per inorder traversal, and implement operations like finding the successor / predecessor of an element, insert an element, inorder traversal.
23. WAP to implement various operations on AVL Tree.

IT-202 (C-4): COMPUTER ORIENTED NUMERICAL METHODS
Theory: 60 Lectures

Unit 1: Floating point representation and computer arithmetic, Significant digits, Errors: Round-off error, Local truncation error, Global truncation error, Order of a method, Convergence and terminal conditions, Efficient computations.

Unit 2: Bisection method, Secant method, Regula−Falsi method Newton−Raphson method, Newton‘s method for solving nonlinear systems Gauss elimination method (with row pivoting) and Gauss−Jordan method, Gauss Thomas method for tridiagonal systems

Unit 3: Iterative methods: Jacobi and Gauss-Seidel iterative methods Interpolation: Lagrange‘s form and Newton‘s form.

Unit 4: Finite difference operators, Gregory Newton forward and backward differences Interpolation Piecewise polynomial interpolation: Linear interpolation, Cubic spline interpolation (only method), Numerical differentiation: First derivatives and second order derivatives, Richardson extrapolation.

Unit 5: Numerical integration: Trapezoid rule, Simpson‘s rule (only method), Newton−Cotes open formulas.

Unit 6: Extrapolation methods: Romberg integration, Gaussian quadrature, Ordinary differential equation: Euler‘s method Modified Euler‘s methods: Heun method and Mid-point method, Runge- Kutta second methods: Heun method without iteration, Mid-point method and Ralston‘s methodClassical 4^{th} order Runge-Kutta method, Finite difference method for linear ODE.

REFERNCE BOOKS:

[1] Laurence V. Fausett, Applied Numerical Analysis, Using MATLAB, Pearson, 2/e (2012)
[2] M.K. Jain, S.R.K. Iyengar and R.K. Jain, Numerical Methods for Scientific and Engineering Computation, New Age International Publisher, 6/e (2012)
[3] Steven C Chapra, Applied Numerical Methods with MATLAB for Engineers and Scientists,

Tata McGraw Hill, 2/e (2010).

IT LAB-202 (C-4): COMPUTER ORIENTED NUMERICAL METHODS
Lab Practical: 60 Lectures

1. Find the roots of the equation by bisection method.
2. Find the roots of the equation by secant/Regula−Falsi method.
3. Find the roots of the equation by Newton‘s method.
4. Find the solution of a system of nonlinear equation using Newton‘s method.
5. Find the solution of tridiagonal system using Gauss Thomas method.
6. Find the solution of system of equations using Jacobi/Gauss-Seidel method.
7. Find the cubic spline interpolating function.
8. Evaluate the approximate value of finite integrals using Gaussian/Romberg integration.

3rd SEMESTER

IT-301 (C-5): DIGITAL LOGIC AND INFORMATION COMMUNICATION TECHNOLOGY

THEORY: 60 LECTURES

Unit1: Boolean algebra and Logic gates (10 Lectures)

Boolean operators, axiomatic definition of Boolean algebra, Rules (postulates and basic theorems) of Boolean algebra, dual and complement of Boolean expression, Canonical form and Standard form, Sum of product and product of sum for m. Conversion between Boolean expression and truth table. Boolean expression and their simplification by algebraic method, Karnaugh map method (till four variable k-map) and Quine Mc Cluskey method, Don't care condition.

Logic gates:

Different types of gates, Implementation of logic expression with logic gates.

Unit2: Combinational circuit (12 Lectures)

Adder: half adder, full adder, parallel binary adder, Subtracters: half subtracter and full subtracter, Magnitude comparator, Decoder, Encoder, Application examples of decoder and encoder, Multiplexer, Demultiplexer, Application examples of multiplexer and demultiplexer, programmable logic Array (PLA)

Unit3: Sequential Circuit (10 Lectures)

Simple RS flipflop or latch, Clocked RS flipflop, D flipflop, JK flipflop, T flip flop, Edge triggered flipflop (SR, D, JK), Asynchronous preset and clear inputs, master Slave Flip Flop, JK Master slave flip flop., edge triggering and level triggering

Unit 4: Evolution of computer system (5 Lectures)

Modern computer, Classification of computer,Personal Computer hardware: Monitor, Keyboard, Mouse, Scanner, printer, speaker.

Unit 5 Hard Disk Drive (7 Lectures)

Logical structure and file system, FAT, NTFS. Hard disk tools: Disk cleanup, error checking, de fragmentation, scanning for virus, formatting, installing additional HDD. New trends in HDD. Floppy Disk Drive

Unit 6: Optical Media (8 Lectures)

CDROM, theory of operation, drive speed, buffer, cache, CD-r, CD-RW, DVD ROM, DVD technology, preventive maintenance for DVD and CD drives, New Technologies. Driver installation, Writing and cleaning CD and DVD.

Unit 7: Processor (8 Lectures)

Intel processor family. Latest trends in processor, Motherboard, Sockets and slots, power connectors. Peripheral connectors. Bus slots, USB, pin connectors. Different kinds of motherboards. RAM, different kinds of RAM. RAM up gradation**.** Cache and Virtual Memory concept.

Recommended Books:

1. Digital Logic and Computer Design, Morris M. Mano
2. Digital Fundamentals, Floyd and Jain
3. Comdex: Hardware and Networking Course Kit:: DreamTech press PC hardware: A beginners Guide: Ron Gilster: Tata Mc Graw Hill.

IT LAB-301 (C-5): DIGITAL LOGIC AND INFORMATION COMMUNICATION TECHNOLOGY

Lab Practical: 60 Lectures

1. Identify the peripherals of a computer, components in a CPU and its functions. Draw the block diagram of the CPU along with the configuration of each peripheral and submit to your instructor.
2. Every student should disassemble and assemble the PC back to working condition. Lab instructors should verify the work and follow it up with a Viva.
3. Every student should individually install MS windows on the personal computer. Lab instructor should verify the installation and follow it up with a Viva.
4. Every student should install Linux on the computer. This computer should have windows installed. The system should be configured as dual boot with both windows and Linux. Lab instructors should verify the installation and follow it up with a Viva.
5. Basic commands in Linux.
6. Hardware Troubleshooting: Students have to be given a PC which does not boot due to improper assembly or defective peripherals. They should identify the problem and fix it to get the computer back to working condition. The work done should be verified by the instructor and followed up with a Viva.
7. Software Troubleshooting: Students have to be given a malfunctioning CPU due to system software problems. They should identify the problem and fix it to get the computer back to working condition. The work done should be verified by the instructor and followed up with a Viva.
8. The test consists of various systems with Hardware / Software related troubles, Formatted disks without operating systems. Installation of antivirus software, configure their personal firewall and windows update on their computer. Then they need to customize their browsers to block pop ups, block active x downloads to avoid viruses and/or worms.

IT-302 (C-6): OBJECT ORIENTED PROGRAMMING USING C++

THEORY: 60 LECTURES

Unit1: Principles of Object Oriented Programming (10 Lectures)

Basic concept of OOP, Procedural programming vs OOP. Introducing Object Oriented Approach relating to other paradigms. Benefits of OOP and methods. Applications of OOP. Abstraction, Encapsulation, Inheritance, Polymorphism, Review of C, Difference between C and C++.

Unit2: Basic Elements and Ideas (10 Lectures)

Keywords and Identifiers in C++, Variables and Constants, Declaration and Initialization of Variables, Concept of Dynamic Initialization of variables, Enumerated variables, Basic data types, Arrays and Strings, User Defined Data types, Arithmetic, Relational, Logical Operators and Operator Precedence, Manipulators, Type Conversions and type cast operators, Console I/O: cin, cout functions. Control Statements.if; if-else; else….if; switch statements. Loops: for, while, do-while, Break, continue, go to. Pointer new, delete operators. Functions in C++: main function, function prototyping, call by reference, return by reference , functions inline, friend, virtual, library.

Unit3: Classes and Objects (10 Lectures)

Encapsulation, information hiding, abstract data types, Object & classes, attributes, functions, C++ class declaration, member functions, State identity and behavior of an object, static data members and member functions, friend functions, constant member functions. Constructors and destructors, instantiation of objects, Default parameter value, object types.

Unit4: Overloading (8 Lectures)

Function overloading: Function overloading with various data types, scooping rules for function overloading, Special features of function overloading. Operator overloading: Concept of Operator Overloading , overloading of Unary and Binary Operators., overloading binary operators using friends, manipulation of strings using operators.

Unit5: Inheritance (8 Lectures)

Concept of inheritance, Types of Inheritance Single, multilevel, multiple, hierarchical, hybrid, virtual base class, abstract class. Type of Derivations – public, private & protected, Constructors in Derived Classes.

Unit6: Virtual Functions and Polymorphism (5 Lectures)

Polymorphism, Categorization of polymorphism techniques: compile time polymorphism, Polymorphism by parameter, run time polymorphism pointers to derived class , Early binding vs. late binding, virtual function, pure virtual function.

Unit7:Files and Exception Handling (5 Lectures)

Need For a Data File, Opening and Closing a File, Detecting Endof File, Classes for File Stream Operations , Sequential Input and Output Operations, Random Access File Processing. Concept and Use of Exception Handling. Throwing Mechanism, Catching Mechanism,Specifying Exception.

Unit8: Templates (4 Lectures)

Function Template and Class Template**.**

REFERENCE BOOKS

i) Herber t Schild, ―The complete reference to C++‖, Osborn McGraw Hill
ii) R. Lafore, ―Object Or iented Programming using C++‖, Galgotia Publications
iii) Ian Graham, ―Object Oriented Methods‖, Addison Wesley.
iv) E. Balaguruswamy, "Object Oriented Programming with C++", Tata McGraw Hill 1997.
v) D. ravichandran, ―Programming With C++‖, Tata McGraw Hill Publishing Company Ltd.

IT LAB-302 (C-6): OBJECT ORIENTED PROGRAMMING USING C++
Lab Practical: 60 LECTURES

Each student should do at least 12 assignments from the following list.

1. Define a class named ***triangle*** to represent a triangle using the lengths of the three sides. Write a constructor to initialize objects of this class, given the lengths of the sides. Write member functions to check
(a) if a triangle is isosceles
(b) if a triangle is equilateral.
Write a main function to test your functions.

2. Define a structure **employee** with the following specifications.
Empno: Integer
Ename: 20 character
Basic, hra, da: float
Calculate() : a function to compute net pay as basic+hra+da with float return type.
Getdata(): a function to read values for empno, ename, basic, hra, da.
Dispdata(): a function to display all the data on the screen
Write a main program to test the program.

3. Define a class ***circle*** to represent circles. Add a data member ***radius*** to store the radius of a circle. Write member functions area() and perimeter() to compute the area and perimeter of a circle.

4. Define a class ***complex*** with two data members ***real*** and ***imag*** to represent real and imaginary part of a complex number.
Write member functions
rpart(): to return the real part of a complex number
ipart() : to return the imaginary part of a complex number
Add() : to add two complex numbers.
Mul() : to multiply two complex numbers.
Write constructors with zero, one and two arguments to initialize objects.
// This is an example of polymorphism.

5. Define a class ***point*** with two data members ***xordinate*** and ***yordinate*** to represent all points in the two dimensional plane by storing their x co-ordinate and y co-ordinate values.
Write member functions
dist(): to return the distance of the point from the origin.
slope(): to return the slope of the line obtained by joining this point with the origin.

Write constructors with zero, one and two arguments to initialize objects.
Write a friend function to compute the distance between two points.

6. Define a class ***String*** with the following data members
char *p;
int size and write member functions to do the following (without using library function) and using dynamic memory allocation.
Length of the string
Compare two string
Copy one string to another.
Reverse the string.
Write suitable constructors and destructors. Write a copy constructor for the class.

7. For the class ***complex*** defined in 3 above, overload the <<, >>, + and * operators in the usual sense. Also overload the unary – operator.

8. For the class ***string*** defined in 5 above, overload the <<, >> and + operators where + is to be used for concatenating two strings.

9. Define a class ***time*** to store time as hour, minute and second, all being integer values. Write member functions to display time in standard formats. Also overload the ++ and -- operators to increase and decrease a given time by one second where the minute and hour values will have to be updated whenever necessary.

10. Define a class to store matrices. Write suitable friend functions to add and multiply two matrices
11. Write a program to show the implementation of static members using class.

12. Define a class ***student*** with the following specification:
rollno :integer
sname :20 characters
Derive two classes ***artsst*** and ***scst.*** The class astst will represent students belonging to Arts stream and the class scst will represent students belonging to science stream. The artsst class will have additional data members ***ph, hs, en*** and **as** to store marks obtained by a student in three subjects Philosophy, History, English and Assamese. The class scst will have additional data members ***ph, ch, ma and eg*** to store marks obtained in Physics, Chemistry, Mathematics and English.
Write the following member functions in the classes artst and scst
ctotal() : A function to calculate the total marks obtained by a student
takedata() : function to accept values of the data members
Showdata() : function to display the mark sheet of a student .

13. Define an abstract base class ***printer.*** Derive three classes, ***laser-printer, dmp, line-printer*** and ***ink-jet-printer.*** The derived classes will have data members to store the features of that particular printer. Write pure virtual function display() in the base class and redefine it in the derived classes.

14. Define a abstract base class ***figure*** and add to it pure virtual functions
display() to display a figure
get() to input parameters of the figure
area() to compute the area of a figure
perimeter() to compute the perimeter of a figure.

Derive three classes ***circle, rectangle*** and t***riangle*** from it. A circle is to be represented by its radius, rectangle by its length and breadth and triangle by the lengths of its sides. Write a main function and write necessary statements to achieve run time polymorphism.

15. Write an interactive program to compute square root of a number. The input value must be tested for validity. If it is negative, the user defined function ***my_sqrt()*** should raise an exception.

16. Define a class ***rational*** to store rational numbers as a pair of integers, representing the numerator and denominator. Write a member functions for setting the values of the numerator and denominator. This function should raise an exception if attempt is made to set a zero value as the denominator and in such cases it should be set to 1.

17. Write a class template for storing an array of elements. Overload the << and >> operators. Write a member function to sort the array in descending order.

18. Write a class template for representing a singly linked list. Write functions for inserting, deleting, searching and for displaying a linked list. Write a main function to test it on a linked list of integers and characters.

IT-303 (C-7): DATABASE MANAGEMENT SYSTEM
Theory: 60 Lectures

Unit 1:Introduction (6 Lectures)
Characteristics of database approach, data models, database system architectureand data independence.

Unit 2:Entity Relationship(ER) Modeling (8 Lectures)

Entity types, relationships, constraints.

Unit 3:Relation data model (20 Lectures)

Relational model concepts, relational constraints, relational algebra, SQLqueries

Unit 4:Database design (15 Lectures)

Mapping ER/EER model to relational database, functional dependencies,Lossless decomposition, Normalforms(upto BCNF).

Unit 5:Transaction Processing (3 Lectures)

ACID properties, concurrency control

Unit 6:File Structure and Indexing (8 Lectures)

Operations on files, File of Unordered and ordered records, overview of File organizations, Indexing structures for files(Primary index, secondary index, clustering index), Multilevel indexing using B and B+ trees.

Books Recommended:

1. R. Elmasri, S.B. Navathe, Fundamentals of Database Systems 6th Edition, Pearson Education, 2010.
2. R. Ramakrishanan, J. Gehrke, Database Management Systems 3rd Edition, McGraw-Hill, 2002.
3. A. Silberschatz, H.F. Korth, S. Sudarshan, Database System Concepts 6th Edition, McGraw Hill, 2010
4. R. Elmasri, S.B. Navathe Database Systems Models, Languages, Design and application Programming, 6th Edition, Pearson Education, 2013

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IT LAB-303 (C-7): Database Management Systems

Lab Practical: 60 Lectures

Create and use the following database schema to answer the given queries.

EMPLOYEE Schema

Field	Type	NULL	KEY	DEFAULT
Eno	Char(3)	NO	PRI	NIL
Ename	Varchar(50)	NO		NIL
Job_type	Varchar(50)	NO		NIL
Manager	Char(3)	Yes	FK	NIL

Hire_date	Date	NO		NIL
Dno	Integer	YES	FK	NIL
Commission	Decimal(10,2)	YES		NIL
Salary	Decimal(7,2)	NO		NIL

DEPARTMENT Schema

Field	Type	NULL	KEY	DEFAULT
Dno	Integer	No	PRI	NULL
Dname	Varchar(50)	Yes		NULL
Location	Varchar(50)	Yes		New Delhi

Query List

1. Query to display Employee Name, Job, Hire Date, Employee Number; for each employee with the Employee Number appearing first.

2. Query to display unique Jobs from the Employee Table.

3. Query to display the Employee Name concatenated by a Job separated by a comma.

4. Query to display all the data from the Employee Table. Separate each Column by a comma and name the said column as THE_OUTPUT.

5. Query to display the Employee Name and Salary of all the employees earning more than $2850.

6. Query to display Employee Name and Department Number for the Employee No= 7900.
7. Query to display Employee Name and Salary for all employees whose salary is not in the range of $1500 and $2850.
8. Query to display Employee Name and Department No. of all the employees in Dept 10 and Dept 30 in the alphabetical order by name.
9. Query to display Name and Hire Date of every Employee who was hired in 1981.
10. Query to display Name and Job of all employees who don‘t have a current Manager.
11. Query to display the Name, Salary and Commission for all the employees who earn commission.
12. Sort the data in descending order of Salary and Commission.
13. Query to display Name of all the employees where the third letter of their name is _A‘
14. Query to display Name of all employees either have two _R‘s or have two _A‘s in their name and are either in Dept No = 30 or their Manger‘s Employee No = 7788.
15. Query to display Name, Salary and Commission for all employees whose Commission Amount is 14 greater than their Salary increased by 5%.
16. Query to display the Current Date.
17. Query to display Name, Hire Date and Salary Review Date which is the 1st Monday after six months of employment.
18. Query to display Name and calculate the number of months between today and the date each

employee was hired.

19. Query to display the following for each employee <E-Name> earns < Salary> monthly but wants < 3 * Current Salary >. Label the Column as Dream Salary.
20. Query to display Name with the 1st letter capitalized and all other letter lower case and length of their name of all the employees whose name starts with _J', 'A' and _M'.
21. Query to display Name, Hire Date and Day of the week on which the employee started.
22. Query to display Name, Department Name and Department No for all the employees.
23. Query to display Unique Listing of all Jobs that are in Department # 30.
24. Query to display Name, Dept Name of all employees who have an _A' in their name.
25. Query to display Name, Job, Department No. And Department Name for all the employees working at the Dallas location.
26. Query to display Name and Employee no. Along with their Manger's Name and the Manager's employee no; along with the Employees' Name who do not have a Manager.
27. Query to display Name, Dept No. And Salary of any employee whose department No. and salary matches both the department no. And the salary of any employee who earns a commission.
28. Query to display Name and Salaries represented by asterisks, where each asterisk (*) signifies $100.
29. Query to display the Highest, Lowest, Sum and Average Salaries of all the employees
30. Query to display the number of employees performing the same Job type functions.
31. Query to display the no. of managers without listing their names.
32. Query to display the Department Name, Location Name, No. of Employees and the average salary for all employees in that department.
33. Query to display Name and Hire Date for all employees in the same dept. as Blake.
34. Query to display the Employee No. And Name for all employees who earn more than the average salary.
35. Query to display Employee Number and Name for all employees who work in a department with any employee whose name contains a _T'.
36. Query to display the names and salaries of all employees who report to King.
37. Query to display the department no, name and job for all employees in the Sales department.

IT –304 (SEC-1): PROGRAMMING IN JAVA

Theory: 60 Lectures

UNIT 1: Introduction to Java (4 Lectures)

Java Architecture and Features, Understanding the semantic and syntax differences between C++ and Java, Compiling and Executing a Java Program, Variables, Constants, Keywords Data Types, Operators (Arithmetic, Logical and Bitwise) and Expressions, Comments, Doing Basic Program Output, Decision Making Constructs (conditional statements and loops) and Nesting, Java Methods (Defining, Scope, Passing and Returning Arguments, Type Conversion and Type and Checking, Built-in Java Class Methods),

UNIT 2: Arrays, Strings and I/O (8 Lectures)

Creating & Using Arrays (One Dimension and Multi-dimensional), Referencing Arrays Dynamically, Java Strings: The Java String class, Creating & Using String Objects, Manipulating Strings, String Immutability & Equality, Passing Strings To & From Methods, String Buffer Classes. Simple I/O

using System.out and the Scanner class, Byte and Character streams, Reading/Writing from console and files.

UNIT 3: Object-Oriented Programming Overview (4 Lectures)

Principles of Object-Oriented Programming, Defining & Using Classes, Controlling Access to Class Members, Class Constructors, Method Overloading, Class Variables & Methods, Objects as parameters, final classes, Object class, Garbage Collection.

UNIT4: Inheritance, Interfaces, Packages, Enumerations, Autoboxing and Metadata (14 lectures)

Inheritance: (Single Level and Multilevel, Method Overriding, Dynamic Method Dispatch, Abstract Classes), Interfaces and Packages, Extending interfaces and packages, Package and Class Visibility, Using Standard Java Packages (util, lang, io, net), Wrapper Classes, Autoboxing/Unboxing, Enumerations and Metadata.

UNIT 5: Exception Handling, Threading, Networking and Database Connectivity (15 Lectures)

Exception types, uncaught exceptions, throw, built-in exceptions, Creating your own exceptions; Multi-threading: The Thread class and Runnable interface, creating single and multiple threads, Thread prioritization, synchronization and communication, suspending/resuming threads. Using java.net package, Overview of TCP/IP and Datagram programming. Accessing and manipulating databases using JDBC.

UNIT 6: Applets and Event Handling (15 Lectures)

Java Applets:Introduction to Applets, Writing Java Applets, Working with Graphics, Incorporating Images & Sounds. Event Handling Mechanisms,Listener Interfaces, Adapter and Inner Classes. The design and Implementation of GUIs using the AWT controls, Swing components of Java Foundation Classes such as labels, buttons, textfields, layout managers, menus, events and listeners; Graphic objects for drawing figures such as lines, rectangles, ovals, using different fonts. Overview of servlets.

REFERENCE BOOKS

1. Ken Arnold, James Gosling, David Homes, "The Java Programming Language", 4th Edition, 2005.
2. James Gosling, Bill Joy, Guy L Steele Jr, GiladBracha, Alex Buckley"The Java Language Specification, Java SE 8 Edition (Java Series)", Published by Addison Wesley, 2014.
3. Joshua Bloch, "Effective Java" 2nd Edition,Publisher: Addison-Wesley, 2008.
4. Cay S. Horstmann, GaryCornell, "Core Java 2 Volume 1 ,9th Edition,Printice Hall.2012
5. Cay S. Horstmann, Gary Cornell, "Core Java 2 Volume 2 - Advanced Features)", 9th Edition, Printice Hall.2013
6. Bruce Eckel, "Thinking in Java", 3rd Edition, PHI, 2002.
7. E. Balaguruswamy, "Programming with Java", 4th Edition, McGraw Hill.2009.
8. Paul Deitel, Harvey Deitel, "Java: How to Program", 10th Edition, Prentice Hall, 2011. 9.

"Head First Java", Orielly Media Inc. 2nd Edition, 2005.

10. David J. Eck, "Introduction to Programming Using Java", Published by CreateSpace Independent Publishing Platform, 2009.
11. John R. Hubbard, "Programming with JAVA", Schaum's Series, 2nd Edition, 2004.

IT LAB-304 (SEC-1): Programming in Java

Lab Practical: 60 Lectures

1. To find the sum of any number of integers entered as command line arguments
2. To find the factorial of a given number
3. To learn use of single dimensional array by defining the array dynamically.
4. To learn use of .lenth in case of a two dimensional array
5. To convert a decimal to binary number
6. To check if a number is prime or not, by taking the number as input from the keyboard
7. To find the sum of any number of integers interactively, i.e., entering every number from the keyboard, whereas the total number of integers is given as a command line argument
8. Write a program that show working of different functions of String and StringBufferclasss like setCharAt(, setLength(), append(), insert(), concat()and equals().
9. Write a program to create a ―distance‖ class with methods where distance is computed in terms of feet and inches, how to create objects of a class and to see the use of this pointer
10. Modify the ―distance‖ class by creating constructor for assigning values (feet and inches) to the distance object. Create another object and assign second object as reference variable to another object reference variable. Further create a third object which is a clone of the first object.
11. Write a program to show that during function overloading, if no matching argument is found, then java will apply automatic type conversions(from lower to higher data type)
12. Write a program to show the difference between public and private access specifiers. The program should also show that primitive data types are passed by value and objects are passed by reference and to learn use of final keyword
13. Write a program to show the use of static functions and to pass variable length arguments in a function.
14. Write a program to demonstrate the concept of boxing and unboxing.
15. Create a multi-file program where in one file a string message is taken as input from the user and the function to display the message on the screen is given in another file (make use of Scanner package in this program).
16. Write a program to create a multilevel package and also creates a reusable class to generate Fibonacci series, where the function to generate fibonacii series is given in a different file belonging to the same package.
17. Write a program that creates illustrates different levels of protection in classes/subclasses belonging to same package or different packages
18. Write a program ―DivideByZero‖ that takes two numbers a and b as input, computes a/b, and invokes Arithmetic Exception to generate a message when the denominator is zero.
19. Write a program to show the use of nested try statements that emphasizes the sequence of checking for catch handler statements.
20. Write a program to create your own exception types to handle situation specific to your

application (Hint: Define a subclass of Exception which itself is a subclass of Throwable).
21. Write a program to demonstrate priorities among multiple threads.

4th SEMESTER

IT-401 (C-8): DATA COMMUNICATION AND COMPUTER NETWORKS
Theory: 60 Lectures

Unit 1: INTRODUCTION 6 Lectures)
Usage of Computer Network, study of topology, concept of protocol, Connection less and connection Oriented Service, Layered architecture, study of OSI and TCP model.

Unit 2 : PHYSICAL LAYER (10 Lectures)
Introduction to Guided and Unguided media, physical description of twisted pair, coaxial cable, and fiber optic cable, Maximum data rate of a channel (Nyquist and shannons law), Basic concepts of Modulation and demodulation, Data encoding techniques (Manchester and Differential Mancestar encoding) . Network connecting devices hub, repeater, bridge, switch, router, and gateway

Unit 3: DATA LINK LAYER (7 Lectures)
Functions and services of DLL, Framing and Framing Methods, Concept of Error Control, Error Correcting code(Hamming code), Error detecting code(CRC), Concept of Flow Control, Piggybacking, Stop-and-Wait sliding window protocol, Pipelining techniques(Go backN, Selective Repeat).

Unit 4: MAC (7 Lectures)
What is MAC? Static Channel Allocation, Dynamic Channel Allocation, Pure ALOHA, Slotted ALOHA, Carrier Sense Protocol, 1-persistent CSMA, Non-PersistentCSMA, CSMA/CD, Ethernet(IEEE 802.3) and Ethernet Frame Format, Basic concept of Wireless LAN(IEEE 802.11), Binary Exponential Backoff Algorithm.

Unit 5: NETWORK LAYER (10 Lectures)
Services and Functions of Network Layer, Virtual Circuit and Datagram Subnet, Routing, Distance Vector Routing, the Count-to-Infinity problem, Link State Routing, Congestion (definition and factors of congestion only), Definition of Quality of Service, Traffic shaping, Leaky Bucket and token Bucket Algorithm, Concept of IP Address.

Unit 6: TRANSPORT LAYER (10 Lectures)
Functionality of transport Layer, Establishment and release of connection, TCP and UDP(Overview), Introduction to Sockets and socket primitives, port numbers.

Unit 7: APPLICATION LAYER (10 Lectures)
Concept of E-mail, Telnet, WWW, DNS, HTTP, FTP, URL, SMTP, MIME.

REFERENCE BOOKS

1. Red Hat Linux:Proffitt:PHI
2. Introduction to system Administration:IBM series:PHI

IT LAB-401 (C-8): DATA COMMUNICATION AND COMPUTER NETWORKS

Lab Practical: 60 Lectures

Each student should do at least 4 assignments from the following list.
Avoid using Loopback Communication for the assignments,1-4:

1. Write a server socket program using TCP/IP where the client side will send a request for an existing file to the server side and if the file exists in the server then send the contents of that particular file to the client in reply, otherwise display a message ―file does not exist on the server‖, if exists displays the contents on the client side.

2. Develop a chat application using TCP/IP

3. Develop a client-server application using TCP/IP to input user‘s information and finally send them to the server and store there in a file.

4. Develop a server socket program where the client takes principal, rate of interest and number of years and send them to the server. In the server receive this information and find the simple interest and finally send the result to the client again and display it on the client‘s VDU.

5. Configure a Local Area Network (Wired/Ethernet) in Linux environment. Configure the network interface card using ifconfig command and also explore ping, ifdown and ifup commands.

IT-402 (C-9): OPERATING SYSTEM

Theory: 60 Lectures

UNIT 1. Introduction (10 Lectures)

Basic OS functions, resource abstraction, types of operating systems–multiprogramming systems, batch systems , time sharing systems; operating systems for personal computers & workstations, process control & real time systems.

UNIT 2. Operating System Organization (6 Lectures)

Processor and user modes, kernels, system calls and systemprograms.

UNIT 3. Process Management **(20**Lectures)

System view of the process and resources, process abstraction, processhierarchy, threads, threading issues, thread libraries; Process Scheduling, non-pre-emptive and pre-emptive scheduling algorithms; concurrent and processes, critical section, semaphores, methods for inter-process communication; deadlocks.

UNIT 4. Memory Management (10 Lectures)

Physical and virtual address space; memory allocation strategies -fixedand variable partitions, paging, segmentation, virtual memory

UNIT 5. File and I/O Management (10 Lectures)

Directory structure, file operations, file allocation methods, devicemanagement.

UNIT 6. Protection and Security (4 Lectures)

Policy mechanism, Authentication, Internal access Authorization.

Recommended Books:

1. A Silberschatz, P.B. Galvin, G. Gagne, Operating Systems Concepts, 8th Edition, John Wiley Publications 2008.
2. A.S. Tanenbaum, Modern Operating Systems, 3rd Edition, Pearson Education 2007.
3. G. Nutt, Operating Systems: A Modern Perspective, 2nd Edition Pearson Education 1997.
4. W. Stallings, Operating Systems, Internals & Design Principles , 5th Edition, Prentice Hall of India. 2008.
5. M. Milenkovic, Operating Systems- Concepts and design, Tata McGraw Hill 1992.

IT LAB-402 (C-9): OPERATING SYSTEMS

Lab Practical: 60 Lectures

C/ C++ programs

1. WRITE A PROGRAM (using *fork()* and/or *exec()* commands) where parent and child execute:
   a) same program, same code.
   b) same program, different code.
   c) before terminating, the parent waits for the child to finish its task.
2. WRITE A PROGRAM to report behaviour of Linux kernel including kernel version, CPU type and model. (CPU information)
3. WRITE A PROGRAM to report behaviour of Linux kernel including information on configured memory, amount of free and used memory. (memory information)
4. WRITE A PROGRAM to print file details including owner access permissions, file access time, where file name is given as argument.

5. WRITE A PROGRAM to copy files using system calls.
6. Write program to implement FCFS scheduling algorithm.
7. Write program to implement Round Robin scheduling algorithm.
8. Write program to implement SJF scheduling algorithm.
9. Write program to implement non-preemptive priority based scheduling algorithm.
10. Write program to implement preemptive priority based scheduling algorithm.
11. Write program to implement SRJF scheduling algorithm.
12. Write program to calculate sum of n numbers using *thread* library.
13. Write a program to implement first-fit, best-fit and worst-fit allocation strategies.

IT-403 (C-10): COMPUTER ORGANIZATION AND ARCHITECTURE
Theory: 60 Lectures

Unit1: Introduction (10 Lectures)

Functional units of a computer, basic instructions, interconnection of functional units, bus structure, memory locations, memory addresses, memor y operations, instruction and instruction sequencing (straight Line sequencing and branching), addressing modes,introduction to assembly language, stack, subroutine, I/O instructions.

Unit2: Register Transfer Logic (8 Lectures)

Introduction, inter register transfer, arithmetic microoperation, logic microoperation, shift microoperation, Conditional control statements, fixed point binary data, instruction code, design of a simple computer.

Unit3: Processor logic design (8 Lectures)

Processor organization, design of arithmetic and logic unitt, status register, design of accumulator.

Unit4: Control logic design (8 Lectures)

Hardware control, microprogrammed control block diagram, symbolic microprogram, microprogrammed CPU organization.

Unit5: I/O Subsystem (13 Lectures)

Program controlled I/O, Interrupts: enabling and disabling interrupts, handling interrupts from multiple sources (priority control), DMA, structure and working of hard disk, CDROM, printer.

Unit6: Memory subsystem (13 Lectures)

Semiconductor memory, SRAM, DRAM, ROM, speed size and cost, Cache memory,Mapping functions, replacement algorithms.

Suggested Reading:

1. Computer System Architecture, M.Morris Mano, PHI publication
2. Computer Architecture, Hamachar, Vranesic and Zaky.

IT-404 (SEC 2): DIGITAL IMAGE PROCESSING USING MATLAB

Theory: 60 Lectures

Unit 1. Introduction (6 Lectures)

Light, Brightness adaption and discrimination, Pixels, coordinate conventions, Imaging Geometry, Perspective Projection, Spatial Domain Filtering, sampling and quantization.

Unit 2. Spatial Domain Filtering (7 Lectures)

Intensity transformations, contrast stretching, histogram equalization, Correlation and convolution, Smoothing filters, sharpening filters, gradient and Laplacian.

Unit 3. Filtering in the Frequency domain (8 Lectures)

Hotelling Transform, Fourier Transforms and properties, FFT (Decimation in Frequency and Decimation in Time Techniques), Convolution, Correlation, 2-D sampling, Discrete CosineTransform, Frequency domain filtering.

Unit 4. Image Restoration (8 Lectures)

Basic Framework, Interactive Restoration, Image deformation and geometric transformations, image morphing, Restoration techniques, Noise characterization, Noise restoration filters, Adaptive filters, Linear, Position invariant degradations, Estimation of Degradation functions, Restoration from projections.

Unit 5. Image Compression (10 Lectures)

Encoder-Decoder model, Types of redundancies, Lossy and Lossless compression, Entropy of an information source, Shannon's 1st Theorem, Huffman Coding, Arithmetic Coding, Golomb Coding, LZW coding, Transform Coding, Sub-image size selection, blocking artifacts, DCT implementation using FFT, Run length coding, FAX compression (CCITT Group-3 and Group-4), Symbol-based coding, JBIG-2, Bit-plane encoding, Bit-allocation, Zonal Coding, Threshold Coding, JPEG, Lossless predictive coding, Lossy predictive coding, Motion Compensation

Unit 6. Wavelet based Image Compression (5 Lectures)

Expansion of functions, Multi-resolution analysis, Scaling functions, MRA refinement equation, Wavelet series expansion, Discrete Wavelet Transform (DWT), Continuous Wavelet Transform, Fast Wavelet Transform, 2-D wavelet Transform, JPEG-2000 encoding, Digital Image Watermarking.

Unit 7. Morphological Image Processing (7 Lectures)

Basics, SE, Erosion, Dilation, Opening, Closing, Hit-or-Miss Transform, Boundary Detection, Hole filling, Connected components, convex hull, thinning, thickening, skeletons, pruning, Geodesic Dilation, Erosion, Reconstruction by dilation and erosion.

Unit 8. Image Segmentation (9 Lectures)

Boundary detection based techniques, Point, line detection, Edge detection, Edge linking, local processing, regional processing, Hough transform, Thresholding, Iterative thresholding, Otsu's method, Moving averages, Multivariable thresholding, Region-based segmentation, Watershed algorithm, Use of motion in segmentation

Reference Books

1. R C Gonzalez , R E Woods, Digital Image Processing, 3rd Edition, Pearson Education.2008.
2. A K Jain, Fundamentals of Digital image Processing, Prentice Hall of India.1989.
3. K R Castleman, Digital Image Processing, Pearson Education.1996
4. Schalkoff, Digital Image Processing and Computer Vision, John Wiley and Sons.1989.
5. Rafael C. Gonzalez, Richard E. Woods, Steven Eddins,' Digital Image Processing using MATLAB', Pearson Education, Inc., 2004.

IT LAB-404 (SEC-2) DIGITAL IMAGE PROCESSING
Lab Practical: 60 Lectures

1. Write program to read and display digital image using MATLAB or SCILAB
   a. Become familiar with SCILAB/MATLAB Basic commands
   b. Read and display image in SCILAB/MATLAB
   c. Resize given image
   d. Convert given color image into gray-scale image
   e. Convert given color/gray-scale image into black & white image
   f. Draw image profile
   g. Separate color image in three R G & B planes
   h. Create color image using R, G and B three separate planes
   i. Flow control and LOOP in SCILAB
   j. Write given 2-D data in image file

2. To write and execute image processing programs using point processing method
   a. Obtain Negative image
   b. Obtain Flip image
   c. Thresholding

d. Contrast stretching

3. To write and execute programs for image arithmetic operations
   a. Addition of two images
   b. Subtract one image from other image
   c. Calculate mean value of image
   d. Different Brightness by changing mean value

4. To write and execute programs for image logical operations
   a. AND operation between two images
   b. OR operation between two images
   c. Calculate intersection of two images
   d. Water Marking using EX-OR operation
   e. NOT operation (Negative image)

5. To write a program for histogram calculation and equalization using
   a. Standard MATLAB function
   b. Program without using standard MATLAB functions
   c. C Program

6. To write and execute program for geometric transformation of image
   a. Translation
   b. Scaling
   c. Rotation
   d. Shrinking
   e. Zooming

7. To understand various image noise models and to write programs for
   a. image restoration
   b. Remove Salt and Pepper Noise
   c. Minimize Gaussian noise
   d. Median filter and Weiner filter

8. Write and execute programs to remove noise using spatial filters
   a. Understand 1-D and 2-D convolution process
   b. Use 3x3 Mask for low pass filter and high pass filter

9. Write and execute programs for image frequency domain filtering
   a. Apply FFT on given image
   b. Perform low pass and high pass filtering in frequency domain
   c. Apply IFFT to reconstruct image

10. Write a program in C and MATLAB/SCILAB for edge detection using different edge detection mask
11. Write and execute program for image morphological operations erosion and dilation.
12. To write and execute program for wavelet transform on given image and perform inverse wavelet transform to reconstruct image.

5th SEMESTER

IT-501 (C-11): SOFTWARE ENGINEERING

Theory: 60 Lectures

Unit 1: Introduction (8 Lectures)

The Evolving Role of Software, Software Characteristics, Changing Nature of Software, Software Engineering as a Layered Technology, Software Process Framework, Framework and Umbrella Activities, Process Models, Capability Maturity Model Integration (CMMI).

Unit 2: Requirement Analysis (10 Lectures)

Software Requirement Analysis, Initiating Requirement Engineering Process, Requirement Analysis and Modeling Techniques, Flow Oriented Modeling, Need for SRS, Characteristics and Components of SRS.

Unit 3: Software Project Management (8Lectures)

Estimation in Project Planning Process, Project Scheduling.

Unit 4: Risk Management (8 Lectures)

Software Risks, Risk Identification, Risk Projection and Risk Refinement, RMMM Plan.

Unit 5: Quality Management (8 Lectures)

Quality Concepts, Software Quality Assurance, Software Reviews,Metrics for Process and Projects.

Unit 6: Design Engineering (10 Lectures)

Design Concepts, Architectural Design Elements, Software Architecture, Data Design at the Architectural Level and Component Level, Mapping of Data Flow into Software Architecture, Modeling Component Level Design.

Unit 7: Testing Strategies & Tactics (8 Lectures)

Software Testing Fundamentals, Strategic Approach to Software Testing, Test Strategies for Conventional Software, Validation Testing, System testing, Black-Box Testing, White-Box Testing and their type, Basis Path Testing.

Recommended Books:

1. R.S. Pressman, Software Engineering: A Practitioner‘s Approach (7th Edition), McGraw-Hill, 2009.
2. P. Jalote, An Integrated Approach to Software Engineering (2nd Edition), Narosa Publishing House, 2003.

3. K.K. Aggarwal and Y. Singh, Software Engineering (2nd Edition), New Age International Publishers, 2008.
4. I. Sommerville, Software Engineering (8th edition), Addison Wesley, 2006.
5. D. Bell, Software Engineering for Students (4th Edition), Addison-Wesley, 2005.
6. R. Mall, Fundamentals of Software Engineering (2nd Edition), Prentice-Hall of India, 2004.

IT LAB (C-11): SOFTWARE ENGINEERING LAB
Lab Practical: 60 Lectures

S. No.	Practical Title
1.	Problem Statement, • Process Model
2.	Requirement Analysis: • Creating a Data Flow • Data Dictionary, Use Cases
3.	Project Management: • Computing FP • Effort • Schedule, Risk Table, Timeline chart
4.	Design Engineering: • Architectural Design • Data Design, Component Level Design
5.	Testing: • Basis Path Testing

Sample Projects:

1. **Criminal Record Management**: Implement a criminal record management system for jailers, police officers and CBI officers
2. **DTC Route Information**: Online information about the bus routes and their frequency and fares
3. **Car Pooling**: To maintain a web based intranet application that enables the corporate employees within an organization to avail the facility of carpooling effectively.
4. Patient Appointment and Prescription Management System
5. Organized Retail Shopping Management Software
6. Online Hotel Reservation Service System
7. Examination and Result computation system
8. Automatic Internal Assessment System
9. Parking Allocation System
10. Wholesale Management System

IT 502 (C-12): WEB TECHNOLOGIES
Theory: 60 Lectures

Unit 1: Internet Basics: 3 Lectures

History of the internet , the world wide web, getting connected ,web page, home page, web site, Internet services: email.

Unit 2: Client Server Model: 15 Lectures

Structure of an HTML document. HTML tags. The HTTP protocol details. Client side software. Web browsers (Netscape/Mozilla as example). DHTML Web server architecture and functions of an web server. JDBC and ODBC. Server side vs client side scripts, advantages and disadvantages of each. Client side and server side scripting languages and their uses. Dynamic web page. CGI scripts, Java Scripts and JSP as examples. PHP and Perl as scr ipting language. Browser plugins

Unit 3: Web Object Model: CORBA 5 Lectures

Unit 4 XML: 12 Lectures

Well formed XML syntax. references, well formed documents XML semantics. DTD, XML Schema, RELAXNG. Displaying XML on web. XML extensions. Processing XML files, Using a programming language and the SAX API,Using a programming language and the DOM API,Using a transformation engine and a filter ,Push Parsing ,Data binding ,Nonextractive XML

Unit 5: Distributed Multitiered Application: 10 Lectures

J2EE Components ,J2EE Clients, Web Components, Business Components. J2EE Containers, Container Services , Container Types, Enter prise JavaBeans Technology, Java Ser vlet Technology, JavaServer Pages Technology.

Unit 6: Application server: 10 Lectures

Persistence, Transaction processing, Concur rency control, Events using, Java Message Service, naming and directory services (JNDI),Secur ity (Java Cryptography Extension (JCE) and JAAS) Deployment of software components in an application server Remote procedure calls using RMIIIOP.

Unit 6 : Web Security: 5 Lectures

Firewall, wrapper and Proxy.

Suggested reading:

1. The Internet Complete, M.L. Young
2. Using CGI by J. Dwight, M. Erwin, R. Niles.

3. Mastering JavaScript and Jscript by J. Jaworski
4. Dynamic HTML by D. Godmann.
5. Understanding HTML by D.P. Nagpal

IT LAB-502 (C-12): WEB TECHNOLOGY

Lab Practical: 60 Lectures

HTML

(At least 12 assignments has to be done from this group)

1. Create a HTML document consisting of HTML heading, paragraphs and images.

2. Create a HTML document and insert comments in the HTML source code and insert horizontal lines.

3. Construct HTML document to set the font of a text , size of the font, style of the font.

4. Create a HTML document to show how to create hyperlinks.

5. Create a HTML document to use an image as a link.

6. Create a HTML document to open link in a new browser window.

7. Create a HTML document to jump to another part of a document (on the same page).

8. Create a HTML document to insert images from another folder or another server.

9. Create an image-map, with clickable regions.

10. Create a HTML document with all table elements (Table, Caption, Table Row, Table Data element, Table Heading Element, THEAD, TFOOT, TBODY)

11. Create HTML document to make an unordered list, an ordered list, different types of ordered lists, different types of unordered lists, Nested list, Definition list.

12. Create HTML form with the all FORM elements (text fields, password field, Checkboxes, Radio buttons, Select elements, Drop-down list with a pre-selected value, Textarea (a multi-line text input field) and buttons.

13. Create HTML document with all Frame elements (FRAMESET, FRAME, NOFRAMES, and INLINE FRAME).

14. Create a HTML document to add AUDIO and VIDEO.

15. . Create a HTML document to aligning images (Let the image float to the left/right of a paragraph)

16. Create a HTML document to jump to a specified section within a frame

17. Construct a HTML document with CSS to Set the background colour of a page.

18. Construct a HTML document with CSS to set an image as the background of a page

19. Construct HTML document with CSS to Set the text color of different elements and align the text.

20. Construct HTML document to set different colours to visited/unvisited links, Specify a background colour for links

XML Each student should do at least 2 assignments from the following list

21. Construct an XML document that contain information about products of an organization.

22. Construct an XML document that contain information of 5 students (such as roll no., name , address, class).

23. Construct an XML document that contain details of 10 books.

JAVAScript *(At least 8 assignments has to be done from this group)*

24. Write a program in javasrcript to accept a name from the user and display the same name in an alert box.

25. Write a program in javasrcript to display a message in a confirm box.

26. Write a program in javasrcript to display the message _time is running out' in the status bar.

27. Write a program in JavaScript to enter marks of a student and find his/her grade according to the following:

if marks>=90 then grade A
if marks>=80 then grade B
if marks>=70 then grade C
if marks>=60 then grade D
else fail.

28. Write a program in JavaScript to create a button and when the button is clicked the message _Hello World' is displayed on an alert box..

29. Write a program in JavaScript to accept 2 nos from the user and show the working of all arithmetic operators.

30. Write a program in JavaScript to accept 2 strings and concatenate them.

31. Write a program in JavaScript to display the current date and time.

32. Write a program in JavaScript to find the length of an array.

33. Write a program in JavaScript to check whether a string is palindrome or not.

34. Write a program in JavaScript that responds to a mouse click anywhere on the page

(using mouse click).

35. Write a program in JavaScript to display the contents of a check box in a alert box.

36. Write a program to validate a form in the user id and password forms.

37. Write a program in JavaScript to crate a welcome cookie, Button animation, Image map with added JavaScript Simple timing, Timing event in an infinite loop

VBScript ***(At least 4 assignments has to be done from this group)***

38. Write a program in VBScript to create a variable.

39. Write a program in VBScript to uppercase to lowercase.

40. Write a program in VBScript to Create an array

41. Write a program in VBScript using conditional statements loop

42. Write a program in VBScript using loop.

43. Write a program in VBScript to display Date and Time

44. Write a program in VBScript to display the current month and day.

ASP

Each student should do at least 2 assignments from the following list

45. Write a program in ASP to interact with a user in a form that uses the "get" method.

46. Write a program in ASP to interact with a user in a form that uses the "post" method.

47. Write a program in ASP to interact with a user in a form with radio buttons.

48. Write a program in ASP to create a welcome cookie.

IT-503 DSE-1(A): MICROPROCESSOR
Theory: 60 Lectures

Unit1: Internal Organization of 8085A microprocessor (10 Lectures)

User Programmable registers, PC, SP, accumulator, flags, data bus, address bus, control bus, instruction word size, opcode format, data format, memory addressing, I/O addressing, address decoding for memory and I/O.

Unit2: 8085A microprocessor architecture (15 Lectures)

Pinout of 8085A microprocessor, multiplexed address/data bus, control and status signal, demultiplexing of control signals, other signals, bus timings, fetch decode and execute cycle, timing diagram for opcode fetch memory read and memory write, interfacing memory and I/O.

Unit3: Assembly language programming in 8085A microprocessor (15 Lectures)

Complete instruction set in detail, programming examples, logic operation, counters and time delays, stack and subroutine, processing arrays, bit manipulation.

Unit4: Interfacing (15 Lectures)

In and OUT instruction, decoding addresses, Interfacing LED, relay, seven segment display, switch, keyboard,.

Unit5: Interrupts (5 Lectures)

Vectored interrupts, interrupt prior ities, general purpose programmable peripheral devices, 8255A control and status registers, programming 8255A, introduction to 8279, 8254 and 8237 (block diagrams and basic functions).

Suggested Reading :

1. Microprocessor Architecture, Programming and Application with the 8085 by Ramesh S. Gaonkar.

IT LAB-503 DSE-1(A): Microprocessor
Lab Practical: 60 Lectures

Each student should do at least 8 assignments from the following list

1. Write a program to add two 8 bit numbers & store it in a memory location 8820h.

2. Write a program to copy a block of memory from one location 8820h to another location 8840h.

3. Write a program to perform the addition of two 16 bit numbers.

4. Write a program to add two numbers & store it in a register **e**.

5. Write a program to load two unsigned numbers in register b & c. Subtract b from c. If the result is in 2‘s complement, convert the result in absolute magnitude & display it.

6. Write a program to find the difference of two numbers & store the result in 8830h.

7. Write a program to find the larger / smaller of two given numbers.

8. Write a program to subtract two numbers and add it to a given memory location.

9. Write a program to perform xy5,where x and y are 16bit numbers.

10. Write a program to find 2‘s complement of a number.

IT-503 DSE-1(B): THEORY OF COMPUTATION
Theory: 60 Lectures

Unit1: Finite Automata **(**10 Lectures)

DFA, NFA, NFA with €moves. Equivalence of DFA and NFA. Reduction of the number of states in a finite automata.

Unit2: Regular Languages and Regular Grammar **(**7 Lectures)

Concept of languages and grammar. Regular expressions. Connection between regular expressions and regular languages. Regular grammars, Right and LeftLinear Grammars. Equivalence between Regular languages and Regular grammars.

Unit3: Properties of Regular Languages **(**10 Lectures**)**

Closure under simple set operations union, intersection, concatenation, complementation and starclosure.proof of pumping lemma for regular language. Proof of nonregularity using Pigeonhole principle and using pumping lemma for regular languages.

Unit4: Context free languages (10 Lectures**)**

Contextfree grammars, leftmost and rightmost derivations, derivation trees. Parsing and Ambiguity in grammars and languages. Simplification of Context free Grammars removing useless productions, empty productions and unitproductions. Normal forms Chomsky and Greibach normal forms.

Unit5: Pushdown Automata **(**8 Lectures)

Definition and language accepted (acceptance by empty stack and final state and their equivalence).Pushdown Automata and Context free languages. Deterministic PDA and Deterministic Context free Languages.

Unit7: Properties of Context free Languages (5 Lectures)

Pumping Lemma for CFL. Using Pumping Lemma to show certain languages not to be Context free. Closure properties of CFL – closure under union, concatenation and star closure and showing that CFLs are not closed under intersection and complementation.

Unit8: Complexity Classes (10 Lectures)

Time and Space complexity of algorithms, average case and worst case analysis, asymptotic notation as a measure of algorithm complexity, O, , o, , and notations. Analysis of sorting algorithms Selection sort, Bubble sort, Insertion so t, Heap sort, Quick sort and analysis of searching algorithms – linear search and binary search.

Suggested Reading

1. An introduction to Formal Languages and Automata, Peter Linz, Narosa.
2. Introduction to Automata Theory, Languages and Computation, Hopcroft and Ullman, Addison Wesley.

3. K. L. P. Mishra, N. Chandrasekaran; Theory of Computer Science (Automata, Languages and Computation), P. H. I.
4. T. H. Cormen, C. E. Leiserson and R. L. Rivest, Introduction to Algorithms, Tata Mcgraw Hill Publishers.

IT-504 DSE-2(A): WEB APPLICATION DESIGN USING PHP
Theory: 60 Lectures

UNIT I (8 Lectures)

Introduction to PHP as a programming Language: - Advantages of PHP, the server side architecture Decomposed, overview of PHP, history, object oriented support, benefits in running PHP as a server side script. Installing a web server, Internet information server, and IIS installation, testing web server setup.

UNIT II (16 Lectures)

The basics of PHP: - data types, variables, constants, operators, Arrays, Conditional statements (if statement, Executing Multiple Statements, else if clause and switch statement), Iterations (for loop, while loop, controlling an array using a while loop, do while statement, foreach loop and special loop key words)

String Manipulation and Regular Expression:

Creating and accessing String , Searching & Replacing String, Formatting, joining and splitting String , String Related Library functions, use and advantage of regular expression over inbuilt function , use of preg_match(), preg_replace(), preg_split() functions in regular expression

UNIT III (10 Lectures)

Functions, user defined functions, functions with arguments, built in functions(print(), includer(), header(), phpinfo()), PHP server Variables, working with date and time , performing mathematical operations , working with string functions . System Variable (GET, POST, cookies& Session, Forums)

UNIT IV (16 Lectures)

Working with forms, form elements (Text Box, Text Area, Password, Radio Button, Checkbox, The Combo Box, Hidden Field and image), adding elements to a form, uploading files to the Web Server using PHP, building a challenge and response subsystem and understanding the functionality of the FORM attribute Method Regular Expressions: - Engine, types of Regular Expressions, symbols used in Regular Expressions. Error handling in PHP: - Displaying errors, warnings, types of errors, error levels in PHP, logging Errors and Ignoring errors.

UNIT V (10 Lectures)

Data base connectivity using PHP (MySQL, ODBC, ORACLE, SQL) Performing, executing Commands, different types of Data Base Operations like Insertion, deletion, update and query on data

REFERENCE BOOKS

1. Beginning PHP and MySQL,W. Jason Gilmore, Apress, 2010, Fourth Edition Froovice to Professional.
2. PHP6 and MySQL, Steve Suehring, Tim Converse and Joyce Park, Wiley India 2010, Second Edition.
3. HTML4 Complete ,E.Stephen Mask, Janan Platt BPB Publications, First Edition 1998.

IT LAB-504 DSE-2(A): WEB APPLICATION DESIGN USING PHP
Lab Practical: 60 Lectures

1. Create a PHP page using functions for comparing three integers and print the largest number.

2. Write a function to calculate the factorial of a number (non-negative integer). The function accept the number as an argument.
3. WAP to check whether the given number is prime or not.

4. Create a PHP page which accepts string from user. After submission that page displays the reverse of provided string.

5. Write a PHP function that checks if a string is all lower case.

6. Write a PHP script that checks whether a passed string is palindrome or not? (A palindrome is word, phrase, or sequence that reads the same backward as forward, e.g., madam or nurses run)

7. WAP to sort an array.
8. Write a PHP script that removes the whitespaces from a string.
Sample string : 'The quick " " brown fox' Expected Output : Thequick""brownfox
9. Write a PHP script that finds out the sum of first n odd numbers.

10. Create a login page having user name and password. On clicking submit, a welcome message should be displayed if the user is already registered (i.e.name is present in the database) otherwise error message should be displayed.

11. Write a PHP script that checks if a string contains another string.

12. Create a simple 'birthday countdown' script, the script will count the number of days between current day and birth day.

13. Create a script to construct the following pattern, using nested for loop.

*
* *
* * *
* * * *
* * * * *
14. Write a simple PHP program to check that emails are valid.
15. WAP to print first n even numbers.
17. Using switch case and dropdown list display a ―Hello‖ message depending on the language selected in drop down list.

IT-504 DSE-2(B): DATA MINING AND WAREHOUSING

Theory: 60 Lectures

Unit-I: Data Warehousing (15 Lectures)

Overview and concepts: Need for Data Warehousing, Basic elements of Data Warehousing, differences between Database Systems and Data Warehouse. Planning and Requirements: Project planning and management, collecting the requirements. Architecture and Infrastructure: Data Warehouse Architecture and its components, Infrastructure and metadata. Data Design and Data Representation: Principles of dimensional modeling, advanced topics data extraction, transformation and loading, data quality. Information Access and Delivery: Matching information to classes of users, OLAP in Data Warehouse, Data warehousing and the web. Implementation and Maintenance: Physical design process, Data Warehouse deployment, growth and maintenance.

Unit-2: Data Mining
Introduction (10 Lectures)

Basics of data mining, Different definitions of Data Mining and related concepts, Data mining process Data preparation, data cleaning and data visualization. KDD process. Data miming techniques: Clustering, Association rules and Decision trees.

Unit-3: Clustering (12 Lectures)

Partitional versus Hierarchical Clustering, types of data in clustering. Partitional clustering methods – kmeans, kmedoids, PAM, CLARA, CLARANS. Hierarchical clustering methods – BIRCH, CURE. Density based clustering methods DBSCAN. Categorical clustering – DBSCAN.

Unit-4: Rule Mining (12 Lectures)

What is an association rule? Mining association rules, frequent sets and border sets, algorithms for mining association rules – Apriori algorithm, PincerSearch algorithm, Border algorithm. Generalized association rule, quantitative association rule, association
rule with item constraint.

Unit-5: Decision Trees (6 Lectures)

Introduction, tree construction principle, decision tree generation algorithms – CART, ID3.

Unit-6: Advanced Topics (5 Lectures)

(only basics of the following topics):
Web mining : Web Content Mining, Web Structure , Mining, Web Usage mining.Spatial mining, Temporal mining – Temporal association rules, sequence mining and GSP algorithm, discovery of frequent episodes.

REFERENCE BOOKS

1. A.K. Puzari, Data Mining Techniques, University Press..
2. J. Han and M. Kamber. Data Mining: Concepts and Techniques. Morgan Kaufman. 2001.

6th SEMESTER

IT-601 (C-13): SYSTEM ADMINISTRATION
Theory: 60 Lectures

Unit 1: Introduction (10 Lectures)

What is System Administration? Duties of a System Administrator. Basic features of the Linux operating system. Installation requirements,Partioning the Hard drive in Linux, Installing the Linux system, Linux system Startup and Shutdown.

Unit 2: Linux file system (14 Lectures)

Basics of Linux file system: hierarchy and types. commands ***ls***, ***cp, mv, rm, mkdir, rmdir, more, touch, ln, mount, umount, mkfs***,. absolute and relative path names. Linux file types, attributes of file, setting user and group ownership of files and access permissions. mounting and unmounting file systems and partitions. Structure of /etc/fstab file and its purpose. hard link, symbolic link. Intorductions of Shells. Linux environment variables. Basics of Shell Programming

Unit 3: Linux Program and Processes (14 Lectures)

Program and Process. Foreground process, Background Process, daemons. Basic commands for starting and stopping processes. Examining the list of running processes on the system and understand the data presented there. cron, crontab file format, Standard I/O, Standard error ,redirection and piping.

Unit 4: Managing user accounts (10 Lectures)

Adding a user, password, Creating Groups, adding and deleting groups, viewing user account information, structure of /etc/passwd, /etc/shadow, /etc/group files System monitoring and logging, Monitoring memory usage, disk space usage. Backup and Restore procedure

Unit 5: IP and Server Configuration (12 Lectures)

IP address and IP address classes, subneting, CIDR, Interface configuring with ifconfig, Gateway configuration, adding routes, ping, netstat, traceroute. Understanding the significance of the /etc/services file and well known port numbers. Server configuration DHCP, NFS, NIS, SAMBA, PROXY..

REFERENCE BOOKS

1. Red Hat Linux:Proffitt:PHI.
2. Introduction to system Administration:IBM series:PHI.
3. Essential System Administration:Frisch:O'REILLY

IT LAB-601 (C-13) SYSTEM ADMINISTRATION
Lab Practical: 60 Lectures

Each student should do at least 15 assignments from the following list.

1. Installation of Linux Operating System and partitioning the disk.
2. Installing software packages in linux OS using GUI as well as command line.
3. Changing the default run level of a system
4. Mounting and un mounting a removable media.
5. Finding the list of all running processes and redirect the output in a file.
6. Use of different kill signals to kill a running process.
7. Bringing a process from back ground to fore ground and vice-versa.
8. Adding and managing user accounts.
9. Monitoring disk space quota and memory usage and redirect the output in a file.
10. Backup and restoring a file.
11. Compression and extracting a file. Use command line.
12. Configuring a network interface and assigning a default route.
13. Scheduling job using crontab.
14. Changing the ownership and access permission of file or directory. Use command line.
15. Copy, move and rename a file.
16. Configuring a ftp server
17. Assigning address of DNS.
18. Use of ssh, telnet, netstat, ping, route commands.
19. Use grep, awk, sed commands.
20. Use of redirection and piping.
21. Monitoring and managing system log infomation.
22. Basics of firewall using iptables.
23. Basics of configuring http server.
24. Managing different services in linux.
25. Monitoring the traffic going through a network interface.
26. Write shell script to

a. Find factorial of a given number
b. Convert a decimal number to hexadecimal number

IT-602 (C-14): COMPUTER GRAPHICS
Theory: 60 Lectures

1. Introduction (5 Lectures) Basic elements of Computer graphics, Applications of Computer Graphics.

2. Graphics Hardware (8 Lectures)
Architecture of Raster and Random scan display devices, input/output devices.

3. Fundamental Techniques in Graphics (22 Lectures)
Raster scan line, circle and ellipse drawing, thick primitives, Polygon filling, line and polygon clipping algorithms, 2D and 3D Geometric Transformations, 2D and 3D Viewing Transformations (Projections-Parallel and Perspective), Vanishing points.

4. Geometric Modeling (10 Lectures)
Representing curves & Surfaces.

5. Visible Surface determination (8 Lectures)
Hidden surface elimination.

6. Surface rendering (7 Lectures)
Illumination and shading models. Basic color models and Computer Animation.

REFERENCE BOOKS

1. J.D.Foley, A.Van Dan, Feiner, Hughes Computer Graphics Principles & Practice 2nd edition Publication Addison Wesley 1990.
2. D.Hearn, Baker: Computer Graphics, Prentice Hall of India 2008.
3. D.F.Rogers Procedural Elements for Computer Graphics, McGraw Hill 1997.
4. D.F.Rogers, Adams Mathematical Elements for Computer Graphics, McGraw Hill 2nd edition 1989.

IT LAB-602 (C-14) COMPUTR GRAPHICS
Lab Practical: 60 Lectures

1. Write a program to implement Bresenham‘s line drawing algorithm.
2. Write a program to implement mid-point circle drawing algorithm.
3. Write a program to clip a line using Cohen and Sutherland line clipping algorithm.
4. Write a program to clip a polygon using Sutherland Hodgeman algorithm.
5. Write a program to apply various 2D transformations on a 2D object (use homogenous coordinates).
6. Write a program to apply various 3D transformations on a 3D object and then apply parallel and perspective projection on it.
7. Write a program to draw Hermite/Bezier curve.

IT-603 DSE-3(A) COMPILER DESIGN
Theory: 60 lectures

Unit 1: Introduction (10 Lectures)

What is a compiler? Phases of compiler. Overview of working of a compiler, linker, loader.

Unit 2: Lexical Analysis (13 Lectures)

NFA, DFA, conversion from NFA to DFA. Regular expression. Regular expression to NFA conversion. Minimization of DFA. ,Structuer of Lexical analyzer ,use of finite autometa to write lexical analyser .

Unit 3: Syntax analysis (12 Lectures)

Grammar representation. Derivation and parse tree. Ambiguity and possible elimination. Top down parsing. Recursive descent and predictive top down parsing. Elimination of Left recursion. Bottom up parsing. Operator precedence parsing, LR parsing (including SLR and LALR). Er ror detection and recovery. Parser table construction.

Unit 4: Code generation (15 Lectures)

Symbol table contents, implementation. Type checking. Syntax directed translation. Forms of intermediate codes. Abstract Syntax Trees, Directed Acyclic Graph, Three address code. Intermediate code generation for different language constructs , boolean expressions, if, ifelse, while, case or switch. Target code generation issues, registerallocation, Runtime storage management

Unit 5: Code Optimisation (10 Lectures)

DAG, basic blocks, Common subexpression elimination, variable propogation, code motion, strength reduction, elimination of dead code, loop optimisation.

REFERENCE BOOKS

1. Aho, Sethi, Ullman; Compilers, Principles, Techniques, Tools, Pearson Education.
2. Compiler Design, Santanu Chattopadhyay, P.H.I.

IT-603 DSE 3(B): SYSTEM ANALYSIS AND DESIGNING
Theory: 60 Lectures

Unit 1: Introduction (5 Lectures)

System Definition and Concepts: General Theory systems, Manual and automated Systems, Reallife Business Sub –Systems. System .Environments and Boundaries .Real Time and distributed systems. Basic principles of successful systems. Approach to system Development: Structured system Analysis and Design, Prototype, joint Application Development.

Unit 2: Systems Analyst (5 Lectures)

Role and Need of Systems Analyst. Qualification and responsibilities .System Analysis as a profession

Unit 3: System Development Cycle (8 Lectures)

Introduction to Systems Development Life Cycle(SDLC) Various phases of SDLC: Study, Analysis, Design, Development, Implementation, Maintenance Systems documentation consideration: principles of systems Documentation, Types of documentation and their importance, Enforcing documentation discipline in an organization.

Unit 4: System Planning (8 Lectures)

Data and fact gathering techniques: interviews, Group Communication Questionnaires, presentations &Site visits. Assessing project Feasibility: Technical, Operational, Economic, Cost Benefits Analysis, Schedule Legal and contractual, political. Modem methods for determining system requirements: joint Application, Development program, prototyping, Business process Reengineering. System Selection plan and proposal.

Unit 5: Modular and Structured Design (5 Lectures)

Module Specifications. Top –Down and bottom- up design. Module coupling and Cohesion. Structure charts.

Unit 4: System design and Modeling (10 Lectures)

Process Modeling, logical and physical design, Conceptual Data Modeling : entity Relationship Analysis, Entity –relationship Modeling, ERDs and DFDS Concepts of Normalization. Process Description: Structured English, Decision Thee, Decision Tables Documentation: Data Dictionary Recording Data Description

Unit 6: Input and output (7 Lectures)

Classification of forms, input/ output forms design. User interface design, Graphical interfaces. Standards and guidelines for GUI Design. Designing physical Files and databases: Designing Fields, Designing Physical Records , Designing Physical Files, Designing Databases. Introduction to CASE Tools, Features Advantages and Limitations of CASE Tools, Awareness about some commercial CASE Tools.

Unit 7: System Implementation and Maintenance (7 Lectures)

Planning Consideration. Conversion methods, procedures and controls. System acceptance criteria. System Evaluation and performance. Testing and Validation. Preparing User Manual. Maintenance Activities and Issues.

Unit 8: Computer System Audit and Security (5 Lectures)

Audit of Computer System Usage. Types of Threats to Computer System and Control Measures: Threat and Risk Analysis, Disaster Recovery and Contingency planning, viruses.

REFERENCE BOOKS

1. J Hoffer,‖Modern Systems Analysis and Design‖, Joey George and Joseph Valacich, Pearson Education.
2. A Dennis and BH Wixom,‖System Analysis and Design‖ John Wiley and Sons, Inc.

IT-604 DSE-4: Dissertation / Project work

This option to be offered only in 6th Semester.

The students will be allowed to work on any project based on the concepts studied in core / elective or skill based elective courses.

The group size should be maximum of three (03) students.

Each group will be assigned a teacher as a supervisor who will handle both their theory as well lab classes.

A maximum of Four (04) projects would be assigned to one teacher.

Choice Based Credit System
B.Sc. (*Honours*) Mathematics

Semester	Core Course (14)	Ability Enhancement Compulsory Course (AECC) (2)	Skill Enhancement Course (SEC) (2)	Discipline Specific Elective (DSE) (4)	Generic Elective (GE) (4)
1	CC1: Calculus (P)	AECC1			GE1
	CC2: Algebra				
2	CC3: Real Analysis	AECC2			GE2
	CC4: Differential Equations				
3	CC5: Theory of Real Functions (P)		SEC1		GE3
	CC6: Group Theory I				
	CC7: PDE and Systems of ODE (P)				
4	CC8: Numerical Methods (P)		SEC2		GE4
	CC9: Riemann Integration and Series of Functions				
	CC10: Ring Theory and Linear Algebra I				
5	CC11: Multivariate Calculus			DSE-1	
	CC12: Group Theory II			DSE-2	
6	CC13: Metric Spaces and Complex Analysis			DSE-3	
	CC14: Ring Theory and Linear Algebra II			DSE-4	

(P) *means course with practicals*

Discipline Specific Electives (DSE)

Choices for DSE 1

Number Theory

Choices for DSE 2

Probability and Statistics

Choices for DSE 3

Theory of Equations

Choices for DSE 4

Mechanics

Skill Enhancement Course (SEC)

SEC 1

Analytical Geometry

SEC 2

Vector Calculus

Generic Electives (GE)

Choices for GE 1

Differential Calculus

Choices for GE 2

Algebra

Choices for GE 3

Real Analysis

Choices for GE 4

Differential Equations

Details of courses under B.Sc. (Honours) Mathematics

Course	***Credits**	
	Theory + Practical	Theory + Tutorial
I. Core Course		
(14 Papers)	14×4 = 56	14×5 = 70
Core Course Practical / Tutorial*	14×2 = 28	14×1 = 14
(14 Papers)		
II. Elective Course (8 Papers)		
A.1. Discipline Specific Elective	4×4 = 16	4×5 = 20
(4 Papers)		
A.2. Discipline Specific Elective Practical/ Tutorial*	4×2 = 8	4×1 = 4
(4 Papers)		
B.1. Generic Elective/ Interdisciplinary	4×4 = 16	4×5 = 20
(4 Papers)		
B.2. Generic Elective Practical/ Tutorial*	4×2 = 8	4×1 = 4
(4 Papers)		

•Optional Dissertation or project work in place of one Discipline Specific Elective Paper (6 credits) in 6th Semester

III. Ability Enhancement Courses

1. **Ability Enhancement Compulsory Courses (AECC)**		
(2 Papers of 2 credit each)	2×2 = 4	2×2 = 4
Environmental Science English/MIL Communication		
2. **Skill Enhancement Courses (SEC)**		
(Minimum 2)	2×2 = 4	2×2 = 4

(2 Papers of 2 credits each)

Total credit	140	140

Institute should evolve a system/ policy about ECA/ General Interest/ Hobby/ Sports/ NCC/ NSS/ related courses on its own.

*** Wherever there is a practical there will be no tutorial and vice-versa**

SEMESTER- I

CC-1: Calculus

Hyperbolic functions, higher order derivatives, Leibniz rule and its applications to problems of type $e^{ax+b}sinx$, $e^{ax+b}cosx$, $(ax+b)^n sinx$, $(ax+b)^n cosx$, concavity and inflection points, asymptotes, curve tracing in Cartesian coordinates, tracing in polar coordinates of standard curves, L Hospital s rule, applications in business, economics and life sciences.

Reduction formulae, derivations and illustrations of reduction formulae of the type $\int \sin nx\, dx$, $\int \cos nx\, dx$, $\int \tan nx\, dx$, $\int \sec nx\, dx$, $\int (\log x)^n\, dx$, $\int sin^n x\, sin^m x\, dx$, volumes by slicing, disks and washers methods, volumes by cylindrical shells, parametric equations, parameterizing a curve, arc length, arc length of parametric curves, area of surface of revolution. Techniques of sketching conics, reflection properties of conics, rotation of axes and second degree equations, classification into conics using the discriminant, polar equations of conics.

Triple product, introduction to vector functions, operations with vector-valued functions, limits and continuity of vector functions, differentiation and integration of vector functions, tangent and normal components of acceleration, modelling ballistics and planetary motion, Kepler's second law.

List of Practicals (using any software)

(i) Plotting of graphs of function e^{ax+b}, log(ax + b), 1/(ax + b), sin(ax + b), cos(ax + b), |ax + b| and to illustrate the effect of a and b on the graph.

(ii) Plotting the graphs of polynomial of degree 4 and 5, the derivative graph, the second derivative graph and comparing them.

(iii) Sketching parametric curves (Eg. Trochoid, cycloid, epicycloids, hypocycloid).

(iv) Obtaining surface of revolution of curves.

(v) Tracing of conics in cartesian coordinates/ polar coordinates.

(vi) Sketching ellipsoid, hyperboloid of one and two sheets, elliptic cone, elliptic, paraboloid, hyperbolic paraboloid using cartesian coordinates.

(vii) Matrix operation (addition, multiplication, inverse, transpose).

Books Recommended

1. G.B. Thomas and R.L. Finney, *Calculus*, 9th Ed., Pearson Education, Delhi, 2005.

2. M.J. Strauss, G.L. Bradley and K. J. Smith, *Calculus*, 3rd Ed., Dorling Kindersley (India) P. L td. (Pearson Education), Delhi, 2007.

3. H. Anton, I. Bivens and S. Davis, *Calculus*, 7th Ed., John Wiley and Sons (Asia) P. Ltd., Singapore, 2002.

4. R. Courant and F. John, *Introduction to Calculus and Analysis* (Volumes I & II), SpringerVerlag, New York, Inc., 1989.

CC-2: Algebra

Polar representation of complex numbers, n^{th} roots of unity, De Moivre's theorem for rational indices and its applications.

Equivalence relations, Functions, Composition of functions, Invertible functions, One to one correspondence and cardinality of a set, Well-ordering property of positive integers, Division algorithm, Divisibility and Euclidean algorithm, Congruence relation between integers, Principles of Mathematical Induction, statement of Fundamental Theorem of Arithmetic.

Systems of linear equations, row reduction and echelon forms, vector equations, the matrix equation Ax=b, solution sets of linear systems, applications of linear systems, linear independence.

Introduction to linear transformations, matrix of a linear transformation, inverse of a matrix, characterizations of invertible matrices. Subspaces of R^n, dimension of subspaces of R^n and rank of a matrix, Eigen values, Eigen Vectors and Characteristic Equation of a matrix.

Books Recommended

1. TituAndreescu and DorinAndrica, *Complex Numbers from A to Z*, Birkhauser, 2006.

2. Edgar G. Goodaire and Michael M. Parmenter, *Discrete Mathematics with Graph Theory*, 3rd Ed., Pearson Education (Singapore) P. Ltd., Indian Reprint, 2005**.**

3. David C. Lay, *Linear Algebra and its Applications*, 3rd Ed., Pearson Education Asia, Indian Reprint, 2007.

GE-1: Differential Calculus

Limit and Continuity (ε and δ definition), Types of discontinuities, Differentiability of functions, Successive differentiation, Leibnitz's theorem, Partial differentiation, Euler's theorem on homogeneous functions.

Tangents and normals, Curvature, Asymptotes, Singular points, Tracing of curves. Parametric representation of curves and tracing of parametric curves, Polar coordinates and tracing of curves in polar coordinates.

Rolle.s theorem, Mean Value Theorems, Taylor's Theorem with Lagrange's & Cauchy's forms of remainder. Taylor's series, Maclaurin's series of sin x, cos x, ex, log(l+x), (l+x)m, Applications of Mean Value theorems to Monotonic functions and inequalities. Maxima & Minima. Indeterminate forms.

Books Recommended

1. H. Anton, I. Birens and S. Davis, *Calculus*, John Wiley and Sons, Inc., 2002.

2. G.B. Thomas and R.L. Finney, *Calculus*, Pearson Education, 2007.

SEMESTER- II

CC-3: Real Analysis

Review of Algebraic and Order Properties of R, δ-neighbourhood of a point in R, Idea of countable sets, uncountable sets and uncountability of R. Bounded above sets, Bounded below sets, Bounded Sets, Unbounded sets, Suprema and Infima, The Completeness Property of R, The Archimedean Property, Density of Rational (and Irrational) numbers in R, Intervals. Limit points of a set, Isolated points, Illustrations of Bolzano-Weierstrass theorem for sets.

Sequences, Bounded sequence, Convergent sequence, Limit of a sequence. Limit Theorems, Monotone Sequences, Monotone Convergence Theorem. Subsequences, Divergence Criteria, Monotone Subsequence Theorem (statement only), Bolzano Weierstrass Theorem for Sequences. Cauchy sequence, Cauchy s Convergence Criterion.

Infinite series, convergence and divergence of infinite series, Cauchy Criterion, Tests for convergence: Comparison test, Limit Comparison test, Ratio Test, Cauchy s n^{th} root test, Integral test, Alternating series, Leibniz test, Absolute and Conditional convergence.

Books Recommended

1. R.G. Bartle and D. R. Sherbert, *Introduction to Real Analysis*, 3rd Ed., John Wiley and Sons (Asia) Pvt. Ltd., Singapore, 2002.
2. Gerald G. Bilodeau , Paul R. Thie, G.E. Keough, *An Introduction to Analysis*, 2nd Ed., Jones & Bartlett, 2010.
3. Brian S. Thomson, Andrew. M. Bruckner and Judith B. Bruckner, *Elementary Real Analysis*, Prentice Hall, 2001.
4. S.K. Berberian, *A First Course in Real Analysis*, Springer Verlag, New York, 1994.

CC-4: Differential Equations

Differential equations and mathematical models. General, particular, explicit, implicit and singular solutions of a differential equation. Exact differential equations and integrating factors, separable equations and equations reducible to this form, linear equation and Bernoulli equations, special integrating factors and transformations.

Introduction to compartmental model, exponential decay model, lake pollution model (case study of Lake Burley Griffin), drug assimilation into the blood (case of a single cold pill, case of a course of cold pills), exponential growth of population, limited growth of population, limited growth with harvesting.

General solution of homogeneous equation of second order, principle of super position for homogeneous equation, Wronskian: its properties and applications, Linear homogeneous and non-homogeneous equations of higher order with constant coefficients, Euler s equation, method of undetermined coefficients, method of variation of parameters.

Equilibrium points, Interpretation of the phase plane, predatory-prey model and its analysis, epidemic model of influenza and its analysis, battle model and its analysis.

List of Practicals (using any software)

1. Plotting of second order solution family of differential equation.
2. Plotting of third order solution family of differential equation.
3. Growth model (exponential case only).
4. Decay model (exponential case only).
5. Lake pollution model (with constant/seasonal flow and pollution concentration).
6. Case of single cold pill and a course of cold pills.
7. Limited growth of population (with and without harvesting).
8. Predatory-prey model (basic volterra model, with density dependence, effect of DDT, two prey one predator).
9. Epidemic model of influenza (basic epidemic model, contagious for life, disease with carriers).
10. Battle model (basic battle model, jungle warfare, long range weapons).
11. Plotting of recursive sequences.
12. Study the convergence of sequences through plotting.
13. Verify Bolzano-Weierstrass theorem through plotting of sequences and hence identify convergent subsequences from the plot.
14. Study the convergence/divergence of infinite series by plotting their sequences of partial sum.
15. Cauchy s root test by plotting n^{th} roots.
16. Ratio test by plotting the ratio of n^{th} and $(n+1)^{th}$ term.

Books Recommended

1. Belinda Barnes and Glenn R. Fulford, *Mathematical Modeling with Case Studies, A Differential Equation Approach using Maple and Matlab*, 2nd Ed., Taylor and Francis group, London and New York, 2009.
2. C.H. Edwards and D.E. Penny, *Differential Equations and Boundary Value problems Computing and Modeling*, Pearson Education India, 2005.
3. S.L . Ross, *Differential Equations*, 3rd Ed., John Wiley and Sons, India, 2004.
4. Martha L Abell, James P Braselton, *Differential Equations with MATHEMATICA*, 3rd Ed., Elsevier Academic Press, 2004.

GE-2: Algebra

Definition and examples of groups, examples of abelian and non-abelian groups, the group Zn of integers under addition modulo n and the group U(n) of units under multiplication modulo n.

Cyclic groups from number systems, complex roots of unity, circle group, the general linear group GLn (n,R), groups of symmetries of (i) an isosceles triangle, (ii) an equilateral triangle, (iii) a rectangle, and (iv) a square, the permutation group Sym (n), Group of quaternions.

Subgroups, cyclic subgroups, the concept of a subgroup generated by a subset and the commutator subgroup of group, examples of subgroups including the center of a group. Cosets, Index of subgroup, Lagrange's theorem, order of an element, Normal subgroups: their definition, examples, and characterizations, Quotient groups.

Definition and examples of rings, examples of commutative and non-commutative rings: rings from number systems, Zn the ring of integers modulo n, ring of real quaternions, rings of matrices, polynomial rings, and rings of continuous functions. Subrings and ideals, Integral domains and fields, examples of fields: Zp, Q, R, and C. Field of rational functions.

Books Recommended

1. John B. Fraleigh, *A First Course in Abstract Algebra*, 7th Ed., Pearson, 2002.
2. M. Artin, *Abstract Algebra*, 2nd Ed., Pearson, 2011.
3. Joseph A Gallian, *Contemporary Abstract Algebra*, 4th Ed., Narosa, 1999.
4. George E Andrews, *Number Theory*, Hindustan Publishing Corporation, 1984.

SEMESTER-III

CC-5: Theory of Real Functions

Limits of functions ($\epsilon - \delta$ approach), sequential criterion for limits, divergence criteria. Limit theorems, one sided limits. Infinite limits and limits at infinity. Continuous functions, sequential criterion for continuity and discontinuity. Algebra of continuous functions. Continuous functions on an interval, intermediate value theorem, location of roots theorem, preservation of intervals theorem. Uniform continuity, non-uniform continuity criteria, uniform continuity theorem.

Differentiability of a function at a point and in an interval, Caratheodory s theorem, algebra of differentiable functions. Relative extrema, interior extremum theorem. Rolle s theorem, Mean value theorem, intermediate value property of derivatives, Darboux s theorem. Applications of mean value theorem to inequalities and approximation of polynomials, Taylor s theorem to inequalities.

Cauchy s mean value theorem. Taylor's theorem with Lagrange's form of remainder, Taylor s theorem with Cauchy s form of remainder, application of Taylor s theorem to convex functions, relative extrema. Taylor s series and Maclaurin's series expansions of exponential and trigonometric functions, $\ln(1 + x)$, $1/ax+b$ and $(1 +x)^n$.

Books Recommended

1. R. Bartle and D.R. Sherbert, *Introduction to Real Analysis*, John Wiley and Sons, 2003.

2. K .A. Ross, *Elementary Analysis: The Theory of Calculus*, Springer, 2004.

3. A. Mattuck, *Introduction to Analysis*, Prentice Hall, 1999.

4. S.R. Ghorpade and B.V. Limaye, *A Course in Calculus and Real Analysis*, Springer, 2006.

CC-6: Group Theory I

Symmetries of a square, Dihedral groups, definition and examples of groups including permutation groups and quaternion groups (illustration through matrices), elementary properties of groups.

Subgroups and examples of subgroups, centralizer, normalizer, centre of a group, product of two subgroups.

Properties of cyclic groups, classification of subgroups of cyclic groups. Cycle notation for permutations, properties of permutations, even and odd permutations, alternating group, properties of cosets, Lagrange s theorem and consequences including Fermat s Little theorem.

External direct product of a finite number of groups, normal subgroups, factor groups, Cauchy's theorem for finite abelian groups.

Group homomorphisms, properties of homomorphisms, Cayley s theorem, properties of isomorphisms, First, Second and Third isomorphism theorems.

Books Recommended

1. John B. Fraleigh, *A First Course in Abstract Algebra*, 7th Ed., Pearson, 2002**.**

2. M. Artin, *Abstract Algebra*, 2nd Ed., Pearson, 2011.

3. Joseph A. Gallian, *Contemporary Abstract Algebra*, 4th Ed., Narosa Publishing House, New Delhi, 1999.

4. Joseph J. Rotman, *An Introduction to the Theory of Groups*, 4th Ed., Springer Verlag, 1995.

5. I.N. Herstein, *Topics in Algebra*, Wiley Eastern Limited, India, 1975.

CC-7: PDE and Systems of ODE

Partial Differential Equations Basic concepts and Definitions, Mathematical Problems. First Order Equations: Classification, Construction and Geometrical Interpretation. Method of Characteristics for obtaining General Solution of Quasi Linear Equations. Canonical Forms of First-order Linear Equations. Method of Separation of Variables for solving first order partial differential equations.

Derivation of Heat equation, Wave equation and Laplace equation. Classification of second order linear equations as hyperbolic, parabolic or elliptic. Reduction of second order Linear Equations to canonical forms.

The Cauchy problem, the Cauchy-Kowaleewskaya theorem, Cauchy problem of an infinite string. Initial Boundary Value Problems, Semi-Infinite String with a fixed end, Semi-Infinite String with a Free end, Equations with non-homogeneous boundary conditions, Non Homogeneous Wave Equation. Method of separation of variables, solving the Vibrating String Problem, Solving the Heat Conduction problem

Systems of linear differential equations, types of linear systems, differential operators, an operator method for linear systems with constant coefficients, Basic Theory of linear systems in normal form, homogeneous linear systems with constant coefficients: Two Equations in two unknown functions, The method of successive approximations, the Euler method, the modified Euler method, The Runge-Kutta method.

List of Practicals (using any software)

(i) Solution of Cauchy problem for first order PDE.

(ii) Finding the characteristics for the first order PDE.

(iii) Plot the integral surfaces of a given first order PDE with initial data.

(iv) Solution of wave equation $\frac{\partial^2 u}{\partial t^2} - c_2 \frac{\partial^2 u}{\partial x^2} = 0$ for the following associated conditions

(a) u(x,0)=∅(x) , $u_t(x,0) = \breve{\circ}(x), \quad x \in R, t > 0$

(b) u(x,0)=∅(x) , $u_t(x,0) = \breve{\circ}(x)$, u(0,t)=0 , $x \in (0,\infty), t > 0$

(c) u(x,0)=∅(x) , $u_t(x,0) = \breve{\circ}(x)$, u_t (0,t)=0, $x \in (0,\infty), t > 0$

(d) u(x,0)=∅(x) , $u_t(x,0) = \breve{\circ}(x)$, u (0,t)=0 , u (1,t)=0, $0 < x < l, t > 0$

(v) (v) Solution of wave equation $\frac{\partial u}{\partial t} - k_2 \frac{\partial^2 u}{\partial x^2} = 0$ for the following associated conditions

(a) u(x,0)=∅(x), u(0,t)=a, u(l, t)=b, $0 < x < l, t > 0$

(b) u(x,0)=∅(x), $x \in R, 0 < t < T$

(e) u(x,0)=∅(x), u(0,t)=a, $x \in (0,\infty), t > 0$

Books Recommended

1. TynMyint-U and LokenathDebnath, *Linear Partial Differential Equations for Scientists and Engineers*, 4th edition, Springer, Indian reprint, 2006.

2. S.L. Ross, *Differential equations*, 3rd Ed., John Wiley and Sons, India, 2004.

3. Martha L Abell, James P Braselton, *Differential equations with MATHEMATICA*, 3rd Ed., Elsevier Academic Press, 2004.

SEC-2: Analytical Geometry

Techniques for sketching parabola, ellipse and hyperbola. Reflection properties of parabola, ellipse and hyperbola. Classification of quadratic equations representing lines, parabola, ellipse and hyperbola. Spheres, Cylindrical surfaces. Illustrations of graphing standard quadric surfaces like cone, ellipsoid.

Books Recommended

1. G.B. Thomas and R.L. Finney, *Calculus*, 9th Ed., Pearson Education, Delhi, 2005.
2. H. Anton, I. Bivens and S. Davis, *Calculus*, John Wiley and Sons (Asia) Pvt. Ltd., 2002.
3. S.L. Loney, *The Elements of Coordinate Geometry*, McMillan and Company, London.
4. R.J.T. Bill, *Elementary Treatise on Coordinate Geometry of Three Dimensions*, McMillan India Ltd., 1994.

GE -3: Real Analysis

Finite and infinite sets, examples of countable and uncountable sets. Real line, bounded sets, suprema and infima, completeness property of R, Archimedean property of R, intervals. Concept of cluster points and statement of Bolzano-Weierstrass theorem.

Real Sequence, Bounded sequence, Cauchy convergence criterion for sequences. Cauchy's theorem on limits, order preservation and squeeze theorem, monotone sequences and their convergence (monotone convergence theorem without proof).

Infinite series. Cauchy convergence criterion for series, positive term series, geometric series, comparison test, convergence of p-series, Root test, Ratio test, alternating series, Leibnitz's test (Tests of Convergence without proof). Definition and examples of absolute and conditional convergence.

Sequences and series of functions, Point wise and uniform convergence. Mn-test, M-test, Statements of the results about uniform convergence and integrability and differentiability of functions, Power series and radius of convergence.

Books Recommended

1. T. M. Apostol, *Calculus* (Vol. I), John Wiley and Sons (Asia) P. Ltd., 2002.
2. R.G. Bartle and D. R Sherbert, *Introduction to Real Analysis*, John Wiley and Sons (Asia) P. Ltd., 2000.
3. E. Fischer, *Intermediate Real Analysis*, Springer Verlag, 1983.
4. K.A. Ross, *Elementary Analysis- The Theory of Calculus Series*- Undergraduate Texts in Mathematics, Springer Verlag, 2003.

SEMESTER- IV

CC-8: Numerical Methods

Use of Scientific Calculator is allowed.

Algorithms, Convergence, Errors: Relative, Absolute, Round off, Truncation.

Transcendental and Polynomial equations: Bisection method, Newton s method, Secant method. Rate of convergence of these methods.

System of linear algebraic equations: Gaussian Elimination and Gauss Jordan methods. Gauss Jacobi method, Gauss Seidel method and their convergence analysis.

Interpolation: Lagrange and Newton s methods. Error bounds. Finite difference operators. Gregory forward and backward difference interpolation.

Numerical Integration: Trapezoidal rule, Simpson s rule, Simpsons 3/8th rule, Boole s Rule. Midpoint rule, Composite Trapezoidal rule, Composite Simpson s rule.

Ordinary Differential Equations: Euler s method. Runge-Kutta methods of orders two and four.

List of Practicals (using any software)

(i) Calculate the sum 1/1 + 1/2 + 1/3 + 1/4 + ---------- + 1/ N.
(ii) To find the absolute value of an integer.
(iii) Enter 100 integers into an array and sort them in an ascending order.
(iv) Bisection Method.
(v) Newton Raphson Method.
(vi) Secant Method.
(vii) Regula Falsi Method.
(viii) L U decomposition Method.
(ix) Gauss-Jacobi Method.
(x) SOR Method or Gauss-Siedel Method.
(xi) Lagrange Interpolation or Newton Interpolation. (xii) Simpson s rule.

Note: For any of the CAS (Computer aided software) Data types-simple data types, floating data types, character data types, arithmetic operators and operator precedence, variables and constant declarations, expressions, input/output, relational operators, logical operators and logical expressions, control statements and loop statements, Arrays should be introduced to the students.

Books Recommended

1. Brian Bradie, *A Friendly Introduction to Numerical Analysis*, Pearson Education, India, 2007.

2. M.K. Jain, S.R.K. Iyengar and R.K. Jain, *Numerical Methods for Scientific and Engineering Computation*, 6th Ed., New age International Publisher, India, 2007.

3. C.F. Gerald and P.O. Wheatley, *Applied Numerical Analysis*, Pearson Education, India, 2008.

4. Uri M. Ascher and Chen Greif, *A First Course in Numerical Methods*, 7th Ed., PHI Learning Private Limited, 2013.

5. John H. Mathews and Kurtis D. Fink, *Numerical Methods using Matlab*, 4th Ed., PHI L earning Private Limited, 2012.

CC-9: Riemann Integration and Series of Functions

Riemann integration; inequalities of upper and lower sums; Riemann conditions of integrability.

Riemann sum and definition of Riemann integral through Riemann sums; equivalence of two definitions; Riemann integrability of monotone and continuous functions, Properties of the Riemann integral; definition and integrability of piecewise continuous and monotone functions. Intermediate Value theorem for Integrals; Fundamental theorems of Calculus.

Improper integrals; Convergence of Beta and Gamma functions.

Pointwise and uniform convergence of sequence of functions. Theorems on continuity, derivability and integrability of the limit function of a sequence of functions. Series of functions; Theorems on the continuity and derivability of the sum function of a series of functions; Cauchy criterion for uniform convergence and Weierstrass M-Test.

Limit superior and Limit inferior. Power series, radius of convergence, Cauchy Hadamard Theorem, Differentiation and integration of power series; Abel s Theorem; Weierstrass Approximation Theorem.

Books Recommended

1. K.A. Ross, *Elementary Analysis*, *The Theory of Calculus*, Undergraduate Texts in Mathematics, Springer (SIE), Indian reprint, 2004.

2. R.G. Bartle D.R. Sherbert, *Introduction to Real Analysis*, 3rd Ed., John Wiley and Sons (Asia) Pvt. L td., Singapore, 2002.

3. Charles G. Denlinger, *Elements of Real Analysis*, Jones & Bartlett (Student Edition), 2011.

CC-10: Ring Theory and Linear Algebra I

Definition and examples of rings, properties of rings, subrings, integral domains and fields, characteristic of a ring. Ideal, ideal generated by a subset of a ring, factor rings, operations on ideals, prime and maximal ideals.

Ring homomorphisms, properties of ring homomorphisms, Isomorphism theorems I, II and III, field of quotients.

Vector spaces, subspaces, algebra of subspaces, quotient spaces, linear combination of vectors, linear span, linear independence, basis and dimension, dimension of subspaces.

Linear transformations, null space, range, rank and nullity of a linear transformation, matrix representation of a linear transformation, algebra of linear transformations. Isomorphisms, Isomorphism theorems, invertibility and isomorphisms, change of coordinate matrix.

Books Recommended

1. John B. Fraleigh, *A First Course in Abstract Algebra*, 7th Ed., Pearson, 2002.
2. M. Artin, *Abstract Algebra*, 2nd Ed., Pearson, 2011.
3. Stephen H. Friedberg, Arnold J. Insel, Lawrence E. Spence, *Linear Algebra*, 4th Ed., PrenticeHall of India Pvt. L td., New Delhi, 2004.
4. Joseph A. Gallian, *Contemporary Abstract Algebra*, 4th Ed., Narosa Publishing House, New Delhi, 1999.
5. S. Lang, *Introduction to Linear Algebra*, 2nd Ed., Springer, 2005.
6. Gilbert Strang, *Linear Algebra and its Applications*, Thomson, 2007.
7. S. Kumaresan, *Linear Algebra- A Geometric Approach*, Prentice Hall of India,1999.
8. Kenneth Hoffman, Ray Alden Kunze, *Linear Algebra*, 2nd Ed., Prentice-Hall of India Pvt. L td., 1971.
9. D.A.R. Wallace, *Groups, Rings and Fields*, Springer Verlag London L td., 1998.

SEC-2: Vector Calculus

Differentiation and partial differentiation of a vector function. Derivative of sum, dot product and cross product of two vectors.

Gradient, divergence and curl.

Books Recommended

1. G.B. Thomas and R.L. Finney, *Calculus*, 9th Ed., Pearson Education, Delhi, 2005.
2. H. Anton, I. Bivens and S. Davis, *Calculus*, John Wiley and Sons (Asia) P. Ltd. 2002.
3. P.C. Matthew's, *Vector Calculus*, Springer Verlag London Limited, 1998.

GE-4: Differential Equations

First order exact differential equations. Integrating factors, rules to find an integrating factor. First order higher degree equations solvable for x, y, p. Methods for solving higher-order differential equations. Basic theory of linear differential equations, Wronskian, and its properties. Solving a differential equation by reducing its order.

Linear homogenous equations with constant coefficients, Linear non-homogenous equations, The method of variation of parameters, The Cauchy-Euler equation, Simultaneous differential

equations, Total differential equations.

Order and degree of partial differential equations, Concept of linear and non-linear partial differential equations, Formation of first order partial differential equations, Linear partial differential equation of first order, Lagrange's method, Charpit's method.

Classification of second order partial differential equations into elliptic, parabolic and hyperbolic through illustrations only.

Books Recommended

1. Shepley L. Ross, *Differential Equations*, 3rd Ed., John Wiley and Sons, 1984.
2. I. Sneddon, *Elements of Partial Differential Equations*, McGraw-Hill, International Edition, 1967.

DSE-1: Number Theory

Linear Diophantine equation, prime counting function, statement of prime number theorem, Goldbach conjecture, linear congruences, complete set of residues, Chinese Remainder theorem, Fermat s Little theorem, Wilson s theorem.

Number theoretic functions, sum and number of divisors, totally multiplicative functions, definition and properties of the Dirichlet product, the Mobius Inversion formula, the greatest integer function, Euler s phi -function, Euler s theorem, reduced set of residues, some properties of Euler s phi-function.

Order of an integer modulo n, primitive roots for primes, composite numbers having primitive roots, Euler s criterion, the Legendre symbol and its properties, quadratic reciprocity, quadratic congruences with composite moduli. Public key encryption, RSA encryption and decryption, the equation $x^2 + y^2 = z^2$, Fermat s Last theorem.

Books Recommended

1. David M. Burton, *Elementary Number Theory*, 6th Ed., Tata McGraw-Hill, Indian reprint, 2007.

2. Neville Robinns, *Beginning Number Theory*, 2nd Ed., Narosa Publishing House Pvt. Ltd., Delhi, 2007.

SEMESTER IV

CC-11: Multivariate Calculus

Use of Scientific calculator is allowed.

Functions of several variables, limit and continuity of functions of two variables Partial differentiation, total differentiability and differentiability, sufficient condition for differentiability. Chain rule for one and two independent parameters, directional derivatives, the gradient, maximal and normal property of the gradient, tangent planes, Extrema of functions of two variables, method of Lagrange multipliers, constrained optimization problems, Definition of vector field, divergence and curl.

Double integration over rectangular region, double integration over non-rectangular region, Double integrals in polar co-ordinates, Triple integrals, Triple integral over a parallelepiped and solid regions. Volume by triple integrals, cylindrical and spherical co-ordinates.

Change of variables in double integrals and triple integrals. Line integrals, Applications of line integrals: Mass and Work. Fundamental theorem for line integrals, conservative vector fields, independence of path.

Green s theorem, surface integrals, integrals over parametrically defined surfaces. Stoke s theorem, The Divergence theorem.

Books Recommended

1. G.B. Thomas and R.L. Finney, *Calculus*, 9th Ed., Pearson Education, Delhi, 2005.
2. M.J. Strauss, G.L. Bradley and K. J. Smith, *Calculus*, 3rd Ed., Dorling Kindersley (India) Pvt. L td. (Pearson Education), Delhi, 2007.
3. E. Marsden, A.J. Tromba and A. Weinstein, *Basic Multivariable Calculus*, Springer (SIE), Indian reprint, 2005.
4. James Stewart, *Multivariable Calculus*, *Concepts and Contexts*, 2nd Ed., Brooks /Cole, Thomson L earning, USA, 2001.

CC-12: Group Theory II

Automorphism, inner automorphism, automorphism groups, automorphism groups of finite and infinite cyclic groups, applications of factor groups to automorphism groups, Characteristic subgroups, Commutator subgroup and its properties.

Properties of external direct products, the group of units modulo n as an external direct product, internal direct products, Fundamental Theorem of finite abelian groups.

Group actions, stabilizers and kernels, permutation representation associated with a given group action, Applications of group actions: Generalized Cayley s theorem, Index theorem.

Groups acting on themselves by conjugation, class equation and consequences, conjugacy in S_n, *p*-groups, Sylow s theorems and consequences, Cauchy s theorem, Simplicity of A_n for $n \geq 5$, non-simplicity tests.

Books Recommended

1. John B. Fraleigh, *A First Course in Abstract Algebra*, 7th Ed., Pearson, 2002.
2. M. Artin, *Abstract Algebra*, 2nd Ed., Pearson, 2011.
3. Joseph A. Gallian, *Contemporary Abstract Algebra*, 4th Ed., Narosa Publishing House, 1999.
4. David S. Dummit and Richard M. Foote, *Abstract Algebra*, 3rd Ed., John Wiley and Sons (Asia) Pvt. L td., Singapore, 2004.
5. J.R. Durbin, *Modern Algebra*, John Wiley & Sons, New York Inc., 2000.
6. D. A. R. Wallace, *Groups*, *Rings and Fields*, Springer Verlag London L td., 1998.

DSE-2: Probability and Statistics

Sample space, probability axioms, real random variables (discrete and continuous), cumulative distribution function, probability mass/density functions, mathematical expectation, moments, moment generating function, characteristic function, discrete distributions: uniform, binomial, Poisson, geometric, negative binomial, continuous distributions: uniform, normal, exponential.

Joint cumulative distribution function and its properties, joint probability density functions, marginal and conditional distributions, expectation of function of two random variables, conditional expectations, independent random variables, bivariate normal distribution, correlation coefficient, joint moment generating function (jmgf) and calculation of covariance (from jmgf), linear regression for two variables.

Chebyshev s inequality, statement and interpretation of (weak) law of large numbers and strong law of large numbers, Central Limit theorem for independent and identically distributed random variables with finite variance, Markov Chains, Chapman-Kolmogorov equations, classification of states.

Books Recommended

1. Robert V. Hogg, Joseph W. McKean and Allen T. Craig, *Introduction to Mathematical Statistics*, Pearson Education, Asia, 2007.
2. Irwin Miller and Marylees Miller, John E. Freund, *Mathematical Statistics with Applications*, 7th Ed., Pearson Education, Asia, 2006.
3. Sheldon Ross, *Introduction to Probability Models*, 9th Ed., Academic Press, Indian Reprint, 2007.
4. Alexander M. Mood, Franklin A. Graybill and Duane C. Boes, *Introduction to the Theory of Statistics*, 3rd Ed., Tata McGraw- Hill, Reprint 2007

SEMESTER- VI

CC-13: Metric Spaces and Complex Analysis

Metric spaces: definition and examples. Sequences in metric spaces, Cauchy sequences. Complete Metric Spaces. Open and closed balls, neighbourhood, open set, interior of a set. Limit point of a set, closed set, diameter of a set, Cantor s theorem. Subspaces, dense sets, separable spaces.

Continuous mappings, sequential criterion and other characterizations of continuity. Uniform continuity. Homeomorphism, Contraction mappings, Banach Fixed point Theorem. Connectedness, connected subsets of R.

Limits, Limits involving the point at infinity, continuity. Properties of complex numbers, regions in the complex plane, functions of complex variable, mappings. Derivatives, differentiation formulas, Cauchy-Riemann equations, sufficient conditions for differentiability.

Analytic functions, examples of analytic functions, exponential function, Logarithmic function, trigonometric function, derivatives of functions, definite integrals of functions. Contours, Contour integrals and its examples, upper bounds for moduli of contour integrals. CauchyGoursat theorem, Cauchy integral formula.

L iouville s theorem and the fundamental theorem of algebra. Convergence of sequences and series, Taylor series and its examples.

L aurent series and its examples, absolute and uniform convergence of power series.

Books Recommended

1. Satish Shirali and HarikishanL . Vasudeva, *Metric Spaces*, Springer Verlag, L ondon, 2006.
2. S. K umaresan, *Topology of Metric Spaces*, 2nd Ed., Narosa Publishing House, 2011.
3. G.F. Simmons, *Introduction to Topology and Modern Analysis*, McGraw-Hill, 2004.
4. James Ward Brown and Ruel V. Churchill, *Complex Variables and Applications*, 8th Ed., McGraw Hill International Edition, 2009.
5. Joseph Bak and Donald J. Newman, *Complex Analysis*, 2nd Ed., Undergraduate Texts in Mathematics, Springer-Verlag New Y ork, Inc., NewYork, 1997.

CC-14: Ring Theory and Linear Algebra II

Polynomial rings over commutative rings, division algorithm and consequences, principal ideal domains, factorization of polynomials, reducibility tests, irreducibility tests, Eisenstein criterion, unique factorization in Z[x]**.** Divisibility in integral domains, irreducibles, primes, unique factorization domains, Euclidean domains.

Dual spaces, dual basis, double dual, transpose of a linear transformation and its matrix in the dual basis, annihilators, Eigen spaces of a linear operator, diagonalizability, invariant subspaces and Cayley-Hamilton theorem, the minimal polynomial for a linear operator.

Inner product spaces and norms, Gram-Schmidt orthogonalisation process, orthogonal complements, Bessel s inequality, the adjoint of a linear operator, Least Squares Approximation, minimal solutions to systems of linear equations, Normal and self-adjoint operators, Orthogonal projections and Spectral theorem.

Books Recommended

1. John B. Fraleigh, *A First Course in Abstract Algebra*, 7th Ed., Pearson, 2002.
2. M. Artin, *Abstract Algebra*, 2nd Ed., Pearson, 2011.
3. Joseph A. Gallian, *Contemporary Abstract Algebra*, 4th Ed., Narosa Publishing House, 1999.
4. Stephen H. Friedberg, Arnold J. Insel, Lawrence E. Spence, *Linear Algebra*, 4th Ed., PrenticeHall of India Pvt. L td., New Delhi, 2004.
5. S. Lang, *Introduction to Linear Algebra*, 2nd Ed., Springer, 2005.
6. Gilbert Strang, *Linear Algebra and its Applications*, Thomson, 2007.
5. S. Kumaresan, *Linear Algebra- A Geometric Approach*, Prentice Hall of India, 1999.
6. Kenneth Hoffman, Ray Alden Kunze, *Linear Algebra*, 2nd Ed., Prentice-Hall of India Pvt. Ltd., 1971.
7. S.H. Friedberg, A.L .Insel and L .E. Spence, *Linear Algebra*, Prentice Hall of India Pvt. Ltd., 2004.

DSE-3: Theory of Equations

General properties of polynomials, Graphical representation of a polynomial, maximum and minimum values of a polynomials, General properties of equations, Descarte's rule of signs positive and negative rule, Relation between the roots and the coefficients of equations.

Symmetric functions, Applications of symmetric function of the roots, Transformation of equations. Solutions of reciprocal and binomial equations. Algebraic solutions of the cubic and biquadratic. Properties of the derived functions.

Symmetric functions of the roots, Newton s theorem on the sums of powers of roots, homogeneous products, limits of the roots of equations.

Separation of the roots of equations, Strums theorem, Applications of Strum s theorem, Conditions for reality of the roots of an equation and biquadratic. Solution of numerical equations.

Books Recommended

1. W.S. Burnside and A.W. Panton, *The Theory of Equations*, Dublin University Press, 1954.
2. C. C. MacDuffee, *Theory of Equations*, John Wiley & Sons Inc., 1954.

DSE-4: Mechanics

Moment of a force about a point and an axis, couple and couple moment, Moment of a couple about a line, resultant of a force system, distributed force system, free body diagram, free body involving interior sections, general equations of equilibrium, two point equivalent loading, problems arising from structures, static indeterminacy.

Laws of Coulomb friction, application to simple and complex surface contact friction problems, transmission of power through belts, screw jack, wedge, first moment of an area and the centroid, other centers, Theorem of Pappus-Guldinus, second moments and the product of area of a plane area, transfer theorems, relation between second moments and products of area, polar moment of area, principal axes.

Conservative force field, conservation for mechanical energy, work energy equation, kinetic energy and work kinetic energy expression based on center of mass, moment of momentum equation for a single particle and a system of particles, translation and rotation of rigid bodies, Chasles theorem, general relationship between time derivatives of a vector for different references, relationship between velocities of a particle for different references, acceleration of particle for different references.

Books Recommended

1. I.H. Shames and G. Krishna Mohan Rao, *Engineering Mechanics: Statics and Dynamics*, (4th Ed.), Dorling Kindersley (India) Pvt. L td. (Pearson Education), Delhi, 2009.

2. R.C. Hibbeler and Ashok Gupta, *Engineering Mechanics: Statics and Dynamics*, 11th Ed., Dorling Kindersley (India) Pvt. L td. (Pearson Education), Delhi.

Bodoland University
Curriculum Structures for UG syllabus (For Computer Science (Honours)),

No. of papers=14+12=26, Total Credits= 140
Total Marks = 2400

SEM-I						
Paper Code	**Course**	**L+T+P**	**Credit**	End Sem	Int	Total
CS-101H	C-1	4+0+2 5+1+0	6	60(L)+20(P) 60(L)+20(T)	20 20	100
CS-102H	C-2	4+0+2 5+1+0	6	60(L)+20(P) 60(L)+20(T)	20	100
MATH-GE-103H	GE-1	4+0+2 5+1+0	6	60(L)+20(P) 60(L)+20(T)	20 20	100
COMM-104HR	AECC-1:**English/Hindi/MIL(Communication)**	2	2	50(L)		50
Total-			**20**	**290**	**60**	**350**

SEM-II						
Paper Code	**Course**	**L+T+P**	**Credit**	End Sem	Int	Total
CS -201H	C-3	4+0+2 5+1+0	6	60(L)+20(P) 60(L)+20(T)	20	100
CS-202H	C-4	4+0+2 5+1+0	6	60(L)+20(P) 60(L)+20(T)	20	100
MATH-GE-203H	GE-2	4+0+2 5+1+0	6	60(L)+20(P) 60(L)+20(T)	20	100
ENV-204HR	AECC-2:**Environmental Science**	2	2	50(L)		50
Total-			**20**	**290**	**60**	**350**

SEM-III						
Paper Code	**Course**	**L+T+P**	**Credit**	End Sem	Int	Total
CS-301H	C-5	4+0+2 5+1+0	6	60(L)+20(P) 60(L)+20(T)	20	100
CS-302H	C-6	4+0+2 5+1+0	6	60(L)+20(P) 60(L)+20(T)	20	100
CS-303H	C-7	4+0+2 5+1+0	6	60(L)+20(P) 60(L)+20(T)	20	100
CS–SEC1-304HR	SEC-1	2	2	50(L)		50
PHY–GE-305H	GE-3	4+0+2 5+1+0	6	60(L)+20(P) 60(L)+20(T)	20	100
Total-			**26**	**370**	**80**	**450**

SEM-IV						
Paper Code	**Course**	**L+T+P**	**Credit**	End Sem	Int	Total
CS-401H	C-8	4+0+2 5+1+0	6	60(L)+20(P) 60(L)+20(T)	20	100
CS-402H	C-9	4+0+2 5+1+0	6	60(L)+20(P) 60(L)+20(T)	20	100
CS-403H	C-10	4+0+2 5+1+0	6	60(L)+20(P) 60(L)+20(T)	20	100
CS–SEC2-404HR	SEC-2	2	2	50(L)		50
PHY-GE-405H	GE-4	4+0+2 5+1+0	6	60(L)+20(P) 60(L)+20(T)	20	100
Total-			**26**	**370**	**80**	**450**

SEM-V						
Paper Code	**Course**	**L+T+P**	**Credit**	End Sem	Int	Total
CS -501H	C-11	4+0+2 5+1+0	6	60(L)+20(P) 60(L)+20(T)	20	100
CS-502H	C-12	4+0+2 5+1+0	6	60(L)+20(P) 60(L)+20(T)	20	100
CS–DSE1-503H	DSE-1	4+0+2 5+1+0	6	60(L)+20(P) 60(L)+20(T)	20	100
CS–DSE2-504H	DSE-2	4+0+2 5+1+0	6	60(L)+20(P) 60(L)+20(T)	20	100
Total-			**24**	**320**	**80**	**400**

SEM-VI						
Paper Code	**Course**	**L+T+P**	**Credit**	End Sem	Int	Total
CS-601H	C-13	4+0+2 5+1+0	6	60(L)+20(P) 60(L)+20(T)	20	100
CS-602H	C-14	4+0+2 5+1+0	6	60(L)+20(P) 60(L)+20(T)	20	100
CS–DSE3-603H	DSE-3	4+0+2 5+1+0	6	60(L)+20(P) 60(L)+20(T)	20	100
CS–DSE4-604H	DSE-4 (Project/Dissertation)	4+0+2 5+1+0	6	60(L)+20(P) 60(L)+20(T)	20	100
Total-			**24**	**320**	**80**	**400**

1. Where there is a practical there will be no tutorial or vice-versa.
2. Institute should evolve a system/policy about ECA/ General Interest/Hobby/Sports/NCC/NSS/related courses on its own.
3. **Skill Enhancement Courses (SEC)**: These courses are to be chosen from a pool of courses designed to provide value-based and/or skill-based knowledge and should contain both theory and lab/hands-on/training/field work. The main purpose of these courses is to provide students life-skills in hands-on mode so as to increase their employability. The list provided under this category are suggestive in nature and each Institution/College has complete freedom to suggest their own papers under this category based on their expertise, specialization, requirements, scope and need. However, in this case approval of Academic section of the University is mandatory.

1ST SEMESTER

C-I: Programming Fundamentals using C/C++

Theory: 60 Lectures

1. Introduction to C and C++ (3 Lectures)

History of C and C++, Overview of Procedural Programming and Object-Orientation Programming, Using main() function, Compiling and Executing Simple Programs in C++.

2. Data Types, Variables, Constants, Operators and Basic I/O (5 Lectures)

Declaring, Defining and Initializing Variables, Scope of Variables, Using Named Constants, Keywords, Data Types, Casting of Data Types, Operators (Arithmetic, Logical and Bitwise), Using Comments in programs, Character I/O (getc, getchar, putc, putcharetc), Formatted and Console I/O (printf(), scanf(), cin, cout), Using Basic Header Files (stdio.h, iostream.h, conio.hetc).

3. Expressions, Conditional Statements and Iterative Statements (5 Lectures)

Simple Expressions in C++ (including Unary Operator Expressions, Binary Operator Expressions), Understanding Operators Precedence in Expressions, Conditional Statements (if construct, switch-case construct), Understanding syntax and utility of Iterative Statements (while, do-while, and for loops), Use of break and continue in Loops, Using Nested Statements (Conditional as well as Iterative)

4. Functions and Arrays (10 Lectures)

Utility of functions, Call by Value, Call by Reference, Functions returning value, Void functions, Inline Functions, Return data type of functions, Functions parameters, Differentiating between Declaration and Definition of Functions, Command Line Arguments/Parameters in Functions, Functions with variable number of Arguments.

Creating and Using One Dimensional Arrays (Declaring and Defining an Array, Initializing an Array, Accessing individual elements in an Array, Manipulating array elements using loops), Use Various types of arrays (integer, float and character arrays / Strings) Two-dimensional Arrays (Declaring, Defining and Initializing Two Dimensional Array, Working with Rows and Columns), Introduction to Multi-dimensional arrays

5. Derived Data Types (Structures and Unions) (3 Lectures)

Understanding utility of structures and unions, Declaring, initializing and using simple structures and unions, Manipulating individual members of structures and unions, Array of Structures, Individual data members as structures, Passing and returning structures from functions, Structure with union as members, Union with structures as members.

6. Pointers and References in C++ (7 Lectures)

Understanding a Pointer Variable, Simple use of Pointers (Declaring and Dereferencing Pointers to simple variables), Pointers to Pointers, Pointers to structures, Problems with

Pointers, Passing pointers as function arguments, Returning a pointer from a function, using arrays as pointers, Passing arrays to functions. Pointers vs. References, Declaring and initializing references, Using references as function arguments and function return values

7. Memory Allocation in C++ (3 Lectures)

Differentiating between static and dynamic memory allocation, use of malloc, calloc and free functions, use of new and delete operators, storage of variables in static and dynamic memory allocation

8. File I/O, Preprocessor Directives (4 Lectures)

Opening and closing a file (use of fstream header file, ifstream, ofstream and fstream classes), Reading and writing Text Files, Using put(), get(), read() and write() functions, Random access in files, Understanding the Preprocessor Directives (#include, #define, #error, #if, #else, #elif, #endif, #ifdef, #ifndef and #undef), Macros

9. Using Classes in C++ (7 Lectures)

Principles of Object-Oriented Programming, Defining & Using Classes, Class Constructors, Constructor Overloading, Function overloading in classes, Class Variables &Functions, Objects as parameters, Specifying the Protected and Private Access, Copy Constructors,Overview of Template classes and their use.

10. Overview of Function Overloading and Operator Overloading (5 Lectures)

Need of Overloading functions and operators, Overloading functions by number and type of arguments, Looking at an operator as a function call, Overloading Operators (including assignment operators, unary operators)

11. Inheritance, Polymorphism and Exception Handling (8 Lectures)

Introduction to Inheritance (Multi-Level Inheritance, Multiple Inheritance), Polymorphism (Virtual Functions, Pure Virtual Functions), Basics Exceptional Handling (using catch and throw, multiple catch statements), Catching all exceptions, Restricting exceptions, Rethrowing exceptions.

Reference Books

1. HerbtzSchildt, "C++: The Complete Reference", Fourth Edition, McGraw Hill.2003
2. BjarneStroustrup, "The C++ Programming Language", 4th Edition, Addison-Wesley , 2013.
3. BjarneStroustroup, "Programming -- Principles and Practice using C++", 2nd Edition, Addison-Wesley 2014.
4. E Balaguruswamy, "Object Oriented Programming with C++", Tata McGraw-Hill Education, 2008.
5. Paul Deitel, Harvey Deitel, "C++ How to Program", 8th Edition, Prentice Hall, 2011. 5. John

R. Hubbard, "Programming with C++", Schaum's Series, 2nd Edition, 2000.

6. Andrew Koeni, Barbara, E. Moo, "Accelerated C++", Published by Addison-Wesley , 2000. 7.

Scott Meyers, "Effective C++", 3rd Edition, Published by Addison-Wesley, 2005.

8. Harry, H. Chaudhary, "Head First C++ Programming: The Definitive Beginner's Guide", First Create space Inc, O-D Publishing, LLC USA.2014
9. Walter Savitch, "Problem Solving with C++", Pearson Education, 2007.
10. Stanley B. Lippman, JoseeLajoie, Barbara E. Moo, "C++ Primer", Published by Addison-Wesley, 5th Edition, 2012

COMPUTER SCIENCE LAB (C-I): Programming Fundamentals using C/C++ Lab
Practical: 60 Lectures

1. WAP to print the sum and product of digits of an integer.
2. WAP to reverse a number.
3. WAP to compute the sum of the first n terms of the following series S =
   1+1/2+1/3+1/4+……
4. WAP to compute the sum of the first n terms of the following series S =1-
   2+3-4+5……..
5. Write a function that checks whether a given string is Palindrome or not. Use this function to find whether the string entered by user is Palindrome or not.
6. Write a function to find whether a given no. is prime or not. Use the same to generate the prime numbers less than 100.
7. WAP to compute the factors of a given number.
8. Write a macro that swaps two numbers. WAP to use it.
9. WAP to print a triangle of stars as follows (take number of lines from user):

```
    *
   ***
  *****
 *******
*********
```

10. WAP to perform following actions on an array entered by the user:
    i) Print the even-valued elements
    ii) Print the odd-valued elements
    iii) Calculate and print the sum and average of the elements of array
    iv) Print the maximum and minimum element of array
    v) Remove the duplicates from the array
    vi) Print the array in reverse order

    The program should present a menu to the user and ask for one of the options. The menu should also include options to re-enter array and to quit the program.
11. WAP that prints a table indicating the number of occurrences of each alphabet in the text entered as command line arguments.
12. Write a program that swaps two numbers using pointers.
13. Write a program in which a function is passed address of two variables and then alter its contents.
14. Write a program which takes the radius of a circle as input from the user, passes it to another function that computes the area and the circumference of the circle and displays the value of area and circumference from the main() function.
15. Write a program to find sum of n elements entered by the user. To write this program, allocate memory dynamically using malloc() / calloc() functions or new operator.
16. Write a menu driven program to perform following operations on strings:

a) Show address of each character in string
b) Concatenate two strings without using strcat function.
c) Concatenate two strings using strcat function.
d) Compare two strings
e) Calculate length of the string (use pointers)
f) Convert all lowercase characters to uppercase
g) Convert all uppercase characters to lowercase
h) Calculate number of vowels
i) Reverse the string

17. Given two ordered arrays of integers, write a program to merge the two-arrays to get an ordered array.
18. WAP to display Fibonacci series (i)using recursion, (ii) using iteration
19. WAP to calculate Factorial of a number (i)using recursion, (ii) using iteration
20. WAP to calculate GCD of two numbers (i) with recursion (ii) without recursion.
21. Create Matrix class using templates. Write a menu-driven program to perform following Matrix operations (2-D array implementation):
    a) Sum b) Difference c) Product d) Transpose
22. Create the Person class. Create some objects of this class (by taking information from the user). Inherit the class Person to create two classes Teacher and Student class. Maintain the respective information in the classes and create, display and delete objects of these two classes (Use Runtime Polymorphism).
23. Create a class Triangle. Include overloaded functions for calculating area. Overload assignment operator and equality operator.
24. Create a class Box containing length, breath and height. Include following methods in it:
    a) Calculate surface Area
    b) Calculate Volume
    c) Increment, Overload ++ operator (both prefix & postfix)
    d) Decrement, Overload -- operator (both prefix & postfix)
    e) Overload operator == (to check equality of two boxes), as a friend function
    f) Overload Assignment operator
    g) Check if it is a Cube or cuboid

    Write a program which takes input from the user for length, breath and height to test the above class.
25. Create a structure Student containing fields for Roll No., Name, Class, Year and Total Marks. Create 10 students and store them in a file.
26. Write a program to retrieve the student information from file created in previous question and print it in following format: Roll No. Name Marks
27. Copy the contents of one text file to another file, after removing all whitespaces.
28. Write a function that reverses the elements of an array in place. The function must accept only one pointer value and return void.
29. Write a program that will read 10 integers from user and store them in an array. Implement array using pointers. The program will print the array elements in ascending and descending order.

C-2: Computer System Architecture

Theory: 60 Lectures

1. Introduction (8 lectures)

Logic gates, boolean algebra, combinational circuits, circuit simplification, flip-flops and sequential circuits, decoders, multiplexers, registers, counters and memory units.

2. Data Representation and Basic Computer Arithmetic (10 lectures)

Number systems, complements, fixed and floating point representation, character representation, addition, subtraction, magnitude comparison, multiplication and division algorithms for integers

3. Basic Computer Organization and Design (13 lectures)

Computer registers, bus system, instruction set, timing and control, instruction cycle, memory reference, input -output and interrupt, Interconnection Structures, Bus Interconnection design of basic computer.

4. Central Processing Unit (15 lectures)

Register organization, arithmetic and logical micro-operations, stack organization, micro programmed control. Instruction formats, addressing modes, instruction codes, machine language, assembly language, input output programming, RISC, CISC architectures, pipelining and parallel architecture.

5. Memory Organization (6 lectures)

Cache memory, Associative memory, mapping.

6. Input-Output Organization (8 lectures)

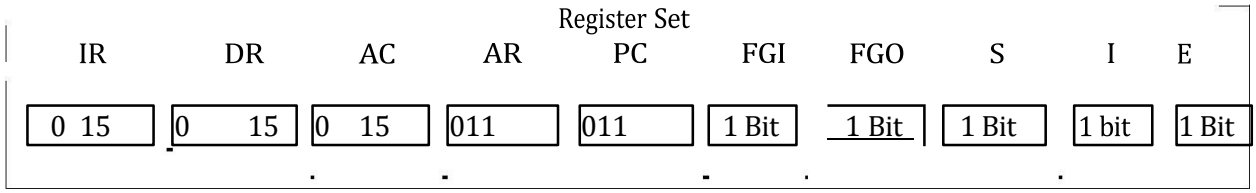
Input / Output: External Devices, I/O Modules, Programmed I/O, Interrupt-Driven I/O, Direct Memory Access, I/O Channels.

Recommended Books:

1. M. Mano, Computer System Architecture, Pearson Education 1992
2. A. J. Dos Reis, Assembly Language and Computer Architecture using C++ and JAVA, Course Technology, 2004 th
3. W. Stallings, Computer Organization and Architecture Designing for Performance, 8 Edition, Prentice Hall of India,2009
4. M.M. Mano , Digital Design, Pearson Education Asia,2013
5. Carl Hamacher, Computer Organization, Fifth edition, McGrawHill, 2012.

COMPUTER SCIENCE LAB (C-2): Computer System Architecture
Lab Practical: 60 Lectures

1. Create a machine based on the following architecture:



Memory	Instruction format
4096 words 16 bits per word	0 3 4 15 Opcode | Address

Basic Computer Instructions

Memory Reference	Register Reference	Input-Output

Symbol	Hex		Symbol	Hex	Symbol	Hex
AND	0xxx		CLA	E800	INP	F80 0
ADD	2xxx		CLE	E400	OUT	F40 0
LDA	4xxx	Direct	CMA	E200	SKI	F20 0
STA	6xxx	Addressing	CME	E100	SKO	F10 0
BUN	8xxx		CIR	E080	ION	F08 0
BSA	Axxx		CIL	E040	IOF	F04 0
ISZ	Cxxx		INC	E020		
AND_I	1xxx		SPA	E010		
ADD_I	3xxx		SNA	E008		
LDA_I	5xxx	Indirect	SZA	E004		
STA_I	7xxx	Addressing	SZE	E002		
BUN_I	9xxx		HLT	E001		
BSA_I	Bxxx					
ISZ_I	Dxxx					

2. Create the micro operations and associate with instructions as given in the chapter(except interrupts). Design the register set, memory and the instruction set. Use this machine for the assignments of this section.

3. Create a Fetch routine of the instruction cycle.

4. Simulate the machine to determine the contents of AC, E, PC, AR and IR registers in hexadecimal after the execution of each of following register reference instructions:

a. CLA	e. CIR	i. SNA
b. CLE	f. CIL	j. SZA
c. CMA	g. INC	k. SZE
d. CME	h. SPA	l. HLT

Initialize the contents of AC to $(A937)_{16}$, that of PC to $(022)_{16}$ and E to 1.

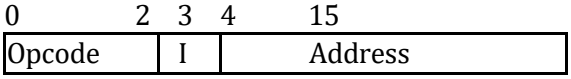
5. Simulate the machine for the following memory-reference instructions with I= 0 and address part = 082. The instruction to be stored at address 022 in RAM. Initialize the memory word at address 082 with the operand B8F2 and AC with A937. Determine the contents of AC, DR, PC, AR and IR in hexadecimal after the execution.

a. ADD	f. BSA
b. AND	g. ISZ
c. LDA	
d. STA	
e. BUN	

6. Simulate the machine for the memory-reference instructions referred in above question with I= 1 and address part = 082. The instruction to be stored at address 026 in RAM. Initialize the memory word at address 082 with the value 298. Initialize the memory word at address 298 with operand B8F2 and AC with A937. Determine the contents of AC, DR, PC, AR and IR in hexadecimal after the execution.

7. Modify the machine created in Practical 1 according to the following instruction format:

Instruction format



   a. The instruction format contains a 3-bit opcode, a 1-bit addressing mode and a 12-bit address. There are only two addressing modes, I = 0 (direct addressing) and I = 1 (indirect addressing).
   b. Create a new register I of 1 bit.
   c. Create two new microinstructions as follows :
      i. Check the opcode of instruction to determine type of instruction (Memory Reference/Register Reference/Input-Output) and then jump accordingly.
      ii. Check the I bit to determine the addressing mode and then jump accordingly.

GE-1:Computer Fundamentals
Theory: 60 lectures

1. **Introduction:** Introduction to computer system, uses, types. **6L**

2. **Data Representation:** Number systems and character representation, binary arithmetic **12L**

3. **Human Computer Interface:** Types of software, Operating system as userinterface, utility programs **6L**

4. **Devices:** Input and output devices (with connections and practical demo),keyboard, mouse, joystick, scanner, OCR, OMR, bar code reader, web camera, monitor, printer, plotter **10L**

5. **Memory:** Primary, secondary, auxiliary memory, RAM, ROM, cache memory,hard disks, optical disks **6L**

6. **Computer Organisation and Architecture:** C.P.U., registers, system bus, mainmemory unit, cache memory, Inside a computer, SMPS, Motherboard, Ports and Interfaces, expansion cards, ribbon cables, memory chips, processors. **12L**

7. **Overview of Emerging Technologies:** Bluetooth, cloud computing, big data,data mining, mobile computing and embedded systems. **8L**

Reference Books:

1. A. Goel, Computer Fundamentals, Pearson Education, 2010.
2. P. Aksoy, L. DeNardis, Introduction to Information Technology, Cengage Learning, 2006
3. P. K.Sinha, P. Sinha, Fundamentals of Computers, BPB Publishers, 2007

Computer Fundamentals Lab
Practical: 60 lectures

Practical exercises based on MS Office/ Open Office tools using document preparation and spreadsheet handling packages.

MS Word

1. Prepare **a grocery list** having four columns (Serial number, The name of the product, quantity and price) for the month of April, 06.

    - Font specifications for Title (Grocery List): 14-point Arial font in bold and italics.
    - The headings of the columns should be in 12-point and bold.
    - The rest of the document should be in 10-point Times New Roman.
    - Leave a gap of 12-points after the title.

2. Create a **telephone directory**.
    - The heading should be 16-point Arial Font in bold
    - The rest of the document should use 10-point font size
    - Other headings should use 10-point Courier New Font.
    - The footer should show the page number as well as the date last updated.

3. Design a **time-table form** for your college.
   - The first line should mention the name of the college in 16-point Arial Font and should be bold.
   - The second line should give the course name/teacher's name and the department in 14-point Arial.
   - Leave a gap of 12-points.
   - The rest of the document should use 10-point Times New Roman font.
   - The footer should contain your specifications as the designer and date of creation.

4. BPB Publications plans to release a new book designed as per your syllabus. Design the **first page of the book** as per the given specifications.
   - The title of the book should appear in bold using 20-point Arial font.
   - The name of the author and his qualifications should be in the center of the page in 16-point Arial font.
   - At the bottom of the document should be the name of the publisher and address in 16-point Times New Roman.
   - The details of the offices of the publisher (only location) should appear in the footer.

5. Create the following one page documents.
   a. Compose a note inviting friends to a get-together at your house, Including a list of things to bring with them.
   b. Design a certificate in landscape orientation with a border around the document.
   c. Design a Garage Sale sign.
   d. Make a sign outlining your rules for your bedroom at home, using a numbered list.

6. Create the following documents:
   (a) A newsletter with a headline and 2 columns in portrait orientation, including at least one image surrounded by text.
   (b) Use a newsletter format to promote upcoming projects or events in your classroom or college.

7. Convert following text to a table, using comma as delimiter

   Type the following as shown (do not bold).

   Color, Style, Item
   Blue, A980, Van
   Red, X023, Car
   Green, YL724, Truck
   Name, Age, Sex
   Bob, 23, M
   Linda, 46, F
   Tom, 29, M

9. Enter the following data into a table given on the next page.

Salesperson	**Dolls**	**Trucks**	**Puzzles**
Kennedy, Sally	1327	1423	1193
White, Pete	1421	3863	2934
Pillar, James	5214	3247	5467
York, George	2190	1278	1928
Banks, Jennifer	1201	2528	1203
Atwater, Kelly	4098	3079	2067
Pillar, James	5214	3247	5467
York, George	2190	1278	1928
Banks, Jennifer	1201	2528	1203
Atwater, Kelly	4098	3079	2067

Add a column Region (values: S, N, N,S,S,S) between the Salesperson and Dolls columns to the given table Sort your table data by Region and within Region by Salesperson in ascending order:

In this exercise, you will add a new row to your table, place the word "Total" at the bottom of the Salesperson column, and sum the Dolls, Trucks, and Puzzles columns.

10. Wrapping of text around the image.

11. Following features of menu option must be covered

FILE	Complete menu
EDIT	Complete menu
VIEW	Complete menu
INSERT	Complete menu
FORMAT	Complete menu
TABLE	Complete menu
WINDOW	Complete menu
HELP	Complete menu
TOOLS	All options except Online collaboration, Tools on Macro, Templates

MS Excel

1. Enter the Following data in Excel Sheet

REGIONAL SALES PROJECTION

State	Qtr1	Qtr2	Qtr3	QTR4	Qtr Total	Rate Amount
Delhi	2020	2400	2100	3000	15	
Punjab	1100	1300	1500	1400	20	
U.P.	3000	3200	2600	2800	17	
Haryana	1800	2000	2200	2700	15	
Rajasthan	2100	2000	1800	2200	20	

TOTAL
AVERAGE

(a) Apply Formatting as follow: I.Title in

TIMES NEW ROMAN

ii. Font Size - 14
iii. Remaining text - ARIAL, Font Size -10
iv. State names and Qtr. Heading Bold, Italic with Gray Fill Color.
v. Numbers in two decimal places.
vi. Qtr. Heading in center Alignment.
vii. Apply Border to whole data.

(b) Calculate State and Qtr. Total
(c) Calculate Average for each quarter
(d) Calculate Amount = Rate * Total.

2. Given the following worksheet

	A	B	C	D
1	Roll No.	Name	Marks	Grade
2	1001	Sachin	99	
3	1002	Sehwag	65	
4	1003	Rahul	41	
5	1004	Sourav	89	
6	1005	HarBhajan	56	

Calculate the grade of these students on the basis of following guidelines:

If Marks	Then Grade
>= 80	A+
>= 60 < 80	A
>= 50 < 60	B
< 50	F

3. Given the following worksheet

	A	B	C	D	E	F	G
1	**Salesman**		**Sales in (Rs.)**				
2	No.	Qtr1	Qtr2	Qtr3	Qtr4	Total	Commission
3	S001	5000	8500	12000	9000		
4	S002	7000	4000	7500	11000		
5	S003	4000	9000	6500	8200		
6	S004	5500	6900	4500	10500		
7	S005	7400	8500	9200	8300		
8	S006	5300	7600	9800	6100		

Calculate the commission earned by the salesmen on the basis of following Candidates:

If Total Sales	**Commission**
< 20000	0% of sales
> 20000 and < 25000	4% of sales
> 25000 and < 30000	5.5% of sales
> 30000 and < 35000	8% of sales
>= 35000	11% of sales

The total sales is sum of sales of all the four quarters.

4. A company XYZ Ltd. pays a monthly salary to its employees which consists of basic salary, allowances & deductions. The details of allowances and deductions are as follows:

Allowances

- HRA Dependent on Basic
  - 30% of Basic if Basic <=1000
  - 25% of Basic if Basic>1000 & Basic<=3000
  - 20% of Basic if Basic >3000
- DA Fixed for all employees, 30% of Basic
- Conveyance Allowance Rs. 50/- if Basic is <=1000 Rs.
  - 75/- if Basic >1000 & Basic<=2000
  - Rs. 100 if Basic >2000
- Entertainment Allowance NIL if Basic is<=1000 Rs. 100/- if Basic > 1000

Deductions

- Provident Fund 6% of Basic
- Group Insurance Premium Rs. 40/- if Basic is <=1500
  - Rs. 60/- if Basic > 1500 & Basic<=3000
  - Rs. 80/- if Basic >3000

Calculate the following:

Gross Salary = Basic + HRA + DA + Conveyance + Entertainment

Total deduction = Provident Fund + Group Insurance Premium

Net Salary = Gross Salary – Total Deduction

5. Create Payment Table for a fixed Principal amount, variable rate of interests and time in the format below:

No. of Instalments	5%	6%	7%	8%	9%
3	XX	XX	XX	XX	XX
4	XX	XX	XX	XX	XX
5	XX	XX	XX	XX	XX
6	XX	XX	XX	XX	XX

6. Use an array formula to calculate Simple Interest for given principal amounts given the rate of Interest and time

Rate of Interest	8%
Time	5 Years
Principal	Simple Interest
1000	?
18000	?
5200	?

7. The following table gives year wise sale figure of five salesmen in Rs.

Salesman	2000	2001	2002	2003
S1	10000	12000	20000	50000
S2	15000	18000	50000	60000
S3	20000	22000	70000	70000
S4	30000	30000	100000	80000
S5	40000	45000	125000	90000

(a) Calculate total sale year wise.

(b) Calculate the net sale made by each salesman

(c) Calculate the maximum sale made by the salesman

(d) Calculate the commission for each salesman under the condition.

(i) If total sales >4,00,000 give 5% commission on total sale made by the salesman.

(ii) Otherwise give 2% commission.

(e) Draw a bar graph representing the sale made by each salesman. (*f*) Draw a pie graph representing the sale made by salesman in 2000.

8. Enter the following data in Excel Sheet

PERSONAL BUDGET FOR FIRST QUARTER

Monthly Income (Net): 1,475

EXPENSES	**JAN**	**FEB**	**MARCH QUARTER TOTAL**	**QUARTER AVERAGE**
Rent600.00	600.00	600.00		
Telephone	48.25	43.50	60.00	
Utilities	67.27	110.00	70.00	
Credit Card	200.00	110.00	70.00	
Oil	100.00	150.00	90.00	
AV to Insurance	150.00			
Cable TV	40.75	40.75	40.75	
Monthly Total				

Calculate Quarter total and Quarter average.

(a) Calculate Monthly total.
(b) Surplus = Monthly income - Monthly total.
(c) What would be total surplus if monthly income is 1500?
(d) How much does telephone expense for March differ from quarter average?
(e) Create a 3D column graph for telephone and utilities.
(f) Create a pie chart for monthly expenses.

9. Enter the following data in Excel Sheet

TOTAL REVENUE EARNED FOR SAM'S BOOKSTALL

Publisher name	**1997**	**1998**	**1999**	**2000**	**total**
A	Rs. 1,000.00	Rs. 1100.00	Rs. 1,300.00	Rs. 800.00	
B	Rs. 1,500.00	Rs. 700.00	Rs. 1,000.00	Rs. 2,000.00	
C	Rs. 700.00	Rs. 900.00	Rs. 1,500.00	Rs. 600.00	
D	Rs. 1,200.00	Rs. 500.00	Rs. 200.00	Rs. 1,100.00	
E Rs	800.00	Rs. 1,000.00	Rs. 3,000.00 Rs.	560.00	

(a) Compute the total revenue earned.
(b) Plot the line chart to compare the revenue of all publishers for 4 years.
(b) Chart Title should be _Total Revenue of sam's Bookstall (1997-2000)'
(c) Give appropriate categories and value axis title.

10. Generate 25 random numbers between 0 & 100 and find their sum, average and count. How many no. are in range 50-60

2ND SEMESTER

C-3: Programming in Java

Theory: 60 Lectures

1. Introduction to Java (4 Lectures)

Java Architecture and Features, Understanding the semantic and syntax differences between C++ and Java, Compiling and Executing a Java Program, Variables, Constants, Keywords Data Types, Operators (Arithmetic, Logical and Bitwise) and Expressions, Comments, Doing Basic Program Output, Decision Making Constructs (conditional statements and loops) and Nesting, Java Methods (Defining, Scope, Passing and Returning Arguments, Type Conversion and Type and Checking, Built-in Java Class Methods),

2. Arrays, Strings and I/O (8 Lectures)

Creating & Using Arrays (One Dimension and Multi-dimensional), Referencing Arrays Dynamically, Java Strings: The Java String class, Creating & Using String Objects,
Manipulating Strings, String Immutability & Equality, Passing Strings To & From Methods, String Buffer Classes. Simple I/O using System.out and the Scanner class, Byte and Character streams, Reading/Writing from console and files.

3. Object-Oriented Programming Overview (4 Lectures)

Principles of Object-Oriented Programming, Defining & Using Classes, Controlling Access to Class Members, Class Constructors, Method Overloading, Class Variables & Methods, Objects as parameters, final classes, Object class, Garbage Collection.

3. Inheritance, Interfaces, Packages, Enumerations, Autoboxing and Metadata (14 lectures)

Inheritance: (Single Level and Multilevel, Method Overriding, Dynamic Method Dispatch, Abstract Classes), Interfaces and Packages, Extending interfaces and packages, Package and Class Visibility, Using Standard Java Packages (util, lang, io, net), Wrapper Classes, Autoboxing/Unboxing, Enumerations and Metadata.

4. Exception Handling, Threading, Networking and Database Connectivity (15 Lectures)

Exception types, uncaught exceptions, throw, built-in exceptions, Creating your own exceptions; Multi-threading: The Thread class and Runnable interface, creating single and multiple threads, Thread prioritization, synchronization and communication, suspending/resuming threads. Using java.net package, Overview of TCP/IP and Datagram programming. Accessing and manipulating databases using JDBC.

5. Applets and Event Handling (15 Lectures)

Java Applets:Introduction to Applets, Writing Java Applets, Working with Graphics,

Incorporating Images & Sounds. Event Handling Mechanisms,Listener Interfaces, Adapter and Inner Classes. The design and Implementation of GUIs using the AWT controls, Swing components of Java Foundation Classes such as labels, buttons, textfields, layout managers, menus, events and listeners; Graphic objects for drawing figures such as lines, rectangles, ovals, using different fonts. Overview of servlets.

Reference Books

1. Ken Arnold, James Gosling, David Homes, "The Java Programming Language", 4th Edition, 2005.
2. James Gosling, Bill Joy, Guy L Steele Jr, GiladBracha, Alex Buckley"The Java Language Specification, Java SE 8 Edition (Java Series)", Published by Addison Wesley, 2014.
3. Joshua Bloch, "Effective Java" 2nd Edition,Publisher: Addison-Wesley, 2008.
4. Cay S. Horstmann, GaryCornell, "Core Java 2 Volume 1 ,9thEdition,Printice Hall.2012
5. Cay S. Horstmann, Gary Cornell, "Core Java 2 Volume 2 - Advanced Features)", 9th Edition, Printice Hall.2013
6. Bruce Eckel, "Thinking in Java", 3rd Edition, PHI, 2002.
7. E. Balaguruswamy, "Programming with Java", 4th Edition, McGraw Hill.2009.
8. Paul Deitel, Harvey Deitel, "Java: How to Program", 10th Edition, Prentice Hall, 2011. 9.

"Head First Java", Orielly Media Inc. 2nd Edition, 2005.

10. David J. Eck, "Introduction to Programming Using Java", Published by CreateSpace Independent Publishing Platform, 2009.
11. John R. Hubbard, "Programming with JAVA", Schaum's Series, 2nd Edition, 2004.

COMPUTER SCIENCE LAB (C-3): Programming in Java Lab

Practical: 60 Lectures

1. To find the sum of any number of integers entered as command line arguments
2. To find the factorial of a given number
3. To learn use of single dimensional array by defining the array dynamically.
4. To learn use of .lenth in case of a two dimensional array
5. To convert a decimal to binary number
6. To check if a number is prime or not, by taking the number as input from the keyboard
7. To find the sum of any number of integers interactively, i.e., entering every number from the keyboard, whereas the total number of integers is given as a command line argument
8. Write a program that show working of different functions of String and StringBufferclasss like setCharAt(, setLength(), append(), insert(), concat()and equals().
9. Write a program to create a ―distance‖ class with methods where distance is computed in terms of feet and inches, how to create objects of a class and to see the use of this pointer
10. Modify the ―distance‖ class by creating constructor for assigning values (feet and inches) to the distance object. Create another object and assign second object as reference variable to another object reference variable. Further create a third object which is a clone of the first object.
11. Write a program to show that during function overloading, if no matching argument is found, then java will apply automatic type conversions(from lower to higher data type)
12. Write a program to show the difference between public and private access specifiers. The program should also show that primitive data types are passed by value and objects are passed by reference and to learn use of final keyword
13. Write a program to show the use of static functions and to pass variable length arguments in a function.

14. Write a program to demonstrate the concept of boxing and unboxing.
15. Create a multi-file program where in one file a string message is taken as input from the userand the function to display the message on the screen is given in another file (make use of Scanner package in this program).
16. Write a program to create a multilevel package and also creates a reusable class to generate Fibonacci series, where the function to generate fibonacii series is given in a different file belonging to the same package.
17. Write a program that creates illustrates different levels of protection in classes/subclasses belonging to same package or different packages
18. Write a program —DivideByZero‖ that takes two numbers a and b as input, computes a/b, and invokes Arithmetic Exception to generate a message when the denominator is zero.
19. Write a program to show the use of nested try statements that emphasizes the sequence of checking for catch handler statements.
20. Write a program to create your own exception types to handle situation specific to your application (Hint: Define a subclass of Exception which itself is a subclass of Throwable).
21. Write a program to demonstrate priorities among multiple threads.
22. Write a program to demonstrate multithread communication by implementing synchronization among threads (Hint: you can implement a simple producer and consumer problem).
23. Write a program to create URL object, create a URLConnection using the openConnection() method and then use it examine the different components of the URLand content.
24. Write a program to implement a simple datagram client and server in which a message that is typed into the server window is sent to the client side where it is displayed.
25. Write a program that creates a Banner and then creates a thread to scrolls the message in the banner from left to right across the applet‘s window.
26. Write a program to get the URL/location of code (i.e. java code) and document(i.e. html file).
27. Write a program to demonstrate different mouse handling events like mouseClicked(), mouseEntered(), mouseExited(), mousePressed, mouseReleased() and mouseDragged().
28. Write a program to demonstrate different keyboard handling events.
29. Write a program to generate a window without an applet window using main() function. 30. Write a program to demonstrate the use of push buttons.

C-4: Discrete Structures
Theory: 60 Lectures

1. **Introduction:** (15 Lectures) Sets - finite and Infinite sets, uncountably Infinite Sets; functions,relations, Properties of Binary Relations, Closure, Partial Ordering Relations; counting - Pigeonhole Principle, Permutation and
Combination; Mathematical Induction, Principle of Inclusion and Exclusion.

2. **Growth of Functions**: (8 Lectures)
Asymptotic Notations, Summation formulas and properties, Bounding Summations, approximation by Integrals

3. **Recurrences**: (10 Lectures) Recurrence Relations, generating functions, Linear RecurrenceRelations with constant coefficients and their solution, Substitution Method, Recurrence Trees, Master Theorem

4. Graph Theory (15 Lectures) Basic Terminology, Models and Types, multigraphs andweighted graphs, Graph Representaion, Graph Isomorphism, Connectivity, Euler and Hamiltonian Paths and Circuits, Planar Graphs, Graph Coloring, Trees, Basic Terminology and properties of Trees, Introduction to SpanningTrees

5. Prepositional Logic (12 Lectures)

Logical Connectives, Well-formed Formulas, Tautologies, Equivalences, Inference Theory

Recommended Books:

1. C.L. Liu , D.P. Mahopatra, Elements of Discrete mathematics, 2nd Edition , Tata McGraw Hill, 1985,
2. Kenneth Rosen, Discrete Mathematics and Its Applications, Sixth Edition ,McGraw Hill 2006
3. T.H. Coremen, C.E. Leiserson, R. L. Rivest, Introduction to algorithms, 3rd edition Prentice Hall on India, 2009
4. M. O. Albertson and J. P. Hutchinson, Discrete Mathematics with Algorithms , John wiley Publication, 1988
5. J. L. Hein, Discrete Structures, Logic, and Computability, 3rd Edition, Jones and Bartlett Publishers, 2009
6. D.J. Hunter, Essentials of Discrete Mathematics, Jones and Bartlett Publishers, 2008

COMPUTER SCIENCE LAB (C4): Discrete Structures LAB

Practical: 15 Lectures

1. C++ programs to implement the Kruskal's algorithm to generate a minimum cost spanning tree.
2. C++ programs to implement the Prim's algorithm to generate a minimum cost spanning tree.
3. C++ program to implement Euler Circuit problem.
4. C++ program to implement Hamiltonian Cycle.
5. C++ Program to Evaluate Truth Value of Conjuction.
6. C++ program to Evaluate Truth Value of Disjuction.
7. Write a c++ program to print the union of two sets.
8. Write a c++ program to print the intersection of two sets.
9. Write a c++ program to print the Permutation of character string of two sets.
10. Write a c++ program to print the combination of a number of two sets.
11. Write a c++ program to find and print all the elements in the Cartesian product of two sets.
12. Write a c++ program to print the subtraction of two sets.
13. Write a c++ program to print the power of two sets.
14. Write a c++ program to print the proper subset of sets.
15. Write a c++ program to print the symmetric difference of two sets.

GE-2: Introduction to Programming

Theory: 60 lectures

1. Introduction to C and C++ (5 Lectures)

History of C and C++, Overview of Procedural Programming and Object-Orientation Programming, Using main() function, Compiling and Executing Simple Programs in C++.

2. Data Types, Variables, Constants, Operators and Basic I/O (10 Lectures)

Declaring, Defining and Initializing Variables, Scope of Variables, Using Named Constants, Keywords, Data Types, Casting of Data Types, Operators (Arithmetic, Logical and Bitwise), Using Comments in programs, Character I/O (getc, getchar, putc, putcharetc), Formatted and Console I/O (printf(), scanf(), cin, cout), Using Basic Header Files (stdio.h, iostream.h, conio.hetc).

3. Expressions, Conditional Statements and Iterative Statements (10 Lectures)

Simple Expressions in C++ (including Unary Operator Expressions, Binary Operator Expressions), Understanding Operators Precedence in Expressions, Conditional Statements (if construct, switch-case construct), Understanding syntax and utility of Iterative Statements (while, do-while, and for loops), Use of break and continue in Loops, Using Nested Statements (Conditional as well as Iterative)

4. Functions and Arrays (10 Lectures)

Utility of functions, Call by Value, Call by Reference, Functions returning value, Void functions, Inline Functions, Return data type of functions, Functions parameters, Differentiating between Declaration and Definition of Functions, Command Line Arguments/Parameters in Functions, Functions with variable number of Arguments.Creating and Using One Dimensional Arrays (Declaring and Defining an Array, Initializing an Array, Accessing individual elements in an Array, Manipulating array elements using loops), Use Various types of arrays (integer, float and character arrays / Strings) Two-dimensional Arrays (Declaring, Defining and Initializing Two Dimensional Array, Working with Rows and Columns), Introduction to Multi-dimensional arrays

5. Derived Data Types (Structures and Unions) (5 Lectures)

Understanding utility of structures and unions, Declaring, initializing and using simple structures and unions, Manipulating individual members of structures and unions, Array of Structures, Individual data members as structures, Passing and returning structures from functions, Structure with union as members, Union with structures as members.

6. File I/O, Preprocessor Directives (8 Lectures)

Opening and closing a file (use of fstream header file, ifstream, ofstream and fstream classes), Reading and writing Text Files, Using put(), get(), read() and write() functions, Random access in files, Understanding the Preprocessor Directives (#include, #define, #error, #if, #else, #elif, #endif, #ifdef, #ifndef and #undef), Macros

7. Using Classes in C++ (8 Lectures)

Principles of Object-Oriented Programming, Defining & Using Classes, Class Constructors, Constructor Overloading, Function overloading in classes, Class Variables &Functions, Objects as parameters, Specifying the Protected and Private Access, Copy Constructors, Overview ofTemplate classes and their use.

8. Inheritance and Polymorphism

Introduction to Inheritance and Polymorphism

Reference Books:

1. HerbtzSchildt, "C++: The Complete Reference", Fourth Edition, McGraw Hill.2003 2. BjarneStroustrup, "The C++ Programming Language", 4th Edition, Addison-Wesley , 2013.
3. BjarneStroustroup, "Programming -- Principles and Practice using C++", 2nd Edition, Addison-Wesley 2014.
4. E Balaguruswamy, "Object Oriented Programming with C++", Tata McGraw-Hill Education, 2008.
5. Paul Deitel, Harvey Deitel, "C++ How to Program", 8th Edition, Prentice Hall, 2011. 6. John R. Hubbard, "Programming with C++", Schaum's Series, 2nd Edition, 2000.

3RD SEMESTER

C-5: Data Structures

Theory: 60 Lectures

1. **Arrays** **(5 Lectures)**
Single and Multi-dimensional Arrays, Sparse Matrices (Array and Linked Representation)

2. **Stacks** **(5 Lectures)**
Implementing single / multiple stack/s in an Array; Prefix, Infix and Postfix expressions, Utility and conversion of these expressions from one to another; Applications of stack; Limitations of Array representation of stack

3. **Linked Lists** **(10 Lectures)**
Singly, Doubly and Circular Lists (Array and Linked representation); Normal and Circular representation of Stack in Lists; Self Organizing Lists; Skip Lists

4. **Queues** **(5 Lectures)**
Array and Linked representation of Queue, De-queue, Priority Queues

5. **Recursion** **(5 lectures)**
Developing Recursive Definition of Simple Problems and their implementation; Advantages and Limitations of Recursion; Understanding what goes behind Recursion (Internal Stack Implementation)

6. **Trees** **(20 Lectures)**
Introduction to Tree as a data structure; Binary Trees (Insertion, Deletion , Recursive and Iterative Traversals on Binary Search Trees); Threaded Binary Trees (Insertion, Deletion, Traversals); Height-Balanced Trees (Various operations on AVL Trees).

7. **Searching and Sorting** **(5 Lectures)**
Linear Search, Binary Search, Comparison of Linear and Binary Search, Selection Sort, Insertion Sort, Insertion Sort, Shell Sort, Comparison of Sorting Techniques

8. **Hashing** **(5 Lectures)**
Introduction to Hashing, Deleting from Hash Table, Efficiency of Rehash Methods, Hash Table Reordering, Resolving collusion by Open Addressing, Coalesced Hashing, Separate Chaining, Dynamic and Extendible Hashing, Choosing a Hash Function, Perfect Hashing Function

Reference Books:

1. Adam Drozdek, "Data Structures and algorithm in C++", Third Edition, Cengage Learning, 2012.
2. SartajSahni, Data Structures, "Algorithms and applications in C++", Second Edition, Universities Press, 2011.
3. Aaron M. Tenenbaum, Moshe J. Augenstein, YedidyahLangsam, "Data Structures Using C and C++:, Second edition, PHI, 2009.
4. Robert L. Kruse, "Data Structures and Program Design in C++", Pearson,1999.
5. D.S Malik, Data Structure using C++,Second edition, Cengage Learning, 2010.
6. Mark Allen Weiss, "Data Structures and Algorithms Analysis in Java", Pearson Education, 3rd edition, 2011

7. Aaron M. Tenenbaum, Moshe J. Augenstein, YedidyahLangsam, "Data Structures Using Java, 2003.
8. Robert Lafore, "Data Structures and Algorithms in Java, 2/E", Pearson/ Macmillan Computer Pub,2003
9. John Hubbard, "Data Structures with JAVA", McGraw Hill Education (India) Private Limited; 2 edition, 2009
10. Goodrich, M. and Tamassia, R. "Data Structures and Algorithms Analysis in Java", 4th Edition, Wiley,2013

COMPUTER SCIENCE LAB (C-5): Data Structures Lab

Practical: 60 Lectures

1. Write a program to search an element from a list. Give user the option to perform Linear or Binary search. Use Template functions.
2. WAP using templates to sort a list of elements. Give user the option to perform sorting using Insertion sort, Bubble sort or Selection sort.
3. Implement Linked List using templates. Include functions for insertion, deletion and search of a number, reverse the list and concatenate two linked lists (include a function and also overload operator +).
4. Implement Doubly Linked List using templates. Include functions for insertion, deletion and search of a number, reverse the list.
5. Implement Circular Linked List using templates. Include functions for insertion, deletion and search of a number, reverse the list.
6. Perform Stack operations using Linked List implementation.
7. Perform Stack operations using Array implementation. Use Templates.
8. Perform Queues operations using Circular Array implementation. Use Templates.
9. Create and perform different operations on Double-ended Queues using Linked List implementation.
10. WAP to scan a polynomial using linked list and add two polynomial.
11. WAP to calculate factorial and to compute the factors of a given no. (i)using recursion, (ii) using iteration
12. (ii) WAP to display fibonacci series (i)using recursion, (ii) using iteration
13. WAP to calculate GCD of 2 number (i) with recursion (ii) without recursion
14. WAP to create a Binary Search Tree and include following operations in tree:
    (a) Insertion (Recursive and Iterative Implementation)
    (b) Deletion by copying
    (c) Deletion by Merging
    (d) Search a no. in BST
    (e) Display its preorder, postorder and inorder traversals Recursively
    (f) Display its preorder, postorder and inorder traversals Iteratively
    (g) Display its level-by-level traversals
    (h) Count the non-leaf nodes and leaf nodes
    (i) Display height of tree
    (j) Create a mirror image of tree
    (k) Check whether two BSTs are equal or not
15. WAP to convert the Sparse Matrix into non-zero form and vice-versa.
16. WAP to reverse the order of the elements in the stack using additional stack.
17. WAP to reverse the order of the elements in the stack using additional Queue.
18. WAP to implement Diagonal Matrix using one-dimensional array.
19. WAP to implement Lower Triangular Matrix using one-dimensional array.
20. WAP to implement Upper Triangular Matrix using one-dimensional array.
21. WAP to implement Symmetric Matrix using one-dimensional array.
22. WAP to create a Threaded Binary Tree as per inorder traversal, and implement operations like

finding the successor / predecessor of an element, insert an element, inorder traversal.

23. WAP to implement various operations on AVL Tree.

C-6: Operating Systems
Theory: 60 Lectures

1. Introduction (10 Lectures)

Basic OS functions, resource abstraction, types of operating systems–multiprogramming systems, batch systems , time sharing systems; operating systems for personal computers & workstations, process control & real time systems.

2. Operating System Organization (6 Lectures)

Processor and user modes, kernels, system calls and systemprograms.

3. Process Management **(20** Lectures)

System view of the process and resources, process abstraction, processhierarchy, threads, threading issues, thread libraries; Process Scheduling, non-pre-emptive and pre-emptive scheduling algorithms; concurrent and processes, critical section, semaphores, methods for inter-process communication; deadlocks.

4. Memory Management (10 Lectures)

Physical and virtual address space; memory allocation strategies -fixedand variable partitions, paging, segmentation, virtual memory

5. File and I/O Management (10 Lectures)

Directory structure, file operations, file allocation methods, devicemanagement.

6. Protection and Security (4 Lectures)

Policy mechanism, Authentication, Internal access Authorization.

Recommended Books:

1. A Silberschatz, P.B. Galvin, G. Gagne, Operating Systems Concepts, 8th Edition, John Wiley Publications 2008.
2. A.S. Tanenbaum, Modern Operating Systems, 3rd Edition, Pearson Education 2007.
3. G. Nutt, Operating Systems: A Modern Perspective, 2nd Edition Pearson Education 1997.
4. W. Stallings, Operating Systems, Internals & Design Principles , 5th Edition, Prentice Hall of India. 2008.
5. M. Milenkovic, Operating Systems- Concepts and design, Tata McGraw Hill 1992.

COMPUTER SCIENCE LAB (C-6): Operating Systems Lab

Practical: 60 Lectures

C/ C++ programs

WRITE A PROGRAM (using *fork()* and/or *exec()* commands) where parent and child execute:

a) same program, same code.
b) same program, different code.

-

c) before terminating, the parent waits for the child to finish its task.

2. WRITE A PROGRAM to report behaviour of Linux kernel including kernel version, CPU type and model. (CPU information)
3. WRITE A PROGRAM to report behaviour of Linux kernel including information on configured memory, amount of free and used memory. (memory information)
4. WRITE A PROGRAM to print file details including owner access permissions, file access time, where file name is given as argument.
5. WRITE A PROGRAM to copy files using system calls.
6. Write program to implement FCFS scheduling algorithm.
7. Write program to implement Round Robin scheduling algorithm.
8. Write program to implement SJF scheduling algorithm.

9. Write program to implement non-preemptive priority based scheduling algorithm.
10. Write program to implement preemptive priority based scheduling algorithm.
11. Write program to implement SRJF scheduling algorithm.
12. Write program to calculate sum of n numbers using *thread* library.
13. Write a program to implement first-fit, best-fit and worst-fit allocation strategies.

COMPUTER SCIENCE (C-7): Computer Networks
Theory: 60 Lectures

1. Introduction to Computer Networks (8 Lectures)

Network definition; network topologies; network classifications; network protocol; layered network architecture; overview of OSI reference model; overview of TCP/IP protocol suite.

2. Data Communication Fundamentals and Techniques (10 Lectures)

Analog and digital signal; data-ratelimits; digital to digital line encoding schemes; pulse code modulation; parallel and serial transmission; digital to analog modulation-; multiplexing techniques- FDM, TDM; transmission media.

3. Networks Switching Techniques and Access mechanisms (10 Lectures)

Circuit switching; packetswitching- connectionless datagram switching, connection-oriented virtual circuit switching; dial-up modems; digital subscriber line; cable TV for data transfer.

4. Data Link Layer Functions and Protocol (10 Lectures)

Error detection and error correction techniques;data-link control- framing and flow control; error recovery protocols- stop and wait ARQ, go-back-n ARQ; Point to Point Protocol on Internet.

5. Multiple Access Protocol and Networks (5 Lectures)

CSMA/CD protocols; Ethernet LANS; connectingLAN and back-bone networks- repeaters, hubs, switches, bridges, router and gateways;

6. Networks Layer Functions and Protocols (6 Lectures)

Routing; routing algorithms; network layer protocolof Internet- IP protocol, Internet control protocols.

7. Transport Layer Functions and Protocols (6 Lectures)

Transport services- error and flow control,Connection establishment and release- three way handshake;

8. Overview of Application layer protocol (5 Lectures)

Overview of DNS protocol; overview of WWW &HTTP protocol.

Reference Books

1. B. A. Forouzan: Data Communications and Networking, Fourth edition, THM ,2007.
2. A. S. Tanenbaum: Computer Networks**,** Fourth edition**,** PHI , 2002

COMPUTER SCIENCE LAB (C-7): Computer Networks Lab

Practical: 60 Lectures

1. Simulate Cyclic Redundancy Check (CRC) error detection algorithm for noisy channel.
2. Simulate and implement stop and wait protocol for noisy channel.
3. Simulate and implement go back n sliding window protocol.
4. Simulate and implement selective repeat sliding window protocol.
5. Simulate and implement distance vector routing algorithm
6. Simulate and implement Dijkstra algorithm for shortest path routing.

SEC-1:UNIX/Linux Programming

1. Introduction **(5 L)**

- What is linux/unix Operating systems
- Difference between linux/unix and other operating systems
- Features and Architecture
- Various Distributions available in the market
- Installation, Booting and shutdown process
- System processes (an overview)
- External and internal commands
- Creation of partitions in OS
- Processes and its creation phases – Fork, Exec, wait

1. **User Management and the File System** **(5L)**

- Types of Users, Creating users, Granting rights
- User management commands
- File quota and various file systems available
- File System Management and Layout, File permissions
- Login process, Managing Disk Quotas
- Links (hard links, symbolic links)

2. **Shell introduction and Shell Scripting** **(6L)**

- What is shell and various type of shell, Various editors present in linux
- Different modes of operation in vi editor
- What is shell script, Writing and executing the shell script
- Shell variable (user defined and system variables)
- System calls, Using system calls
- Pipes and Filters
- Decision making in Shell Scripts (If else, switch), Loops in shell
- Functions
- Utility programs (cut, paste, join, tr , uniq utilities)
- Pattern matching utility (grep)

Reference Books:

1. Sumitabha, Das, Unix Concepts And Applications, Tata McGraw-Hill Education, 2006

2. Michael Jang RHCSA/ RHCE Red Hat Linux Certification: Exams (Ex200 & Ex300) (Certification Press), 2011

3. Nemeth Synder& Hein, Linux Administration Handbook, Pearson Education, 2nd Edition ,2010

4. W. Richard Stevens, Bill Fenner, Andrew M. Rudoff, Unix Network Programming,

The sockets Networking API, Vol. 1, 3rd Edition,2014

Software Lab Based on Linux:
Practical : 30Lectures

1. Write a shell script to check if the number entered at the command line is prime or not.
2. Write a shell script to modify ―cal‖ command to display calendars of the specified months.
3. Write a shell script to modify ―cal‖ command to display calendars of the specified range of months.
4. Write a shell script to accept a login name. If not a valid login name display message – ―Entered login name is invalid‖.

5. Write a shell script to display date in the mm/dd/yy format.
6. Write a shell script to display on the screen sorted output of —who‖ command along with the total number of users .
7. Write a shell script to display the multiplication table any number,
8. Write a shell script to compare two files and if found equal asks the user to delete the duplicate file.
9. Write a shell script to find the sum of digits of a given number.
10. Write a shell script to merge the contents of three files, sort the contents and then display them page by page.
11. Write a shell script to find the LCD(least common divisor) of two numbers.
12. Write a shell script to perform the tasks of basic calculator.
13. Write a shell script to find the power of a given number.
14. Write a shell script to find the binomial coefficient C(n , x).
15. Write a shell script to find the permutation P(n,x).
16. Write a shell script to find the greatest number among the three numbers.
17. Write a shell script to find the factorial of a given number.
18. Write a shell script to check whether the number is Armstrong or not.

Write a shell script to check whether the file have all the permissions or not.

GE-3: Computer Networks and Internet Technologiees

Theory: 60 lectures

1. **Computer Networks:** Introduction to computer network, data communication, components of data communication, data transmission mode, data communication measurement, LAN, MAN, WAN, wireless LAN, internet, intranet, extranet. **6L**

2. **Network Models:** Client/ server network and Peer-to-peer network, OSI, TCP/IP, layers and functionalities. **8L**

3. **Transmission Media:** Introduction, Guided Media: Twisted pair, Coaxial cable, Optical fiber. Unguided media: Microwave, Radio frequency propagation, Satellite. **4L**

4. **LAN Topologies:** Ring, bus, star, mesh and tree topologies. **2L**

5. **Network Devices:** NIC, repeaters, hub, bridge, switch, gateway and router. **2L**

6. **Internet Terms:** Web page, Home page, website, internet browsers, URL, Hypertext, ISP, Web server, download and upload, online and offline. **2L**

7. **Internet Applications:** www, telnet, ftp, e-mail, social networks, search engines, Video Conferencing, e-Commerce, m-Commerce, VOIP, blogs. **6L**

8. **Introduction to Web Design:** Introduction to hypertext markup language (html) Document type definition, creating web pages, lists, hyperlinks, tables, web forms, inserting images, frames, hosting options and domain name registration. Customized Features: Cascading style sheet (css) for text formatting and other manipulations. **16L**

9. **JavaScript Fundamentals:** Data types and variables, functions, methods and events, controlling program flow, JavaScript object model, built-in objects and operators. **14L**

Reference Books:

1. Andrew S. Tanenbaum, David J. Wetherall Computer Networks (5th Edition),PHI, 2010
2. B. A. Forouzan, Data Communication and Networking , TMH,2003.
3.D.R. Brooks, An Introduction to HTML and Javascript for Scientists and Engineers, Springer W. Willard,2009

4. HTML A Beginner's Guide, Tata McGraw-Hill Education, 2009.

5. J. A. Ramalho, Learn Advanced HTML 4.0 with DHTML, BPB Publications, 2007

Computer Networks and Internet Technologies Lab
Practical: 60 lectures

Practical exercises based on concepts listed in theory using HTML.

1. Create HTML document with following formatting – Bold, Italics, Underline, Colors, Headings, Title, Font and Font Width, Background, Paragraph, Line Brakes, Horizontal Line, Blinking text as well as marquee text.
2. Create HTML document with Ordered and Unordered lists, Inserting Images, Internal and External linking

3. Create HTML document with Table:

<table>
<tr><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td colspan="3"></td><td colspan="2" rowspan="2"></td></tr>
<tr><td colspan="3"></td></tr>
</table>

4. Create Form with Input Type, Select and Text Area in HTML.
5. Create an HTML containing Roll No., student‘s name and Grades in a tabular form.
6. Create an HTML document (having two frames) which will appear as follows:

<table>
<tr><td>About

Department 1

Department 2

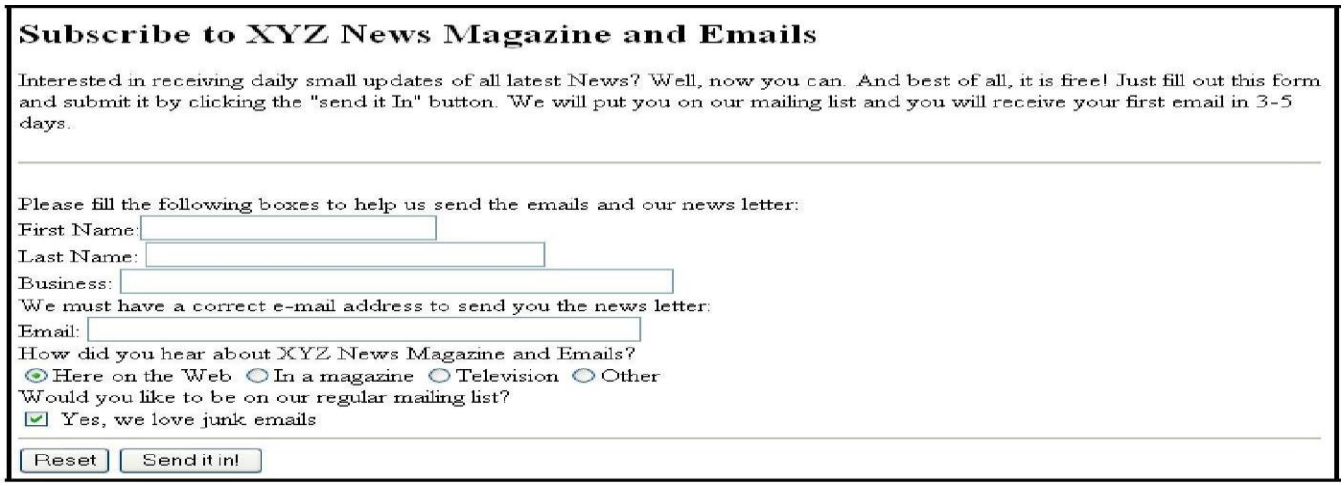
Department 3</td><td>This frame would show the contents according to the link clicked by the user on the left Frame.</td></tr>
</table>

7. Create an HTML document containing horizontal frames as follows:

<table>
<tr><td>Department Names (could be along with Logos)</td></tr>
<tr><td>Contents according to the Link clicked</td></tr>
</table>

8. Create a website of 6 – 7 pages with different effects as mentioned in above problems.

9. Create a form using HTML which has the following types of controls:
   - V. Text Box
   - VI. Option/radio buttons
   - VII. Check boxes
   - VIII. Reset and Submit buttons



List of Practical using Javascript :

Create event driven program for following:

1. Print a table of numbers from 5 to 15 and their squares and cubes using alert. 8. Print the largest of three numbers.
2. Find the factorial of a number n.
3. Enter a list of positive numbers terminated by Zero. Find the sum and average of these numbers.
4. A person deposits Rs 1000 in a fixed account yielding 5% interest. Compute the amount in the account at the end of each year for n years.
5. Read n numbers. Count the number of negative numbers, positive numbers and zeros in the list.

4TH SEMESTER

C-8: Design and Analysis of Algorithms

Theory: 60 Lectures

1. Introduction (5 Lectures)
Basic Design and Analysis techniques of Algorithms, Correctness of Algorithm.

2. Algorithm Design Techniques (8 Lectures)
Iterative techniques, Divide and Conquer, DynamicProgramming, Greedy Algorithms.

3. Sorting and Searching Techniques (20 Lectures
Elementary sorting techniques–Bubble Sort, InsertionSort, Merge Sort, Advanced Sorting techniques - Heap Sort, Quick Sort, Sorting in Linear Time - Bucket Sort, Radix Sort and Count Sort, Searching Techniques, Medians & Order Statistics, complexity analysis;

34.Lower Bounding Techniques (5 Lectures)
Decision Trees

5. Balanced Trees (7 Lectures)
Red-Black Trees

6. Advanced Analysis Technique (5 Lectures)
Amortized analysis

7. Graphs (5 Lectures)
Graph Algorithms–Breadth First Search, Depth First Search and its Applications,Minimum Spanning Trees.

8. String Processing (5Lectures)
String Matching, KMP Technique

Recommended Books:

1. T.H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein Introduction to Algorithms, PHI, 3rd Edition 2009
2. Sarabasse& A.V. Gelder Computer Algorithm – Introduction to Design and Analysis, Publisher – Pearson 3rd Edition 1999

COMPUTER SCIENCE LAB (C-8): Design and Analysis of Algorithms Lab

Practical: 60 Lectures

1. i. Implement Insertion Sort (The program should report the number of comparisons)
   ii. Implement Merge Sort(The program should report the number of comparisons)
2. Implement Heap Sort(The program should report the number of comparisons)
3. Implement Randomized Quick sort (The program should report the number of comparisons)
4. Implement Radix Sort
5. Create a Red-Black Tree and perform following operations on it:
   i. Insert a node
   ii. Delete a node
   iii. Search for a number & also report the color of the node containing this number.
6. Write a program to determine the LCS of two given sequences
7. Implement Breadth-First Search in a graph
8. Implement Depth-First Search in a graph
9. Write a program to determine the minimum spanning tree of a graph

For the algorithms at S.No 1 to 3 test run the algorithm on 100 different inputs of sizes varying from 30 to 1000. Count the number of comparisons and draw the graph. Compare it with a graph of nlogn.

C-9: Software Engineering
Theory: 60 Lectures

1. Introduction (8 Lectures)

The Evolving Role of Software, Software Characteristics, Changing Nature ofSoftware, Software Engineering as a Layered Technology, Software Process Framework, Framework and Umbrella Activities, Process Models, Capability Maturity Model Integration (CMMI).

2. Requirement Analysis(10 Lectures)
Software Requirement Analysis, Initiating Requirement EngineeringProcess, Requirement Analysis and Modeling Techniques, Flow Oriented Modeling, Need for SRS, Characteristics and Components of SRS.

3. Software Project Management (8Lectures)
Estimation in Project Planning Process, Project Scheduling.

4. Risk Management (8 Lectures)
Software Risks, Risk Identification, Risk Projection and Risk Refinement,RMMM Plan.

5. Quality Management (8 Lectures)
Quality Concepts, Software Quality Assurance, Software Reviews,Metrics for Process and Projects.

6. Design Engineering (10 Lectures)
Design Concepts, Architectural Design Elements, Software Architecture,Data Design at the

Architectural Level and Component Level, Mapping of Data Flow into Software Architecture, Modeling Component Level Design.

7. Testing Strategies & Tactics (8 Lectures) Software Testing Fundamentals, Strategic Approachto SoftwareTesting, Test Strategies for Conventional Software, Validation Testing, System testing,Black-Box Testing, White-Box Testing and their type, Basis Path Testing.

Recommended Books:

1. R.S. Pressman, Software Engineering: A Practitioner's Approach (7th Edition), McGraw-Hill, 2009.
2. P. Jalote, An Integrated Approach to Software Engineering (2nd Edition), Narosa Publishing House, 2003.
3. K.K. Aggarwal and Y. Singh, Software Engineering (2nd Edition), New Age International Publishers, 2008.
4. I. Sommerville, Software Engineering (8th edition), Addison Wesley, 2006.
5. D. Bell, Software Engineering for Students (4th Edition), Addison-Wesley, 2005.
6. R. Mall, Fundamentals of Software Engineering (2nd Edition), Prentice-Hall of India, 2004.

COMPUTER SCIENCE LAB (C-9): Software Engineering Lab
Practical: 60 Lectures

S. No.	Practical Title
1.	• Problem Statement, • Process Model
2.	Requirement Analysis: • Creating a Data Flow • Data Dictionary, Use Cases
3.	Project Management: • Computing FP • Effort • Schedule, Risk Table, Timeline chart
4.	Design Engineering: • Architectural Design • Data Design, Component Level Design
5.	Testing: • Basis Path Testing

Sample Projects:

1. **Criminal Record Management**: Implement a criminal record management system forjailers, police officers and CBI officers
2. **DTC Route Information**: Online information about the bus routes and their frequency andfares
3. **Car Pooling**: To maintain a web based intranet application that enables the corporateemployees within an organization to avail the facility of carpooling effectively.
4. Patient Appointment and Prescription Management System
5. Organized Retail Shopping Management Software
6. Online Hotel Reservation Service System
7. Examination and Result computation system
8. Automatic Internal Assessment System
9. Parking Allocation System
10. Wholesale Management System

C-10: Database Management Systems
Theory: 60Lectures

1. Introduction (6 Lectures)
Characteristics of database approach, data models, database system architectureand data independence.

2. Entity Relationship(ER) Modeling (8 Lectures)

Entity types, relationships, constraints.

3. Relation data model (20 Lectures)

Relational model concepts, relational constraints, relational algebra, SQLqueries

4. Database design (15 Lectures)
Mapping ER/EER model to relational database, functional dependencies,Lossless decomposition, Normalforms(upto BCNF).

5. Transaction Processing (3 Lectures)
ACID properties, concurrency control

6. File Structure and Indexing (8 Lectures)Operations on files, File of Unordered and ordered records, overview of File organizations,Indexing structures for files(Primary index, secondary index, clustering index), Multilevel indexing using B and B+ trees

Books Recommended:

1. R. Elmasri, S.B. Navathe, Fundamentals of Database Systems 6th Edition, PearsonEducation, 2010.
2. R. Ramakrishanan, J. Gehrke, Database Management Systems 3rd Edition, McGraw-Hill, 2002.
3. A. Silberschatz, H.F. Korth, S. Sudarshan, Database System Concepts 6thEdition, McGrawHill, 2010.
4. R. Elmasri, S.B. Navathe Database Systems Models, Languages, Design and application Programming, 6th Edition, Pearson Education,2013.

COMPUTER SCIENCE LAB (C-10): Database Management Systems

Lab Practical: 60 Lectures

Create and use the following database schema to answer the given queries.

EMPLOYEE Schema

Field	Type	NULL	KEY	DEFAULT
Eno	Char(3)	NO	PRI	NIL
Ename	Varchar(50)	NO		NIL
Job_type	Varchar(50)	NO		NIL
Manager	Char(3)	Yes	FK	NIL
Hire_date	Date	NO		NIL
Dno	Integer	YES	FK	NIL
Commission	Decimal(10,2)	YES		NIL
Salary	Decimal(7,2)	NO		NIL

DEPARTMENT Schema

Field	Type	NULL	KEY	DEFAULT
Dno	Integer	No	PRI	NULL
Dname	Varchar(50)	Yes		NULL
Location	Varchar(50)	Yes		New Delhi

Query List

1. Query to display Employee Name, Job, Hire Date, Employee Number; for each employee with the Employee Number appearing first.

2. Query to display unique Jobs from the Employee Table.

3. Query to display the Employee Name concatenated by a Job separated by a comma.

4. Query to display all the data from the Employee Table. Separate each Column by a comma and name the said column as THE_OUTPUT.

5. Query to display the Employee Name and Salary of all the employees earning more than $2850.

6. Query to display Employee Name and Department Number for the Employee No= 7900.
7. Query to display Employee Name and Salary for all employees whose salary is not in the range of $1500 and $2850.
8. Query to display Employee Name and Department No. of all the employees in Dept 10 and Dept 30 in the alphabetical order by name.

9. Query to display Name and Hire Date of every Employee who was hired in 1981.
10. Query to display Name and Job of all employees who don‘t have a current Manager.
11. Query to display the Name, Salary and Commission for all the employees who earn commission.
12. Sort the data in descending order of Salary and Commission.
13. Query to display Name of all the employees where the third letter of their name is _A‘
14. Query to display Name of all employees either have two _R‘s or have two _A‘s in their name and are either in Dept No = 30 or their Manger‘s Employee No = 7788.
15. Query to display Name, Salary and Commission for all employees whose Commission Amount is 14 greater than their Salary increased by 5%.
16. Query to display the Current Date.
17. Query to display Name, Hire Date and Salary Review Date which is the 1st Monday after six months of employment.
18. Query to display Name and calculate the number of months between today and the date each employee was hired.

19. Query to display the following for each employee <E-Name> earns < Salary> monthly but wants < 3 * Current Salary >. Label the Column as Dream Salary.
20. Query to display Name with the 1st letter capitalized and all other letter lower case and length of their name of all the employees whose name starts with _J‘, ‘A‘ and _M‘.
21. Query to display Name, Hire Date and Day of the week on which the employee started.
22. Query to display Name, Department Name and Department No for all the employees.
23. Query to display Unique Listing of all Jobs that are in Department # 30.
24. Query to display Name, Dept Name of all employees who have an _A‘ in their name.
25. Query to display Name, Job, Department No. And Department Name for all the employees working at the Dallas location.
26. Query to display Name and Employee no. Along with their Manger‘s Name and the Manager‘s employee no; along with the Employees‘ Name who do not have a Manager.
27. Query to display Name, Dept No. And Salary of any employee whose department No. and salary matches both the department no. And the salary of any employee who earns a commission.
28. Query to display Name and Salaries represented by asterisks, where each asterisk (*) signifies $100.
29. Query to display the Highest, Lowest, Sum and Average Salaries of all the employees
30. Query to display the number of employees performing the same Job type functions.
31. Query to display the no. of managers without listing their names.
32. Query to display the Department Name, Location Name, No. of Employees and the average salary for all employees in that department.
33. Query to display Name and Hire Date for all employees in the same dept. as Blake.
34. Query to display the Employee No. And Name for all employees who earn more than the average salary.

35. Query to display Employee Number and Name for all employees who work in a department with any employee whose name contains a _T‘.
36. Query to display the names and salaries of all employees who report to King.
37. Query to display the department no, name and job for all employees in the Sales department.

SEC-2:Oracle (SQL/PL-SQL)
Theory: 15 Lectures

1. Introduction to Oracle as RDBMS

SQL Vs. SQL * Plus:
SQL Commands and Data types, Operators and Expressions, Introduction to SQL * Plus. (2L)

2. Managing Tables and Data:
- Creating and Altering Tables (Including constraints)
- Data Manipulation Command like Insert, update, delete
- SELECT statement with WHERE, GROUP BY and HAVING, ORDER BY, DISTINCT, Special operator like IN, ANY, ALL BETWEEN, EXISTS, LIKE
- Join, Built in functions

3. Other Database Objects
- View
- Synonyms, Index

4. Transaction Control Statements
- Commit, Rollback, Save point

5. Introduction to PL/SQL
- SQL v/s PL/SQL
- PL/SQL Block Structure
- Language construct of PL/SQL (Variables, Basic and Composite Data type, Conditions looping etc.)
- % TYPE and % ROWTYPE
- Using Cursor (Implicit, Explicit)

Books Recommended:

1. Ivan Bayross, "SQL, PL/SQL the Programming Language of Oracle Paperback", BPB Publicatins, 2010.

2. Steven Feuerstein, Bill Pribyl , "Oracle PL/SQL Programming", 6th Edition, O'Reilly Media, 2014.

3. Rajeeb C. Chatterjee, "Learning Oracle SQL and PL/SQL: A simplified Guide", PHI, 2012.

4. Ron Hardman, Michael Mclaughlin, "Expert Oracle PL/SQL", Oracle Press, 2005.

5. Michael Mclaughlin, "Oracle Database 11g PL/SQL Programming", Oracle Press, 2008.

6. John Watson, RoopeshRamklass, "OCA Oracle Database11g SQL Fundamentals I Exam Guide", Oracle Press, 2008.

Software Lab Based on SQL/PL-SQL:
Practical: 30 Lectures

[SQL COMMANDS]
1) SQL* formatting commands
2) To create a table, alter and drop table. **(1+2 Labs)**

3) To perform select, update, insert and delete operation in a table.
4) To make use of different clauses viz where, group by, having, order by, union and intersection,
5) To study different constraints.

[SQL FUNCTION]

6) To use oracle function viz aggregate, numeric, conversion, string function.
7) To understand use and working with joins.
8) To make use of transaction control statement viz rollback, commit and save point.
9) To make views of a table.
10) To make indexes of a table. **[PL/SQL]**
11) To understand working with PL/SQL
12) To implement Cursor on a table.
13) To implement trigger on a table

GE-4:Introduction to Database System
Theory: 60 lectures

Database: Introduction to database, relational data model, DBMS architecture, data**4L** independence, DBA, database users, end users, front end tools
E-R Modeling: Entity types, entity set, attribute and key, relationships, relation**4L** types, E- R diagrams, database design using ER diagrams
Relational Data Model: Relational model concepts, relational constraints, primary**14L** and foreign key, normalization: 1NF, 2NF, 3NF
Structured Query Language: SQL queries, create a database table, create**18L** relationships between database tables, modify and manage tables, queries, forms, reports, modify, filter and view data.

Reference Books :

1. P. Rob, C. Coronel, Database System Concepts by, Cengage Learning India, 2008
2. R. Elmsasri,S. Navathe Fundamentals of Database Systems, Pearson Education, Fifth Edition, 2007
3. MySQL : Reference Manual

Introduction to Database System Lab
Practical: 60 lectures

1) Create a database having two tables with the specified fields, to computerize a library system of a Delhi University College.
LibraryBooks (Accession number, Title, Author, Department, PurchaseDate, Price)
IssuedBooks (Accession number, Borrower)
   a) Identify primary and foreign keys. Create the tables and insert at least 5 records in each table.
   b) Delete the record of book titled ―Database System Concepts‖.
   c) Change the Department of the book titled ―Discrete Maths‖ to ―CS‖.
   d) List all books that belong to ―CS‖ department.
   e) List all books that belong to ―CS‖ department and are written by author ―Navathe‖.
   f) List all computer (Department=‖CS‖) that have been issued.
   g) List all books which have a price less than 500 or purchased between ―01/01/1999‖ and ―01/01/2004‖.
2) Create a database having three tables to store the details of students of Computer Department

in your college.

Personal information about Student (College roll number, Name of student, Date of birth, Address, Marks(rounded off to whole number) in percentage at 10 + 2, Phone number) Paper Details (Paper code, Name of the Paper)

Student's Academic and Attendance details (College roll number, Paper code, Attendance, Marks in home examination).

a) Identify primary and foreign keys. Create the tables and insert at least 5 records in each table.
b) Design a query that will return the records (from the second table) along with the name of student from the first table, related to students who have more than 75% attendance and more than 60% marks in paper 2.
c) List all students who live in ―Delhi‖ and have marks greater than 60 in paper 1.
d) Find the total attendance and total marks obtained by each student.
e) List the name of student who has got the highest marks in paper 2.

3) Create the following tables and answer the queries given below:

Customer (CustID, email, Name, Phone, ReferrerID) Bicycle (BicycleID, DatePurchased, Color, CustID, ModelNo) BicycleModel (ModelNo, Manufacturer, Style) Service (StartDate, BicycleID, EndDate)

a) Identify primary and foreign keys. Create the tables and insert at least 5 records in each table.
b) List all the customers who have the bicycles manufactured by manufacturer ―Honda‖.
c) List the bicycles purchased by the customers who have been referred by customer ―C1‖.
d) List the manufacturer of red colored bicycles.
e) List the models of the bicycles given for service.

4) Create the following tables, enter at least 5 records in each table and answer the queries given below.

EMPLOYEE (Person_Name, Street, City) WORKS (Person_Name, Company_Name, Salary) COMPANY (Company_Name, City)

MANAGES (Person_Name, Manager_Name)

a) Identify primary and foreign keys.
b) Alter table employee, add a column ―email‖ of type varchar(20).
c) Find the name of all managers who work for both Samba Bank and NCB Bank.
d) Find the names, street address and cities of residence and salary of all employees who work for ―Samba Bank‖ and earn more than $10,000.
e) Find the names of all employees who live in the same city as the company for which they work.
f) Find the highest salary, lowest salary and average salary paid by each company.
g) Find the sum of salary and number of employees in each company.
h) Find the name of the company that pays highest salary.

5) Create the following tables, enter at least 5 records in each table and answer the queries given below.

Suppliers (SNo, Sname, Status, SCity)Parts (PNo, Pname, Colour, Weight,City) Project (JNo, Jname, Jcity)Shipment (Sno, Pno, Jno, Qunatity)

a) Identify primary and foreign keys.
b) Get supplier numbers for suppliers in Paris with status>20.
c) Get suppliers details for suppliers who supply part P2. Display the supplier list in increasing order of supplier numbers.

d) Get suppliers names for suppliers who do not supply part P2.
e) For each shipment get full shipment details, including total shipment weights.
f) Get all the shipments where the quantity is in the range 300 to 750 inclusive.
g) Get part nos. for parts that either weigh more than 16 pounds or are supplied by suppliers S2, or both.
h) Get the names of cities that store more than five red parts.
i) Get full details of parts supplied by a supplier in London.
j) Get part numbers for part supplied by a supplier in London to a project in London.
k) Get the total number of project supplied by a supplier (say, S1).
l) Get the total quantity of a part (say, P1) supplied by a supplier (say, S1).

5TH SEMESTER

C-11: Internet Technologies
Theory: 60 Lectures

1. Java **(5 lectures)**
Use of Objects, Array and ArrayList class

2. JavaScript **(15 lectures)**
Data types, operators, functions, control structures, events and event handling.

3. JDBC **(10 lectures)**
JDBC Fundamentals, Establishing Connectivity and working with connection interface, working with statements, Creating and Executing SQL Statements, Working with Result Set Objects.

4. JSP **(20 lectures)**
Introduction to JavaServer Pages, HTTP and Servlet Basics, The Problem with Servlets, The Anatomy of a JSP Page, JSP Processing, JSP Application Design with MVC, Setting Up the JSP Environment, Implicit JSP Objects, Conditional Processing, Displaying Values, Using an expression to Set an Attribute, Declaring Variables and Methods, Error Handling and Debugging, Sharing Data Between JSP Pages, Requests, and Users, Database Access.

5. Java Beans **(10 lectures)**
Java Beans Fundamentals, JAR files, Introspection, Developing a simple Bean, Connecting to DB

Recommended Books:

1. Ivan Bayross, Web Enabled Commercial Application Development Using Html, Dhtml,javascript, Perl Cgi , BPB Publications, 2009.
2. Cay Horstmann, BIG Java, Wiley Publication , 3rd Edition., 2009
3. Herbert Schildt , Java 7, The Complete Reference, , 8th Edition, 2009.

4. Jim Keogh ,The Complete Reference J2EE, TMH, , 2002.
5. O'Reilly , Java Server Pages, Hans Bergsten, Third Edition, 2003.

COMPUTER SCIENCE LAB (C-11): Internet Technologies Lab

Practical: 60 Lectures

Create event driven program for following:

1. Print a table of numbers from 5 to 15 and their squares and cubes using alert.
2. Print the largest of three numbers.
3. Find the factorial of a number n.
4. Enter a list of positive numbers terminated by Zero. Find the sum and average of these numbers.
5. A person deposits Rs 1000 in a fixed account yielding 5% interest. Compute the amount in the account at the end of each year for n years.
6. Read n numbers. Count the number of negative numbers, positive numbers and zeros in the list.

C-12:Theory of Computation

Theory: 60 Lectures

1. Languages (8 Lectures)

Alphabets, string, language, Basic Operations on language, Concatenation, KleeneStar

2. Finite Automata and Regular Languages (20 Lectures)

Regular Expressions, Transition Graphs, Deterministics and non-deterministic finite automata, NFA to DFA Conversion, Regular languages and their relationship with finite automata, Pumping lemma and closure properties of regular languages.

3. Context free languages(17 Lectures)

Context free grammars, parse trees, ambiguities in grammars and languages, Pushdown automata (Deterministic and Non-deterministic), Pumping Lemma, Properties of context free languages, normal forms.

4. TuringMacines and Models of Computations(15 Lectures)

RAM, Turing Machine as a model of computation, Universal Turing Machine, Language acceptability, decidability, halting problem, Recursively enumerable and recursive languages, unsolvability problems.

Recommended Books:

1. Daniel I.A.Cohen, Introduction to computer theory, John Wiley,1996
2. Lewis & Papadimitriou, Elements of the theory of computation , PHI 1997.

3. Hoperoft, Aho, Ullman, Introduction to Automata theory, Language & Computation –3rd Edition, Pearson Education. 2006
4. P. Linz, An Introduction to Formal Language and Automata 4th edition Publication Jones Bartlett, 2006

COMPUTER SCIENCE LAB/Tutorial (C-12): Theory of Computation
Tutorial: 15 Lectures

DSE-1:Digital Image Processing

Theory: 60 Lectures

1. Introduction (6 Lectures)
Light, Brightness adaption and discrimination, Pixels, coordinate conventions, Imaging Geometry, Perspective Projection, Spatial Domain Filtering, sampling and quantization.

2. Spatial Domain Filtering (7 Lectures)
Intensity transformations, contrast stretching, histogram equalization, Correlation and convolution, Smoothing filters, sharpening filters, gradient and Laplacian.

3. Filtering in the Frequency domain (8 Lectures)
Hotelling Transform, Fourier Transforms and properties, FFT (Decimation in Frequency and Decimation in Time Techniques), Convolution, Correlation, 2-D sampling, Discrete Cosine Transform, Frequency domain filtering.

4. Image Restoration (8 Lectures)
Basic Framework, Interactive Restoration, Image deformation and geometric transformations, image morphing, Restoration techniques, Noise characterization, Noise restoration filters, Adaptive filters, Linear, Position invariant degradations, Estimation of Degradation functions, Restoration from projections.

5. Image Compression (10 Lectures)
Encoder-Decoder model, Types of redundancies, Lossy and Lossless compression, Entropy of an information source, Shannon's 1st Theorem, Huffman Coding, Arithmetic Coding, Golomb Coding, LZW coding, Transform Coding, Sub-image size selection, blocking artifacts, DCT implementation using FFT, Run length coding, FAX compression (CCITT Group-3 and Group-4), Symbol-based coding, JBIG-2, Bit-plane encoding, Bit-allocation, Zonal Coding, Threshold Coding, JPEG, Lossless predictive coding, Lossy predictive coding, Motion Compensation

6. Wavelet based Image Compression (5 Lectures)
Expansion of functions, Multi-resolution analysis, Scaling functions, MRA refinement equation, Wavelet series expansion, Discrete Wavelet Transform (DWT), Continuous Wavelet Transform, Fast Wavelet Transform, 2-D wavelet Transform, JPEG-2000 encoding, Digital Image Watermarking.

7. Morphological Image Processing (7 Lectures)
Basics, SE, Erosion, Dilation, Opening, Closing, Hit-or-Miss Transform, Boundary Detection, Hole filling, Connected components, convex hull, thinning, thickening, skeletons, pruning, Geodesic Dilation, Erosion, Reconstruction by dilation and erosion.

8. Image Segmentation (9 Lectures)

Boundary detection based techniques, Point, line detection, Edge detection, Edge linking, local processing, regional processing, Hough transform, Thresholding, Iterative thresholding, Otsu's method, Moving averages, Multivariable thresholding, Region-based segmentation, Watershed algorithm, Use of motion in segmentation

Reference Books

1. R C Gonzalez , R E Woods, Digital Image Processing, 3rd Edition, Pearson Education.2008.
2. A K Jain, Fundamentals of Digital image Processing, Prentice Hall of India.1989.
3. K R Castleman, Digital Image Processing, Pearson Education.1996
4. Schalkoff, Digital Image Processing and Computer Vision, John Wiley and Sons.1989.
5. Rafael C. Gonzalez, Richard E. Woods, Steven Eddins,' Digital Image Processing using MATLAB', Pearson Education, Inc., 2004.

Digital Image Processing Lab

Practical: 60 Lectures

1. Write program to read and display digital image using MATLAB or SCILAB
   a. Become familiar with SCILAB/MATLAB Basic commands
   b. Read and display image in SCILAB/MATLAB
   c. Resize given image
   d. Convert given color image into gray-scale image
   e. Convert given color/gray-scale image into black & white image
   f. Draw image profile
   g. Separate color image in three R G & B planes
   h. Create color image using R, G and B three separate planes
   i. Flow control and LOOP in SCILAB
   j. Write given 2-D data in image file

2. To write and execute image processing programs using point processing method
   a. Obtain Negative image
   b. Obtain Flip image
   c. Thresholding
   d. Contrast stretching

3. To write and execute programs for image arithmetic operations
   a. Addition of two images
   b. Subtract one image from other image
   c. Calculate mean value of image
   d. Different Brightness by changing mean value

4. To write and execute programs for image logical operations
   a. AND operation between two images
   b. OR operation between two images
   c. Calculate intersection of two images
   d. Water Marking using EX-OR operation
   e. NOT operation (Negative image)

5. To write a program for histogram calculation and equalization using
   a. Standard MATLAB function
   b. Program without using standard MATLAB functions
   c. C Program

6. To write and execute program for geometric transformation of image
   a. Translation
   b. Scaling

c. Rotation
d. Shrinking
e. Zooming

7. To understand various image noise models and to write programs for
   a. image restoration
   b. Remove Salt and Pepper Noise
   c. Minimize Gaussian noise
   d. Median filter and Weiner filter

8. Write and execute programs to remove noise using spatial filters
   a. Understand 1-D and 2-D convolution process
   b. Use 3x3 Mask for low pass filter and high pass filter

9. Write and execute programs for image frequency domain filtering
   a. Apply FFT on given image
   b. Perform low pass and high pass filtering in frequency domain
   c. Apply IFFT to reconstruct image

10. Write a program in C and MATLAB/SCILAB for edge detection using different edge detection mask
11. Write and execute program for image morphological operations erosion and dilation.
12. To write and execute program for wavelet transform on given image and perform inverse wavelet transform to reconstruct image.

DSE-2: Numerical Methods

Theory: 60 Lectures

1. Floating point representation and computer arithmetic, Significant digits, Errors: Round-off error, Local truncation error, Global truncation error, Order of a method, Convergence and terminal conditions, Efficient computations

2. Bisection method, Secant method, Regula–Falsi methodNewton–Raphson method, Newton‘s method for solving nonlinear systemsGauss elimination method (with row pivoting) and Gauss–Jordan method, Gauss Thomas method for tridiagonal systems

3. Iterative methods: Jacobi and Gauss-Seidel iterative methods Interpolation: Lagrange‘s form and Newton‘s form
4. Finite difference operators, Gregory Newton forward and backward differences Interpolation Piecewise polynomial interpolation: Linear interpolation, Cubic spline interpolation (only method), Numerical differentiation: First derivatives and second order derivatives, Richardson extrapolation
5. Numerical integration: Trapezoid rule, Simpson‘s rule (only method), Newton–Cotes open formulas
6. Extrapolation methods: Romberg integration, Gaussian quadrature, Ordinary differential equation: Euler‘s method Modified Euler‘s methods: Heun method and Mid-point method, Runge-Kutta second methods: Heun method without iteration, Mid-point method and Ralston‘s method Classical 4^{th} order Runge-Kutta method, Finite difference method for linear ODE

REFERNCE BOOKS:

[1] Laurence V. Fausett, Applied Numerical Analysis, Using MATLAB, Pearson, 2/e (2012)
[2] M.K. Jain, S.R.K. Iyengar and R.K. Jain, Numerical Methods for Scientific and Engineering Computation, New Age International Publisher, 6/e (2012)
[3] Steven C Chapra, Applied Numerical Methods with MATLAB for Engineers and Scientists, Tata McGraw Hill, 2/e (2010)

Numerical Methods Lab

Practical: 60 lectures

1. Find the roots of the equation by bisection method.
2. Find the roots of the equation by secant/Regula–Falsi method.
3. Find the roots of the equation by Newton's method.
4. Find the solution of a system of nonlinear equation using Newton's method.
5. Find the solution of tridiagonal system using Gauss Thomas method.
6. Find the solution of system of equations using Jacobi/Gauss-Seidel method.
7. Find the cubic spline interpolating function.
8. Evaluate the approximate value of finite integrals using Gaussian/Romberg integration.

6TH SEMESTER

C-13: Artificial Intelligence

Theory: 60 Lectures

1. Introduction(06 Lectures)

Introduction to Artificial Intelligence, Background and Applications, Turing Test and Rational Agent approaches to AI, Introduction to Intelligent Agents, their structure, behaviour and environment.

2. Problem Solving and Searching Techniques(20 Lectures)

Problem Characteristics, Production Systems, Control Strategies, Breadth First Search, Depth First Search, Hill climbing and its Variations, Heuristics Search Techniques: Best First Search, A* algorithm, Constraint Satisfaction Problem, Means-End Analysis, Introduction to Game Playing, Min-Max and Alpha-Beta pruning algorithms.

3. Knowledge Representation(20 Lectures)

Introduction to First Order Predicate Logic, Resolution Principle, Unification, Semantic Nets, Conceptual Dependencies, Frames, and Scripts, Production Rules, Conceptual Graphs.Programming in Logic (PROLOG)

4. Dealing with Uncertainty and Inconsistencies(08 Lectures)
Truth Maintenance System, Default Reasoning, Probabilistic Reasoning, Bayesian Probabilistic Inference, Possible World Representations.

5. Understanding Natural Languages(06 Lectures)

Parsing Techniques, Context-Free and Transformational Grammars, Recursive and Augmented Transition Nets.

BOOKS RECOMMENDED:

1. DAN.W. Patterson, Introduction to A.I and Expert Systems – PHI, 2007.

2. Russell &Norvig, Artificial Intelligence-A Modern Approach**,** LPE, Pearson Prentice Hall, 2nd edition, 2005.
3. Rich & Knight, Artificial Intelligence – Tata McGraw Hill, 2nd edition, 1991.
4. W.F. Clocksin and Mellish, Programming in PROLOG, Narosa Publishing House, 3rd edition, 2001.
5. Ivan Bratko, Prolog Programming for Artificial Intelligence, Addison-Wesley, Pearson Education, 3rd edition, 2000.

COMPUTER SCIENCE LAB (C-13): Artificial Intelligence Lab

Practical: 60 Lectures

1. Write a prolog program to calculate the sum of two numbers.

2. Write a prolog program to find the maximum of two numbers.
3. Write a prolog program to calculate the factorial of a given number.

4. Write a prolog program to calculate the nth Fibonacci number.

5. Write a prolog program, insert_nth(item, n, into_list, result) that asserts that result is the list into_list with item inserted as the n'th element into every list at all levels.

6. Write a Prolog program to remove the Nth item from a list.

7. Write a Prolog program, remove-nth(Before, After) that asserts the After list is the Before list with the removal of every n'th item from every list at all levels.

8. Write a Prolog program to implement append for two lists.

9. Write a Prolog program to implement palindrome(List).

10. Write a Prolog program to implement max(X,Y,Max) so that Max is the greater of two numbers X and Y.

11. Write a Prolog program to implement maxlist(List,Max) so that Max is the greatest number in the list of numbers List.

12. Write a Prolog program to implement sumlist(List,Sum) so that Sum is the sum of a given list of numbers List.

13. Write a Prolog program to implement two predicates evenlength(List) and oddlength(List) so that they are true if their argument is a list of even or odd length respectively.

14. Write a Prolog program to implement reverse(List,ReversedList) that reverses lists.

15. Write a Prolog program to implement maxlist(List,Max) so that Max is the greatest number in the list of numbers List using cut predicate.

16. Write a Prolog program to implement GCD of two numbers.

17. Write a prolog program that implements Semantic Networks/Frame Structures.

C-14: Computer Graphics

Theory: 60 Lectures

1. Introduction (5 Lectures)Basic elements of Computer graphics, Applications of Computer Graphics.

2. Graphics Hardware (8 Lectures)
Architecture of Raster and Random scan display devices, input/output devices.

3. Fundamental Techniques in Graphics(22 Lectures)

Raster scan line, circle and ellipse drawing, thick primitives, Polygon filling, line and polygon clipping algorithms, 2D and 3D Geometric Transformations, 2D and 3D Viewing Transformations (Projections- Parallel and Perspective), Vanishing points.

4. GeometricModeling(10 Lectures)
Representing curves & Surfaces.

5. Visible Surface determination (8 Lectures)
Hidden surface elimination.

6. Surface rendering (7 Lectures)
Illumination and shading models. Basic color models and Computer Animation.

Books Recommended:

1. J.D.Foley, A.Van Dan, Feiner, Hughes Computer Graphics Principles & Practice 2nd edition Publication Addison Wesley 1990.

2. D.Hearn, Baker: Computer Graphics, Prentice Hall of India 2008.

3. D.F.Rogers Procedural Elements for Computer Graphics, McGraw Hill 1997.
4. D.F.Rogers, Adams Mathematical Elements for Computer Graphics, McGraw Hill 2nd edition 1989.

COMPUTER SCIENCE LAB (C-14): Computer Graphics Lab

Practical: 60 Lectures

1. Write a program to implement Bresenham's line drawing algorithm.
2. Write a program to implement mid-point circle drawing algorithm.
3. Write a program to clip a line using Cohen and Sutherland line clipping algorithm.
4. Write a program to clip a polygon using Sutherland Hodgeman algorithm.
5. Write a program to apply various 2D transformations on a 2D object (use homogenous coordinates).
6. Write a program to apply various 3D transformations on a 3D object and then apply parallel and perspective projection on it.
7. Write a program to draw Hermite/Bezier curve.

DSE-3:Systems Programming

Theory: 60 lectures

1. **Assemblers & Loaders, Linkers:** 10L

One pass and two pass assembler, design of an assembler, Absolute loader, relocation and linking concepts, relocating loader and Dynamic Linking.

2. **Introduction:** 2L

Overview of compilation, Phases of a compiler

3. **Lexical Analysis:** 6L

Role of a Lexical analyzer, Specification and recognition of tokens, Symbol table, lex

4. **Parsing:** 10L

Bottom up parsing- LR parser, yacc.

5. **Intermediate representations** 10L

Three address code generation, syntax directed translation, translation of types, control Statements

6. **Storage organization:** 5L

Activation records, stack allocation

7. Code Generation: 5L

Object code generation

Reference Books

1. SantanuChattopadhyaya, *Systems Programming*, PHI, 2011.
2. Alfred V. Aho, Monica S. Lam, Ravi Sethi, Jeffrey D. Ullman, *Compilers: Principles*,*Techniques*, *and Tools*, 2nd edition, Prentice Hall, 2006.
3. D. M. Dhamdhere, *Systems Programming*, Tata McGraw Hill, 2011.
4. Leland Beck, D. Manjula, *System Software: An Introduction to System Programming*, 3rd edition, Pearson Education, 2008.
5. Grune D, Van Reeuwijk . K, Bal H. E, Jacobs C J H, Langendoen K, *Modern CompilerDesign*, 2nd edition, Springer, 2012

SYSTEMS PROGRAMMING LAB
Practical: 60 lectures

[1] To implement an assembler for a hypothetical language.

[2] To get familiar with lex: write a program to recognize numbers, identifiers.

[3] To get familiar with yacc: write a desk calculator.

DSE-4: Dissertation / Project work

This option to be offered only in 6th Semester.

The students will be allowed to work on any project based on the concepts studied in core / elective or skill based elective courses.

The group size should be maximum of three (03) students.

Each group will be assigned a teacher as a supervisor who will handle both their theory as well lab classes.

A maximum of Four (04) projects would be assigned to one teacher.

B. Sc. (Honours): COMPUTER SCIENCE (Modified on 07/08/2020)

SL. NO.	CORE COURSE (14)	ABILITY ENHANCEMENT COURSE (AECC) (2)	SKILL ENHANCEMENT COURSE (SEC) (2)	ELECTIVE: DISCIPLINE SPECIFIC DSE (4)	ELECTIVE: GENERIC (GE) (4)
1	C1 :Programming Fundamentals using C/C++ (4+4 lab)	(English/Hindi/MIL Communication)			GE 1: Computer Fundamentals
	C2: Computer System Architecture (4+4 lab)				
2	C3: Programming in JAVA (4+4 lab)	Environmental Science			GE 2: Introduction to Programming
	C4: Discrete Structures (5+1 lab)				
3	C5: Data Structure (4+4 lab)		SEC 1: UNIX/ LINUX Programming		GE3: Computer Networks and Internet Technologies
	C6: Operating System (4+4 lab)				
	C7: Computer Networks (4+4 lab)				
4	C8: Design and Analysis of Algorithms (4+4 lab)		SEC 2: Oracle (SQL/ PL-SQL)		GE4: Introduction to Database Systems
	C9: Software Engineering (4+4 lab)				
	C10: Data Base Management System (4+4 lab)				
5	C11:Internet Technologies (4+4 lab)			DSE 1: Digital Image Processing	
	C12: Theory of Computation (5+1 lab/Tutorial)			DSE 2: Numerical Methods	
6	C13: Artificial Intelligence (4+4 lab)			DSE 3: System Programming	
	C14: Computer Graphics (4+4 lab)			DSE 4: DISSERTATION/ PROJECT WORK	

B. Sc. (Regular): COMPUTER SCIENCE (Modified on 07/08/2020)

SL. NO.	CORE COURSE (14)	ABILITY ENHANCEMENT COURSE (AECC) (2)	SKILL ENHANCEMENT COURSE (SEC) (2)	ELECTIVE: DISCIPLINE SPECIFIC DSE (4)
1	DSC – 1A	(English/Hindi/MIL Communication)		
	DSC – 2A			
	DSC- 3A : Computer Fundamentals			
2	DSC – 1 B	Environmental Science		
	DSC – 2B			
	DSC- 3B : Introduction to Programming			
3	DSC – 1 C		SEC 1: Android Programming	
	DSC – 2C			
	DSC- 3C : Computer Networks & Internet Technologies			
4	DSC – 1 D		SEC 2: XML Programming	
	DSC – 2D			
	DSC- 3D : Introduction to Database Systems			
5			SEC 3: PHP Programming	DSE-1A
				DSE -2A
				DSE-3A : Programming in Visual Basic/Gambas
6			SEC 4: UNIX/LINUX Programming	DSE-1B
				DSE -2B
				DSE-3B: Software Testing

Bodoland University
Curriculum Structures for UG syllabus for B.Sc. (Regular Course)
SUBJECT: COMPUTER SCIENCE
No. of papers=12+12=24, Total Credits= 120
Total Marks=2100

Table 1: For SEM-I						
Paper Code	**Course**	**L+T+P**	**Credit**	**End Sem**	**Int**	**TotalMarks**
Paper-101P	DSC-1A	4+0+2 5+1+0	6	60(L)+20(P) 60(L)+20(T)	20	100
Paper-102P	DSC-2A	4+0+2 5+1+0	6	60(L)+20(P) 60(L)+20(T)	20	100
Paper-103P	DSC-3A	4+0+2 5+1+0	6	60(L)+20(P) 60(L)+20(T)	20	100
Paper-104HP	AECC-1: **English/Hindi/MIL (Communication)**	2	2	50		50
Total-			**20**	**290**	**60**	**350**

Table 2: For SEM-II						
Paper Code	**Course**	**L+T+P**	**Credit**	**End Sem**	**Int**	**TotalMarks**
Paper-201P	DSC-1B	4+0+2 5+1+0	6	60(L)+20(P) 60(L)+20(T)	20	100
Paper-202P	DSC-2B	4+0+2 5+1+0	6	60(L)+20(P) 60(L)+20(T)	20	100
Paper-203P	DSC-3B	4+0+2 5+1+0	6	60(L)+20(P) 60(L)+20(T)	20	100
Paper-204HP	AECC-2: **Environmental Science**	2	2	50		50
Total-			**20**	**290**	**60**	**350**

Table 3: For SEM-III						
Paper Code	**Course**	**L+T+P**	**Credit**	**End Sem**	**Int**	**TotalMarks**
Paper-301P	DSC-1C	4+0+2 5+1+0	6	60(L)+20(P) 60(L)+20(T)	20	100
Paper-302P	DSC-2C	4+0+2 5+1+0	6	60(L)+20(P) 60(L)+20(T)	20	100
Paper-303P	DSC-3C	4+0+2 5+1+0	6	60(L)+20(P) 60(L)+20(T)	20	100
Paper-304HP	SEC-1	2	2	50		50
Total-			**20**	**290**	**60**	**350**

Table 4: For SEM-IV						
Paper Code	**Course**	**L+T+P**	**Credit**	**End Sem**	**Int**	**TotalMarks**
Paper-401P	DSC-1A	4+0+2 5+1+0	6	60(L)+20(P) 60(L)+20(T)	20	100
Paper-402P	DSC-2A	4+0+2 5+1+0	6	60(L)+20(P) 60(L)+20(T)	20	100
Paper-403P	DSC-3A	4+0+2 5+1+0	6	60(L)+20(P) 60(L)+20(T)	20	100
Paper-404HP	SEC-2	2	2	50		50
Total-			**20**	**290**	**60**	**350**

Table 5: For SEM-V						
Paper Code	**Course**	**L+T+P**	**Credit**	**End Sem**	**Int**	**TotalMarks**
Paper-501P	DSE-1A	4+0+2 5+1+0	6	60(L)+20(P) 60(L)+20(T)	20	100
Paper-502P	DSE-2A	4+0+2 5+1+0	6	60(L)+20(P) 60(L)+20(T)	20	100
Paper-503P	DSE-3A	4+0+2 5+1+0	6	60(L)+20(P) 60(L)+20(T)	20	100
Paper-504P	SEC-3	2	2	50		50
Total-			**20**	**290**	**60**	**350**

SYLLABUS FOR REGULAR COURSE (COMPUTER SCIENCE)

Table 1: For SEM-I						
Paper Code	**Course**	**L+T+P**	**Credit**	**End Sem**	**Int**	**TotalMarks**
PHY-101R	DSC-1A	4+0+2 5+1+0	6	60(L)+20(P) 60(L)+20(T)	20	100
CS-DSC-102 R	DSC-2A	4+0+2 5+1+0	6	60(L)+20(P) 60(L)+20(T)	20	100
MATH-103 R	DSC-3A	4+0+2 5+1+0	6	60(L)+20(P) 60(L)+20(T)	20	100
COMM-104H R	AECC-1: **English/Hindi/MIL (Communication)**	2	2	50		50
Total-			**20**	**290**	**60**	**350**

Table 3: For SEM-III						
Paper Code	**Course**	**L+T+P**	**Credit**	**End Sem**	**Int**	**TotalMarks**

Table 2: For SEM-II

Paper Code	Course	L+T+P	Credit	End Sem	Int	TotalMarks
PHY-201 R	DSC-1B	4+0+2 5+1+0	6	60(L)+20(P) 60(L)+20(T)	20	100
CS-DSC-202 R	DSC-2B	4+0+2 5+1+0	6	60(L)+20(P) 60(L)+20(T)	20	100
MATH-203P	DSC-3B	4+0+2 5+1+0	6	60(L)+20(P) 60(L)+20(T)	20	100
ENV-204H R	AECC-2: **Environmental Science**	2	2	50		50
Total-			**20**	**290**	**60**	**350**

PHY-301 R	DSC-1C	4+0+2 5+1+0	6	60(L)+20(P) 60(L)+20(T)	20	100
CS-DSC-302 R	DSC-2C	4+0+2 5+1+0	6	60(L)+20(P) 60(L)+20(T)	20	100
MATH-303 R	DSC-3C	4+0+2 5+1+0	6	60(L)+20(P) 60(L)+20(T)	20	100
CS-SEC1-304 R	SEC-1	2	2	50		50
Total-			**20**	**290**	**60**	**350**

Table 4: For SEM-IV						
Paper Code	**Course**	**L+T+P**	**Credit**	**End Sem**	**Int**	**TotalMarks**
PHY-401 R	DSC-1A	4+0+2 5+1+0	6	60(L)+20(P) 60(L)+20(T)	20	100
CS-DSC-402 R	DSC-2A	4+0+2 5+1+0	6	60(L)+20(P) 60(L)+20(T)	20	100
MATH-403 R	DSC-3A	4+0+2 5+1+0	6	60(L)+20(P) 60(L)+20(T)	20	100
CS-SEC2-404 R	SEC-2	2	2	50		50
Total-			**20**	**290**	**60**	**350**

Table 6: For SEM-VI						
Paper Code	**Course**	**L+T+P**	**Credit**	**End Sem**	**Int**	**TotalMarks**

Table 5: For SEM-V						
Paper Code	**Course**	**L+T+P**	**Credit**	**End Sem**	**Int**	**TotalMarks**
PHY-501 R	DSE-1A	4+0+2 5+1+0	6	60(L)+20(P) 60(L)+20(T)	20	100
CS-DSE-502 R	DSE-2A	4+0+2 5+1+0	6	60(L)+20(P) 60(L)+20(T)	20	100
MATH-503 R	DSE-3A	4+0+2 5+1+0	6	60(L)+20(P) 60(L)+20(T)	20	100
CS-SEC3-504 R	SEC-3	2	2	50		50
Total-			**20**	**290**	**60**	**350**

Paper-601P	DSE-1B	4+0+2 5+1+0	6	60(L)+20(P) 60(L)+20(T)	20	100
Paper-602P	DSE-2B	4+0+2 5+1+0	6	60(L)+20(P) 60(L)+20(T)	20	100

Table 6: For SEM-VI

Paper Code	Course	L+T+P	Credit	End Sem	Int	Total Marks
Paper-603P	DSE-3B	4+0+2 5+1+0	6	60(L)+20(P) 60(L)+20(T)	20	100
Paper-604P	SEC-4	2	2	50		50
Total			20	290	60	350

CS-DSE-602 R	DSE-2B	4+0+2 5+1+0	6	60(L)+20(P) 60(L)+20(T)	20	100
MATH-603 R	DSE-3B	4+0+2 5+1+0	6	60(L)+20(P) 60(L)+20(T)	20	100
CS-SEC4-604 R	SEC-4	2	2	50		50
Total-			**20**	**290**	**60**	**350**

1ST SEMESTER

DSC-2A:Computer Fundamentals
Theory: 60 lectures

Introduction: Introduction to computer system, uses, types. **6L**

Data Representation: Number systems and character representation, binary arithmetic **12L**

6L

Human Computer Interface: Types of software, Operating system as userinterface, utility programs

10L

Devices: Input and output devices (with connections and practical demo),keyboard, mouse, joystick, scanner, OCR, OMR, bar code reader, web camera, monitor, printer, plotter

6L

Memory: Primary, secondary, auxiliary memory, RAM, ROM, cache memory,hard disks, optical disks

12L

Computer Organisation and Architecture: C.P.U., registers, system bus, mainmemory unit, cache memory, Inside a computer, SMPS, Motherboard, Ports and Interfaces, expansion cards, ribbon cables, memory chips, processors.

8L

Overview of Emerging Technologies: Bluetooth, cloud computing, big data,data mining, mobile computing and embedded systems.

Reference Books:

1. A. Goel, Computer Fundamentals, Pearson Education, 2010.
2. P. Aksoy, L. DeNardis, Introduction to Information Technology, Cengage Learning, 2006
3. P. K.Sinha, P. Sinha, Fundamentals of Computers, BPB Publishers, 2007

Computer Fundamentals Lab
Practical: 60 lectures

Practical exercises based on MS Office/ Open Office tools using document preparation and spreadsheet handling packages.

MS Word

1. Prepare **a grocery list** having four columns (Serial number, The name of the product, quantity and price) for the month of April, 06.

    - Font specifications for Title (Grocery List): 14-point Arial font in bold and italics.
    - The headings of the columns should be in 12-point and bold.
    - The rest of the document should be in 10-point Times New Roman.
    - Leave a gap of 12-points after the title.

2. Create a **telephone directory**.
    - The heading should be 16-point Arial Font in bold
    - The rest of the document should use 10-point font size
    - Other headings should use 10-point Courier New Font.
    - The footer should show the page number as well as the date last updated.

3. Design a **time-table form** for your college.
    - The first line should mention the name of the college in 16-point Arial Font and should be bold.
    - The second line should give the course name/teacher‘s name and the department in 14-point Arial.
    - Leave a gap of 12-points.
    - The rest of the document should use 10-point Times New Roman font.
    - The footer should contain your specifications as the designer and date of creation.

4. BPB Publications plans to release a new book designed as per your syllabus. Design the **first page of the book** as per the given specifications.
    - The title of the book should appear in bold using 20-point Arial font.
    - The name of the author and his qualifications should be in the center of the page in 16-

point Arial font.

- At the bottom of the document should be the name of the publisher and address in 16-point Times New Roman.
- The details of the offices of the publisher (only location) should appear in the footer.

5. Create the following one page documents.
   a. Compose a note inviting friends to a get-together at your house, Including a list of things to bring with them.
   b. Design a certificate in landscape orientation with a border around the document.
   c. Design a Garage Sale sign.
   d. Make a sign outlining your rules for your bedroom at home, using a numbered list.
6. Create the following documents:
   (a) A newsletter with a headline and 2 columns in portrait orientation, including at least one image surrounded by text.
   (b) Use a newsletter format to promote upcoming projects or events in your classroom or college.
7. Enter the following data into a table given on the next page.

Salesperson	**Dolls**	**Trucks**	**Puzzles**
Kennedy, Sally	1327	1423	1193
White, Pete	1421	3863	2934
Pillar, James	5214	3247	5467
York, George	2190	1278	1928
Banks, Jennifer	1201	2528	1203
Atwater, Kelly	4098	3079	2067
Pillar, James	5214	3247	5467
York, George	2190	1278	1928
Banks, Jennifer	1201	2528	1203
Atwater, Kelly	4098	3079	2067

Add a column Region (values: S, N, N,S,S,S) between the Salesperson and Dolls columns to the given table Sort your table data by Region and within Region by Salesperson in ascending order:

In this exercise, you will add a new row to your table, place the word "Total" at the bottom of the Salesperson column, and sum the Dolls, Trucks, and Puzzles columns.

8. Wrapping of text around the image.
9. Following features of menu option must be covered

FILE	Complete menu
EDIT	Complete menu
VIEW	Complete menu
INSERT	Complete menu

FORMAT	Complete menu
TABLE	Complete menu
WINDOW	Complete menu
HELP	Complete menu
TOOLS	All options except Online collaboration, Tools on Macro, Templates

MS Excel

1. Enter the Following data in Excel Sheet

REGIONAL SALES PROJECTION

State	Qtr1	Qtr2	Qtr3	QTR4	Qtr Total	Rate Amount
Delhi	2020	2400	2100	3000	15	
Punjab	1100	1300	1500	1400	20	
U.P.	3000	3200	2600	2800	17	
Haryana	1800	2000	2200	2700	15	
Rajasthan	2100	2000	1800	2200	20	

TOTAL
AVERAGE

(a) Apply Formatting as follow: I.Title in

TIMES NEW ROMAN

ii. Font Size - 14
iii. Remaining text - ARIAL, Font Size -10
iv. State names and Qtr. Heading Bold, Italic with Gray Fill Color.
v. Numbers in two decimal places.
vi. Qtr. Heading in center Alignment.
vii. Apply Border to whole data.

(b) Calculate State and Qtr. Total
(c) Calculate Average for each quarter
(d) Calculate Amount = Rate * Total.

2. Given the following worksheet

	A	B	C	D
1	Roll No.	Name	Marks	Grade
2	1001	Sachin	99	
3	1002	Sehwag	65	
4	1003	Rahul	41	
5	1004	Sourav	89	
6	1005	HarBhajan	56	

Calculate the grade of these students on the basis of following guidelines:

If Marks	Then Grade
>= 80	A+
>= 60 < 80	A
>= 50 < 60	B
< 50	F

3. Given the following workshee

	A	B	C	D	E	F	G
1	**Salesman**		**Sales in (Rs.)**				
2	No.	Qtr1	Qtr2	Qtr3	Qtr4	Total	Commission
3	S001	5000	8500	12000	9000		
4	S002	7000	4000	7500	11000		
5	S003	4000	9000	6500	8200		
6	S004	5500	6900	4500	10500		
7	S005	7400	8500	9200	8300		
8	S006	5300	7600	9800	6100		

Calculate the commission earned by the salesmen on the basis of following Candidates:

If Total Sales	**Commission**
< 20000	0% of sales
> 20000 and < 25000	4% of sales
> 25000 and < 30000	5.5% of sales
> 30000 and < 35000	8% of sales
>= 35000	11% of sales

The total sales is sum of sales of all the four quarters.

4. A company XYZ Ltd. pays a monthly salary to its employees which consists of basic salary, allowances & deductions. The details of allowances and deductions are as follows:

Allowances

- HRA Dependent on Basic
  - 30% of Basic if Basic <=1000
  - 25% of Basic if Basic>1000 & Basic<=3000
  - 20% of Basic if Basic >3000
- DA Fixed for all employees, 30% of Basic
- Conveyance Allowance Rs. 50/- if Basic is <=1000 Rs. 75/-
  - if Basic >1000 & Basic<=2000
  - Rs. 100 if Basic >2000
- Entertainment Allowance NIL if Basic is<=1000
  - Rs. 100/- if Basic > 1000

Deductions

- Provident Fund 6% of Basic
- Group Insurance Premium Rs. 40/- if Basic is <=1500
  - Rs. 60/- if Basic > 1500 & Basic<=3000
  - Rs. 80/- if Basic >3000

Calculate the following:

Gross Salary = Basic + HRA + DA + Conveyance + Entertainment

Total deduction = Provident Fund + Group Insurance Premium

Net Salary = Gross Salary – Total Deduction

5. Create Payment Table for a fixed Principal amount, variable rate of interests and time in the format below:

No. of Instalments	5%	6%	7%	8%	9%
3	XX	XX	XX	XX	XX
4	XX	XX	XX	XX	XX
5	XX	XX	XX	XX	XX
6	XX	XX	XX	XX	XX

6. Use an array formula to calculate Simple Interest for given principal amounts given the rate of Interest and time

Rate of Interest	8%
Time	5 Years
Principal	Simple Interest
1000	?
18000	?
5200	?

7. The following table gives year wise sale figure of five salesmen in Rs.

Salesman	2000	2001	2002	2003
S1	10000	12000	20000	50000
S2	15000	18000	50000	60000
S3	20000	22000	70000	70000
S4	30000	30000	100000	80000
S5	40000	45000	125000	90000

(a) Calculate total sale year wise.

(b) Calculate the net sale made by each salesman

(c) Calculate the maximum sale made by the salesman

(d) Calculate the commission for each salesman under the condition.

(i) If total sales >4,00,000 give 5% commission on total sale made by the salesman.

(ii) Otherwise give 2% commission.

(e) Draw a bar graph representing the sale made by each salesman. (*f*)Draw a pie graph representing the sale made by salesman in 2000.

8. Enter the following data in Excel Sheet

PERSONAL BUDGET FOR FIRST QUARTER

Monthly Income (Net): 1,475

EXPENSES	**JAN**	**FEB**	**MARCH QUARTER TOTAL**	**QUARTER AVERAGE**
Rent600.00	600.00	600.00		
Telephone	48.25	43.50	60.00	
Utilities	67.27	110.00	70.00	
Credit Card	200.00	110.00	70.00	
Oil	100.00	150.00	90.00	
AV to Insurance	150.00			
Cable TV	40.75	40.75	40.75	

Monthly Total

Calculate Quarter total and Quarter average.

(a) Calculate Monthly total.

(b) Surplus = Monthly income - Monthly total.

(c) What would be total surplus if monthly income is 1500.

(d) How much does telephone expense for March differ from quarter average.

(e) Create a 3D column graph for telephone and utilities.

(f) Create a pie chart for monthly expenses.

9. Enter the following data in Excel Sheet

TOTAL REVENUE EARNED FOR SAM'S BOOKSTALL

Publisher name	**1997**	**1998**	**1999**	**2000**	**total**
A	Rs. 1,000.00	Rs. 1100.00	Rs. 1,300.00	Rs. 800.00	
B	Rs. 1,500.00	Rs. 700.00	Rs. 1,000.00	Rs. 2,000.00	
C	Rs. 700.00	Rs. 900.00	Rs. 1,500.00	Rs. 600.00	
D	Rs. 1,200.00	Rs. 500.00	Rs. 200.00	Rs. 1,100.00	
E	Rs 800.00	Rs. 1,000.00	Rs. 3,000.00	Rs. 560.00	

(a) Compute the total revenue earned.

(b) Plot the line chart to compare the revenue of all publisher for 4 years.

(b) Chart Title should be _Total Revenue of sam's Bookstall (1997-2000)'

(c) Give appropriate categories and value axis title.

10. Generate 25 random numbers between 0 & 100 and find their sum, average and count. How many no. are in range 50-60

2ND SEMESTER

DSC-2B:Introduction to Programming

Theory: 60 lectures

Introduction to C and C++ (5 Lectures)

History of C and C++, Overview of Procedural Programming and Object-Orientation Programming, Using main() function, Compiling and Executing Simple Programs in C++.

Data Types, Variables, Constants, Operators and Basic I/O (10 Lectures)
Declaring, Defining and Initializing Variables, Scope of Variables, Using Named Constants, Keywords, Data Types, Casting of Data Types, Operators (Arithmetic, Logical and Bitwise), Using Comments in programs, Character I/O (getc, getchar, putc, putcharetc), Formatted and Console I/O (printf(), scanf(), cin, cout), Using Basic Header Files (stdio.h, iostream.h, conio.hetc).

Expressions, Conditional Statements and Iterative Statements (10 Lectures)
Simple Expressions in C++ (including Unary Operator Expressions, Binary Operator Expressions), Understanding Operators Precedence in Expressions, Conditional Statements (if construct, switch-case construct), Understanding syntax and utility of Iterative Statements (while, do-while, and for loops), Use of break and continue in Loops, Using Nested Statements (Conditional as well as Iterative)

Functions and Arrays (10 Lectures)

Utility of functions, Call by Value, Call by Reference, Functions returning value, Void functions, Inline Functions, Return data type of functions, Functions parameters, Differentiating between Declaration and Definition of Functions, Command Line Arguments/Parameters in Functions, Functions with variable number of Arguments.

Creating and Using One Dimensional Arrays (Declaring and Defining an Array, Initializing an Array, Accessing individual elements in an Array, Manipulating array elements using loops), Use Various types of arrays (integer, float and character arrays / Strings) Two-dimensional Arrays (Declaring, Defining and Initializing Two Dimensional Array, Working with Rows and Columns), Introduction to Multi-dimensional arrays

Derived Data Types (Structures and Unions) (5 Lectures)
Understanding utility of structures and unions, Declaring, initializing and using simple structures and unions, Manipulating individual members of structures and unions, Array of Structures, Individual data members as structures, Passing and returning structures from functions, Structure with union as members, Union with structures as members.

File I/O, Preprocessor Directives (8 Lectures)
Opening and closing a file (use of fstream header file, ifstream, ofstream and fstream classes), Reading and writing Text Files, Using put(), get(), read() and write() functions, Random access in files, Understanding the Preprocessor Directives (#include, #define, #error, #if, #else, #elif, #endif, #ifdef, #ifndef and #undef), Macros

Using Classes in C++ (8 Lectures)
Principles of Object-Oriented Programming, Defining & Using Classes, Class Constructors, Constructor Overloading, Function overloading in classes, Class Variables &Functions, Objects as parameters, Specifying the Protected and Private Access, Copy Constructors, Overview of
Template classes and their use.

Inheritance and Polymorphism (4 Lectures)
Introduction to Inheritance and Polymorphism

Reference Books:

1. HerbtzSchildt, "C++: The Complete Reference", Fourth Edition, McGraw Hill.2003
2. BjarneStroustrup, "The C++ Programming Language", 4th Edition, Addison-Wesley , 2013.

3. BjarneStroustroup, "Programming -- Principles and Practice using C++", 2nd Edition, Addison-Wesley 2014.

4. E Balaguruswamy, "Object Oriented Programming with C++", Tata McGraw-Hill Education, 2008.

5. PaulDeitel, Harvey Deitel, "C++ How to Program", 8th Edition, Prentice Hall, 2011.

6. John R. Hubbard, "Programming with C++", Schaum's Series, 2nd Edition, 2000.

7. Andrew Koeni, Barbara, E. Moo, "Accelerated C++", Published by Addison-Wesley

8. Scott Meyers, "Effective C++", 3rd Edition, Published by Addison-Wesley, 2005.

9. Harry, H. Chaudhary, "Head First C++ Programming: The Definitive Beginner's Guide", First Create space Inc, O-D Publishing, LLC USA.2014

10. Walter Savitch, "Problem Solving with C++", Pearson Education, 2007.

11. Stanley B. Lippman, JoseeLajoie, Barbara E. Moo, "C++ Primer", Published by Addison-Wesley, 5th Edition, 2012

Introduction to c/c++ Programming Lab

Practical: 60 lectures

1. Write a program to find greatest of three numbers.
2. Write a program to find gross salary of a person
3. Write a program to find grade of a student given his marks.
4. Write a program to find divisor or factorial of a given number.
5. Write a program to print first ten natural numbers.
6. Write a program to print first ten even and odd numbers.
7. Write a program to find grade of a list of students given their marks.

3RD SEMESTER

DSC-2C:Computer Networks and Internet Technologies

Theory: 60 lectures

Computer Networks: Introduction to computernetwork, data communication,components of data communication, data transmission mode, data communication measurement, LAN, MAN, WAN, wireless LAN, internet, intranet, extranet.**6L**

Network Models: Client/ server network and Peer-to-peer network, OSI, TCP/IP,layers and functionalities.**8L**

Transmission Media: Introduction, Guided Media: Twisted pair, Coaxial cable, Optical fiber. Unguided media: Microwave, Radio frequency propagation, Satellite.**4L**

LAN Topologies: Ring, bus, star, mesh and tree topologies.**2L**

Network Devices: NIC, repeaters, hub, bridge, switch, gateway and router.**2L**

Internet Terms: Web page, Home page, website, internet browsers, URL, Hypertext, ISP, Web server, download and upload, online and offline.**2L**

Internet Applications: www, telnet, ftp, e-mail, social networks, search engines, Video Conferencing, e-Commerce, m-Commerce, VOIP, blogs.**6L**

Introduction to Web Design: Introduction to hypertext markup language (html) Document type definition, creating web pages, lists, hyperlinks, tables, web forms, inserting images, frames, hosting options and domain name registration. Customized Features: Cascading style sheet (css) for text formatting and other manipulations.**16L**

JavaScript Fundamentals: Data types and variables, functions, methods and events, controlling program flow, JavaScript object model, built-in objects and operators.**14L**

Reference Books:

1. Andrew S. Tanenbaum, David J. Wetherall Computer Networks (5th Edition),PHI, 2010

2. B. A. Forouzan, Data Communication and Networking , TMH,2003.

3.D.R. Brooks, An Introduction to HTML and Javascript for Scientists and Engineers, Springer W. Willard,2009

4. HTML A Beginner's Guide, Tata McGraw-Hill Education, 2009.

5. J. A. Ramalho, Learn Advanced HTML 4.0 with DHTML, BPB Publications, 2007

SEC-1 : Android Programming

Introduction: History of Android, Introduction to Android Operating Systems, AndroidDevelopment Too (2L)

Overview of object oriented programming using Java: OOPs Concepts: Inheritance,Polymorphism, Interfaces, Abstract class, Threads, Overloading and Overriding, Java Virtual Machine. (4L)

Development Tools: Installing and using Eclipse with ADT plug-in, Installing Virtualmachine for Android sandwich/Jelly bean (Emulator), configuring the installed tools, creating a android project – Hello Word, run on emulator, Deploy it on USB-connected Android device. (5L)

User Interface Architecture: Application context, intents, Activity life cycle, multiple screensize (2L)

)

User Interface Design: Form widgets, Text Fields, Layouts, Button control, toggle buttons,Spinners(Combo boxes),Images, Menu, Dialog.(2L)

Database: Understanding of SQLite database, connecting with thedatabase (2L)

Book Recommended:

1. Android application development for java programmers. By James C. Sheusi. Publisher: Cengage Learning, 2013.

ONLINE READING / SUPPORTING MATERIAL:

1. http://www.developer.android.com
2. http://developer.android.com/about/versions/index.html
3. http://developer.android.com/training/basics/firstapp/index.html
4. http://docs.oracle.com/javase/tutorial/index.htm (Available in the form of free downloadable ebooks also).
5. http://developer.android.com/guide/components/activities.html
6. http://developer.android.com/guide/components/fundamentals.html
7. http://developer.android.com/guide/components/intents-filters.html.
8. http://developer.android.com/training/multiscreen/screensizes.html
9. http://developer.android.com/guide/topics/ui/controls.html
10. http://developer.android.com/guide/topics/ui/declaring-layout.html
11. http://developer.android.com/training/basics/data-storage/databases.html

Software Lab Based on Android Programming:

1. Create ―Hello World‖ application. That will display ―Hello World‖ in the middle of the screen in the emulator. Also display ―Hello World‖ in the middle of the screen in the Android Phone.
2. Create an application with login module. (Check username and password).
3. Create spinner with strings taken from resource folder (res >> value folder) and on changing the spinner value, Image will change.
4. Create a menu with 5 options and and selected option should appear in text box.
5. Create a list of all courses in your college and on selecting a particular course teacher-in-charge of that course should appear at the bottom of the screen.
6. Create an application with three option buttons, on selecting a button colour of the screen will change.
7. Create and Login application as above. On successful login, pop up the message.
8. Create an application to Create, Insert, update, Delete and retrieve operation on the database.

4TH SEMESTER

DSC-2D : Introduction to Database System
Theory: 60 lectures

Database: Introduction to database, relational data model, DBMS architecture, data**4L** independence DBA, database users, end users, front end tools
E-R Modeling: Entity types, entity set, attribute and key, relationships, relation**4L** types, E- R diagrams database design using ER diagrams
Relational Data Model: Relational model concepts, relational constraints, primary**14L** and foreign key normalization: 1NF, 2NF, 3NF
Structured Query Language: SQL queries, create a database table, create**18L** relationships betwee database tables, modify and manage tables, queries, forms, reports, modify, filter and view data.

Reference Books :

1. P. Rob, C. Coronel, Database System Concepts by, Cengage Learning India, 2008
2. R. Elmsasri,S. Navathe Fundamentals of Database Systems, Pearson Education, Fifth Edition, 2007
3. MySQL : Reference Manual

Introduction to Database System Lab
Practical: 60 lectures

1) Create a database having two tables with the specified fields, to computerize a library system of a Delhi University College.
LibraryBooks (Accession number, Title, Author, Department, PurchaseDate, Price)
IssuedBooks (Accession number, Borrower)

a) Identify primary and foreign keys. Create the tables and insert at least 5 records in each table.
b) Delete the record of book titled ―Database System Concepts‖.
c) Change the Department of the book titled ―Discrete Maths‖ to ―CS‖.
d) List all books that belong to ―CS‖ department.
e) List all books that belong to ―CS‖ department and are written by author ―Navathe‖.
f) List all computer (Department=‖CS‖) that have been issued.
g) List all books which have a price less than 500 or purchased between ―01/01/1999‖ and ―01/01/2004‖.

2) Create a database having three tables to store the details of students of Computer Department in your college.
Personal information about Student (College roll number, Name of student, Date of birth, Address, Marks(rounded off to whole number) in percentage at 10 + 2, Phone number)
Paper Details (Paper code, Name of the Paper)
Student's Academic and Attendance details (College roll number, Paper code, Attendance, Marks in home examination).

a) Identify primary and foreign keys. Create the tables and insert at least 5 records in each table.
b) Design a query that will return the records (from the second table) along with the name of student from the first table, related to students who have more than 75% attendance and more than 60% marks in paper 2.
c) List all students who live in ―Delhi‖ and have marks greater than 60 in paper 1.
d) Find the total attendance and total marks obtained by each student.
e) List the name of student who has got the highest marks in paper 2.

3) Create the following tables and answer the queries given below:
Customer (CustID, email, Name, Phone, ReferrerID) Bicycle (BicycleID, DatePurchased, Color CustID, ModelNo) BicycleModel (ModelNo, Manufacturer, Style) Service (StartDate, BicycleID EndDate)

a) Identify primary and foreign keys. Create the tables and insert at least 5 records in each table.

b) List all the customers who have the bicycles manufactured by manufacturer ―Honda‖.

c) List the bicycles purchased by the customers who have been referred by customer ―C1‖.

d) List the manufacturer of red colored bicycles.

e) List the models of the bicycles given for service.

4) Create the following tables, enter at least 5 records in each table and answer the queries given below.

EMPLOYEE (Person_Name, Street, City) WORKS (Person_Name, Company_Name, Salary
COMPANY (Company_Name, City)
MANAGES (Person_Name, Manager_Name)

a) Identify primary and foreign keys.

b) Alter table employee, add a column ―email‖ of type varchar(20).

c) Find the name of all managers who work for both Samba Bank and NCB Bank.

d) Find the names, street address and cities of residence and salary of all employees who work for ―Samba Bank‖ and earn more than $10,000.

e) Find the names of all employees who live in the same city as the company for which they work.

f) Find the highest salary, lowest salary and average salary paid by each company.

g) Find the sum of salary and number of employees in each company.

h) Find the name of the company that pays highest salary.

5) Create the following tables, enter at least 5 records in each table and answer the queries given below.

Suppliers (SNo, Sname, Status, SCity)Parts (PNo, Pname, Colour, Weight,City) Project (JNo, Jname, Jcity)Shipment (Sno, Pno, Jno, Qunatity)

a) Identify primary and foreign keys.

b) Get supplier numbers for suppliers in Paris with status>20.

c) Get suppliers details for suppliers who supply part P2. Display the supplier list in increasing order of supplier numbers.

d) Get suppliers names for suppliers who do not supply part P2.

e) For each shipment get full shipment details, including total shipment weights.

f) Get all the shipments where the quantity is in the range 300 to 750 inclusive.

g) Get part nos. for parts that either weigh more than 16 pounds or are supplied by suppliers S2, or both.

h) Get the names of cities that store more than five red parts.

i) Get full details of parts supplied by a supplier in London.

j) Get part numbers for part supplied by a supplier in London to a project in London.

k) Get the total number of project supplied by a supplier (say, S1).

l) Get the total quantity of a part (say, P1) supplied by a supplier (say, S1).

SEC-2 :XML Programming

Introduction: Understanding Mark-up Languages, Introduction to XML and itsGoals. (3L)

XML Basics: XML Structure and Syntax, Document classes andRules. (5L)

Other XML Concepts: Scripting XML, XML as Data, Linking withXML. (4L)

XML with Style: XSL –Style Sheet Basics, XSL basics, XSL stylesheets. (3L)

Books Recommended

1. XML in action web technology by William J. Pardi
2. Step by Step XML by Michael J. Young

Software Lab Based on XML:

Exercise #1 – Information Structure

In this exercise, student will practice identifying the structure of an information object. For the sample document provided below:

Label the information structures you see, including containing structures.

Exercise 2# Deconstructing an XML Document

In this exercise, student will practice identifying the explicit structure within an XML document. In a sense, this is the reverse of what you did in Exercise #1. For the sample XML markup below, create a document-like representation (or a simple drawing) for the content contained within the XML tags:

```
<book>
<coverInfo>
    <title>The XML
    Handbook</title><author>Charles F.
    Goldfarb</author><author>Paul
    Prescod</author><edition>Second</edi
    tion>
```

5TH SEMESTER

SEC-3:PHP Programming (1 +2 Lab)

Introduction to PHP: (3L)

- PHP introduction, inventions and versions, important tools and software requirements (like Web Server, Database, Editors etc.)
- PHP with other technologies, scope of PHP
- Basic Syntax, PHP variables and constants
- Types of data in PHP , Expressions, scopes of a variable (local, global)
- PHP Operators : Arithmetic, Assignment, Relational , Logical operators, Bitwise , ternary and MOD operator.
- PHP operator Precedence and associativity

Handling HTML form withPHP: (2L)

- Capturing Form Data
- GET and POST form methods
- Dealing with multi value fields
- Redirecting a form after submission

PHP conditional events andLoops: (3L)

- PHP IF Else conditional statements (Nested IF and Else)
- Switch case, while ,For and Do While Loop
- Goto , Break ,Continue and exit

PHP Functions: (3L)

- Function, Need of Function , declaration and calling of a function
- PHP Function with arguments, Default Arguments in Function
- Function argument with call by value, call by reference
- Scope of Function Global and Local

String Manipulation and RegularExpression: (3L)

- Creating and accessing String , Searching & Replacing String
- Formatting, joining and splitting String , String Related Library functions
- Use and advantage of regular expression over inbuilt function
- Use of preg_match(), preg_replace(), preg_split() functions in regular expression

Array:(3L)

- Anatomy of an Array ,Creating index based and Associative array ,Accessing array
- Looping with Index based array, with associative array using each() and foreach()
- Some useful Library function

Reference Books:

1. Steven Holzner, "PHP: The Complete Reference Paperback", McGraw Hill Education (India), 2007.

2. Timothy Boronczyk, Martin E. Psinas, "PHP and MYSQL (Create-Modify-Reuse)", Wiley India Private Limited, 2008.

3. Robin Nixon, "Learning PHP, MySQL, JavaScript, CSS & HTML5", 3rd Edition Paperback, O'reilly, 2014.

4. Luke Welling, Laura Thompson, PHP and MySQL Web Development", 4th Edition, Addition Paperback, Addison-Wesley Professsional,2008.

5. David Sklar, Adam Trachtenberg, "PHP Cookbook: Solutions & Examples for PHP Programmers", 2014.

Software Lab Based on PHP:

1. Create a PHP page using functions for comparing three integers and print the largest number.
2. Write a function to calculate the factorial of a number (non-negative integer). The function accept the number as an argument.
3. WAP to check whether the given number is prime or not.
4. Create a PHP page which accepts string from user. After submission that page displays the reverse of provided string.
5. Write a PHP function that checks if a string is all lower case.
6. Write a PHP script that checks whether a passed string is palindrome or not? (A palindrome is word, phrase, or sequence that reads the same backward as forward, e.g., madam or nurses run)
7. WAP to sort an array.
8. Write a PHP script that removes the whitespaces from a string.
   Sample string : 'The quick " " brown fox'
   Expected Output : Thequick""brownfox
9. Write a PHP script that finds out the sum of first n odd numbers.
10. Create a login page having user name and password. On clicking submit, a welcome message should be displayed if the user is already registered (i.e.name is present in the database) otherwise error message should be displayed.
11. Write a PHP script that checks if a string contains another string.
12. Create a simple 'birthday countdown' script, the script will count the number of days between current day and birth day.
13. Create a script to construct the following pattern, using nested for loop.

```
*
* *
* * *
* * * *
* * * * *
```

14. Write a simple PHP program to check that emails are valid.
15. WAP to print first n even numbers.
16. $color = array('white', 'green', 'red'')
    Write a PHP script which will display the colors in the following way :
    Output :
    white, green, red,
    •
    green
    • red
    • white
17. Using switch case and dropdown list display a —Hello|| message depending on the language selected in drop down list.
18. Write a PHP program to print Fibonacci series using recursion.
19. Write a PHP script to replace the first 'the' of the following string with 'That'.

    Sample :'the quick brown fox jumps over the lazy dog.'
    Expected Result : That quick brown fox jumps over the lazy dog.

DSE-2A :Programming in VB/GAMBAS
Theory: 60 lectures

GUI Environment: Introduction to graphical user interface (GUI), programming language (procedural, object oriented, event driven), the GUI environment, compiling, debugging, and running the programs. **4L**

Controls : Introduction to controls textboxes, frames, check boxes, option buttons, images, setting borders and styles, the shape control, the line control, working with multiple controls and their properties, designing the user interface, keyboard access, tab controls, default & cancel property, coding for controls. **8L**

Operations: Data types, constants, named & intrinsic, declaring variables, scope of variables, val function, arithmetic operations, formatting data. **4L**

Decision Making : If statement, comparing strings, compound conditions (and, or, not), nested if statements, case structure, using if statements with option buttons & check boxes, displaying message in message box, testing whether input is valid or not. **8L**

Modular programming: Menus, sub-procedures and sub-functions defining / creating and modifying a menu, using common dialog box, creating a new sub-procedure, passing variables to procedures, passing argument by value or by reference, writing a function/ procedure. **6L**

Forms Handling : Multiple forms creating, adding, removing forms in project, hide, show method, load, unload statement, me keyword, referring to objects on a different forms **6L**

Iteration Handling: Do/loops, for/next loops, using msgbox function, using string function **4L**

Arrays and Grouped Data Control: Arrays - 1-dimension arrays, initializing an array using for each, user-defined data types, accessing information with user-defined data types, using list boxes with array, two dimensional arrays. lists, loops and printing list boxes & combo boxes, filling the list using property window / add item method, clear method, list box properties, removing an item from a list, list box/ combo box operations. **10L**

Database Connectivity: Database connectivity of forms with back end tool like mysql, populating the data in text boxes, list boxes etc. searching of data in database using forms. Updating/ editing of data based on a criterion. **10L**

Reference Books:

1. Reference: Programming in Visual Basic 6.0 by Julia Case Bradley, Anita C. Millispangh(Tata Mcgraw Hill Edition 2000 (Fourteenth Reprint 2004)

Programming in VB/GAMBAS Lab
Practical: 60 lectures

1. Print a table of numbers from 5 to 15 and their squares and Cubes.
2. Print the largest of three numbers.
3. Find the factional of a number n.
4. Enter a list of positive numbers terminated by zero. Find the sum and average of these numbers.
5. A person deposits Rs. 1000 in a fixed account yielding 5% interest. Complete the amount in the account at the end of each year for n years.
6. Read n numbers. Count the number of negative numbers, positive numbers and zeros in the list.
7. Read n numbers. Count the number of negative numbers, positive numbers and zeroes in the list.use arrays.
8. Read a single dimension array. Find the sum and average of these numbers.
9. Read a two dimension array. Find the sum of two 2D Array.
10. Create a database Employee and Make a form in VB 6.0 to allow data entry to **Employee Form** with the following command buttons:

Employee Form

Employee Name:

NEXT

Employee Id:

Date of Joining:

Designation:

Department:

Address:

Basic Pay:

PREV

FIRST

LAST

DELETE

SAVE

CANCEL

6TH SEMESTER

SEC-4: Unix/ Linux Programming Syllabus **(1+2 Labs)**

Introduction **(5 L)**

- What is linux/unix Operating systems
- Difference between linux/unix and other operating systems
- Features and Architecture
- Various Distributions available in the market
- Installation, Booting and shutdown process

- System processes (an overview)
- External and internal commands
- Creation of partitions in OS
- Processes and its creation phases – Fork, Exec, wait

User Management and the File System **(5 L)**

- Types of Users, Creating users, Granting rights
- User management commands
- File quota and various file systems available
- File System Management and Layout, File permissions
- Login process, Managing Disk Quotas
- Links (hard links, symbolic links)

Shell introduction and ShellScripting (6L)

- What is shell and various type of shell, Various editors present in linux
- Different modes of operation in vi editor
- What is shell script, Writing and executing the shell script
- Shell variable (user defined and system variables)
- System calls, Using system calls
- Pipes and Filters
- Decision making in Shell Scripts (If else, switch), Loops in shell
- Functions
- Utility programs (cut, paste, join, tr , uniq utilities)
- Pattern matching utility (grep)

Reference Books:

1. Sumitabha, Das, Unix Concepts And Applications, Tata McGraw-Hill Education, 2006
2. Michael Jang RHCSA/ RHCE Red Hat Linux Certification: Exams (Ex200 & Ex300) (Certification Press), 2011
3. Nemeth Synder& Hein, Linux Administration Handbook, Pearson Education, 2nd Edition ,2010
4. W. Richard Stevens, Bill Fenner, Andrew M. Rudoff, Unix Network Programming, The sockets Networking API, Vol. 1, 3rd Edition,2014

Software Lab Based on Linux:

1. Write a shell script to check if the number entered at the command line is prime or not.
2. Write a shell script to modify ―cal‖ command to display calendars of the specified months.
3. Write a shell script to modify ―cal‖ command to display calendars of the specified range of months.
4. Write a shell script to accept a login name. If not a valid login name display message – ―Entered login name is invalid‖.
5. Write a shell script to display date in the mm/dd/yy format.
6. Write a shell script to display on the screen sorted output of ―who‖ command along with the total

number of users .

7. Write a shell script to display the multiplication table any number,
8. Write a shell script to compare two files and if found equal asks the user to delete the duplicate file.
9. Write a shell script to find the sum of digits of a given number.
10. Write a shell script to merge the contents of three files, sort the contents and then display them page by page.
11. Write a shell script to find the LCD(least common divisor) of two numbers.
12. Write a shell script to perform the tasks of basic calculator.
13. Write a shell script to find the power of a given number.
14. Write a shell script to find the binomial coefficient C(n , x).
15. Write a shell script to find the permutation P(n,x).
16. Write a shell script to find the greatest number among the three numbers.
17. Write a shell script to find the factorial of a given number.
18. Write a shell script to check whether the number is Armstrong or not.
19. Write a shell script to check whether the file have all the permissions or not.

DSE-2B:Software Testing (1+2 Labs)

Introduction (4L)

Strategic Approach to Software Testing, Test Strategies for Conventional Software, Validation Testing, System Testing, Basic Terminologies, V Shaped Software Lifecycle Model

Functional Testing\ Black-box Testing (5L)

Boundary Value Analysis, Equivalence Class Testing, Decision Table Based Testing

Structural Testing\ White-box Testing (6L)

Basis Path Testing: Program Graph, DD Path graph, Cyclomatic Complexity, Graph Matrices, Control Flow Testing: Statement Coverage, Branch Coverage, Condition Coverage, Path Coverage

Books Recommended:

1. Roger S. Pressman, Software Engineering: A Practitioner‘s Approach, Seventh Edition, Mc Graw Hill Education.2009
2. Yogesh Singh, Software Testing, Cambridge University Press.2011.

Computer Lab Based on Software Testing:

1. Write a program that take three inputs (a,b&c) that represent the sides of a triangle, and the output is one of the below four:
    a. Not a triangle
    b. Scalene triangle
    c. Isosceles triangle
    d. Equilateral triangle

    1.1 Generate test cases using Boundary Value Analysis, Equivalence Class Partitioning and Decision Table Testing.
    1.2 Generate test cases using Basis path testing.
    1.3 Run code coverage tool.
2. Write a program that determines the nature of roots of a quadratic equation. Output should be one of the following:-

    - Not a quadratic equation.
    - Complex roots
    - Real roots
    - Single roots

    I. Generate test cases using Boundary Value Analysis, Equivalence Class Partitioning and

Decision Table Testing.

II. Generate test cases using Basis path testing. III.

Run code coverage tool

3. Write a program that checks whether the number is even or odd. Run code coverage tool and find the amount of code being covered.

4. Write a program that dynamically allocates memory to10 integers using malloc() or calloc() and

- donot free memory leading to memory leaks. Verify the same usingValgrind.
- Now, free memory using free() at the end of the program to avoid memory leaks. Verify the same using Valgrind.

Use LoadUI load testing tool to test the web application performance.

B.Sc. (REGULAR COURSE)(Modified on 07/08/2020)

SL. NO.	CORE COURSE (14)	ABILITY ENHANCEMENT COURSE (AECC) (2)	SKILL ENHANCEMENT COURSE (SEC) (2)	ELECTIVE: DISCIPLINE SPECIFIC DSE (4)
1	DSC – 1A DSC – 2A: Computer Fundamentals DSC- 3A	(English/Hindi/MIL Communication)		
2	DSC – 1 B DSC – 2B: Introduction to Programming DSC- 3B	Environmental Science		
3	DSC – 1 C DSC – 2C: DSC- 3C: Computer Networks & Internet Technologies		SEC 1: Android Programming	
4	DSC – 1 D DSC – 2D: DSC- 3D : Introduction to Database Systems		SEC 2:XML Programming	
5			SEC 3:PHP Programming	DSE-1A DSE -2A: Programming in Visual Basic/Gambas DSE-3A
6			SEC 4: UNIX/LINUX Programming	DSE-1B DSE -2B: Software Testing DSE-3B

BODOLAND UNIVERSITY

M.Sc. Syllabus in Botany under Choice Based Credit System (CBCS)
(*w. e. f.* 2015-2016)

DEPARTMENT OF BOTANY, BODOLAND UNIVERSITY
CBCS SYLLABUS *w.e.f.* 2019-20

1. Name of the Course : M.Sc., Botany
2. Duration of the Course : Two Years (Four Semesters)

SEMESTER I

Course Code	Course Title	Credits	L+T+P	Total Marks		
				In-Sem	End-Sem	Total
BOT 101	Phycology, Mycology & Lichenology	4	3+1+0	20	80	100
BOT 102	Bryology, Pteridology & Paleobotany	4	3+1+0	20	80	100
BOT 103	Gymnosperm, Angiosperm anatomy & Advanced morphology	4	3+1+0	20	80	100
BOT 104	Instrumentation & Laboratory technique	4	3+1+0	20	80	100
BOT 105(P)	Practical-I	5	0+0+5	20	80	100
BOT 106 (OE)	1. Plant propagation and nursery management 2. a	2	1+1+0	10	40	50
Total		**23**		**100**	**400**	**550**

SEMESTER II

BOT 201	Plant Taxonomy & Economic Botany	4	3+1+0	20	80	100
BOT 202	Cytology, Genetics, Plant Breeding & Evolution	4	3+1+0	20	80	100
BOT 203	Plant physiology & Biochemistry	4	3+1+0	20	80	100
BOT 204	Ecology, environment & Phytogeography	4	3+1+0	20	80	100
BOT 205(P)	Practical-I	5	0+0+5	20	80	100
BOT 206(Open elective-I)	1. Elective-I 2.	2	2+0+0	10	40	50
Total		**23**		**110**	**440**	**550**

SEMESTER III

BOT 301	Microbiology & Plant pathology	4	3+1+0	20	80	100
BOT 302	Molecular biology & Plant Biotechnology	4	3+1+0	20	80	100
BOT 303	Reproductive & Developmental Biology	4	3+1+0	20	80	100
BOT 304	Bioinformatics & Biostatistics	4	3+1+0	20	80	100
BOT 305 (P)	Practical-I	5	0+0+5	20	80	100
BOT 306 (DSE-II)	1. Elective –II 2.	3	3+0+0	20	80	100
		24		**120**	**480**	**600**

SEMESTER IV

BOT 401	Special Paper-I *(Any one from list)*	4	4+1+0	20	80	100
BOT 402	Special Paper-II	4	4+1+0	20	80	100

BOT 403	Special paper III	4	4+1+0	20	80	100
BOT 404 (P)	**Advanced Practical (Special paper)**	4	0+0+4	20	80	100
	Project Work/Dissertation	6	0+0+6	20	80	100
Total		**22**		**100**	**400**	**500**
Grand Total		**92**				**2200**

Details of the elective courses:

ELE-I (Open)	I. Biodiversity & conservation
ELE-II (Open)	I. Plant resources, Pharmacognosy & Ethnobotany / II. IPR, Traditional knowledge & Ethnobotany
DSE-I	1. A 2.

Special Paper-I
Special Paper-II
Special Paper III
} ***any one from the list***

Special paper

i) Angiosperm Taxonomy
ii) Microbiology
iii) Advanced Plant Physiology and Biochemistry
iv) Ecology
v) Cytology, Genetics and Plant Breeding
vi) Mycology and plant pathology

SEMESTER-I
PAPER CODE: BOT-101
PAPER TITLE: PHYCOLOGY, MYCOLOGY & LICHENOLOGY
Total Marks=100

PHYCOLOGY

Unit - I

Algal Diversity and distribution: Thallus Organization; Pigments; Food reserves; Reproduction-Different types of life cycle in Algae.

Algal cytology: Ultra structure of algal cell, Cell wall, Flagella, Chloroplast, Pyrenoids, Eyespot; Importance of algal intra-cellular structures in classification.

Classification of Algae: Criteria for classification of Algae; Recent trends in Algal Classification.

Unit-II

General account: Thallus structure, reproduction, life cycle and post fertilization stages, phylogeny, inter-relationship and Evolutionary trends in following: Chorophyta, Xanthophyta, Pheophyta, Rhodophyta, Bacillariophyta and Chrysophyta Cynophyta: Cell structure, reproduction interrelationships, cynotoxins and cynophages

Economic importance of Algae: Role of Algae in soil fertility, Industrial uses of Algae, Algae as Biofuels, Algal cell culture techniques.

Ecological importance: Algae in global warming-Carbon capture by Algae, Algal indicators, Algal blooms, Eutrophication, Algae in Bio-remediation.

MYCOLOGY

Unit-III

General characteristics of Fungi: Fungal cytology: Ultrastructure of Fungal cell, Composition of fungal cell wall; Fungal Nutrition; Life cycle; Reproduction and Somatic recombination in fungi: Heterothallism, Parasexuality, Heterokaryosis, Evolution of sex in Fungi

Classification: Recent trends in fungal classification with reference to vegetative and reproductive structures; Outline of classification as per Anisworth, Alexopolous and Webster.

Unit-IV

Comparative account of thallus structure, spore producing organs; Life cycle pattern, phylogeny and interrelationships of the following: **Mastigomycotina, Zygomycotina, Acomyctina, Deuteromycotina, Basidiomycotina.**

Ecological and physiological specialization in fungi: Mycorrhizal interaction; Application as biofertillizer and bioprotector in forestry and agriculture; Wood decaying fungi; Common parasitic fungi of plants and animals; Entomogenous fungi, mycoparasite and mycoherbicides, Economic importance of Fungi

LICHENOLOGY

Unit-V

General characteristics, distribution, thallus structure and reproduction, Classification and nomenclature, mechanism of phycobiont and mycobiont interaction, Role of lichen in Succession and monitoring pollutants, Economic importance of Lichen.

PAPER CODE: BOT-102

PAPER TITLE: BRYOLOGY, PTERIDOLOGY & PALEOBOTANY

Total Marks=100

BRYOLOGY

Unit-I

Introduction- Origin, evolution, History of classification and interrelationships.

Diversity in morphology and reproduction: Habitat, Structural organization of gametophytes, Reproduction, sporophytes, spore dispersal mechanism and evolutionary perspective (**Hepaticae, Anthocerotae & Musci)**

Unit-II:

Diversity and distribution of Bryophytes in North East India, Economic importance of Bryophytes; Bryophytes as pollution indicator and monitoring.

PTERIDOLOGY

Unit-III:

Introduction: Theories of origin and interrelationship of pteridophytes; evolution and classification of vascular cryptogams.

Diversity in morphology and reproduction: Diversity of life cycle pattern in Pteridophytes, Apospory and apogamy, heterospory and seed habit, Telome concept; evolution of Sorus.

Ecology & distribution of ferns of N.E. India with special reference to Assam.

Unit-IV:

Morphological and reproductive diversity of **Psilotales, Lycopodiales, Selaginellales, Isoetales, Equisetales**.

Morphological, anatomical and reproductive diversity of **Leptosporangiate** and **Eusporangiate groups**.

Unit-V:

Paleobotany: Geological time scale, fossilization process, classification and nomenclature of fossil plants, techniques in studying fossils.

General account of major fossil groups -**Psilophytales, Zosterophyllales, Lepidodendrales, Asteroxylales, Sphenophyllales, Calamitales, Cladoxylales, Coenopteridales.**

PAPER CODE: BOT-103

PAPER TITLE: GYMNOSPERMS, ANGIOSPERMS ANATOMY AND ADVANCED MORPHOLOGY

Total Marks: 100

Gymnosperms:

Unit-I

Systems of Classification and salient features of major taxa; characteristics, affinities and relationships of **Cycadofilicales, Bennettitales and Cordaitales**.

Unit-II

Characteristics, affinities and relationships of **Ginkgoales, Coniferales, Taxales and Gnetales.**

Economic importance of Gymnosperms, Xylotomy.

Angiosperms anatomy:

Unit-III

Morphogenesis and organogenesis in plants: Meristem, types, origin and activity; **Organization** of **shoot** and **root** apical meristem. Periderm: Origin and activity, Rytidome, protective tissue in Monocotyedons, bark and cork; Cambium- Origin, function, behavior- normal and abnormal. Types of Stomata & Trichome

Unit-IV

Nodal Anatomy- different patterns of nodal anatomy, cambium, vascular cambium, cork cambium, factors influencing the activity of vascular cambium; anomalous secondary growth; seedling anatomy; leaf anatomy, wood anatomy; floral anatomy.

Unit-V

Advanced Morphology: Origin and evolution of flower- Co- evolution of flower and pollinator; origin and evolution of polypetalae, sympetalae, stamens and carpels; Staminodia. Nectaries; types and evolution of ovaries, placenta.

PAPER CODE: BOT-104

PAPER TITLE: INSTRUMENTATION & LABORATORY TECHNIQUE

Total Marks: 100

Unit-1

Microscopic Techniques: General features of Microscope, Principles of microscopy, bright and dark field microscopes, Phase-Contrast, Fluorescence, Confocal, Electron microscopy; Fixation and staining techniques for electron microscope, Micrometry.

Unit-II

Herbarium techniques- drying, poisoning, pressing, labeling, cataloging and preservation.

Microtomy: Principle, sample preparation, block preparation, sectioning, staining and mounting

Unit-III

Dissection, Maceration, Squash, Peeling and whole mount – Pre-treatment and procedures.

Serial Sectioning – Double / Multiple Staining.

Histochemical Techniques – Localisation of specific compounds / reactions / activities in tissues.

Cytochemical Techniques - Localisation of specific compounds / reactions / activities in cells.

Unit-IV

Chromatographic techniques: Basic concepts, Gel filtration chromatography, Ion-exchange chromatography, Affinity chromatography, Gas chromatography, High Performance Liquid Chromatography

Electrophoresis: Basic concepts, Gel Electrophoresis –agarose and acrylamide (native, denaturing and gradient), Isoelectric focusing.

Unit-V

Immunological techniques: Antibody generation, Detection of molecules using ELISA, RIA, western blot, immunoprecipitation, flow cytometry and immunofluorescence microscopy, detection of molecules in living cells, in situ localization by techniques such as FISH and GISH.

Spectroscopic Techniques: Basic concept Visible, UV, IR Spectrophotometry, flourimetry, circular dichroism, NMR & ESR Spectroscopy, atomic absorption and mass spectrometry.

Radiolabeling techniques: Detection and measurement of different types of radioisotopes normally used in biology, safety guidelines.

PAPER CODE: BOT-105 (P)

Total Marks: 100

1. Study of range of thallus organization and reproductive structures of algae with the help of suitable representatives.

2. Culture of algal cells and estimation of their growth by cell counting method
3. Study of morphological, anatomical and reproductive features of some fungi growing in Assam
4. Study of morphological and anatomical features of some lichens growing in Assam
5. Study of Bryophytes in their natural habitats.
6. Study of some important genera of Bryophytes available in NE India with respect to their morphology, anatomy and reproductive structures.
7. Study of epidermal morphology of some important ferns.
8. Study of some important living members of major groups of Pteridophytes.
9. Study of some important fossil members of major groups of Pteridophytes
10. Study of morphological, anatomical and reproductive features of gymnosperms available in the region.
11. Study of different types of inflorescence (morphology), primitive and advance flowers, ovaries and fruits
12. Study the epidermal morphology, anomalous secondary growth, abnormal activity of cambium in selected familiar plants of Angiosperms.
13. Morphology of different types of ovary and placentation types.
    Angiosperms
14. Preparation and use of stains- Haematoxylin, safranin, fast geen and light green, Crystal violet, Methyle violet, Methyl green, Methylene blue, Iodine green, Ruthenium red, Congo red, Pararosanisin.

SEMESTER-II
Paper code: 201
Plant Taxonomy & Economic Botany
Total Marks: 100

Unit-I

Historical development of Plant Taxonomy, Pre Darwinian, Post Darwinian and recent system of classifications, Broad outlines of Bentham and Hooker's system, Engler and Prantle system, Hutchinson's system, Takhtajan's system and Cronquist's system of classification,recent trends in Plant Taxonomy, Use computers, GIS and GPS in plant taxonomy, characteristic features and evolution of early Angiosperms.

Unit-II

Principles and rules of nomenclature, ICBN / ICN- history, major rules, typification, principles of priority and its limitation, effective and valid publication, author citation, rejection of names and names of hybrids.

Unit-III

Plant collection and documentation, importance of botanical gardens and herbaria in taxonomic studies, important botanical-gardens and herbaria in the world and India, activities of Botanical Survey of India.

Unit-IV

Phylogeny and floral evolution of selected families of the following orders- Magnoliales, Ranunculales, Euphorbiales, Scrophuriales, Lamiales, Asterales, Orchidales, Zingiberales, Poales.

Indian flora- its past and present position with particular reference to N. E. India.

Unit-V

Economic Botany: Centre of origins; Origin, evolution, botany, cultivation and uses of Cereals and Millets, Legumes, Sugar yielding plants, Spices and condiments, Fibre yielding plants, Timber yielding plants, Dyes; Rubber yielding plant, Gums and Resins, Oil yielding plants; Medicinal and aromatics plants, NTFPs and their uses. Economic importance of microbes, role of microbes in industries.

PAPER CODE: BOT-202

. **Cytology, Genetics, Plant Breeding & Evolution**

Total Marks: 100

UNIT-I

Structural organization and function of intracellular organelles; Nucleus and its components; Structure of Chromatin and chromosomes; structure and function of cytoskeleton; Cell division and cell cycle, regulation and control, Apoptesis.

UNIT-II

Prokaryotic and Eukaryotic Chromosomes; Eukaryotic chromosomes- Chemical composition, DNA packaging; Centromeres and Telomeres; Heterochromatin, Euchromatin; Unique and Repetitive DNA Transposons, interrupted genes, gene families; Genome size and Evolutionary Complexity; C-value paradox; Special types of chromosomes; Organellar genome; Prokaryotic gene regulation and Eukaryotic gene regulation

UNIT-III

Mendelian laws; Gene interactions; Multiple alleles; Qualitative and Quantitative inheritance; Meiosis; Recombination and Crossing Over; Linkage; Gene mapping and Linkage mapping; Autosomal inheritance; Sex chromosomes and Sex-linked inheritance; cytoplasmic inheritance; Genetic diseases, in-born errors of metabolism and gene therapy.

UNIT-IV

Mutation: Basic concept, spontaneous and induced mutation, physical and chemical mutagens; Molecular basis of mutations; Transposons and their use in mutagenesis; Oncogenes and cancer

UNIT-V

Plant Breeding: Distant hybridization in Plant Breeding, barrier to distance hybridization, techniques for distant hybridization; Back Cross methods of plant breeding, application and genetic consequences; Breeding for quantitative characters, handling of quantitative data, environmental effect on quantitative characters, estimation of heritability and genetic advance.

Evolution: Lamarck; Darwin–concepts of variation, adaptation, struggle, fitness and natural selection; spontaneity of mutations; the evolutionary synthesis; Origin of basic biological molecules; Concept of Oparin and Haldane

Paper code: BOT-203
Plant Physiology and Biochemistry
Total Marks: 100

Unit-I

Membrane structure and function: Structure of model membrane, lipid bilayer and membrane protein diffusion, osmosis, ion channels, active transport, membrane pumps, mechanism of sorting and regulation of intracellular transport, electrical properties of membranes.

Biomolecules: Structures and functions: Carbohydrate, lipids, proteins and nucleic acid.

Unit-II

Enzymes: Principles of catalysis, enzymes and enzyme kinetics, enzyme regulation, mechanism of enzyme catalysis, isozymes

Protein synthesis and processing: Nitrate and ammonium assimilation; amino acid biosynthesis. Ribosome, formation of initiation complex, initiation factors and their regulation, elongation and elongation factors, termination, genetic code, aminoacylation of tRNA, tRNA-identity, aminoacyl tRNA synthetase, and translational proof-reading, translational inhibitors, Post- translational modification of proteins.

Unit-III

Photosynthesis: Light harvesting complexes; mechanisms of electron transport; photoprotective mechanisms; CO2 fixation-C3, C4 and CAM pathways.

Respiration and photorespiration: Citric acid cycle; plant mitochondrial electron transport and ATP synthesis; alternate oxidase; photorespiratory pathway.

Unit-IV

Plant hormones: Biosynthesis, storage, breakdown and transport; physiological effects and mechanisms of action.

Sensory photobiology: Structure, function and mechanisms of action of phytochromes, cryptochromes and phototropins; stomatal movement; photoperiodism and biological clocks.

Unit-V

Solute transport and photo-assimilate translocation: uptake, transport and translocation of water, ions, solutes and macromolecules from soil, through cells, across membranes, through xylem and phloem; transpiration; mechanisms of loading and unloading of photoassimilates.

References

1. *A Textbook of Plant Physiology, Chemistry and Biotechnology by SK Verma and Mohit Verma*
2. *Text Book of Plant Physiology by CP Malik and A. Srivastava*
3. *Principles of Biochemistry by Lehninger*
4. *Introduction to Plant Physiology by WG Hopkins and Norman Huner*
5. *Plant Physiology by Lincoln Taiz and Equardo Zeiger*
6. *Biochemistry and Molecular Biology of Plants by BB Buchanan, W Gruissem and RL Jones (2000).*
7. *Plant Metabolism (Second Edition) by DT Dennis, DH Turpin, DD Lefebvre and DB Layzell (eds) (1997).*
8. *Life processes in Plants by AW Galstone (1989).*
9. *Biochemistry and Physiology of Plant Hormones by TC Moore (1989).*
10. *Physiochemical and Environmental Plant Physiology (Second Edition) by PS Nobel (1999).*
11. *Outline of Biochemistry by E.E. Conn, PK Stumpf and G Bruening*

Paper code: BOT-204
ECOLOGY, ENVIRONMENT & PHYTOGEOGRAPHY

Total Marks: 100

Unit –I

Concept, Principal and scope of Ecology; Environment: Physical and Biotic Environment; Interrelationship of Abiotic and Biotic Environment

Ecosytem: Types; structure; ecosystem function; energy flow and mineral cycling (C, N, P); primary production and decomposition; structure and function of some Indian ecosystems: terrestrial (forest, grassland) and aquatic (fresh water, marine, estuarine).

Unit-II

Population Ecology: Concept; characteristics of population (Density, Natality, Morality, Dispersion, Population size, Age structure); population growth curves; population regulation; Life history strategies (r and K selection); population interactions.

Community Ecology: Nature of communities; community structure and attributes; levels of species diversity and its measurement; Edges and Ecotones; Methods of studying plant communities, Concept of habitat and niche; niche width and overlap; fundamental and realized niche; resource partitioning; character displacement.

UNIT-III

Ecological succession- types; mechanisms; changes involved in succession; concept of climax

UNIT-IV

Environmental pollution: Environmental pollution- kinds, sources, effects on plants and ecosystems, types of pollutants of various industrial effluents such as pulp and paper mills, oil exploration and refinery, petrochemicals, iron and steel industries, domestic wastes, organic debris, agricultural wastes, pesticides. Eutrophication - causes and effects and control measures. Causes of soil pollution; Effects of pesticides on soil components, residual toxicity and pollution, Global change- greenhouse gases, consequences of climate change; ozone layer depletion, causes and consequences

UNIT-V

Phytogeography-Definition, principles and objectives of phytogeography; Descriptive and Dynamic phytogeography; Continuous and discontinuous plant distribution in India; Routes and barriers to plant migration, barrier hypothesis, Age and Area hypothesis; continental drift hypothesis, land - bridges hypothesis, shifting of poles, island theories of biogeography, theories of differentiation and natural selection, types and areas of natural distribution,

Centers of origin; Endemism-Types; Endemism in Indian flora; endemic plants of India with special reference to N E India, Phytogeographical regions of India

SEMESTER-II

PAPER CODE: BOT-205 (P)

Total Marks: 100

1. Taxonomic study of angiospermic plants with analytical drawings, botanical description and identification up to the rank of species.
2. Collection and preparation of herbarium specimens to be submitted along with field note book so as to get acquainted with herbarium techniques. At list east 20 herbarium specimens of common plants to be prepared and submitted.
3. Study of locally available economic products of plant origin.
4. Medicinal plants and their uses.
5. Preparation of fixatives, stains and their uses
6. Chromosome analysis and Karyotype analysis.
7. Study of chromosome behaviour in meiosis and chromosome anomalies in plant cells.
8. Study of the techniques of emasculation, selfing and crossing in some self-pollinated and cross-pollinated plants.
9. Preparation of buffers, solutions and dilutions, extraction of proteins from plant materials and estimation by Lowry's method using BSA standard curve.
10. Extraction of carbohydrates from plant materials and estimation of reducing sugars by Somogyi-Nelson method.
11. Extraction of plant phenolics and estimation of total phenols and O-dihydroxy phenols
12. Extraction of chloroplast pigments and quantitative estimation; Determination of cholorophyll a/b ratio in C3 and C4 plants
13. Separation of amino acid mixture by thin layer chromatography
14. SDS-PAGE analysis of proteins
15. Effect of different solutes and temperature on membrane permeability.
16. Effect of solutes on the response of membranes to different chemicals.
17. Determination of minimum size and number of quadrates necessary to study herbaceous communities.

18. Determination of abundance, density, frequency, basal cover of plant communities by quadrate method.

19. Estimation of above ground and below ground biomass from unit area.

20. Effect of biotic disturbances on botanical composition.

21. Study of similarity between plant communities using index of similarity and dissimilarity.

22. Estimation of dissolved oxygen content in eutrophic and oligotrophic water samples.

23. Morpho-anatomical adaptive features of hydrophytes and xerophytes.

24. Preparation of a map of India showing biogeographical zones. To plot Biosphere Reserves/ Ramsar sites/National Parks/Wildlife Sanctuaries located in different biogeographical zones of India in general and NE India in particular.

FIELD STUDIES: Collection of specimen and preparation of field report by studying within the NE states.

References

1. *Methods and Techniques in Plant Physiology by A Bhattacharya and Vijay Laxmi*

SEMESTER-II

PAPER CODE: BOT-206 (Open Elective)

Biodiversity & conservation
Total Marks: 50

Unit -I

Biodiversity – concept, components and types; importance of biodiversity conservation, Different approaches for biodiversity. conservation-In-situ conservation:
Biodiversity – assessment, conservation and management, biodiversity act of India and related international conventions. Sustainable development, natural resource management in changing environment.

Unit-II

Strategies for conservation – *in situ* conservation: international efforts and Indian initiatives, protected regions for conservation of biodiversity, sanctuaries, biospheres reserves, national parks, nature reserves, preservation plots; RET Plants of Northeast India and their conservation initiatives.

Strategies for conservation – *ex situ* conservation : Principles and practices; botanical gardens, gene banks, Field Gene Bank, seed banks, ex-situ conservation: botanical gardens, zoos, aquaria, homestead garden; in-vitro Conservation: germplasm and gene bank; tissue culture: pollen and spore bank, DNA bank. *in vitro* repositories, cryobanks; National Bureau of Plant Genetic Resources (NBPGR), Indian Council of Agricultural Research (ICAR) and their conservation efforts.

SEMESTER-III
PAPER CODE: BOT-301
Paper title: Microbiology and Plant Pathology
Total Marks: 100

Unit-I

Microbial diversity: Bacteria: Bacterial cell: Ultra structure, cell wall, different groups of bacteria, recent developments in classification.

Virus: Types and nomenclature of viruses, replication of RNA and DNA viruses, tumor virus, viroids, prions and interferons.

Microbial techniques: Microbial techniques, Isolation of microbes, pure culture, preservation, types of culture, growth media, bacterial growth curve; Control of microorganisms: Sterilization and disinfection

Unit-II

Microbial metabolism (Principals of bioenergetics, enzymes in metabolism, bacterial photosynthesis, catabolism of carbohydrate)

Microbial genetics (Nature of hereditary information, DNA replication, RNA and Protein synthesis, Plasmids, Transposable genetic elements, mutations, genetic recombination) Recombinant DNA technology

Immunology: Innate and acquired immunity, antibodies, cells and tissues of the immune system, immune diseases.

Unit-III

Soil microbiology (Soil microflora, rhizosphere, mycorrhiza, decomposition of organic matter) **Aeromicrobiology** (Aeromicroflora, Air sampling techniques, allergies, air borne diseases) and **water microbiology** (water quality, detection of coliform group in water, waste water treatment)

Unit –IV

Industrial microbiology (Fermentation technology, Production of alcohol andorganic acids); **Food microbiology** (Fermented food products, Milk and milk products, food spoilage and food preservation)

Unit -V

Plant pathology: History of plant diseases; symptomatology; epidemiology and disease forecasting. Stages in disease development, recognition and entry processes of different pathogens like bacteria, virus and fungi in plant host cells. Host-pathogen relationship; alteration of host cell behavior by pathogens; virus induced cell transformation. Molecular basis of plant diseases & defense mechanism

Control of plant diseases: Cultural, chemical, biological, bio-pesticides, breeding for resistant varieties, plant quarantine, integrated pest management.

Paper code: BOT-302

Paper title: Molecular biology & Plant Biotechnology

Total Marks: 100

Unit-I

DNA replication, repair and recombination: Unit of replication, enzymes involved replication origin and replication fork, fidelity of replication, extrachromosomal replicons, DNA damage and repair mechanisms, homologous and site-specific recombination, DNA Methylation and Acetylation.

RNA synthesis and processing: Transcription factors and machinery, formation of initiation complex, transcription activator and repressor, RNA polymerases, capping, elongation, and termination, RNA processing, RNA editing, splicing, and polyadenylation, structure and function of different types of RNA, RNA transport.

Unit-II

Cell signalling: Hormones and their receptors, cell surface receptor, signaling through G-protein coupled receptors, signal transduction pathways, second messengers, regulation of signaling pathways, bacterial and plant two component systems, light signaling in plants, bacterial chemotaxis and quorum sensing.

Cellular communication: Regulation of hematopoiesis, general principles of cell communication, cell adhesion and roles of different adhesion molecules, gap junctions, extracellular matrix, integrins. neurotransmission and its regulation.

Unit-III

Comparative genomics and evolution: Techniques of DNA finger printing and marker development (RFLP, RAPD, AFLP, SSR, SNP), application of DNA fingerprinting in genetic diversity study, genome analysis, genetic mapping, molecular systematics and diagnosis.

Unit-IV

Genetic Engineering: genetic engineering of microorganisms, isolation and cloning plasmid and mitochondrial genes, vectors, restriction digestion, DNA ligation, gene cloning, transformations, microinjection, nuclear transplantation, GMO's in crop development. IPR and legal issues related to GMOs, Advantage and limitations.

Biotechnology for healthcare, agricultures, industries and environmental.

Unit-V

Plant Tissue Culture: importance, requirements, culture medium. Culture of plant tissues: root, meristem anther, pollen and protoplast culture; role of tissue culture in crop improvements, somatic hybrids and cybrids.

References

1. *Biotechnology by BD Singh*
2. *Biotechnology by U Satyanarayan*
3. *Molecular Cell Biology (8^{th} edition) by HF Lodish et al.*
4. *Molecular Biology of the cell by Albert*
5. *Molecular Biology of the gene (7^{th} edition) JD Watson et al.*

6. *Molecular Biology Genes to Protein (3rd edition) by BE Tropp*
7.

SEMESTER-III
PAPER CODE: BOT-303
Paper title: Reproductive and Developmental Biology
Total marks=100

Unit-I

Basic concepts of development: Potency, commitment, specification, induction, competence, determination and differentiation; morphogenetic gradients; cell fate and cell lineages; stem cells.

Unit-II

Development of male and Female Gametophyte: Microsporogenesis and Microgametogenesis, role of tapetum, pollen development, pollen germination, pollen tube growth and guidance

Megasporogenesis and megametogenesis,embryo sac development and structure.

Pollination biology: Primary and secondary attractants of pollination; ultra structural and histochemical details of style and stigma, Pollen pistil interaction

UNIT-III

Fertillization: Barriers to fertilization, genetic incompatibility and methods to overcome incompatibility, Double fertilization in plants and its significance

Embryogenesis: development of embryo (dicot and monocot);

Development, structure and types of Endosperm;

Fruit: Development and maturation of fruit, types and parts of fruits, fruit dispersal strategies

Seed: Types of seed, germination of seed types and nature and dispersal of seeds, factors affecting germination.

Apomixis, apospory& parthenocapy

Unit-IV

An overview of plant development: Shoot and Root development, leaf development and phyllotaxy, transition to flowering, floral meristem and floral development, homoetic genes in plants, senescence, programmed cell death and hypersensitive response in plants.

Unit-V

Palynology: Branches of palynology, Morphology, ultrastructure, pollen chemisitry, viability, storage and adaptation; use and applications, aeropalynology.

Experimental embryology. Anther culture, ovary culture, somatic hybridization and production of cybrids, embryo culture and rescue, clonal propagation, cryopreservation and germplasm storage, somatic embryogenesis, somaclonal variations.

SEMESTER-III
PAPER CODE: BOT-304
Paper title: Biostatistics & Bioinformatics
Total marks=100

Unit-I

Biostatistics: Measures of central tendencies; mean, mode, median, standard errors and standard deviations. Probability; normal, binomial and poisson distribution; Skewness and kurtosis. Chi Square test; characteristics, degrees of freedom, test of goodness of fit, null hypothesis.

Unit-II

Analysis of variance (ANOVA): Variance and co-variance analyses, F-test, steps involved in ANOVA. Correlation; methods of studying the correlation, scatter diagram; regression analysis, regression equation, methods of studying regression, graphic and algebraic methods.

Experimental field designs, principles of field experimentation, analysis of stability Parameters. Statistical software packages and their importance in data analysis.

UNIT III

Introduction to Bioinformatics: Basics of computers, computer languages and operating systems, introduction to bioinformatics, biological databases and data formats, data mining and retrieval systems, nomenclature of nucleotides and amino acids, scope and application of bioinformatics.

- **Databases** - NCBI, EMBL, DDBJ, Genbank, Pubmed, Patent databases, TAIR, PDB, ATIDB).
- **Online tools** - BLAST, ORF finder, Primer3, protein motif and structure prediction tools; Vector NTI, DNASTAR.
- Bioinformatics in genome sequencing and annotation.
- Fundamentals of computer programming.
- Programming in PERL.
- Bioinformatics indrug designing and molecular modeling.
- **Structural bioinformatics and drug discovery.**

Paper code: BOT-305 (P)
Total Marks: 100

Microbiology and plant pathology

1. Isolation and pure culture of microbes from soil, air and water
2. Identification and characterization of isolated pure cultures
3. Estimation of water quality
4. Identification and characterization of milk bacteria, nodule bacteria and endophytic bacteria
5. Phosphatase test for bacterial contamination of milk
6. Gram staining, flagella staining, capsule staining and acid fast staining of bacteria
7. Effect of physical and chemical factors on growth of microbes
8. Isolation and identification of pathogens from diseased plants available in Assam
9. Spore measurement and camera lucida diagram
10. Tissue sectioning and direct observation of pathogen by staining with suitable dye
11. Separation of biomolecules by paper and thin layer chromatography
12. Collection and study of symptoms of plants infected by virus, bacteria and fungi.

Molecular Biology & Plant Biotechnology

1. Protein isolation and gel electrophoresis
2. Genomic DNA isolation and quantification
3. Plasmid isolation and restriction mapping
4. PCR reaction and gel electrophoresis
5. Basic laboratory principles and techniques of plant tissue culture.
8. Mushroom cultivation
9. Preparation of Wines from Grapes.
10. Experiment to demonstrate biofuel extraction from plants and microbes and biogas production.

Reproductive and Developmental Botany

1. Preparation of pollen grain slides following different techniques; Identification of pollen grains from air, lake mud, soil, honey and coal following suitable methods; *in vitro* germination of pollen grains pollen viability. Preparation and submission of 20 nos. of palynological and differentialy stained permanent slides showing different anatomical features, as a part of practical records in the examination.

2. Study of microsporogenesis, megasporogenesis, embryosacs and endosperms with the help of permanent slides.

Biostatistics & Bioinformatics

1. To workout the mean, median, mode, range, standard deviation, standard error and covariance
2. of any population data
3. Application of t-test, F-test and Chi-square test for a given set of data
4. Drawing of line graphs and histograms from tabulated data
5. Preparation of skeleton of analysis of variance of the designs - Randomized block
6. design, split-plot and latin square design
7. Data analysis in SPSS software
8. All the theory classes on bioinformatics should be conducted with the aid of available
9. online and offline bioinformatical tools.
10. Sequence alignment and homologous sequence search
11. Sequence annotation and gene prediction with the help of bioinformatical tools.
12. Protein modeling and structure prediction

Pharmacognosy

1. Microscopic structure of the plant tissues, test for oil: Mustard, coconut, sunflower, castor.
2. Test for gums, resins and tannins.
3. Experiment to demonstrate essential oil extraction from plants

Paper Code: 306 (Open elective)

Paper title: Plant Diversity, Pharmacognosy, Ethnobotany

Unit-I

Plant biodiversity: Concept, utilization and concerns, status in India. Sustainable Development: Basic concepts.

Green revolution: Benefits and adverse consequences, innovations for meeting world food demands, GMO, biosafety regulations.

Unit-II

Pharmacognosy: Scope, Nature and importance of Pharmacognosy; Pharmacognosy as a tool for identification of crude drugs and processed medicine. Introduction to the technique for quality control, monitoring and Regulation. Types of Adulterations and Substitution of Drugs. Sources of contamination of Herbal drugs-Aflatoxins, Heavy Metals, Pesticides.

Unit-III

Ethnobotany: History and importance of ethnobotany. Ethnobotany as an interdisciplinary science. Methodology of Ethnobotanical studies: a) Field work b) Herbarium; The relevance of ethnobotany in the present context: Life style, Material Culture and Indigenous Technology. Ethnic groups and Ethnobotany: Major and

minor ethnic groups and their life styles and Medico-ethnobotanical resources in India with special reference to NE states.

Optional –II (Elective-2): IPR, TRADITIONAL KNOWLEDGE & ETHNOBOTANY

Unit-I

Principles of IPR and Patent law, patent application procedure, Trade Mark, Copyright, Enforcement of IPR, Information Technology related IPR, Computer software and IPR, Biotechnology and IPR, protection of plant varieties, geographical indicators, farmers right, resource rights

Unit-II

Traditional Knowledge: Concept & types of Traditional Knowledge, Holders Protection, need for a Sui-Generis regime, TK *vs* modern knowledge, digital library, biopiracy & bioprospecting.

Unit-III

History and importance of ethnobotany, ethnomedicobotany, ethnozoology, ethnoveterinary, ethnomusicology and ethnoagriculture and methods of studies. Tribals of NE and their socio - cultural practices.

BOT-401
Optional-I: Angiosperm Taxonomy-I

Unit-I

Basics of Taxonomy: Concept, Aims and Principles. Classificatory Systems: Pre- and Post Darwinian Classifications, **Phenetic, Phylogenetic, Cladistic and APG System, Alpha and Omega taxonomy, Numerical Taxonomy**, The components of systematic, Major objectives of systematic.

Unit-II

Concept of Taxa: Species, Genus, Family, Major and Infra specific categories

Unit-III

Concept of Characters: Concept, Correlation, Weighing, variations, Isolation and Speciation.

Unit-IV

Nomenclature: History, Principles and Major rules, Taxonomic hierarchy, Typification, Effective and Valid Publication, Authors' citation, Principles of Priority and Limitations, **Naming a new species;** legitimacy; Synonyms, Draft Biocode and Phylocode.

Unit-V

Taxonomic Literature: Classical and recent literature, **Journals and taxonomic websites**.

Unit-VI

Botanical exploration in India: Contributions made in earlier and recent periods.

BOT-402
Optional-I: Angiosperm Taxonomy-II

Unit-I

Systematic evidence: Morphology, Anatomy, Palynology, Embryology, Cytology, Phytochemistry, Serology

Unit-II

Biosystematics: Definition, importance and categories, major areas.

Unit-III

Molecular Systematics: Diagnostic tools, Restriction Fragment Length Polymorphism (RFLP's), Random Amplified Polymorphic DNA (RAPD), Polymerase Chain Reaction (PCR) analysis, specific applications of RAPD in molecular systematics.

Unit-IV

Tools of Taxonomy: Botanical keys, GIS. GPS, Remote sensing, Flora, Manuals, check list, annoted list, revisionary study, world flora, Indian flora, preparation of flora

Unit-V

Material Basis of taxonomy: Herbarium techniques: Methods of Collection, Identification and Documentation, source of taxonomic materials, plant introduction and acclimatization

Unit-VI

Computation and iData: Analysis of data; commonly available software, construction of Dendrograms and Cladograms

BOT-403
Optional-I:: Angiosperm Taxonomy-III

Unit-I

Phytogeography: Concept, Static and Dynamic Phytogeography, Phytochoria and botanical provinces of India; Major theories, Ranges, Migration and Barriers, Centre of Origin, Vicariance, Endemism, Hotspots, IUCN categories, India as a megadiversity country

Unit-II

Flora of North East India, Endemism, Exotics, RET Plants, their multiplication and conservation.

Unit-III

Botanical Survey of India: History, Activities, Publications.

Unit-IV

Herbaria and Botanic Gardens**:** Role and importance of herbaria and gardens in taxonomic studies, major Herbaria and Botanic Gardens.

Unit-V

Phylogeny of Angiosperms: Origin of Angiosperms, Primitive and advanced angiosperms, Evolutionary trends

Unit-VI

Phylogeny and Evolution of following Taxa:
Magnoliales, Rananculales, Euphorbiales, Scrophulariales, Lamiales, Asterales, Alismatales, Orchidales, Poales, Zingiberales.

BOT-404(P)
Optional-I :: Angiosperm Taxonomy

1. Floristics study of certain small area in and around Kokrajhar, making collection of their own and from these analytical drawing should be made

Detailed studies of Taxa with botanical keys, analytical drawing and description and Identification up to the rank of species.

2. Practices on Nomenclatural problems

3. Writing exercise

4. Classification exercise

5. Technique in molecular systematic.

6. Identification of taxa/Plant parts/herbarium specimens.

7. Ethnobotanical study of the local tribes

BOT-401
Optional-II:: Microbiology-I

Unit-I

General microbiology: History and development of microbiology as a subject, scope of microbiology, microbiology in human welfare, bioterrorism.

Prokaryotes (cell structure and reproduction, diversity and taxonomy) and eukaryotes (cell structure and diversity), New approaches to bacterial taxonomy, Advantages and limitations of DNA and RNA systematics

Unit-II

Control of Microorganisms: Physical, chemical and biological; Antibiotics, mode of action of antibiotics, multidrug resistance in bacteria, principles of microbial assay.

Unit-III

Virus: Process of infection, function of RNA and DNA in viruses, RNA as genetic material, replication of viruses, lytic and lysogenic cycle of bateriophages.

Unit-IV

Microbial physiology: Bioenergetics (principles of bioenergetics information pathways), metabolism (catabolism of glucose, fatty acids and amino acids; biosynthesis of carbohydrates, lipids and amino acids), growth and nutrition.

Bacterial Photosynthesis: Photosynthetic bacteria, bacterial pigments, CO_2 fixation

Unit-V

Microbial Genetics:genetic materials, nuclear DNA, chloroplast DNA, mitochondrial DNA, plasmids, inheritance of traits, vertical and horizontal gene transfer, genes and chromosomes, DNA replication, RNA transcription and protein synthesis, genome evolution.

BOT-401
Optional-II:: Microbiology-II

Unit-I

Microbial molecular biology: Genetic recombination, conjugation, transduction and transformation in bacteria, proteomics, transcriptomics, metabolomics, genomics, gene regulation in prokaryote and eukaryotes, operon concept (*lac*, *ara* and *trp* operons), one gene many enzyme concept, promoter, enhancer, repressor, negative feedback, RNA processing (RNA capping, Poly (A) tail formation, RNA splicing)

Unit-II

Microbial biotechnology: Microbial biotechnology for human welfare, genetic engineering – tools and techniques, vectors (plasmids, bacteriophage and other viral vectors, cosmids, Ti plasmid, bacterial artificial chromosomes and yeast artificial chromosome), cDNA and genomic DNA library,gene cloning, expression of cloned genes, gene therapy, DNA fingerprinting, whole genome sequencing projects, GMOs, micro RNAs, RNAi

Unit-III

Medical microbiology: Important human diseases caused by virus, bacteria, fungi and protozoa. Laboratory diagnoses and control of diseases caused by *Streptococcus pyogenes*, *Neisseria meningitidis*, *Corynebacterium,diphtheriae*, *Clostridium tetani*, *Vibrio cholerae*, *Mycobacterium tuberculosis*, Poliovirus, Hepatitis virus, immunodiagnostics, vaccination, autoimmune diseases.

Unit –IV

Immunolology: The origin of immunology; Inherent immunity; Humoral and cell mediated immunity; Specific and non-specific immunity; Immune responses, Primary and secondary lymphoid organs; Antigen; B and T cells and Macrophages; Major histocompatibility complex (MHC); Antibodies, synthesis of antibody and secretion; Polyclonal and monoclonal antibody; Complement; Antigen-antibody reaction; Hyper sensitivity; Autoimmunity; Graft versus host reaction. Hybridoma technique, advantages and application of monoclonal antibodies.

UNIT V

Cancer biology: Mutagens and carcinogens, tumor cells and genetic abnormalities, genetic rearrangements in progenitor cells, mechanism of oncogene activation, tumor suppressor genes, cancer and cell cycle, virus induced cancer, metastasis, interaction of cancer cells with normal cells, Apoptosis, Tumor suppressors, RB and p53 protein, DNA methylation and cancer.

BOT-403

Optional-II: Microbiology-III

Unit-I

Microbial ecology:

Interactions among microbial population & with plants and animals.

Biotransformations: microbial degradation of pesticides and toxic chemicals, biodegradation of the agricultural residues, bioremediation of contaminated soils, treatment of solid waste, microbial interaction with xenobiotics and inorganic pollutants.

Microbial community in petroleum; MOER, Microorganisms in mineral and energy recovery and fuel and biomass production.

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Unit-II

Soil microbiology: Soil environment, microbial diversity in soil, microbial interaction in soil, cycling of soil nutrients, methods to detect and quantify soil bacteria and their functional characterization, analysis of microbial communities in soil, soil metagenomics, biosensors to monitor soil health and toxicity, biopesticides, Soil suppressiveness to plant diseases.

Unit-III

Agricultural microbiology: Agriculturally important microorganisms; Biological nitrogen fixation; rhizosphere, phyllosphere, phosphate solubilizing microbes, Plant growth promoting rhizobacteria (PGPR), Microbial pesticides

Unit-IV

Industrial microbiology: Industrial importance of microorganisms, Types of Fermentation process, microbial biomass, microbial enzymes, bioreactors, isolation, preservation and maintenance of industrial microbes, kinetics of microbial growth in STR, microbial products, primary and secondary metabolites, downstream processing, application and immobilization of enzymes, selection and strain improvement strategies.

Industrial production of :

a) Amino Acid – Glutamic Acid.

b) Enzyme – Amylase
c) Organic Acid – Lactic acid, Citric acid.
d) Biofuel – Bio-ethanol, bio-butanol.
g) Biopolymer – PHB, PLA.
h) Special Cells – SCP, Baker's Yeast.
i) Bio-fertillizers

Unit- V

Food microbiology: Importance of studying food and dairy microbiology.Primary sources of microorganisms in foods.Factors influencing microbial growth in foods - extrinsic and intrinsic. Principles of food preservation; preservation methods – irradations, drying, heat processing, chilling and freezing, high pressure, modification of atmosphere and chemical preservatives. Fermented food products and Nutritional value of fermented foods; Contamination and spoilage of fruits, vegetables, meat and poultry products.Concept of prebiotics and probiotics.

BOT-404(P)
Optional-II :: Microbiology

1. Isolation of specific microorganisms using specific media
2. Staining of bacterial spore, capsule and flagella
3. Bacteriological water analysis
4. Isolation of anaerobic bacteria

5. Phosphatase test for milk

6. Detection of organic acids produced by fungi by paper chromatography method

7. Assessment of antimicrobial activity of some microbes against some pathogens

8. Biochemical tests (phosphatase, urease, nitrate reductase, cellulase) for the activity of microbes

9. Fermentation of carbohydrates

10. Study of microflora from the rhizosphere of agriculturally important crops

11. Mycorrhiza – spore population and root colonization

12. Biochemical tests for identification of bacteria (catalse, IMViC, peroxidase, nitrate reductase, oxidase, etc)

13. Isolation and quantification of plasmid/DNA/protein

14. Estimation of total proteins, phenol coefficient, absorption maxima of DNA/Protein

15. Study of symptoms and causal organisms of some important plant diseases prevalent in the state

BOT-401
Optional-III:: Mycology and Plant Pathology

Unit-I

History and development of mycology, ultra structure of fungal cell, cellular organization of fungi, dimorphism, Fungal taxonomy: Different groups of fungi, species identification and nomenclature of fungi; systematics and phylogenetic relationship among different groups of fungi; modern trends in identification and classification of fungi; Allied fungi

Unit-II

Fungal reproduction: different mode of reproduction in fungi, different reproductive structures, parasexuality, degeneration of sex, heterothallism, Fungal genetics: Inheritance, complementation, incompatibility.

Unit-III

Fungal physiology, growth, nutrition, development and reproduction of fungi, metabolism in fungi, nutritional specialization in parasitic fungi,

Unit-IV

Ecology of fungi, distribution of fungi, role of fungi in biogeochemical cycling, fungi of terrestrial and aquatic environments, fungi of extreme environments, interaction of fungi with other organisms

Economic importance of fungi, fungi as a source of vitamins, amino acids, organic acids, enzymes and proteins, Ecological services

Unit-V

Fungal biotechnology: yeast as model organism, fungal whole genome sequencing, genetically modified fungi, fungi as biocontrol agent (Mycoherbicides, Mycofungicides, Myconematicides), Edible and poisonous mushrooms, cultivation of mushrooms, economic value of mushrooms

BOT-402
Optional-III:: Mycology and Plant Pathology

Unit- I

The concept of diseases in plants, history of plant pathology, role of fungi and other organisms as causes of plant diseases, losses caused by plant diseases, pathology in 21th century and beyond, plant pathology today and future direction, plant pathology as profession

Unit-II

Diagnosis of plant diseases, Koch's postulate and germ theory of diseases, Parasitism and disease development, pathogenecity and host range, stages of development and disease cycle, symptoms of plant diseases, dissemination of plant pathogens,

UNIT-III

Diseases and changes in plant physiological functions like photosynthesis, movement of water, respiration, permeability of cell membrane, growth and transcription and translation.

Unit-IV

Genetics of plant diseases, genes and disease variability in organisms, mechanism of variability, types of plant resistance to pathogens, Genetics of Virulence in pathogens and resistance in host plants, signal transduction between resistant and pathogenicity genes. Enzymes, toxins and growth regulators in plant disease development, environmental impact on the development of plant diseases, environmental factors that affect plant diseases.

Unit-V

Epidemiology and disease forecasting, Effects of environmental factors on epidemiology; Control of plant diseases, chemical and biological disease control, integrated disease management (IDM), IDM in important crops- rice, wheat, cotton, sugarcane, chickpea, mustard, pulses, and vegetable crops

Symptomatology, disease cycle, control measures and management of some important plant diseases of Assam caused by fungi, bacteria, virus, nematode, fungal like organisms and flagellate protozoa.

Aerobiology and Plant diseases: Air microflora, air sampling techniques, factors affecting the distribution of air microflora, air-borne plant diseases, aero-allergens

BOT-403
Optional-III:: Mycology and Plant Pathology

Unit I

Defence mechanisms in plants, structural and chemical defenses, defense through lack of essential factors, induced structural and biochemical defenses, plant immunization, systemic acquired resistance, Induced resistance, plantibodies

Unit II

Biotechnology and plant diseases – resistant gene identification and insertion in suitable host for crop improvement, strategies for development of disease resistance in plants; GMO (bt-cotton, bt- brinjal, bt-chickpea); Use of immunological techniques in plant pathology.

Unit-IV

Soil borne diseases: Soil as an environment for plant pathogens, nature and importance of rhizosphere and rhizoplane, root exudates, and soil and root borne pathogens. Inoculum potential and density in relation to host and soil variables; Associative and antagonistic effects; Suppressive soils, biological control- concepts and potentialities for managing soil borne pathogens.

Unit-V

Seed pathology: History and economic importance of seed pathology; Morphology and anatomy of infected seeds; Disease development in seed and seedling, seed to plant transmission of pathogens. Seed certification and tolerance limits, Quarantine and SPS under WTO; Evolutionary adaptations of crop plants to defend seed invasion by seed-borne pathogens; Epidemiological factors influencing the transmission of seed-borne diseases, forecasting through seedborne infection. Toxic metabolites affecting seed quality and its impact on human, animal and plant health, management of seed-borne pathogen/diseases and procedure for healthy seed production, seed health testing and methods for detecting seed microorganisms.

Unit-V

Quarantine and seed certification: Definition of pest, pesticides and transgenics as per Govt. notification; relative importance; quarantine – domestic and international. Quarantine restrictions in the movement of agricultural produce, seeds and planting material; History of quarantine legislations, PQ Order 2003; Identification of pest/disease free areas; Symptomatic diagnosis 81 and other techniques to detect pest/pathogen infestations; VHT and other safer techniques of disinfestation/salvaging of infected material.

BOT-404(P)
Optional-III:: Mycology and Plant Pathology

1. Study of vegetative and reproductive structure of different fungal specimens
2. Study of disease symptoms and causal organisms
3. Isolation and identification of pathogen from diseased plant materials
4. Staining of bacterial flagella, spore and capsule
5. *In vitro* inhibition of plant pathogens by different plant extracts
6. Estimation of spore population and root colonization of mycorrhiza
7. Extraction of cellulase/pectinase/xylanase from diseased plants
8. Proving of Koch's postulate at least one disease
9. Study of the effect of fungicides and plant extracts on the germination and growth of plant pathogenic fungi
10. Isolation and enumeration of microbes from soil samples
11. Study of effect of physical and chemical factors on the growth of plant pathogens .

BOT-401
Optional-IV:: Plant Ecology

Unit-I

Development of ecology in India from ancient to recent times, evolutionary ecology, Interaction of ecological factors in the environment.Principles pertaining to limiting factors.Biogeochemical cycles.

Unit-II

Population concepts- characteristics, dynamics and control.mechanisms of population regulation, habitat specific demography, population viability analysis. Species interactions- types of interactions, interspecific competition, herbivory, carnivory, symbiosis, allelopathy, weed-crop interference. Concept of metapopulation – demes and dispersal, interdemic extinctions, age structured populations. Ecological amplitude of a species and adaptation -ecads, ecotypes, ecospecies.

Unit-III

Concepts of community and continuum; analysis of communities (analytical and synthetic characters); community coefficients; interspecific associations; ordination; concept of ecological niche, species diversity (α, β, γ).

Unit-IV

Vegetation development, temporal changes (cyclic and non-cyclic); mechanism of ecological succession (relay floristics and initial floristic composition; facilitation, tolerance and inhibition models); changes in ecosystem properties during succession.

Unit-V

Principles and basic concepts of remote sensing; application of remote sensing in environmental studies: land use mapping, forest survey, habitat analysis, water management, drought monitoring and flood studies, wetland survey, rainfall estimation, pollution studies, soil conservation, watershed management and vegetation mapping.

Unit-VI

Geographical Information System (GIS) - basic principles and techniques, types of geographical data; data structure; vector and raster data: their advantages and disadvantages; Input, verification, storage and output of geographical data; Importance of Geographical Information System in environmental studies. Global Positioning System (GPS): basic principles, Applications in ecological studies.

BOT-402
Optional-IV :: Plant Ecology

Unit-I

Ecosystem organization- structure and functions; Terrestrial and aquatic ecosystems, primary production (methods of measurement, global pattern, controlling factors); energy dynamics (trophic organization, energy flow pathways, ecological efficiencies); litter fall and decomposition (mechanism, controlling factors); ecosystem nutrient cycles and nutrient budgeting.

Unit-II

Ecosystem stability- Concept (resistance and resilience); ecological perturbations (natural and anthropogenic) and their impact on plants and ecosystems; ecology of plant invasion; Wetlands and its importance.

Unit-III

Introduction and elements of system ecology; ecosystem modeling, conceptual model, working model, auxiliary variable and foresters diagram. Basic concepts to statistical ecology, fundamental knowledge on pattern analysis, cluster analysis and ordination.

Unit-IV

Introduction to conservation ecology- principles, postulates and ethics, genetic variation and its loss, variation in natural populations, Species and habitat conservation- prioritizing species and habitat, protected area networks; major

approaches to their management, Indian case studies on conservation/management strategy.

Unit-V

Methods for biodiversity monitoring, megadiversity zones and hot spots; biodiversity and ecosystem services- provisioning, regulating, supporting and cultural; threats to biodiversity: Causes of biodiversity loss, species extinction, vulnerability of species to extinction, IUCN threat categories, Red data book; keystone and flagship species.

Unit-VI

Biodiversity act and biodiversity action plan; IPRs, national and international programs for biodiversity conservation, wildlife values and eco-tourism, wildlife distribution in India, problem in wildlife protection, role of WWF, WCU, CITES, TRAFFIC.

BOT-403
Optional-IV:: Plant Ecology

Unit-I

Scope of environmental management, basic concepts of sustainable development, advantages of environmental monitoring, deterioration of environmental quality with reference to anthropogenic impact; methods of assessment of environmental quality; Short term studies/ surveys; Rapid assessment; Continuous short and long term monitoring; general guidelines for the preparation of environmental impact statement.

Unit-II

Effect of pollution on water quality, on phytoplankton productivity; bio-indicators of water pollution.biological treatment of wastewater. Acid rain and its impact on soil fertility, rivers and lakes; its effects on plants, leaf injury, buffering, reproduction; forest decline. Biomonitoring of air pollution, active and passive monitoring; air pollution tolerance indices; control of air pollution by plants, green belt design. Plant indicators.

Unit-III

Environmental problems of NE India with special reference to shifting cultivation, deforestation, opencast coal mining, oil exploration, encroachment, flood, erosion, landslides etc.; wetlands, its benefits, causes of degradation and its consequences

Environmental Policies and Regulations.Evolution of International Environmental Policies.Environmental Movement in India.International Environmental Treaties and Conventions.Objectives and Provisions of Environmental Acts and Rules of India. IBP, MAB.

Unit-IV

Concepts of ecological restoration, aims and strategies; ecosystem reconstruction, major tools used in restoration, restoration of biological diversity- Acceleration of ecological succession, reintroduction of biota; restoration of degraded ecosystems-Forest, grassland and lake including contaminated soils, mine spoils etc.

Unit-V

Bioremediation, biotransformation, biodegradation and phytoremediation, In situ and Ex situ practices. Use of microbes (algae, bacteria and fungi) and plants to check biodegradation, biotransformation; waste water treatment using aquatic plants; root zone treatment. Ecological techniques for bio-waste and e-waste management.

BOT-404(P)
Optional-IV :: Plant Ecology

1. Determination of light intensity, relative humidity, wind speed, maximum and minimum temperature at different times of the day.

2. Determination of amount of rainfall.

3. Mapping of vegetation

4. Analysis of edaphic characters- soil profile, texture, soil moisture, water holding capacity, porosity, pH, organic matter content, quantitative estimation of N, P, K, Na, Ca and C:N.

5. Determination of carbonates, nitrates, chlorides, base deficiency by rapid soil test method.

6. Analysis of water quality- DO,COD, BOD, pH, hardness, alkalinity, conductivity, free CO2, chloride, phosphate.

7. Estimation of litter contribution in different forest stands; estimation of litter decomposition rate by litter bag technique, soil respiration.

8. Determination of IVI; life-form and biological spectrum; phenology; diversity indices in various plant communities.

9. Determination of gross and net primary productivity of aquatic ecosystem by light and dark method; estimation of phytoplankton biomass in terms of chlorophyll.

10. To study primary productivity for herbaceous community by Harvest method; Leaf Area Index.

11. To find out seed output and reproductive capacity of herbaceous plants.

12. To find out allelopathic effects of weeds on cultivated plants.

13. Morpho-anatomical variation of plant species as affected by environmental changes.

14. Ecological data collection for computer use.

BOT-401
Optional-V: Advanced Plant Physiology and Biochemistry

Unit-1

Membrane transport and translocation of water and solutes: Mechanism of xylem and phloem transport, phloem loading and unloading, passive and active solute transport, membrane transport of proteins. Root microbe interactions in facilitating nutrient uptake.

Unit-II

Nitrogen and sulphur metabolism: Nitrogen fixation, nitrogenase, “nif” genes, regulation of nitrogen fixation, products of nitrogen fixation and their transport, mechanism of nitrate uptake and reduction, transamination, nitrogen metabolism in

relation to photosynthesis and respiration. Sulphate uptake, transport, reduction and assimilation.

Unit-III

Phosphorus nutrition – Forms of phosphorus in soil. Phosphorus uptake, factors controlling 'P' uptake, 'P' fractions in plants. Role of Pyrophosphate in plant metabolism.

Unit-III

The flowering process: Photoperiodism and its significance, endogenous clock and its regulation, floral induction and development- genetic and molecular analysis, role of vernalization.

Unit-IV

Post-harvest physiology: Ripening of fruit and its regulation, post-harvest management. Metabolism of leafy vegetables during storage.A brief idea about role of tissue culture, and mutants in physiological studies.

Unit-V

Stress physiology: Plant responses to water deficit, salinity, metal ion stress, freezing and heat stress, effect of elevated CO2 concentration on plant metabolism, Oxidative stress - Generation of reactive oxygen species, Effect of ROS on metabolism, ROX detoxification mechanisms in plants. Biotic stress - effect of fungal infection on plant metabolism; transgenic approach to overcome the abiotic stress in plants.

Unit-VI

Signal transduction: Overviews, receptors and G- proteins, phospholipids signaling, role of cyclic nucleotides, Calcium-Calmodulin cascade, protein kinases and phosphatases, specific signaling mechanisms. *e.g.*, two component sensor – regulator system in bacteria and plants.

BOT-402

Optional-V: Advanced Plant Physiology and Biochemistry

Unit-I

Respiration and lipid metabolism: Overview of plant respiration, anaerobic respiration, modern concept of electron transport and ATP synthesis; glycolysis in plants and its

regulation; regulation of pentose phosphate pathway and TCA Cycle; inhibitor of respiration, glyoxylate cycle, synthesis of membrane lipids, structural lipids and storage lipids and their catabolism, gluconeogenesis.

Unit-II

Photochemistry and photosynthesis: Evolution of photosynthetic apparatus, photosynthetic pigments and light harvesting complexes, photo-oxidation of water, mechanism of electron and proton transport, carbon assimilation- the Calvin cycle, Rubisco, significance of photorespiration. Regulation of PCR Cycle and C4 Pathway, RUBISCO and PEP Case, C3–C4 intermediates, ecological significance and modification of CAM.

Unit-III

Carbohydrate metabolism: Regulation of starch and sucrose biosynthesis, Synthesis and degradation of cellulose. A brief idea of pectin biosynthesis and enzymes involved in pectin degradation.

Unit-IV

Organic acid metabolism: Metabolism and roles of oxalic acid, ascorbic acid and malic acid.

Unit-V

Secondary metabolites: Shikimate Pathway and its role in biosynthesis of Secondary Metabolites. Biosynthesis of terpenes, phenols and nitrogenous compounds and their roles.

Unit-VI

Phosphorus nutrition – Forms of phosphorus in soil. Phosphorus uptake, factors controlling ‘P’ uptake, ‘P’ fractions in plants. Role of Pyrophosphate in plant metabolism.

BOT-403

Optional-V: Advanced Plant Physiology and Biochemistry

Unit-I

Growth and morphogenesis: Meristems in plant development; development of plant organs: root, stem, leaf and flower; photomorphogenesis: phytochromes and cryptochromes and their photochemical and biochemical properties; phytochrome biosynthesis, cellular localization, roles, mechanism of action of photomorphogenetic receptors.

Unit-II

Plant developments: Biochemical changes during development of seeds; phototropism, geotropism and nastic movements; ripening of fruit and its regulation; metabolism of leafy vegetables during storage.

Unit-III

Senescence and PCD- Biochemical changes during senescence of leaves and petals and regulation of senescence. Programmed Cell Death.

Unit-IV

Enzyme kinetics: Km value, enzyme inhibition, factors responsible for enzyme interaction, abzyme and ribozyme.

Unit-V

A brief idea about role of tissue culture, and mutants in physiological studies.

Unit-VI

Plant Growth Regulators –Biosynthesis and mechanism of action of Phytohormones: auxin, gibberellin, cytokinin, ethylene and ABA. A brief idea about discovery, role and possible mechanism of action of Triacontanol, Brassins, Salicylic acid, Jasmonates and Polyamines. A brief idea about role of plant growth retardants- CCC, Maleic hydrazide, Trizoles and TIBA.

BOT-404(P)
Optional-V: Advanced Plant Physiology and Biochemistry

1. Estimation of starch, Ascorbic acid, Polyphenols, Cellulose.
2. Study of Oxalic acid accumulation in leaf tissue.
3. Hormonal regulation of leaf and petal senescence.
4. Study of changes in starch / protein content during seed development.
5. Study of lipid accumulation during development of oil seeds.
6. To study the effect of different PGRs on seedling growth
7. Sugar and amino acids analysis of phloem sap, with paper chromatography.
8. Determination of Chlorophyll a / b ratio of C3 and C4 plants.

9. Estimation of nitrate in different plant parts.
10. Study of effect of PEG induced water stress on seed germination
11. Measurement of RWC and Osmotic potential
12. Study of protein/ amino acid profile in plants under stress.
13. Study of effect of fungal infection on peroxidase activity.
14. Study of free radicals scavenging enzymes, Catalase and super oxide dismutase.
15. Study of free prolein accumulation in plants under stress.
16. Study of seed germination under stress condition.

BOT-401

Optional-VI :: Cytology, Genetics and Plant Breeding

Unit-I

Cell architecture and function: The evolution of cell; Membrane structure; Cell signaling; Cytoskeleton: The nature of cytoskeleton; Intermediate Filaments; Microtubules; Cell division cycle; cell-division control in multicellular animals.

Unit-II

Chromosome structure and organization: Chromatin structure, nucleosomal and higher order structures, morphology and basic functions of chromosomes: karyotyping, chromosome banding, chromosome labelling, *in situ* hybridization, chromosome painting.

Unit-III

Genome organization in viruses, prokaryotes and eukaryotes; Organization of nuclear and organellar genomes; c-value paradox; repetitive DNA, satellite DNAs and interspersed repeated DNAs; fine structure of gene, split genes, pseudogenes, overlapping genes and multigene families.

Unit-IV

Epigenetics: from phenomenon to field, a brief history of epigenetics-overview and concepts; chromatin modifications and their mechanism of action, concept of 'histone-code' hypothesis, epigenetics in *Saccharomyces cerevisiae,* heterochromatin formation, and gene silencing in *Drosophilla.*

Unit-V

Gene Mutation and its mechanism; molecular basis of gene mutations.DNA damage and repair; mechanism of transposition in prokaryotes, molecular nature and use of transposable elements in eukaryotes; controlling elements in maize, *Drosophila* P element.

Unit-VI

Genetic diversity, genetic distance and phylogenetic analysis; origin and evolution of gene; rate of molecular evolution-amino acids and nucleotide substitutions, synonymous codon, molecular divergence and molecular clock; origin of new genes and proteins; gene duplication and divergence.

BOT-402
Optional-VI :: Cytology, Genetics and Plant Breeding

Unit-I
RNA molecules and processing: Structure and processing of messenger RNA, transfer RNA, ribosomal RNA, small interfering RNAs and micro RNAs, regulation through RNA processing and decay, alternative splicing, mRNA stability, RNA interference (RNAi).

Unit-II
Transcription: RNA polymerase subunits, different sigma factors, initiation, elongation and termination (rho-dependent and independent) of RNA synthesis; antitermination, attenuation; eukaryotic promoters, enhancers, transcription factors, RNA polymerases; translation: in prokaryotes and eukaryotes and their regulation, processing of mRNA for translation. Operon concept in prokaryotes.

Unit-III
Metagenomics: From genomics to metagenomics, 16S rRNA analysis and culturing, culture independent insight, sequence base analysis, functional based analysis, heterologous expression, global impact of metagenomics.

Unit-IV
Techniques in molecular genetics: Electrophoresis, restriction digestion, ligation, DNA probes and hybridization, DNA cloning, vectors, genomic and cDNA library, PCR amplification, nested PCR, forensics and PCR, DNA sequencing, comparative genome analysis, protein analysis, SDS-PAGE, protein purification with chromatographic system, monoclonal antibody and hybridoma Technology, blotting techniques, model organisms in molecular biology.

Unit-V
Genome analysis: Gene and protein sequence data banks. Access to sequence databases on the Internet, Sequence analysis, multiple sequence alignment, homology and analogy, pattern recognition, analysis package; *in silico*computational techniques for gene functions; Human Genome Project, Other sequenced genomes, High-throughput analysis gene functions, Single Nucleotide Polymorphisms.

Unit-VI
Genetic engineering and public concerns: Plant genetic engineering future - genetically engineered foods; molecular farming and plantibodies, antisense RNA technology; ethical and environmental concerns on genetic engineering of plants; biosafety issues related to genetically modified organisms.

BOT-403
Optional-VI :: Cytology, Genetics and Plant Breeding

Unit-I

Principles of plant breeding: Principles involved in breeding and maintaining economic crops; alternative approaches through hybridization and selection; concepts in improvement of major crop species; historically important breeding methods and new approaches; polyploidy inheritance, self-incompatibility.

Unit-II

Quantitative and evolutionary genetics: Polygenic inheritance; QTL mapping using molecular marker, population statistics; heritability; measurement of heritability; Population Genetics: populations, gene pool, gene frequency; Hardy-Weinberg law; the Hardy-Weinberg equilibrium.

Unit III

Chromosome variation in higher plants: Haploid production system, parthenogenesis and apogamy, meiosis in haploid, chromosome pairing in monoploid, breeding application of haploid. Aneuploidy: trisomic, tetrasomic, nullisomic and their significance in genetic studies. Mutation in crop improvement: action of physical and chemical mutagens.

Unit-IV

Plant transformation techniques: Cloning of plant cells and manipulation of plant genes; *Agrobacterium* mediated gene transfer- biology and molecular basis of *Agrobacterium* mediated plant transformation and its application, direct gene transfer methods; development of plant vectors for transformation and features.

Unit-V

Plant genetic engineering: Crop improvement, herbicide resistance, insect resistance, virus resistance, tolerance of environmental extremes in crops - drought, cold, salinity, flooding, heavy metal; plant as bioreactors (molecular farming).

Unit-VI

Plant cell, tissue and organ cultures: Micropropagation and clonal propagation. Synthetic seeds; protoplast culture and somatic hybridization; nuclear and cytoplasmic hybrids; somaclonal variation, DNA-microchip in plant tissue culture industry.

BOT-404(P)
Optional-VI: Cytology, Genetics and Plant Breeding

1. Preparation of smears and squashes from pollen mother cells and root tips using suitable staining techniques.

2. Studies on some special chromosomal staining techniques for chromosome banding.

3. Preparation of karyotypes and idiograms from polar view of mitotic metaphase stage.

4. Studies of chiasma frequencies in meiosis cell division.

5. Studies of natural and induced chromosomal aberrations.

6. Studies of effects of colchicines on polyploidy.

7. Emasculation and artificial hybridization.

8. Isolation of genomic DNA from plant materials, purification, estimation, separation with gel electrophoresis and documentations.

9. Working out of genetical problems.

10. Introduction to NCBI databases, BLAST: BLASTn, BLASTp, sequence manipulation, multiple sequence alignment, primer designing, phylogenetic analysis, protein modelling and protein structure analysis.

REVISED SYLLABUS W.E.F 2020

UNDER GRADUATE COURSE
(SEMESTER)

SUBJECT : BACHELOR OF PHYSIOTHERAPY

BODOLAND UNIVERSITY

DEBARGAON, KOKRAJHAR (B.T.C)

Bachelor of Physiotherapy

Physiotherapy or Physical Therapy (PT) is a **Movement Science** with an established theoretical and scientific base and widespread clinical applications in the **Prevention, Restoration & Rehabilitation, Maintenance and Promotion of optimal physical function.** Physiotherapists **diagnose and manage movement dysfunction and enhance physical and functional abilities**. This physical dysfunction may be the sequelae of involvement of any of the systems like Musculoskeletal, Neurological, Cardiovascular, Respiratory or other body systems.

Physiotherapy is a branch of modern medical science which includes examination, assessment, interpretation, physical diagnosis, planning and execution of treatment and advice to any person for the purpose of preventing, correcting, alleviating and limiting dysfunction, acute and chronic bodily malfunction including life saving measures via chest physiotherapy in the intensive care unit, curing physical disorders or disability, promoting physical fitness, facilitating healing and pain relief and treatment of physical and psychological disorders through modulating psychological and physical response using physical agents, activities and devices including exercise, mobilization, manipulations, therapeutic ultrasound, electrical and thermal agents and electrotherapy for diagnosis, treatment and prevention.

Learning Objectives: At the completion of this course, the student should be able -

1. To delineate the cognitive, affective and psychomotor skills deemed essential for completion of this program and to perform as a competent physiotherapist who will be able to examine, evaluate, diagnose, plan, execute and document physiotherapy treatment independently or along with the multidisciplinary team.
2. To evaluate patients for impairments and functional limitations and able to execute all routine physiotherapeutic procedures as per the evaluation.
3. To operate and maintain physiotherapy equipment used in treatment of patient, physiotherapy treatment planning (both electrotherapy and exercise therapy) & procedures independently.
4. To provide patient education about various physiotherapeutic interventions to the patient and care givers.

Expectations from the future physiotherapy graduates -

1. Coursework entitles independent physiotherapy assessment and treatment in any healthcare delivery centers in India by the graduates.
2. The coursework is designed to train students to work as independent physiotherapists or in conjunction with a multidisciplinary team to diagnose and treat movement disorders as per red and yellow flags.
3. Course works will skill the graduate's physical/ functional diagnosis, treatment planning, and management, administration of physiotherapy treatment and for patient support.
4. Graduates can find employment opportunities in hospitals/nursing homes/sports teams/fitness centers/Community Rehabilitation /Health planning boards/health promotions services in both private and public sectors as well as in independent physiotherapy clinics.

5. Physiotherapy graduate is encouraged to pursue further qualification to attain senior position in the professional field and also to keep abreast with the recent advances, new technology and research. The professional should opt for continuous professional education credits offered by national and international institutes.

Terminal Objectives (Expected Outcomes):

6. The graduate will be a competent and reflective physiotherapy practitioner who can function safely and effectively while adhering to legal, ethical and professional standards of practice in a multitude of physiotherapy settings for patients and clients across the lifespan and along the continuum of care from wellness and prevention to rehabilitation of dysfunction.
7. The graduate will utilize critical inquiry and evidence-based practice to make clinical decisions essential for autonomous practice.
8. The graduate will function as an active member of professional and community organizations. The graduate will be a service-oriented advocate dedicated to the promotion and improvement of community health.
9. The graduate will demonstrate lifelong commitment to learning and professional development.

Eligibility for admission:

Selection procedure:

1. He/she has passed the Higher Secondary (10+2) or equivalent examination recognized by any Indian University or a duly constituted Board with pass marks (50%) in physics, chemistry and biology (botany & zoology), mathematics, (i.e – Physics, chemistry and biology as mandates requirements).

2. Relaxation of Marks: Candidates for reserved quota (SC/ST) shall be given relaxation up to 5% of the marks. The relaxation will not be applicable to candidates seeking admission in any other reserved quota.
3. Candidates who have studied abroad and have passed the equivalent qualification as determined by the Association of Indian Universities will form the guideline to determine the eligibility and must have passed in the subjects: Physics, Chemistry, Biology and English up to 12th Standard level.
4. Candidates who have passed the Senior Secondary school Examination of National Open School with a minimum of 5 subjects with any of the following group subjects.
    a. English, Physics, Chemistry, Botany, Zoology
    b. English, Physics, Chemistry, Biology and any other language
5. He/she has attained the age of 17 years as on - current year
6. He/she has to furnish at the time of submission of application form, a certificate of Physical fitness from a registered medical practitioner and two references from persons other than relatives testifying to satisfactory general character.
7. Admission to Bachelor of Physiotherapy course shall be made on the basis of eligibility and an entrance test to be conducted for the purpose. No candidate will be admitted on any ground unless he/she has appeared in the admission test and interview.
    a. Entrance test, to be conducted by the university as per the syllabus under 10 +2

scheme

b. Successful candidates on the basis of written test will be called for counseling(s) nominated by the University or the board.
c. During subsequent counseling(s) the seat will be allotted as per the merit of the candidate depending on the availability of seats on that particular day.
d. Candidate who fails to attend the Medical Examination on the notified date(s) will forfeit the claim for admission and placement in the waiting list except permitted by the competent authority under special circumstances.
e. The name of the student(s) who remain(s) absent from classes for more than 15 days at a stretch after joining the said course without giving any notice will be governed as per the respective University rules.

Duration of the course

Duration of the course: 4 ½ years (4 years Academic+ 6 months compulsory rotatory internship).

Total of 4455 hours in theory, practical & clinical.

Minimum 960 hours of internship (to be completed in six months duration).

Total hours – 5415 hours

Medium of instruction:

English shall be the medium of instruction for all the subjects of study and for examination of the course.

Semesters:

An academic year consists of two semesters:

Semesters
Odd Semesters 1st, 3rd, 5th, 7th, 9th
Even Semesters 2nd, 4th, 6th ,8th

Credits:

Credit defines the coefficient of contents/syllabus prescribed for a course and determines the number of hours of instruction required per week. Credits will be assigned in each course on the basis of number of lectures/ practical/tutorial/ laboratory work and other forms of learning required, to complete the course contents in a 15-20 week schedule:

- 1 credit = 1 hour of lecture per week
- 1 credit = 2 hours of instruction/practical per week

Credits will be assigned on the basis of the lectures (L) / Clinical Training (CT) / laboratory work (P) / Research Project (RP) and other forms of learning in a 15-20 week schedule L - One credit for one hour lecture per week

- P - One credit for every two hours of laboratory or practical
- CT - One credit for every two hours of Clinical training/Clinical rotation/posting
- RP - One credit for every two hours of Research Project per week

	Lecture - L	**Tutorial – T**	**Practical – P**	**Clinical Training/ Rotation– CT/CR**	**Research Project– RP**
1 Credit	1 Hour	2 Hours	2 Hours	2 Hours	2 Hours
Maximum Credit 31 / Semester					

Types of Courses:

Courses in the programme are of two kinds:

- Core Course
- Foundation Course

Core Course:

A course, which should compulsorily be studied by a candidate as a basic requirement to complete the program, is termed as a Core course. There are Core Theory (CT) and Core Practical (CP) Courses in every semester.

Foundation Course:

A course which should compulsorily be studied by a candidate and shall be evaluated on the basis of examination.

Assigning Credit Hours per Course:

While there is flexibility for the departments in allocation of credits to various courses offered, the general formula would be:

- All core courses will be restricted to a maximum of 8 credits
- All foundation courses will be restricted to a maximum of 2 credits
- Projects will be restricted to a maximum of 2 credits

Assigning total Credits for a Program:

The BPT program credits for 4 ½ years duration will be 222 credits in total, inclusive of clinical rotation/clinical training and research project, exclusive of internship.

COURSE EVALUATION

The performance of every student in each course for university examination will be evaluated as follows:

1. Internal evaluation by the course faculty member(s) based on continuous assessment, for 20% of the marks for the course:
   The internal assessment is done based on continuous evaluation method. Every semester, there will be two internal examinations for theory and practical. For the award of internal marks in theory and practical, the average of the two tests shall be considered along with other components like attendance, presentations, assignments and journal submission.
2. Final examination by the university through written paper or practical examination or oral examination by the student of combination of any two or more of these, for 80% of the marks of the course.
   Every student has to score minimum 50 % of marks to pass in the final University Examination of 80 % marks in theory and practical examination.
3. Aggregate:
   Every student has to have an aggregate score of 50 % marks to pass in the final University Examination of both the internal and external evaluation of 100 % marks in theory and practical examination and the grade will be awarded based on the aggregate marks.
4. GRADING:
   a. The total of the internal evaluation marks and final University examination marks in each course will be converted to a letter grade on a ten-point scale as per the following scheme:

Letter Grade	**Grade Point**
O (Outstanding)	10
A+ (Excellent)	9
A (Very Good)	8
B+ (Good)	7
B (Above Average)	6
C Pass (Average)	5
F (Fail)	0
I (Incomplete)	0
W (Withheld due to non-clearance of dues etc.)	--
ABS (Absent)	0

   b. A student obtaining Grade F will be considered fail and will require reappearing in the examination.

c. Grading System - Marks Equivalence Table

Grades, Grade Points & Cumulative Grade Point Average

Letter Grade	**Grade Point**	% **Range of Marks**
O (Outstanding)	10	90 to 100
A+ (Excellent)	9	80 to < 90
A (Very Good)	8	70 to < 80
B+ (Good)	7	60 to < 70
B (Above Average)	6	55 to < 60
C Pass (Average)	5	50 to < 55
F (Fail)	0	Below 50
I (Incomplete)	0	
W (Withheld due to non-clearance of dues etc.)	--	
ABS (Absent)	0	

d. The student's performance in any semester will be assessed by the Semester Grade Point Average (SGPA). Similarly, his performance at the end of two or more consecutive semesters will be denoted by the Cumulative Grade Point Average (CGPA).
The SGPA and CGPA are defined as follows:

i. SGPA (S) = $(\sum C_i \times G_i) / (\sum C_i)$ where C_i is the number of credits of i^{th} course and G_i is the Grade Point scored in the i^{th} course

ii. CGPA = $(\sum C_i \times S_i) / (\sum C_i)$ where S_i is the SGPA of the i^{th} semester and C_i is the total number of credits in that semester

Grade 'C' and 'B' are considered 2nd Class

Grades 'B+' and above are considered 1st Class,
Whereas 'A+' and above are considered 1st Class with distinction.

Conversion Formula:
Equivalent Percentage = 10 × CGPA

e. To be eligible for the award of Bachelor's/Master's degree, a student must obtain minimum CGPA of 5.00.

INTERNSHIP:

There shall be six months (minimum 960 hrs) of Internship after the final year examination for candidates declared to have passed the examination in all the subjects. Internship should be done in any hospital recognized by the University.

The Internship should be rotatory and cover clinical branches concerned with Physiotherapy such as Orthopaedics, Cardiothoracic including ICU, Neurology, Paediatrics, General Medicine, General Surgery, Obstetrics and Gynaecology, both in-patient and outpatient services. On completion of the rotatory internship, duly signed completion certificate from the concerned authority of the institution in which internship was sought should be procured and submitted to the Principal/Head of program.

No candidate shall be awarded degree certificate without successfully completing six months of Internship.

Transcript:

The transcript issued to the student at the time of leaving the University will contain a consolidated record of all the courses taken, credits earned, grades obtained, SGPA, CGPA, class obtained, etc.

Framework of BPT Curriculum Semester

First Semester (0-6 months)

Course Code	Course Title	Teaching Scheme				
		Contact Hours				Total Credits
		Theory	Practical	Total	L+T+P	
BPTCC1018	Human Anatomy I	75	90	165	4+0+6	5+3=8
BPTCC1028	Human Physiology I	90	60	150	5+0+4	6+2=8
BPTCC1035	Biochemistry	75		75	5+0+0	5
BPTCC1044	Sociology	60		60	4+0+0	4
BPTFC1052	Introduction to Health Care Delivery Services in India	30		30	2+0+0	2
BPTFC1062	Medical Physiotherapy Law and Ethics	30		30	2+0+0	2
BPTFC1072	English Communication and soft skills	30		30	2+0+0	2
Total		390	150	540	36	31

Course Code	Course Title	Examination Scheme				Total Marks
		Theory		Practical		
		Internal	External	Internal	External	
BPTCC1018	Human Anatomy I	20	80	20	80	200
BPTCC1028	Human Physiology I	20	80	20	80	200
BPTCC1035	Biochemistry	20	80			100
BPTCC1044	Sociology	20	80			100
BPTFC1052	Introduction to Health Care Delivery Services in India		50			50
BPTFC1062	Medical Physiotherapy Law and Ethics		50			50
BPTFC1072	English Communication and soft skills		50			50
						750

Second Semester (7-12 months)

Course Code	Course Title	Teaching Scheme				
		Contact Hours				Total Credits
		Theory	Practical	Total	L+T+P	
BPTCC2018	Human Anatomy II	90	60	150	6+0+4	6+2=8
BPTCC2028	Human Physiology II	90	60	150	6+0+4	6+2=8
BPTCC2036	Basic Principles of Biomechanics	60	60	120	4+0+4	4+2=6
BPTCC2044	General and Clinical Psychology	60		60	4+0+0	4
BPTFC2052	Medical Terminology and Record Keeping	30		30	2+0+0	2
BPTFC2062	Introduction to Yoga - Basic theory, science and techniques	15	30	45	1+0+2	1+1=2
Total		345	210	555	37	30

Course Code	Course Title	Examination Scheme				Total Marks
		Theory		Practical		
		Internal	External	Internal	External	
BPTCC2018	Human Anatomy II	20	80	20	80	200
BPTCC2028	Human Physiology II	20	80	20	80	200
BPTCC2036	Basic Principles of Biomechanics	20	80	20	80	200
BPTCC2044	General and Clinical Psychology	20	80	-	-	100
BPTFC2052	Medical Terminology and Record Keeping	-	50	-	-	50
BPTFC2062	Introduction to Yoga - Basic theory, science and techniques	-	40	-	10	50
Total						800

Third Semester (13-18 months)

Course Code	Course Title	Teaching scheme				
		Contact Hours				Total Credits
		Theory	Practical	Total	L+T+P	
BPTCC3017	Biomechanics and Kinesiology	60	90	150	4+0+6	4+3=7
BPTCC3026	Foundation of Exercise Therapy and Therapeutic Massage	60	60	120	4+0+4	4+2=6
BPTCC3033	Pharmacology	45		45	3+0+0	3
BPTCC3044	Pathology	60		60	4+0+0	4
BPTCC3053	Microbiology	45		45	3+0+0	3
BPTFC3062	Introduction to Quality and Patient safety	30		30	2+0+0	2
BPTCE3073	Clinical Education		90	90	0+0+6	3
Total		300	240	540	36	28

Course Code	Course Title	Examination Scheme				Total Marks
		Theory		Practical		
		Internal	External	Internal	External	
BPTCC3017	Biomechanics and Kinesiology	20	80	20	80	200
BPTCC3026	Foundation of Exercise Therapy and Therapeutic Massage	20	80	20	80	200
BPTCC3033	Pharmacology	20	80	-	-	100
BPTCC3044	Pathology	20	80	-	-	100
BPTCC3053	Microbiology	20	80	-	-	100
BPTFC3062	Introduction to Quality and Patient safety	-	50	-	-	50
BPTCE3073	Clinical Education	-	-	20	80	100
Total						850

Fourth Semester (19-24 months)

Course Code	Course Title	Teaching Scheme				
		Contact Hours				Total Credits
		Theory	Practical	Total	L+T+P	
BPTCC4018	Exercise Therapy	60	120	180	4+0+8	4+4=8
BPTCC4028	Electrotherapy	60	120	180	4+0+8	4+4=8
BPTCC4034	Biophysics	60		60	4+0+0	4
BPTFC4042	Basic Computer and Information Science	15	30	45	1+0+2	1+1=2
BPTCE4053	Clinical Education		90	90	0+0+6	3
Total		195	360	555	37	25

Course Code	Course Title	Examination Scheme				Total Marks
		Theory		Practical		
		Internal	External	Internal	External	
BPTCC4018	Exercise Therapy	20	80	20	80	200
BPTCC4028	Electrotherapy	20	80	20	80	200
BPTCC4034	Biophysics	20	80	-	-	100
BPTFC4042	Basic Computer and Information Science	-	40	-	10	50
BPTCE4053	Clinical Education	-	-	20	80	100
Total						650

Fifth Semester (25-30 months)

Course Code	Course Title	Teaching Scheme				
		Contact Hours				Total Credits
		Theory	Practical	Total	L+T+P	
BPTCC5015	Clinical Orthopaedics and Traumatology	75		75	5+0+0	5
BPTCC5025	General Surgery	75		75	5+0+0	5
BPTCC5035	General Medicine	75		75	5+0+0	5
BPTCC5045	Community Medicine	75		75	5+0+0	5
BPTFC5052	Evaluation Methods and Outcome Measures	15	30	45	1+0+2	1+1=2
BPTFC5062	Diagnostic Imaging for Physiotherapist	30		30	2+0+0	2
BPTCE5076	Clinical Education		180	180	0+0+12	6
Total		345	210	555	37	30

Course Code	Course Title	Examination Scheme				Total Marks
		Theory		Practical		
		Internal	External	Internal	External	
BPTCC5015	Clinical Orthopaedics and Traumatology	20	80	-	-	100
BPTCC5025	General Surgery	20	80	-	-	100
BPTCC5035	General Medicine	20	80	-	-	100
BPTCC5045	Community Medicine	20	80	-	-	100
BPTFC5052	Evaluation Methods and Outcome Measures	-	40	-	10	50
BPTFC5062	Diagnostic Imaging for Physiotherapist	-	50	-	-	50
BPTCE5076	Clinical Education	-		20	80	100
Total						600

Sixth Semester (31-36 months)

Course Code	Course Title	Teaching Scheme				
		Contact Hours				Total Credits
		Theory	Practical	Total	L+T+P	
BPTCC6017	Physiotherapy in Orthopaedics and Sports	60	90	150	4+0+6	4+3=7
BPTCC6027	Physiotherapy in General Medicine and General Surgery	60	90	150	4+0+6	4+3=7
BPTCC6034	Clinical Neurology and Neurosurgery	60		60	4+0+0	4
BPTFC6042	Professionalism and Values	30		30	2+0+0	2
BPTCE6056	Clinical Education		180	180	0+0+12	6
Total		210	360	570	38	26

Course Code	Course Title	Examination Scheme				Total Marks
		Theory		Practical		
		Internal	External	Internal	External	
BPTCC6017	Physiotherapy in Orthopaedics and Sports	20	80	20	80	200
BPTCC6027	Physiotherapy in General Medicine and General Surgery	20	80	20	80	200
BPTCC6034	Clinical Neurology and Neurosurgery	20	80	-	-	100
BPTFC6042	Professionalism and Values	-	50	-	-	50
BPTCE6056	Clinical Education	-	-	20	80	100
Total						650

Seventh Semester (37-42 months)

Course Code	Course Title	Teaching Scheme				
		Contact Hours				Total Credits
		Theory	Practical	Total	L+T+P	
BPTCC7017	Physiotherapy in Neurology and Psychosomatic Disorder	60	90	150	4+0+6	4+3=7
BPTCC7025	Clinical Cardiovascular and Pulmonary	75		75	5+0+0	5
BPTCC7034	Biostatistics and Research Methodology	60		60	4+0+0	4
BPTFC7042	Health Promotion and Fitness	15	30	45	2+0+2	1+1=2
BPTFC7052	Principles and Management	30		30	2+0+0	2
BPTFC7061	Critique Inquiry, Case Presentation and Discussion		30	30	0+0+2	1
BPTCE7076	Clinical Education		180	180	0+0+12	6
Total		240	330	570	38	27

Course Code	Course Title	Examination Scheme				Total Marks
		Theory		Practical		
		Internal	External	Internal	External	
BPTCC7017	Physiotherapy in Neurology and Psychosomatic Disorder	20	80	20	80	200
BPTCC7025	Clinical Cardiovascular and Pulmonary	20	80	-	-	100
BPTCC7034	Biostatistics and Research Methodology	20	80	-	-	100
BPTFC7042	Health Promotion and Fitness	-	40	-	10	50
BPTFC7052	Principles and Management	-	50	-	-	50
BPTFC7061	Critique Inquiry, Case Presentation and Discussion	-	-	-	50	50
BPTCE7076	Clinical Education	-	-	20	80	100
Total						650

Eighth Semester (43-48 months)

Course Code	Course Title	Teaching Scheme				
		Contact Hours				Total Credits
		Theory	Practical	Total	L+T+P	
BPTCC8017	Physiotherapy in Cardiovascular, Pulmonary and Intensive Care	60	90	150	4+0+6	4+3=7
BPTCC8026	Community Physiotherapy	60	60	120	4+0+4	4+2=6
BPTFC8032	Clinical Reasoning and Evidence Based Physiotherapy	15	30	45	1+0+2	1+1=2
BPTFC8042	Administration and Teaching Skills	15	30	45	1+0+2	1+1=2
BPTRP8052	Research project	30		30	2+0+0	2
BPTCE8066	Clinical Education		180	180	0+0+12	6
Total		180	390	570	38	25

Course Code	Course Title	Examination Scheme				Total Marks
		Theory		Practical		
		Internal	External	Internal	External	
BPTCC8017	Physiotherapy in Cardiovascular, Pulmonary and Intensive Care	20	80	20	80	200
BPTCC8026	Community Physiotherapy	20	80	20	80	200
BPTFC8032	Clinical Reasoning and Evidence Based Physiotherapy	-	50	-	-	50
BPTFC8042	Administration and Teaching Skills	-	40	-	10	50
BPTRP8052	Research project	-	-	-	50	50
BPTCE8066	Clinical Education	-	-	20	80	100
Total						650

Total Contact Hours of the course = 4455 (Excluding Internship)
Total Credits = 222 (Excluding Internship)

Internship

Course Title	Contact Hours		
	Theory	Practical	Total
Internship		960	960

University End-Semester Examination

- There will be one final university examination at the end of every semester.
- A student must have minimum 75% attendance (Irrespective of the type of absence) in theory and practical in each subject to be eligible for appearing the University examination.
- A student shall be eligible to sit for the examination only, if she / he secure a minimum of 50% in internal assessment (individually in theory and practical as applicable). Internal examinations will be conducted at college/ department level.
- If a student fails either in theory or in practical, he/ she have to re-appear for both.

Supplementary examination:

The supplementary examination will be held in the next semester. Eligibility to appear for supplementary examination will be as per carry over.

Carry over benefit:

- A student will be allowed to keep term for Semester II irrespective of number of heads of failure in Semester I.
- A student will be allowed to keep term for Semester III if she/he passes each Semester I and II OR fails in not more than 2 courses each in semester I and II.
- Student will be allowed to keep term for Semester IV irrespective of number of heads of failure in Semester III. However, student must mandatorily have passed each course of Semester I and II in order to appear for Semester IV exam.
- Student will be allowed to keep term for Semester V, if she/he passes Semester I, II, III and IV OR has passed in all courses of Semester I and II and fails in not more than two courses each of Semester III and IV.
- Student will be allowed to keep term for Semester VI, irrespective of number of heads of failure in Semester V. However, student must mandatorily have passed each course of Semester I, II, III and IV in order to appear for Semester VI exam.
- Student will be allowed to keep term for Semester VII, if she/he passes Semester I, II, III, IV, V and VI OR has passed in all courses of Semester I, II, III and IV and fails in not more than two courses each of Semester V and VI.
- A student will not be allowed to appear for the Semester VIII examination unless she/he has cleared all previous examinations.
- Student will be allowed to commence internship if he/she passes Semester VIII examination.

General Instructions (Practical)

- All the students have to remain present at the examination Centre 15 minutes before the scheduled time for examination.
- Students have to carry with them laboratory manual, I-card or examination receipt, and other necessary requirements for examination.
- Appropriate dress code to be followed
- Candidate should not leave the practical hall without the permission of examiner.
- Use of mobile phones is strictly prohibited.
- The candidate has to leave the laboratory only after the submission of all the answer sheets of the exercises performed.

Case Evaluation:-

- Presentation of required number of cases to the respective clinical supervisors and documentation in the Log book for each posting is mandatory, failing which the particular posting will be repeated.
- Attendance is mandatory at all clinical postings
- Appropriate dress code to be followed at all the clinical posting areas.

Project Report:-

BPT student should submit a suitable project report at the end of VIII Semester before final examination.

Evaluation Criteria for Project

Sr. No	Criteria	Rating					Remark
		1	2	3	4	5	
I.	**Statement of the problem**						
	1. Significance of the problem selected						
	2. Framing of title and objectives						
II.	**Literature Review**						
	1. Inclusion of related studies on the topic and its relevance						
	2. Operational definition						

Signature of the Evaluator

First Semester

HUMAN ANATOMY I

SUBJECT DESCRIPTION –

It is designed to provide students with the working knowledge of the structure of the human body which is essential foundation for their clinical studies. In this subject, the student will learn about the identification of all gross anatomical structures. The focus of the course is in-depth study and analysis of the regional and systemic organization of the body. Particular emphasis will be placed on description of musculoskeletal anatomy which includes bones, joints, muscles, cardiovascular system and respiratory system, as these are related to the application of physiotherapy in patients.

THEORY [75 hrs.]

1. Histology [10 hrs.]
    - General Histology, study of the basic tissues of the body; Microscope, Cell, Epithelium, Connective Tissue, Cartilage, Bone, Muscular tissue, Nerve Tissue – TS & LS, Circulatory system – large sized artery, medium sized artery, large sized vein
    - Lymphoid tissue
    - Skin and its appendages.
2. Embryology [15 hrs.]
    - Ovum, Spermatozoa, fertilization and formation of the Germ layers and their derivations.
    - Development of skin, Fascia, blood vessels, lymphatic,
    - Development of bones, axial and appendicular skeleton and muscles,
    - Neural tube, brain vessels and spinal cord,
    - Development of brain and brain stem structures
3. Regional Anatomy [35 hrs.]
    - Thorax:
        i. Cardio – Vascular System Mediastinum: Divisions and contents Pericardium: Thoracic Wall: position, shape and parts of the heart; conducting System; blood Supply and nerve supply of the heart; names of the blood vessels and their distribution in the body – region wise.
        ii. Respiratory system - Outline of respiratory passages: Pleura and lungs: position, parts, relations, blood supply and nerve supply; Lungs – emphasize on Broncho pulmonary segments.
        iii. Diaphragm: Origin, insertion, nerve supply and action, openings in the diaphragm.
        iv. Intercostal muscles and Accessory muscles of respiration: Origin, insertion, nerve supply and action.

- Abdomen:
    i. Peritoneum: Parietal peritoneum, visceral peritoneum, folds of peritoneum, functions of peritoneum.
    ii. Large blood vessels of the gut.
    iii. Location, size, shape, features, blood supply, nerve supply and functions of the following: stomach, liver, spleen, pancreas, kidney, urinary bladder, intestines, gall bladder.
- Pelvis: Position, shape, size, features, blood supply and nerve supply of the male and female reproductive system.

4. Endocrine glands: [15 hrs.]
    - Position, shape, size, function, blood supply and nerve supply of the following glands: Hypothalamus and pituitary gland, thyroid glands, parathyroid glands, Adrenal glands, pancreatic islets, ovaries and testes, pineal glands, thymus.

PRACTICAL [90hrs.]

List of Practical / Demonstrations

- Histology-Elementary tissue including surface Anatomy [20 hrs.]
- Embryology-models, charts & X-rays [10 hrs.]
- Demonstration of the muscles of the whole body and organs in thorax and abdomen in a cadaver [15hrs]
- Thorax including surface anatomy, abdominal muscles, joints [30 hrs.]
- Surface making of the lung, pleura, fissures and lobes of lungs, heart, liver, spleen, Kidney, cranial nerves, spinal nerves and important blood vessels. [15 hrs.]

STUDENT LEARNING OUTCOMES/ OBJECTIVES:

At the end of the semester the student will be able to:

- To understand the level of organization of the human body.
- To understand the topographical and functional anatomy of thorax and abdomen as well as functions of glands.
- To understand its application in practice of physiotherapy.

Recommended Textbook:

- SNELL [Richard S], Clinical Anatomy for Medical students: Ed. 5. Little Brown and Company Boston. 1995, p898
- B.D Chaurasia's Human Anatomy – Regional and Applied; Volume I, Volume II and Volume III.
- MOORIE [Keith L], Clinically Oriented Anatomy. Ed.3., Williams and Wilkins, Baltimore,1992, p917

- DATTA [A.K], Essentials of human Anatomy: Thorax and Abdomen Ed 2. Vol. I Current Book International, Calcutta 1994, p433
- DATTA [A.K], Essentials of human Head and Neck Ed 2. Vol. II, Current Book International, Calcutta 1995, p363
- SINGH [Inderbir], Text book of Anatomy with color atlas: Introduction, Osteology, Upper Extremity, Lower Extremity. Vol I. P Brothers, New Delhi 1996
- SINGH [Inderbir], Text book of Anatomy with color Atlas: Thorax and Abdomen. Vol II. JP Brothers, New Delhi 1996
- SING H [Inderbir], Text book of Anatomy with color Atlas: Head and Neck Central Nervous System. Vol III. JP Brothers, New Delhi 1996
- SINGH [Inderbir], Human Osteology. JP Brothers, New Delhi 1990,p191
- SINGH [Inderbir], Human Histology. JP Brothers, New Delhi 1990,p191
- SINGH [Inderbir], Human Embryology. JP Brothers, New Delhi 1990,p191

PRACTICALS

- ROMANES [G J], Cunningham manual of practical anatomy: upper and lower limb ed. 15Vol 1 Oxford Medical Publication, Oxford 1996, P263
- ROMANES [G J], Cunningham manual of practical anatomy : Thorax and abdomen ed15 Vol II Oxford Medical Publication, Oxford 1996, P298
- ROMANES [G J], Cunningham manual of practical anatomy : Head and Neck and Brain ed 15 Vol II Oxford Medical Publication, Oxford 1996, P346

HUMAN PHYSIOLOGY – I

SUBJECT DESCRIPTION –

In this subject, the student will enhance in the basics of normal human physiology and in-depth knowledge of fundamental reactions of living organisms, particularly in the human body with special emphasis on the functioning Cell, Blood, Nerve-Muscle Physiology, Cardiovascular, Respiratory, Digestive and Endocrine system.

THEORY [90 hrs.]

1. General Physiology [4hrs.]
    - Cell: Morphology. Organelles: their structure and functions
    - Transport Mechanisms across the cell membrane
    - Body fluids: Distribution, composition.
2. Blood [15hrs.]
    - Introduction: Composition and functions of blood.
    - Plasma: Composition, formation, functions. Plasma proteins.
    - RBC: count and its variations. Erythropoiesis- stages, factors regulating. Reticulo-endothelial system (in brief) Hemoglobin –structure, function and derivatives Anemia (in detail), types of Jaundice. Blood indices, PCV, ESR.
    - WBC: Classification. Morphology, functions, count, its variation of each. Immunity
    - Platelets: Morphology, functions, count, its variations
    - Hemostatic mechanisms: Blood coagulation–factors, mechanisms. Their disorders. Anticoagulants.
    - Blood Groups: Landsteiner's law. Types, significance, determination, Erythroblastosis foetalis.
    - Blood Transfusion: Cross matching. Indications and complications.
    - Lymph: Composition, formation, circulation and functions.
3. Nerve Muscle Physiology [15hrs.]
    - Introduction: Resting membrane potential. Action potential – ionic basis and properties.
    - Nerve: Structure and functions of neurons. Classification, Properties and impulse transmission of nerve fibers. Nerve injury – degeneration and regeneration.
    - Neuroglia: Types and functions.
    - Muscle: Classification. Skeletal muscle: Structure. Neuromuscular junction: Structure. Neuromuscular transmission, myasthenia gravis. Excitation-Contraction coupling. Rigormortis.
4. Cardiovascular System [15 hrs.]
    - Introduction: Physiological anatomy and nerve supply of the heart and blood vessels. Organization of CVS. Cardiac muscles: Structure. Ionic basis of action potential and pacemaker potential. Properties.
    - Conducting system: Components. Impulse conduction Cardiac Cycle: Definition. Phases of cardiac cycle. Pressure and volume curves. Heart sounds – causes, character. ECG: Definition. Different types of leads. Waves and their causes. P-R interval. Heart block.

- Cardiac Output: Definition. Normal value. Determinants. Stroke volume and its regulation. Heart rate and its regulation. Their variations
- Arterial Blood Pressure: Definition. Normal values and its variations. Determinants. Peripheral resistance. Regulation of BP.
- Arterial pulse.
- Shock – Definition. Classification–causes and features
- Regional Circulation: Coronary, Cerebral and Cutaneous circulation.
- Cardiovascular changes during exercise.

5. Respiratory System - [15 hrs.]
    - Introduction: Physiological anatomy – Pleura, tracheo-bronchial tree, alveolus, respiratory membrane and their nerve supply. Functions of respiratory system. Respiratory muscles.
    - Mechanics of breathing: Intrapleural and Intrapulmonary pressure changes during respiration. Chest expansion. Lung compliance: Normal value, pressure-volume curve, factors affecting compliance and its variations. Surfactant – Composition, production, functions. RDS
    - Spirometry: Lung volumes and capacities. Timed vital capacity and its clinical significance. Maximum ventilation volume. Respiratory minute volume.
    - Dead Space: Types and their definition.
    - Pulmonary Circulation. Ventilation-perfusion ratio and its importance.
    - Transport of respiratory gases: Diffusion across the respiratory membrane. Oxygen transport – Different forms, oxygen-hemoglobin dissociation curve. Factors affecting it. P50, Haldane and Bohr Effect. Carbon dioxide transport: Different forms, chloride shift.
    - Regulation of Respiration: Neural Regulation. Hering-breuer's reflex. Voluntary control. Chemical Regulation.
    - Hypoxia: Effects of hypoxia. Types of hypoxia. Hyperbaric oxygen therapy. Acclimatization Hypercapnoea. Asphyxia. Cyanosis – types and features. Dysbarism
    - Disorders of Respiration: Dyspnoea. Orthopnoea. Hyperpnoea, hyperventilation, apnoea, tachypnoea. periodic breathing – types Artificial respiration
    - Respiratory changes during exercise.
6. Digestive System - [6hrs.]
    - Introduction: Physiological anatomy and nerve supply of alimentary canal. Enteric nervous system
    - Salivary Secretion: Saliva: Composition. Functions. Regulation. Mastication (in brief)
    - Swallowing: Definition. Different stages. Function.

- Stomach: Functions. Gastric juice: Gland, composition, function, regulation. Gastrin: Production, function and regulation. Peptic ulcer. Gastric motility. Gastric emptying. Vomiting.
- Pancreatic Secretion: Composition, production, function. Regulation.
- Liver: Functions of liver. Bile secretion: Composition, functions and regulation. Gall bladder: Functions.
- Intestine: Succus entericus: Composition, function and regulation of secretion. Intestinal motility and its function and regulation.
- Mechanism of Defecation.

7. Endocrine System - [20 hrs.]
    - Introduction: Major endocrine glands. Hormone: classification, mechanism of action. Functions of hormones
    - Pituitary Gland: Anterior Pituitary and Posterior Pituitary hormones: Secretory cells, action on target cells, regulation of secretion of each hormone. Disorders: Gigantism, Acromegaly, Dwarfism, Diabetes insipidus. Physiology of growth and development: hormonal and other influences.
    - Pituitary-Hypothalamic Relationship.
    - Thyroid Gland: Thyroid hormone and calcitonin: secretory cells, synthesis, storage, action and regulation of secretion. Disorders: Myxedema, Cretinism, Grave's disease.
    - Parathyroid hormones: secretory cell, action, regulation of secretion. Disorders: Hypoparathyroidism. Hyperthyroidism. Calcium metabolism and its regulation.
    - Adrenal Gland: Adrenal Cortex: Secretory cells, synthesis, action, regulation of secretion of Aldosterone, Cortisol, and Androgens. Disorders: Addison's disease, Cushing's syndrome, Conn's syndrome, Adrenogenital syndrome.
    - Adrenal Medulla: Secretory cells, action, regulation of secretion of adrenaline and noradrenaline. Disorders: Pheochromocytoma.
    - Endocrine Pancreas: Secretory cells, action, regulation of secretion of insulin and glucagon. Glucose metabolism and its regulation. Disorder: Diabetes mellitus.
    - Calcitrol, Thymus and Pineal gland (very brief).
    - Local Hormones. (Briefly).

PRACTICAL [60hrs.]

Practical classes include hematology experiments, clinical examinations, amphibian chart, and recommended demonstrations.

1. Hematology: To be done by the students
    i. Study of Microscope and its uses
    ii. Determination of RBC count
    iii. Determination of WBC count

iv. Differential leukocyte count
v. Estimation of hemoglobin
vi. Calculation of blood indices
vii. Determination of blood groups
viii. Determination of bleeding time
ix. Determination of clotting time

Demonstrations only

i. Determination of ESR
ii. Determination of PCV

2. Amphibian Experiments – Demonstration and Dry charts Explanation. Instruments used for frog experiments. Kymograph, heart liver, Muscle trough, stimulator.
   i. Simple muscle curve.
   ii. Effect of increasing the strength of the stimuli
   iii. Effect of temperature on muscle contraction
   iv. Effect of two successive stimuli.
   v. Effect of Fatigue.
   vi. Effect of load on muscle contraction
   vii. Genesis of tetanus and clonus.
   viii. Velocity of impulse transmission.

STUDENT LEARNING OUTCOMES/ OBJECTIVES:

At the end of the semester the student will be able to:

- Acquire the knowledge of functions of various system of human body.
- Understand the role of various cells, enzymes and hormones of the human body.
- To demonstrate and understand the various hematological findings.
- To enhance the knowledge of various system and applied physiology of it.

Recommended Textbooks:

- Text book of medical physiology – Guyton Arthur
- Concise medical physiology – Chaudhuri Sujit K.
- Human Physiology – Chatterjee C.C
- Text book of practical Physiology – Ranade.
- Text of Physiology – A.K.Jain.
- Basics of Medical physiology- Venkatesh D & Sudhakar H H
- Manipal Manual of Physiology – Prof. C N Chandrashekar

Reference books:

- Review of Medical Physiology – Ganong William F.
- Physiological basis of Medical practice – Best & Taylor

BIOCHEMISTRY

SUBJECT DESCRIPTION –

In this course, the student will learn the essentials of biochemistry in nutrition and biochemical reactions.

THEORY [75hrs.]

1. Nutrition – [10 hrs.]
    - Definition, and its significance Energy requirement of a person - Basal metabolic rate: Definition, Normal values, factor affecting BMR Special dynamic action of food.
    - Physical activities - Energy expenditure for various activities. Calculation of Introduction, Importance of nutrition Calorific values, Respiratory quotient – energy requirement of a person
    - Balanced diet
        i. Recommended dietary allowances
        ii. Role of carbohydrates in diet: Digestible carbohydrates and dietary fibers
        iii. Role of lipids in diet
        iv. Role of proteins in diet: Quality of proteins - Biological value, net protein utilization, Nutritional aspects of proteins-essential and non- essential amino acids. Nitrogen balance
        v. Nutritional disorders.
2. Carbohydrate Chemistry – [5 hrs.]
    - Definition, general classification with examples, Glycosidic bond
    - Structures, composition, sources, properties and functions of Monosaccharides, Disaccharides, Oligosaccharides and Polysaccharides.
    - Glycosaminoglycan (mucopolysaccharides)
3. Lipid Chemistry – [5hrs]
    - Definition, general classification
    - Definition, classification, properties and functions of Fatty acids, Triacylglycerol, Phospholipids, Cholesterol
    - Essential fatty acids and their importance
    - Lipoproteins: Definition, classification, properties, Sources and function Ketone bodies
4. Amino-acid Chemistry – [5hrs]
    - Amino acid chemistry: Definition, Classification, Peptide bonds
    - Peptides: Definition, Biologically important peptides
    - Protein chemistry: Definition, Classification, Functions of proteins.

5. Enzymes – [5hrs]
    - Definition, Active site, Cofactor (Coenzyme, Activator), Proenzyme. Classification with examples, Factors effecting enzyme activity, Enzyme inhibition and significance, Isoenzymes, Diagnostic enzymology (clinical significance of enzymes)
6. Nucleotide and Nucleic acid Chemistry - [4hrs]
    - Nucleotide chemistry: Nucleotide composition, functions of free nucleotides in body.
    - Nucleic acid (DNA and RNA) chemistry: Difference between DNA and RNA, Structure of DNA (Watson and Crick model), Functions of DNA. Structure and functions of tRNA, rRNA, mRNA.
7. Digestion and Absorption - [3hrs]
    - General characteristics of digestion and absorption, Digestion and absorption of carbohydrates, proteins and lipids. Disorders of digestion and absorption – Lactose intolerance.
8. Carbohydrate Metabolism - [5 hrs.]
    - Introduction, Glycolysis – Aerobic, Anaerobic Citric acid cycle, Substrate level phosphorylation.
    - Glycogen metabolism – Glycogenesis, Glycogenolysis, Metabolic disorders glycogen, Gluconeogenesis, Cori cycle
    - Hormonal regulation of glucose, Glycosuria, Diabetes mellitus.
9. Lipid Metabolism - [5 hrs.]
    - Introduction to lipid metabolism, Lipolysis, Oxidation of fatty acids -oxidation of fatty acids,
    - Lipogenesis - Denovo synthesis of fatty acids, chain elongation, desaturation, triacylglycerol synthesis, fat metabolism in adipose tissues
    - Ketone body metabolism: Ketone body formation (ketogenesis), utilization (ketolysis), ketosis, Rothera's test.
    - Cholesterol metabolism: synthesis, degradation, cholesterol transport
    - Hypercholesterolemia and its effects (atherosclerosis and coronary heart diseases) Hypocholesterolemic agents, Common hyperlipoproteinemia, Fatty liver
10. Amino acid and Protein Metabolism - [5 hrs.]
    - Catabolism of amino acids - Introduction, transamination, deamination, Fate of ammonia, transport of ammonia, Urea cycle
    - Specialized products formed from amino acids - from glycine, arginine, methionine, phenylalanine and tyrosine.
11. Vitamins - [7 hrs.]
    - Definition, classification according to solubility,
    - Individual vitamins - Sources, Coenzyme forms, functions, RDA, digestion, absorption and transport, deficiency and toxicity.

12. Mineral Metabolism- [2hrs]
    - Definition, Sources, RDA, Digestion, absorption, transport, excretion, functions, disorder of Individual minerals - Calcium, phosphate, iron, Magnesium, fluoride, selenium, molybdenum, copper. Phosphate, calcium and iron in detail.
13. Cell Biology - [2 hrs.]
    - Introduction, Cell structure, Cell membrane structure and function, various types of absorption. Intracellular organelles and their functions, briefly on cytoskeleton.
14. Muscle Contraction - [2hrs.]
    - Contractile elements in muscle, briefly on the process of muscle contraction, Energy for muscle contraction.
15. Biochemistry of Connective tissue - [2 hrs.]
    - Introduction, various connective tissue proteins: Collagen, elastin - Structure and associated disorders. Glycoproteins, Proteoglycans.
16. Hormone Action - [2 hrs.]
    - Definition, classification, Mechanism of hormone action. Receptors, signal transduction, second messengers and cell function.
17. Acid-Base balance - [2 hrs.]
    - Acids, bases and buffers, pH. Buffer systems of the body, bicarbonate buffer system Role of lungs and kidneys in acid base balance, Acid base imbalance.
18. Water balance - [1 hrs.]
    - Water distribution in the body, Body water, water turnover, Regulation of water balance: role of ADH and thirst center.
19. Electrolyte balance - [1 hrs.]
    - Osmolarity. Distribution of electrolytes.
    - Electrolyte balance: Role of aldosterone, rennin angiotensin system and ANF.
20. Clinical Biochemistry - [2 hrs.]
    - Normal levels of blood and urine constituents, Relevance of blood and urine levels of Glucose, Urea, Uric acid, Creatinine, Calcium, Phosphates, pH and Bicarbonate. Liver function tests, Renal function tests.

STUDENT LEARNING OUTCOMES/ OBJECTIVES:

At the end of the semester the student will be able to:

- To acquire knowledge about chemical composition of nutrients and various metabolic reactions in the body.

Recommended Textbooks:

- MURRAY [ROBERT KK], Harper's Bio Chemistry Ed 24, Prentice Hall. 1996, p925,
- RAMAKRISHNA [S], PRASANNA [KG], RAJAN [R], Text Book of Medical Biochemistry, Ed1, orient Langman, Bombay 1980, and p717.
- VASUDEVAN [DM] and SREE KUMARI [S], Text Book of Bio Chemistry for Medical students, Ed 1, Jaypee Brothers, New Delhi, 1995, p637
- DAS [Debajyothi], Biochemistry, Ed. 7, Academic Publishers Calcutta, 1992, p648
- PRASAD RM, RM's Physiotherapy Textbook Series, Text book of Biochemistry for Bachelor of Physiotherapy First Edition, RM Publications, Mangalore

Reference books:

- Textbook of Medical Bio-Chemistry – Dr. M. N. Chatterjee, Latest Edition, Jaypee Publication.
- Fundamental of Bio-Chemistry – DR. A. C. Deb, Latest Edition, Central Publication.
- Bio-Chemistry introduction – Mekee, Latest Edition, McGraw-Hill Publication.

SOCIOLOGY

SUBJECT DESCRIPTION –

Sociology will introduce student to the basic sociology concepts, principles and social process, social institutions in relation to the individual, family and community and the various social factors affecting the family in rural and urban communities in India will be studied.

THEORY [60hrs.]

1. Introduction: [6 hrs.]
    - Meaning- Definition and scope of sociology
    - Its relation to Anthropology, Psychology, Social Psychology.
    - Methods of Sociological investigations- Case study, social survey, questionnaire, Interview and opinion poll methods.
    - Importance of its study with special reference to Health Care Professionals.
2. Social Factors in Health and disease situations: [4 hrs.]
    - Meaning of social factors
    - Role of social factors in health and illness
3. Socialization: [5 hrs.]
    - Meaning and nature of socialization.
    - Primary, Secondary and Anticipatory socialization.
    - Agencies of socialization.
4. Social Groups: [4 hrs.]
    - Concepts of social groups, influence of formal and informal groups on health and sickness. The role of primary groups and secondary groups in the hospital and rehabilitation setup.
5. Family: [8 hrs.]
    - The family, meaning and definitions.
    - Functions of types of family
    - Changing family patterns
    - Influence of family on the individuals health, family and nutrition, the effects of sickness in the family and psychosomatic disease and their importance to physiotherapy.
6. Community: [5 hrs.]
    - Rural community: Meaning and features –Health hazards of ruralities, health hazards to tribal community.
    - Urban community: Meaning and features- Health hazards of urbanities.
7. Culture and Health: [6 hrs.]
    - Concept of Health
    - Concept of Culture
    - Culture and Health
    - Culture and Health Disorders
8. Social change: [9 hrs.]
    - Meaning of social changes.
    - Factors of social changes.
    - Human adaptation and social change

- Social change and stress.
- Social change and deviance.
- Social change and health programme
- The role of social planning in the improvement of health and rehabilitation.

9. Social Problems of disabled: Consequences of the following social problems in relation to sickness and disability, remedies to prevent these problems. [9 hrs.]
    - Population explosion
    - Poverty and unemployment
    - Beggary
    - Juvenile delinquency
    - Prostitution
    - Alcoholism
    - Problems of women in employment
    - Geriatric problems
    - Problems of underprivileged.
10. Social Security: [2 hrs.]
    - Social security and social legislation in relation to the disabled.
11. Social worker: [2 hrs.]
    - Meaning of Social Work
    - The role of a Medical Social Worker.

STUDENT LEARNING OUTCOMES/ OBJECTIVES:

At the end of the semester the student will be able to:

- Know about Sociology and its importance in the health care delivery system.
- Understand the role of family and community in the development of human behavior.
- Understand the social and economic aspect of community that influence the health of the people.
- Know the role of therapist as a member of society, and the interdependence of individuals and society.

Recommended Textbooks:

- Sachdeva and Vidyabushan, Introduction to the study of sociology
- INDRANI T K, Text Books of Sociology for Graduates Nurses and Physiotherapy Students. JP Brothers, New Delhi,10

Reference books:

- Sociology for Physiotherapy students by Diyendunarayana Bid, 1st Edition, Jaypee Publication.
- Textbook of Sociology for Physiotherapy Students by KP Neeraja, 1st Edition, Jaypee Publication.

INTRODUCTION TO NATIONAL HEALTHCARE DELIVERY SYSTEM IN INDIA

SUBJECT DESCRIPTION: The course provides the students a basic insight into the main features of Indian health care delivery system and how it compares with the other systems of the world. Topics to be covered under the subject are as follows:

THEORY [30 Hrs.]

1. Introduction to healthcare delivery system [8 hrs.]
    a. Healthcare delivery system in India at primary, secondary and tertiary care
    b. Community participation in healthcare delivery system
    c. Health system in developed countries.
    d. Private Sector
    e. National Health Mission
    f. National Health Policy
    g. Issues in Health Care Delivery System in India
2. National Health Programme- Background objectives, action plan, targets, operations, achievements and constraints in various National Heath Programme. [4 hrs.]
3. Introduction to AYUSH system of medicine [7 hrs.]
    a. Introduction to Ayurveda.
    b. Naturopathy
    c. Unani
    d. Siddha
    e. Homeopathy
    f. Need for integration of various system of medicine
4. Health scenario of India- past, present and future [2 hrs.]
5. Demography & Vital Statistics- [4 hrs.]
    a. Demography – its concept
    b. Vital events of life & its impact on demography
    c. Significance and recording of vital statistics
    d. Census & its impact on health policy
6. Epidemiology [5 hrs.]
    e. Principles of Epidemiology
    f. Natural History of disease
    g. Methods of Epidemiological studies
    h. Epidemiology of communicable & non-communicable diseases, disease transmission, host defense immunizing agents, cold chain, immunization, disease monitoring and surveillance.

STUDENT LEARNING OUTCOMES/ OBJECTIVES

At the end of the semester the student will be able to:

- Learner will demonstrate knowledge about the primary aims and objectives of Healthcare delivery system in India.
- Learner will demonstrate knowledge about various Healthcare delivery system & health scenario of India.

Recommended Textbooks:

- Textbook of Preventive & Social Medicine- Dr. K. Park
- Textbook of community medicine: V. K. Mahajan

Reference books

- Population studies – Asha Bhendre
- Effective communication methods – Asha Kaul
- Hospital Administration – Tabish

MEDICAL/ PHYSIOTHERAPY LAW AND ETHICS

SUBJECT DESCRIPTION –

Legal and ethical considerations are firmly believed to be an integral part of medical practice in planning patient care. Advances in medical sciences, growing sophistication of the modern society's legal framework, increasing awareness of human rights and changing moral principles of the community at large, now result in frequent occurrences of healthcare professionals being caught in dilemmas over aspects arising from daily practice.

Medical/ Physiotherapy ethics has developed into a well based discipline which acts as a "bridge" between theoretical bioethics and the bedside. The goal is "to improve the quality of patient care by identifying, analyzing, and attempting to resolve the ethical problems that arise in practice". Doctors are bound by, not just moral obligations, but also by laws and official regulations that form the legal framework to regulate medical practice. Hence, it is now a universal consensus that legal and ethical considerations are inherent and inseparable parts of good medical practice across the whole.

THEORY [30 Hrs.]

Few of the important and relevant topics that need to focus on are as follows:

1. Medical ethics versus medical law - Definition - Goal - Scope [2 hrs.]
2. Introduction to Code of conduct [2 hrs.]
3. Basic principles of medical ethics – Confidentiality [2 hrs.]
4. Malpractice and negligence - Rational and irrational drug therapy [2 hrs.]
5. Autonomy and informed consent - Right of patients [1 hr.]
6. Care of the terminally ill- Euthanasia [2 hrs.]
7. Organ transplantation [2 hrs.]
8. Medical diagnosis versus physiotherapy diagnosis. [2 hrs.]
9. Medico legal aspects of medical records – Medico legal case and type- Records and document related to MLC - ownership of medical records - Confidentiality Privilege communication - Release of medical information - Unauthorized disclosure - retention of medical records - other various aspects. [2 hrs.]
10. Professional Indemnity insurance policy [2 hrs.]
11. Development of standardized protocol to avoid near miss or sentinel events [2 hrs.]
12. Obtaining an informed consent. [1 hr.]
13. Biomedical ethical principles [2 hrs.]
14. Code of ethics for physiotherapists [2 hrs.]
15. Ethics documents for physiotherapists [2 hrs.]
16. Laws affecting physiotherapy practice [2 hrs.]

STUDENT LEARNING OUTCOMES/OBJECTIVES:

At the end of the semester the student will be able to:

- Acquire the knowledge of ethical code of professional practice as well as its moral and legal aspects and its role WHO and WCPT.
- Understand the moral values and meaning of ethics.
- Acquire Hospital Discipline and communication skills in relation with patients, peers, seniors and other Professionals.

Recommended Textbooks:

- Medical Ethics by C M Francis.
- George V Lobo – Current Problems in Medical Ethics
- Consumer Protection Act – 1986, Government of India, New Delhi.
- Francis C M – Hospital Administration
- Davies, R and Macaulay, BMC – Hospital Planning and Administration
- Health Services Management, Analysis& Application , Wadsworth Publishing Company, Belmont 100

ENGLISH, COMMUNICATION AND SOFT SKILLS

SUBJECT DESCRIPTION –

To help learners to develop familiarity with and proficiency in English language, learn the use of language at personal, academic and professional fronts, become accomplished, active readers who appreciate ambiguity and complexity, and who can articulate their own interpretations with an awareness and curiosity for other perspectives. To gain a knowledge of the major traditions of literatures, and an appreciation for the diversity of literary, cultural and social voices within.

THEORY (30 hours)

1. Basic Language Skills: Grammar and Usage. [4 hrs.]
2. Business Communication Skills. With focus on speaking - Conversations, discussions, dialogues, short presentations, pronunciation. [5 hrs.]
3. Teaching the different methods of writing like letters, E-mails, report, case study, collecting the patient data etc. Basic compositions, journals, with a focus on paragraph form and organization. [5 hrs.]
4. Basic concepts & principles of good communication [2 hrs.]
5. Special characteristics of health communication [2 hrs.]
6. Types & process of communication – verbal, non-verbal and written communication. Upward, downward and lateral communication. [3 hrs.]
7. Therapeutic communication: empathy versus sympathy. [2 hrs.]
8. Communication methods for teaching and learning. [2 hrs.]
9. Communication methods for patient education. [3 hrs.]
10. Barriers of communication & how to overcome. [2 hrs.]

STUDENT LEARNING OUTCOMES/ OBJECTIVES:

At the end of the semester, the student will be able to:

- To communicate effectively, communicate message accurately, handle intercultural situation that require thoughtful communication.
- To use appropriate words and tones and so on.
- Understand and demonstrate communicative and functional use of English language.
- Appreciate literature and understand socio-cultural context.

Recommended Text Books

- English For Technical Communication Volume 1&2 Combined, Lakshminarayanan RK
- The Functional Aspects of Communication Skills, Prasad P & Sharma R K
- A Communication Grammar of English, Leech Geoffrey
- English Conversation for All Occasions, GKM
- English Vocabulary in use 100 units……practice, McCarthy M & Odell F 6. Speak Fluent English, Auralog.

Reference:

- English Grammar Collins, Birmingham University, International Language Data Base, Rupa & Co. 1993
- Wren and Martin - Grammar and Composition, 1989, Chanda.& Co, Delhi
- Letters for all Occasions A S Myers. Pub - Harper Perennial
- Spoken English V Shasikumar and P V Dhanija_ Pub. By: Tata McGraw Hill, New Delhi
- Journalism Made Simple , D Wainwright Writers Basic Bookshelf Series, Writers Digest series Interviewing by Joan Clayton Platkon
- Penguin Book of Interviews.

Second Semester

HUMAN ANATOMY II

SUBJECT DESCRIPTION:

Studies are concerned with the topographical and functional anatomy of the limbs. Particular attention is paid to the muscles, bones and joints of the regions. The head and neck and central nervous system (CNS) are studied with particular reference to topics of importance to physiotherapists. The study of the CNS includes detailed consideration of the control of motor function.

THEORY [90hrs.]

1. Musculo Skeletal Anatomy - (All the topics to be taught in detail) [10hrs.]
    - Anatomical positions of body, axes, planes, common anatomical terminologies (Groove, tuberosity, trochanters etc.)
    - Connective tissue classification.
    - Bones- Composition & functions, classification and types according to morphology and development.
    - Joints-definition-classification, structure of fibrous, cartilaginous joints, blood supply and nerve supply of joints.
    - Muscles – origin, insertion, nerve supply and actions.
2. Upper Extremity [15hrs.]
    - Osteology: Clavicles, Scapula, Humerus, Radius, Ulna, Carpals, Metacarpals, Phalanges.
    - Soft parts: Breast, pectoral region, axilla, front of arm, back of arm, cubital fossa, front of fore arm, back of fore arm, palm, dorsum of hand, muscles, nerves, blood vessels and lymphatic drainage of upper extremity.
    - Joints: Shoulder girdle, shoulder joint, elbow joints, radio ulnar joint, wrist joint and joints of the hand.
    - Arches of hand, skin of the palm and dorsum of hand.
3. Lower Extremity[15 hrs.]
    - Osteology: Hip bone, femur, tibia, fibula, patella, tarsals, metatarsals and phalanges.
    - Soft parts: Gluteal region, front and back of the thigh (Femoral triangle, femoral canal and inguinal canal), medial side of the thigh (Adductor canal), lateral side of the thigh, popliteal fossa, anterior and posterior compartment of leg, sole of the foot, lymphatic drainage of lower limb, venous drainage of the lower limb, arterial supply of the lower limb, arches of foot, skin of foot.
    - Joints: Hip Joint, Knee joint, Ankle joint, joints of the foot.
4. Trunk & Pelvis: [10hrs.]
    - Osteology: Cervical, thoracic, lumbar, sacral and coccygeal vertebrae and ribs.
    - Soft tissue: Pre and Para vertebral muscles, intercostal muscles, anterior abdominal wall muscles, Inter-vertebral disc.
    - Pelvic girdle and muscles of the pelvic floor.

5. Head and Neck: [20hrs.]
    - Osteology: Mandible and bones of the skull.
    - Soft parts: Muscles of the face and neck and their nerve and blood supply- extra ocular muscles, triangles of the neck.
    - Gross anatomy of eyeball, nose, ears and tongue.
6. Neuro Anatomy - Organization of Central Nervous system - Spinal nerves and autonomic nervous system mainly pertaining to cardiovascular, respiratory and urogenital system [20hrs.]
    - Cranial nerves
    - Peripheral nervous system
    - Peripheral nerve
    - Neuromuscular junction
    - Sensory end organs
    - Central Nervous System
    - Spinal segments and areas
    - Brain Stem
    - Cerebellum
    - Inferior colliculi
    - Superior Colliculi
    - Thalamus
    - Hypothalamus
    - Corpus striatum
    - Cerebral hemisphere
    - Lateral ventricles
    - Blood supply to brain
    - Basal Ganglia
    - The pyramidal system
    - Pons, medulla, extra pyramidal systems
    - Anatomical integration

PRACTICAL [60hrs.]

List of Practical / Demonstrations *

- Upper extremity including surface Anatomy.
- Lower extremity including surface Anatomy.
- Head & Spinal cord and Neck and Brain including surface Anatomy.
- Histology-Elementary tissue including surface Anatomy.

STUDENT LEARNING OUTCOMES/ OBJECTIVES:
At the end of the semester, the student will be able to:

- To understand the level of organization of the human body.
- To understand the topographical and functional anatomy of the head and neck.
- To understand the nervous system in detail.
- To understand its application in practice of physiotherapy.

Recommended Text books:

- SNELL [Richard S], Clinical Anatomy for Medical students: Ed. 5. Little Brown and
- Company Boston. 1995, p898
- B.D Chaurasia's Human Anatomy – Regional and Applied; Volume I, Volume II and Volume III.
- MOORIE [Keith L], Clinically Oriented Anatomy. Ed.3., Williams and Wilkins, Baltimore,1992, p917,$30
- DATTA [A.K], Essentials of human Anatomy: Thorax and Abdomen Ed 2. Vol. I Current Book International, Calcutta 1994, p433
- DATTA [A.K], Essentials of human Head and Neck Ed 2. Vol. II, Current Book International, Calcutta 1995, p363
- SINGH [Inderbir], Text book of Anatomy with color atlas: Introduction, Osteology, Upper Extremity, Lower Extremity. Vol I. P Brothers, New Delhi 1996
- SINGH [Inderbir], Text book of Anatomy with color Atlas: Thorax and Abdomen. Vol II. Brothers, New Delhi 1996
- SINGH [Inderbir], Text book of Anatomy with color Atlas: Head and Neck Central Nervous System. Vol III. JP Brothers, New Delhi 1996
- SINGH [Inderbir], Human Osteology. JP Brothers, New Delhi 1990,p191
- SINGH [Inderbir], Human Histology. JP Brothers, New Delhi 1990,p191
- SINGH [Inderbir], Human Embryology. JP Brothers, New Delhi 1990,p191

Practicals

- ROMANES [G J], Cunningham manual of practical anatomy: upper and lower limb ed 15Vol 1 Oxford Medical Publication, Oxford 1996, P263
- ROMANES [G J], Cunningham manual of practical anatomy : Thorax and abdomen ed15 Vol II Oxford Medical Publication, Oxford 1996, P298
- ROMANES [G J], Cunningham manual of practical anatomy : Head and Neck and Brain ed 15 Vol II Oxford Medical Publication, Oxford 1996, P346

HUMAN PHYSIOLOGY II

SUBJECT DESCRIPTION –

In this course, the student will learn about basics of normal human physiology with special emphasis on the functioning of the special systems, nervous system, renal system, reproductive system and physiology of exercise.

THEORY [90hrs.]

1. Special Senses - [10hrs.]
    - Vision: Introduction: Functional anatomy of eye ball. Functions of cornea, iris, pupil, aqueous humor – glaucoma, lens – cataract, vitreous humor, rods and cones. Photopic vision. Scotopic vision.
    - Visual Pathway and the effects of lesions.
    - Refractive Errors: myopia, hypermetropia, presbyopia and astigmatism.
    - Visual Reflexes: Accommodation, Pupillary and Light. Visual acuity and Visual field. Light adaptation. Dark adaptation. Color vision – color blindness. Nyctalopia.
    - Audition: Physiological anatomy of the ear. Functions of external ear, middle ear and inner ear. Structure of Cochlea and organ of corti. Auditory pathway. Types of Deafness. Tests for hearing. Audiometry.
    - Taste: Taste buds. Primary tastes. Gustatory pathway.
    - Smell: Olfactory membrane. Olfactory pathway.
    - Vestibular Apparatus: Crista ampullaris and macula. Functions. Disorders
2. Nervous System - [25hrs.]
    - Introduction: Organization of CNS – central and peripheral nervous system. Functions of nervous system. Synapse: Functional anatomy, classification, Synaptic transmission. Properties.
    - Sensory Mechanism: Sensory receptors: function, classification and properties. Sensory pathway: The ascending tracts – Posterior column tracts, lateral spinothalamic tract and the anterior spinothalamic tract – their origin, course, termination and functions. The trigeminal pathway. Sensory cortex. Somatic sensations: crude touch, fine touch, tactile localization, tactile discrimination, stereo gnosis, vibration sense, kinesthetic sensations. Pain sensation: mechanism of pain. Cutaneous pain –slow and fast pain, hyperalgesia. Deep pain. Visceral pain – referred pain. Gate control theory of pain. Tabes dorsalis, sensory ataxia.
    - Motor Mechanism: Motor Cortex. Motor pathway: The descending tracts – pyramidal tracts, extrapyramidal tracts – origin, course, termination and functions. Upper motor neuron and lower motor neuron. Paralysis, monoplegia, paraplegia, hemiplegia and quadriplegia.
    - Reflex Action: components, Bell-Magendie law, classification and Properties. Monosynaptic and polysynaptic reflexes, superficial reflexes,

deep reflexes. Stretch reflex– structure of muscle spindle, pathway, higher control and functions. Inverse stretch reflex. Muscle tone – definition, and properties hypotonia, atonia and hypertonia. UMNL and LMNL

- Spinal cord Lesions: Complete transection and Hemi section of the spinal cord.
- Cerebellum: Functions. Cerebellar ataxia.
- Posture and Equilibrium: Postural reflexes – spinal, medullary, midbrain and cerebral reflexes.
- Thalamus and Hypothalamus: Nuclei. Functions. Thalamic syndrome
- Reticular Formation and Limbic System: Components and Functions.
- Basal Ganglia: Structures included and functions. Parkinson's disease.
- Cerebral Cortex: Lobes. Brodmann's areas and their functions. Higher functions of cerebral cortex – learning, memory and speech.
- EEG: Waves and features. Sleep: REM and NREM sleep.
- CSF: Formation, composition, circulation and functions. Lumbar puncture and its significance. Blood brain barrier. Hydrocephalus.
- ANS: Features and actions of parasympathetic and sympathetic nervous system.

3. Renal System - [10hrs.]
    - Introduction: Physiological anatomy. Nephrons – cortical and juxtamedullary. Juxta-glomerular apparatus. Glomerular membrane. Renal blood flow and its regulation. Functions of kidneys.
    - Mechanism of Urine Formation: Glomerular Filtration: Mechanism of glomerular filtration. GFR – normal value and factors affecting. Renal clearance. Inulin clearance. Creatinine clearance.
    - Tubular Reabsorption: Reabsorption of Na+, glucose, HCO3-, urea and water. Filtered load. Renal tubular transport maximum. Glucose clearance: TmG. Renal threshold for glucose.
    - Tubular Secretion: Secretion of H+ and K+. PAH clearance.
    - Mechanism of concentrating and diluting the Urine: Counter-current mechanism. Regulation of water excretion. Diuresis. Diuretics.
    - Micturition: Mechanism of micturition. Cystometrogram. Atonic bladder, automatic bladder.
    - Acid-Base balance (very brief)
    - Artificial Kidney: Principle of hemodialysis.
    - Skin and temperature regulation.
4. Reproductive System - [15hrs.]
    - Introduction: Physiological anatomy reproductive organs. Sex determination. Sex differentiation. Disorder
    - Male Reproductive System: Functions of testes. Pubertal changes in males. Spermatogenesis. Testosterone: action. Regulation of secretion. Semen.

- Female Reproductive System: Functions of ovaries and uterus. Pubertal changes in females. Oogenesis. Hormones: estrogen and progesterone-action. Regulation of secretion. Menstrual Cycle: Phases. Ovarian cycle. Uterine cycle. Hormonal basis. Menarche. Menopause. Pregnancy: Pregnancy tests. Physiological changes during pregnancy. Functions of placenta. Lactation. Contraception methods

5. Physiology of exercise – [10hrs.]
    - Effects of acute and chronic exercise on
        i. O2 transport
        ii. Muscle strength/power/endurance
        iii. B.M.R. /R.Q.
        iv. Hormonal and metabolic effect
        v. Cardiovascular system
        vi. Respiratory system
        vii. Body fluids and electrolyte
        viii. Effect of gravity / altitude /acceleration / pressure on physical parameters
        ix. Physiology of Age

APPLIED PHYSIOLOGY - [20 hrs.]

More detailed study of the physiology and practical applications of the following selected topics with emphasis on aspects, which should help in understanding the nature and treatment of common clinical situations of interest in Physiotherapy.

1. Pulmonary Functions
    - Properties of gases, Mechanics of respiration, Diffusion capacity, special features of pulmonary circulation and their application.
    - Respiratory adjustments in exercises.
    - Artificial respiration
    - Breath sounds.
2. Cardio vascular Functions
    - Blood flow through arteries, arterioles, capillaries, veins and venuoles.
    - Circulation of Lymph, Edema
    - Factors affecting cardiac output.
    - Circulatory adjustment in exercise and in postural and gravitational changes,
    - Pathophysiology of fainting and heart failure.
3. Muscles and Nervous System Functions
    - Peripheral nervous system, neuromuscular transmission, Types of nerve fibers.
    - Action potential, Strength-duration curve, ECG, EMG, VEP, NCV
    - Degeneration and regeneration of nerve, Reactions of denervations.
    - Synaptic transmission, Stretch reflex- Mechanism and factors affecting it.
    - Posture, Balance and Equilibrium/Coordination of voluntary movement.

- Voluntary motor action, clonus, Rigidity, incoordination.
- Special senses- Vision, taste, hearing, vestibular, Olfaction
- Sympathetic and Parasympathetic regulation, Thermoregulation.

4. Blood functions
    - Thalassemia Syndrome, Hemophilia, VWF
    - Anemia, Leukocytosis
    - Bone marrow transplant
5. Metabolic Functions
    - Diabetes Mellitus, Physiological basis of Peptic Ulcer, Jaundice, GIT disorders and Dietary fiber, Thyroid functions, Vitamins deficiency.

PRACTICAL [60 Hrs.]

1. Clinical Examination
    - Examination of Radial pulse.
    - Recording of blood pressure
    - Examination of CVS
    - Examination of Respiratory system
    - Examination of Sensory system
    - Examination of Motor System
    - Examination of reflexes
    - Examination of cranial nerves
2. Amphibian Experiments – Demonstration and Dry charts Explanation.
    - Normal cardiogram of amphibian heart.
    - Properties of Cardiac muscle
    - Effect of temperature on cardiogram.
3. Recommended Demonstrations
    - Spirometry
    - Artificial Respiration
    - ECG
    - Perimetry
    - Mosso's Ergometry

STUDENT LEARNING OUTCOMES/ OBJECTIVES:
At the end of the semester, the student will be able to:

- Acquire the knowledge of various system of human body.
- Understand the role of various systems like Reproductive, Renal Cardiovascular, Respiratory and Neurological system
- To demonstrate and learn to measure Blood Pressure, Heart Rate, Respiratory Rate, etc.
- To enhance the knowledge about role of exercises and its effect on various regulatory system in the human body.

- To enhance the knowledge of various system and applied physiology of it.

Recommended Text books:

- Text book of medical physiology – Guyton Arthur
- Concise medical physiology – Chaudhuri Sujit K.
- Human Physiology – Chatterjee C.C.
- Text book of practical Physiology – Ranade.
- Text of Physiology – A.K.Jain.
- Basics of Medical physiology- Venkatesh D & Sudhakar H H
- Manipal Manual of Physiology – Prof. C N Chandrashekar

Reference books:

- Review of Medical Physiology – Ganong William F.
- Physiological basis of Medical practice – Best & Taylor

BASIC PRINCIPLES OF BIOMECHANICS

SUBJECT DESCRIPTION –

Biomechanics involves the study of basic concepts of human movement, and application of various biomechanical principles in the evaluation and treatment of disorders of musculoskeletal system.

THEORY [60 hrs.]

1. Basic Concepts in Biomechanics: Kinematics and Kinetics [15 hrs.]
    a. Types of Motion
    b. Location of Motion
    c. Direction of Motion
    d. Magnitude of Motion
    e. Definition of Forces
    f. Force of Gravity
    g. Reaction forces
    h. Equilibrium
    i. Objects in Motion
    j. Force of friction
    k. Concurrent force systems
    l. Parallel force system
    m. Work
    n. Moment arm of force
    o. Force components
    p. Equilibrium of levers
2. Joint structure and Function – [15 hrs.]
    a. Joint design
    b. Materials used in human joints
    c. General properties of connective tissues
    d. Human joint design
    e. Joint function
    f. Joint motion
    g. General effects of disease, injury and immobilization.
3. Muscle structure and function – [15 hrs.]
    a. Mobility and stability functions of muscles
    b. Elements of muscle structure
    c. Muscle function
    d. Effects of immobilization, injury and aging
4. Biomechanics of the Thorax and Chest wall – [10 hrs]
    a. General structure and function
    b. Rib cage and the muscles associated with the rib cage
    c. Ventilatory motions: its coordination and integration
    d. Developmental aspects of structure and function
    e. Changes in normal structure and function I relation to pregnancy, scoliosis and COPD
5. The Temporomandibular Joint- [5 hrs.]
    a. General features, structure, function and dysfunction

PRACTICAL [60 hrs.]

- Demonstration of cardinal planes and axes.
- Movement analysis of Thorax and Chest wall.
- Movement analysis of Temporomandibular joint.

STUDENT LEARNING OUTCOMES/ OBJECTIVES:

At the end of the semester, the student will be able to:

- To acquire knowledge about kinetics & kinematics.
- To analyze musculoskeletal movement in terms of biomechanics and will be able to apply such biomechanical principles to evaluation methods & treatment modes.

Recommended Text books:

- Joint Structure and Function – A comprehensive Analysis, JP Bros Medical Publishers, New Delhi.
- Brunnstrom, Clinical Kinesiology, JP Bros Medical Publishers, Bangalore, 5th Ed 1996,1stIndian Ed 1998
- Clinical Kinesiology for Physical Therapist Assistants, JP Bros Medical Publishers, Bangalore, 1st Indian Ed 1997

Reference books:

- Kinesiology by K Wells, 6th Edition; Saunders Publication
- Biomechanical basis of human movement, Joseph Hamil & Kathleen M. Knutzen, 3rd Edition, LWW Publications.
- Bio-mechanics of Musculoskeletal System by Nigg, 2nd Edition, John Wiley Publication.
- Basic Bio-mechanics of musculoskeletal system by Frenkle, 3rd edition, Lippincott Williams & Wilkins.

GENERAL & CLINICAL PSYCHOLOGY

SUBJECT DESCRIPTION –

Human Psychology involves the study of various behavioral patterns of individuals, theories of development, normal and abnormal aspects of motor, social, emotional and language development, communication and interaction skills appropriate to various age groups. The study of these subjects will help the student to understand their clients while assessment and while planning appropriate treatment methods.

THEORY [60 hrs.]

1. Introduction to Psychology [6 hrs.]
    a. Schools: Structuralism, functionalism, behaviorism, Psychoanalysis.
    b. Methods: Introspection, observation, inventory and experimental method.
    c. Branches: pure psychology and applied psychology
    d. Psychology and physiotherapy
2. Growth and Development [6 hrs.]
    a. Life span: Different stages of development (Infancy, childhood, adolescence, adulthood, middle age, old age).
    b. Heredity and environment: role of heredity and environment in physical and psychological development, "Nature v/s Nurture controversy".
3. Sensation, attention and perception [6 hrs.]
    a. Sensation: Vision, Hearing, Olfactory, Gustatory and Cutaneous sensation, movement, equilibrium and visceral sense.
    b. Attention: Types of attention, Determinants of attention (subjective determinants and objective determinants).
    c. Perception: Gestalt principles of organization of perception (principle of figure ground and principles of grouping), factors influencing perception (past experience and context).
    d. Illusion and hallucination: different types.
4. Motivation [4 hrs.]
    a. Motivation cycle (need, drive, incentive, reward).
    b. Classification of motives.
    c. Abraham Maslow's theory of need hierarchy
5. Frustration and conflict [2 hrs.]
    a. Frustration: sources of frustration.
    b. Conflict: types of conflict.
    c. Management of frustration and conflict
6. Emotions [6 hrs.]
    a. Three levels of analysis of emotion (physiological level, subjective state, and overt behavior).
    b. Theories of emotion
    c. Stress and management of stress.
7. Intelligence [6 hrs.]
    a. Theories of intelligence.
    b. Distribution of intelligence.
    c. Assessment of intelligence

8. Thinking [4 hrs.]
    a. Reasoning: deductive and inductive reasoning
    b. Problem solving: rules in problem solving (algorithm and heuristic)
    c. Creative thinking: steps in creative thinking, traits of creative people
9. Learning [6 hrs.]
    a. Factors effecting learning.
    b. Theories of learning: trial and error learning, classical conditioning, Operant conditioning, insight learning, social learning theory.
    c. The effective ways to learn: Massed/Spaced, Whole/Part, Recitation/Reading, Serial/Free recall, Incidental/Intentional learning, Knowledge of results, association, organization, and mnemonic methods.
10. Personality [8 hrs.]
    a. Approaches to personality: type & trait, behavioristic, psychoanalytic and humanistic approach.
    b. Personality assessment: observation, situational test, questionnaire, rating scale, interview, and projective techniques.
    c. Defense Mechanisms: denial of reality, rationalization, projection, reaction formation, identification, repression, regression, intellectualization, undoing, introjection, acting out.
11. Social psychology [2 hrs.]
    a. Leadership: Different types of leaders. Different theoretical approaches to leadership.
    b. Attitude: development of attitude. Change of attitude.
12. Clinical psychology [4 hrs.]
    - Models of training, abnormal behavior assessment, clinical judgement, psychotherapy, self-management methods, physiotherapist patient interaction, aggression, self- imaging, stress management, assertive training, Group therapy, Body awareness, Pediatric, child and geriatric clinical psychology.

STUDENT LEARNING OUTCOMES/ OBJECTIVES:

At the end of the semester, the student will be able to:

- Know about psychology and its importance in the health care delivery system and gain knowledge of psychological maturation during human development, growth and alteration during ageing process.
- Understand the importance of psychological status of the person in the health and diseases, environmental and emotional influence on the mind and personality.

Recommended Text books:

- Feldman.R.H (1996). Understanding Psychology. New Delhi: Tata McGraw hill.
- Morgan et al (2003). Introduction to Psychology. New Delhi: Tata McGraw hill.
- Lefton ( ). Psychology. Boston: Alwin & Bacot Company.
- Mangal, S.K (2002). Advanced Educational Psychology. New Delhi: prentice hall.
- Atkinson (1996). Dictionary of Psychology.

Reference:

- Psychology: The study of Human behavior, Mishra B. K. PHL Learning.
- Essentials of Educational Psychology, Skinner Charles E. Surjeet Publication.
- Abnormal Psychology, Page James D, Surjeet Publication.

MEDICAL TERMINOLOGIES AND RECORD KEEPING

SUBJECT DESCRIPTION –

This course introduces the elements of medical terminology. Emphasis is placed on building familiarity with medical words through knowledge of roots, prefixes, and suffixes. Topics include: origin, word building, abbreviations and symbols, terminology related to the human anatomy, reading medical orders and reports, and terminology specific to the student's field of study. Spelling is critical and will be counted when grading tests.

THEORY [30hrs]

1. Derivation of medical terms. [2hrs]
2. Define word roots, prefixes, and suffixes. [3hrs]
3. Conventions for combined morphemes and the formation of plurals. [2hrs]
4. Basic medical terms in health care and physiotherapy. [2hrs]
5. Form medical terms utilizing roots, suffixes, prefixes, and combining roots. [2hrs]
6. Interpret basic medical abbreviations/symbols. [3hrs]
7. Utilize diagnostic, surgical, and procedural terms and abbreviations related to the integumentary system, musculoskeletal system, respiratory system, cardiovascular system, nervous system, and endocrine system. [4hrs]
8. Interpret medical records/reports. [6hrs]
9. Data entry and management on electronic health record system. [6hrs]

STUDENT LEARNING OUTCOMES/OBJECTIVES:-

At the end of the semester the student will be able to:

- To describe and analyze the component parts of medical terms.
- To relate the terminology to the names, locations, and functions of the major organs of the body systems.
- To use common terms and abbreviations in documenting medical records related to the major systems of the body.
- To use information technology to access, evaluate and interpret healthcare/public health data.

Recommended textbooks:

- Medical terminology, an illustrated guide: Barbara Janson Cohen
- Record keeping in psychotherapy and counselling. Protecting the confidentiality and professional relationship: Ellen T Luepker
- Electronic Health Records: Understanding and Using Computerized Medical Records by R. Gartee.

Reference books:

- An introduction to medical terminology for health care: A self –teaching package: Andrew R Hutton.
- Electronic Health Records a practical guide for professionals and organizations: Margaret K. Amatayakul.

INTRODUCTION TO YOGA- BASIC THEORY, SCIENCE AND TECHNIQUES

SUBJECT DESCRIPTION –

To help the students understand the core principles of Yoga and its benefits. It helps to gain the knowledge and skills to implement the use of Yoga principles into current clinical practice. To understand the various Yoga postures for different abilities.

THEORY [15 hrs.]

1. Foundations of Yoga [5 hrs.]
   a. Introduction to Yoga and its philosophy
   b. Brief history, development of Yoga
   c. Philosophical foundations of Yoga
   d. Streams & types of Yoga

2. Yoga and Health [5 hrs.]
   a. Concept of body in yoga – Panchakosha theory
   b. Concept of Health and Disease in yoga
   c. Stress management through yoga
   d. Disease prevention and promotion of positive health through yoga

3. Physiological effects of Yoga practices [5 hrs.]
   a. Physiological effects of Shat kriyas
   b. Physiological effects of Asanas
   c. Physiological effects of Pranayamas
   d. Physiological effects of Relaxation techniques and Meditation

PRACTICAL - List of Practical / Demonstrations [30 hrs.]

1. Sukshma Vyayama/Sithilikarna Vyayama and Surya Namaskar: [3 hrs.]
   a. Loosening exercises of each part of the body particularly of the joints
   b. 12 step Surya namaskar with prayer and specific mantras

2. Yogic kriyas [Observation/ demonstration only] [3 hrs.]
   a. Neti (Jala Neti, Sutra Neti)
   b. Dhauti (Vamana Dhauti, Vastra Dhauti)
   c. Trataka
   d. Shankaprakshalana (Laghu & Deergha)

3. Yogasanas
   a. Standing postures [4 hrs.]
      i. Tadasana (Upward stretch posture)
      ii. Ardha Chakrasana (Half wheel posture)
      iii. Ardha Katicakrasana (Half lumber wheel posture)
      iv. Utkatasana (Chair posture)
      v. Pada Hastasana (Hand to toes posture)
      vi. Trikonasana (Triangle posture)
      vii. Parshva Konasana (Side angle posture)
      viii. Garudasana (Eagle posture)
      ix. Vrikshasana (Tree posture)

   b. Prone positions [4 hrs.]

i. Makarasana (Crocodile posture)
ii. Bhujangasana (Cobra posture)
iii. Salabhasana (Locust posture)
iv. Dhanurasana (Bow posture)
v. Naukasana (Boat posture)
vi. Marjalasana (Cat posture)

c. Supine postures [4 hrs.]
   i. Ardha halasana/ Uttana Padasana
   ii. Sarvangasana (All limb posture)
   iii. Pawana muktasana (Wind releasing posture)
   iv. Matsyasana (Fish posture)
   v. Halasana (Plough posture)
   vi. Chakrasana (Wheel posture)
   vii. Setu Bandhasana (Bridge posture)
   viii. Shavasana (Corpse posture)

d. Sitting postures [4 hrs.]
   i. Parvatasana (Mountain posture)
   ii. Bhadrasana (Gracious posture)
   iii. Vajrasana (Adamantine posture)
   iv. Paschimottanasana (Back stretching posture)
   v. Janushirasana (Head to knee posture)
   vi. Simhasana (Lion posture)
   vii. Gomukhasana (Cow head posture)
   viii. Ushtrasana (Camel posture)
   ix. Ardha Matsyendrasana (Half matsyendra spine twist posture)
   x. Vakrasana (Spinal twist posture)
   xi. Kurmasana (Turtle posture)
   xii. Shashankasana (Rabbit posture)
   xiii. Mandukasana (Frog Posture)

e. Meditative postures and Meditation techniques [2 hrs.]
   i. Siddhasana (Accomplished pose)
   ii. Padmasana (Lotus posture)
   iii. Samasana
   iv. Swastikasana (Auspicious posture)

4. Pranayamas [4 hrs.]
   a. The practice of correct breathing and Yogic deep breathing
   b. Kapalabhati
   c. Bhastrika
   d. Sitali
   e. Sitkari
   f. Sadanta
   g. Ujjayi
   h. Surya Bhedana
   i. Chandra Bhedana

j. Anuloma-Viloma/Nadishodana
k. Bhramari

5. Relaxation Techniques [2 hrs.]
   a. Shavasana
   b. Yoga Nidra

STUDENT LEARNING OUTCOMES/OBJECTIVES:
At the end of the semester the student will be able: ϖ

- To know types of yoga, various types of Asanas, Pramayama and Mudra. ϖ
- To perform, yogasanas, pranayama, suryanamaskar and its application. ϖ
- To understand and apply yoga for various conditions.

RECOMMENDED TEXTBOOKS:

- Asana ,Pranayama, Mudra, Bandha by Swami Satyananda Saraswati

REFERENCE BOOKS:

- Asana, pranayama, mudra bandha by Dr. Nagendra H.R
- Yoga Its Basis and Application by Dr.Nagendra H.R.

Third Semester

BIOMECHANICS AND KINESIOLOGY -

SUBJECT DESCRIPTION –

Biomechanics involves the study of basic concepts of human movement, and application of various biomechanical principles in the evaluation and treatment of disorders of musculoskeletal system. Students are taught to understand the various quantitative and qualitative methods of movement. Mechanical principles of various treatment methods are studied. Study of posture and gait are also included.

THEORY [60hrs]

1. Biomechanics of the vertebral column [10hrs.]
    - General structure and function
    - Regional structure and function – Cervical region, thoracic region, lumbar region, sacral region
    - Muscles of the vertebral column
    - General effects of injury and aging
2. Biomechanics of the peripheral joints [40hrs]
    - The shoulder complex: Structure and components of the shoulder complex and their integrated function
    - The elbow complex: Structure and function of the elbow joint – humeroulnar and humeroradial articulations, superior and inferior radioulnar joints; mobility and stability of the elbow complex; the effects of immobilization and injury.
    - The wrist and hand complex: Structural components and functions of the wrist complex; structure of the hand complex; functional position of the wrist and hand.
    - The hip complex: structure and function of the hip joint; hip joint pathology- arthrosis, fracture, bony abnormalities of the femur:
    - The knee complex: structure and function of the knee joint – tibiofemoral joint and patellofemoral joint; effects of injury and disease.
    - The ankle and foot complex.: structure and function of the ankle joint, subtalar joint, talocalcaneonavicular joint, transverse tarsal joint, tarsometatarsal joints, metatarsophalangeal joints, interphalangeal joints, structure and function of the plantar arches, muscles of the ankle and foot, deviations from normal structure and function – Pes Planus and Pes Cavus
3. Analysis of Posture and Gait [10hrs]
    - Static and dynamic posture, postural control, kinetics and kinematics of posture, ideal posture analysis of posture, effects of posture on age, pregnancy, occupation and recreation; general features of gait, gait initiation, kinematics and kinetics of gait, energy requirements, kinematics and kinetics of the trunk and upper extremities in relation to gait, stair case climbing and running, effects of age, gender, assistive devices, disease, muscle weakness, paralysis, asymmetries of the lower extremities, injuries and malalignments in gait; Movement Analysis : ADL activities like sitting – to standing, lifting, various grips , pinches.

PRACTICAL [90 hrs.]

- Shall be conducted for various joint movements and analysis of the same. Demonstration may also be given as how to analyze posture and gait. The student shall be taught and demonstrated to analysis for activities of daily living – ADL – (like sitting to standing, throwing, lifting etc.) The student should be able to explain and demonstrate the movements occurring at the joints, the muscles involved, the movements or muscle action produced, and mention the axis and planes through which the movements occur. The demonstrations may be done on models or skeleton.

STUDENT LEARNING OUTCOMES/ OBJECTIVES:-

At the end of the semester, the student will be able to:

- To acquire knowledge about kinetics & kinematics.
- To analyze musculoskeletal movement in terms of biomechanics and will be able to apply such biomechanical principles to evaluation methods & treatment modes.

Recommended Text books:

- Joint Structure and Function – A comprehensive Analysis, JP Bros Medical Publishers, New Delhi.
- Brunnstrom, Clinical Kinesiology, JP Bros Medical Publishers, Bangalore, 5th Ed 1996,1stIndian Ed 1998
- Clinical Kinesiology for Physical Therapist Assistants, JP Bros Medical Publishers, Bangalore, 1st Indian Ed 1997

Reference books:

- Kinesiology by K Wells, 6^{th} Edition; Saunders Publication
- Biomechanical basis of human movement, Joseph Hamil & Kathleen M. Knutzen, 3^{rd} Edition, LWW Publications.
- Bio-mechanics of Musculoskeletal System by Nigg, 2^{nd} Edition, John Wiley Publication.
- Basic Bio-mechanics of musculoskeletal system by Frenkle, 3^{rd} edition, Lippincott Williams & Wilkins.

FOUNDATION OF EXERCISE THERAPY AND THERAPEUTIC MASSAGE

SUBJECT DESCRIPTION –

In this course, the students will learn the principles and effects of exercise as a therapeutic modality and will learn the techniques in the restoration of physical functions.

THEORY [60 Hrs.]

1. Introduction to Exercise Therapy [5 hrs.]
    - The aims of Exercise Therapy, The techniques of Exercise Therapy, Approach to patient's problems, Assessment of patient's condition – Measurements of Vital parameters, Starting Positions – Fundamental positions & derived Positions, Planning of Treatment
2. Methods of Testing [15 hrs.]
    - Functional tests
    - Measurement of Joint range: ROM-Definition, Normal ROM for all peripheral joints & spine, Goniometer-parts, types, principles, uses, Limitations of goniometry, Techniques for measurement of ROM for all peripheral joints
    - Tests for neuromuscular efficiency
        i. Electrical tests
        ii. Manual Muscle Testing: Introduction to MMT, Principles & Aims, Indications & Limitations, Techniques of MMT for group & individual: Techniques of MMT for upper limb / Techniques of MMT for lower limb / Techniques of MMT for spine.
        iii. Anthropometric Measurements: Muscle girth – biceps, triceps, forearm, quadriceps, calf
        iv. Static power Test
        v. Dynamic power Test
        vi. Endurance test
        vii. Speed test
    - Tests for Co-ordination
    - Tests for sensation
    - Pulmonary Function tests
    - Measurement of Limb Length: true limb length, apparent limb length, segmental limb length
    - Measurement of the angle of Pelvic Inclination
3. Relaxation [5 hrs.]
    - Definitions: Muscle Tone, Postural tone, Voluntary Movement, Degrees of relaxation, Pathological tension in muscle, Stress mechanics, types of stresses, Effects of stress on the body mechanism, Indications of relaxation, Methods & techniques of relaxation-Principles & uses: General, Local, Jacobson's, Mitchel's, additional methods.
4. Passive Movements [5 hrs.]
    - Causes of immobility, Classification of Passive movements, and Specific definitions related to passive movements, Principles of giving passive movements, Indications, contraindications, effects of uses, Techniques of giving passive movements.
5. Active Movements [9 hrs.]

- Definition of strength, power & work, endurance, muscle actions.
- Physiology of muscle performance: structure of skeletal muscle, chemical & mechanical events during contraction &relaxation, muscle fiber type, motor unit, force gradation.
- Causes of decreased muscle performance
- Physiologic adaptation to training: Strength & Power, Endurance.
- Types of active movements
- Free exercise: Classification, principles, techniques, indications, contraindications, effects and uses
- Active Assisted Exercise: Principles, techniques, indications, contraindications, effects and uses Assisted-Resisted Exercise: principles, techniques, indications, contraindications, effects and uses Resisted Exercise: Definition, principles, indications, contraindications, precautions & techniques, effects and uses
- Types of resisted exercises: Manual and Mechanical resistance exercise, Isometric exercise, Dynamic exercise: Concentric and Eccentric, Dynamic exercise: Constant versus variable resistance, Isokinetic exercise, Open-Chain and Closed-Chain exercise.

6. Specific exercise regimens [5 hrs.]
    - Isotonic: de Lormes, Oxford, MacQueen, Circuit weight training
    - Isometric: BRIME (Brief Resisted Isometric Exercise), Multiple Angle Isometrics Isokinetic regimens
7. Aerobic Exercise [5 hrs.]
    - Definition and key terms; Physiological response to aerobic exercise, Examination and evaluation of aerobic capacity – Exercise Testing, Determinants of an Exercise Program, The Exercise Program, Normal and abnormal response to acute aerobic exercise, Physiological changes that occur with training, Application of Principles of an Aerobic conditioning program for patients – types and phases of aerobic training.
8. Stretching [5 hrs.]
    - Definition of terms related to stretching; Tissue response towards immobilization and elongation, Determinants of stretching exercise, Effects of stretching, Inhibition and relaxation procedures, Precautions and contraindications of stretching, Techniques of stretching
9. Individual and Group Exercises [2 hrs.]
    - Advantages and Disadvantages, Organization of Group exercises, Recreational Activities and Sports

THERAPEUTIC MASSAGE

SUBJECT DESCRIPTION- The students will be able to understand the concepts, different types and application of massage on patients during clinical practice.

THEORY [4 Hrs.]

1. History and Classification of Massage Technique
2. Principles, Indications and Contraindications
3. Technique of Massage Manipulations
4. Physiological and Therapeutic Uses of Specific Manipulations

PRACTICAL [60 HRS.]

- Different test methods
- Demonstrate the technique of measuring using goniometry
- Demonstrate muscle strength using the principles and technique of MMT
- Demonstrate the techniques for muscle strengthening based on MMT grading
- Demonstrate techniques of strengthening muscles using resisted exercises
- Demonstrate the techniques for muscle stretching
- Demonstrate relaxation techniques.
- Demonstrate to apply the technique of passive movements
- Demonstrate various techniques of Active movements
- Demonstrate massage technique application according to body parts.

STUDENT LEARNING OUTCOMES/ OBJECTIVES:
At the end of the semester, the student will be able to:

- To describe the basic effects of exercise.
- To measure the joint range of motion using goniometer.
- To describe the physiological and therapeutic effects of various movements.
- To acquire the skills of application of various massage manipulations and its physiological effects, therapeutic uses and merits-demerits of the same.

Recommended Textbooks

- Therapeutic exercise by Barbara Bandy
- Therapeutic exercise by Carolyn Kisner
- Principles of exercise therapy by M.Dena Gardiner
- Practical Exercise therapy by Hollis Margaret
- Therapeutic exercise by Sydney Litch
- Therapeutic exercise by Hall & Brody
- Therapeutic exercise by Basmajjian
- Physical Rehabilitation by O'Sullivan.
- Therapeutic massage by Sinha
- Principles of muscle testing by Hislop.

PHARMACOLOGY –

SUBJECT DESCRIPTION –

This course introduces the student to basic pharmacology of common drugs used, their importance in the overall treatment including Physiotherapy.

THEORY [45 Hrs.]

1. General Pharmacology – [5 hrs.]
    - Introduction, Definitions, Classification of drugs, Sources of drugs, Routes of drug administration, Distribution of drugs, Metabolism and Excretion of drugs Pharmacokinetics, Pharmacodynamics, Factors modifying drug response, Adverse effects.
2. Autonomic Nervous system – [5 hrs.]
    - General considerations – The Sympathetic and Parasympathetic Systems, Receptors, Somatic Nervous System
    - Cholinergic and Anti-Cholinergic drugs, Adrenergic and Adrenergic blocking drugs, Peripheral muscle relaxants.
3. Cardiovascular Pharmacology – [5 hrs.]
    - Drugs used in the treatment of heart failure: Digitalis, Diuretics, Vasodilators, ACE inhibitors Antihypertensive Drugs: Diuretics, Beta Blockers, Calcium Channel Blockers, ACE Inhibitors, Central Acting Alpha Agonists, Peripheral Alpha Antagonists, Direct acting Vasodilators
    - Antiarrhythmic Drugs
    - Drugs used in the treatment of vascular disease and tissue ischemia : Vascular Disease, Hemostasis Lipid-Lowering agents, Antithrombotic, Anticoagulants and Thrombolytic Ischemic Heart Disease – Nitrates, Beta-Blockers, Calcium Channel Blockers, Cerebral Ischemia Peripheral Vascular Disease.
4. Neuropharmacology – [5 hrs.]
    - Sedative-Hypnotic Drugs: Barbiturates, Benzodiazepines
    - Antianxiety Drugs: Benzodiazepines, Other Anxiolytics
    - Drugs Used in Treatment of Mood Disorders: Monoamine Oxidase Inhibitors, Tricyclic Antidepressants, Atypical Antidepressants, Lithium
    - Antipsychotic drugs
5. Disorders of Movement –[5 hrs.]
    - Drugs used in Treatment of Parkinson ’s disease
    - Antiepileptic Drugs
    - Spasticity and Skeletal Muscle Relaxants
6. Inflammatory/Immune Diseases –[10 hrs.]
    - Non-narcotic Analgesics and Nonsteroidal Anti-Inflammatory Drugs: Acetaminophen, NSAIDs, Aspirin, Nonaspirin NSAIDs, drug Interactins with NSAIDs

- Glucocorticoids: Pharmacological Uses of Glucocorticoids, adverse effects, Physiologic Use of Glucocorticoids
- Drugs Used in Treatment of Arthritic Diseases: Rheumatoid Arthritis, Osteoarthritis, Gout
- Drugs Used in the Treatment of Neuromuscular Immune/Inflammatory Diseases: Myasthenia gravis, Idiopathic Inflammatory Myopathies, systemic lupus Erythematous, Scleroderma, Demyelinating Disease
- Respiratory Pharmacology: Obstructive Airway Diseases, Drugs used in Treatment of Obstructive airway Diseases, Allergic Rhinitis

7. Digestion and Metabolism – [2 hrs.]
    - Gastrointestinal Pharmacology: Peptic Ulcer Disease, Constipation, Diarrhea Drugs Used in Treatment of Diabetes Mellitus: Insulin, Oral Hypoglycemic
8. Geriatrics – [3 hrs.]
    - Pharmacology and the geriatric Population: Adverse effects of special concern in the Elderly, Dementia, Postural hypotension.

STUDENT LEARNING OUTCOMES/ OBJECTIVES:-

At the end of the semester, the student will be able to:

- To have an idea about the basics of medicines.
- To know the mechanism of action of drugs for various common diseases.
- To know the therapeutic effects of various drugs.
- To know the adverse effects of various drugs.
- Identify whether the pharmacological effect of the drug interferes with the therapeutic response of physiotherapy and vice-versa.

Recommended Textbooks

- Lippincott's Pharmacology.
- Essential of Medical Pharmacology by Tripathi
- Text book of Medical Pharmacology by Padmaja Udaykumar
- Pharmacology by N.Murugesh
- Pharmacology& Pharmacotherapeutics by Sadowskar

Reference Textbooks

- Pharmacology for Physical Therapist by Panus.
- Handbook of Pharmacology, 1st edition, Dr. UN Panda, AITBS Publication.

PATHOLOGY

SUBJECT DESCRIPTION –

This subject follows the basic subjects of Anatomy, Physiology and Biochemistry and it forms a vital link between preclinical subjects and clinical subjects. Pathology involves the study of causes and mechanisms of diseases. The knowledge and understanding Pathology of diseases is essential to institute appropriate treatment or suggest preventive measures to the patient. Particular effort is made in this course to avoid burdening the student.

THEORY-[60 hrs]

A. General Pathology

1. Introduction to Pathology [2 hrs]
2. Cell injuries [4 hrs]
    - Etiology and Pathogenesis with a brief recall of important aspects of normal cell structure. Reversible cell injury: Types, Sequential changes, Cellular swellings, vacuolation, Hyaline changes, Mucoid changes. Irreversible cell injury: Types of Necrosis & Gangrene, Autolysis. Pathologic calcification: Dystrophic and Metastatic. Intracellular Accumulations - Fatty changes, Protein accumulations, Glycogen accumulations,
    - Pigments - Melanin / Hemosiderin.
    - Extra cellular accumulations: Amyloidosis - Classification, Pathogenesis, Pathology including special stains.
3. Inflammation and Repair [4 hrs]
    - Acute inflammation: features, causes, vascular and cellular events.
    - Inflammatory cells and Mediators. Chronic inflammation: Causes, Types, Classification nonspecific and granulomatous with examples.
    - Repair, Wound healing by primary and secondary union, factors promoting and delaying the process.
    - Healing in specific site including bone healing.
4. Immunopathology [3 hrs]
    - Immune system: General concepts.
    - Hypersensitivity: type and examples, antibody and cell mediated tissue injury with examples. . Secondary immunodeficiency including HIV infection. Auto-immune disorders: Basic concepts and classification, SLE.
    - AIDS-Etiology, Modes of transmission, Diagnostic procedures, handling of infected material and health education.
5. Infectious diseases [4 hrs]
    - Mycobacterial diseases: Tuberculosis, Leprosy and Syphilis.
    - Bacterial disease: Pyogenic, Diphtheria, Gram negative infection, Bacillary dysentery.
    - Viral diseases: Poliomyelitis, Herpes, Rabies, Measles, Rickettsia, Chlamydial infection, HIV infection.

- Fungal disease and opportunistic infections.
- Parasitic diseases: Malaria, Filaria, Amoebiasis, Kala-azar, Cysticercosis, Hydatid cyst.

6. Circulatory Disturbances [4 hrs]
    - Hyperemia/Ischemia and Hemorrhage Edema: Pathogenesis and types. Chronic venous congestion: Lung, Liver, Spleen, Systemic Pathology Thrombosis and Embolism: Formation, Fate and Effects.
    - Infarction: Types, Common sites.
    - Shock: Pathogenesis, types, morphologic changes.
7. Growth Disturbances and Neoplasia [5 hrs]
    - Atrophy, Hypertrophy, Hyperplasia, Aplasia, Hypoplasia, Metaplasia, Malformation, agenesis, dysplasia.
    - Precancerous lesions.
    - Neoplasia: Definition, classification, Biological behavior: Benign and Malignant, Carcinoma and Sarcoma.
    - Malignant Neoplasia: Grades and Stages, Local & Distant spread.
    - Carcinogenesis: Environmental carcinogens, chemical, viral, occupational. Heredity and cellular oncogenes and prevention of cancer.
    - Benign & Malignant epithelial tumours E.g. Squamous papilloma, Squamous cell carcinoma, malignant melanoma. Benign & Malignant mesenchymal tumours E.g.: Fibroma, Lipoma, Neurofibroma, Fibrosarcoma, Liposarcoma, Rhabdo-myosarcoma, Teratoma.
8. Nutritional Disorders [2 hrs]
    - Protein energy malnutrition: Marasmus, Kwashiorkor, and Vitamin deficiency disorders, classification with specific examples.
9. Genetic Disorders [2 hrs]
    - Basic concepts of genetic disorders and some common examples and congenital malformation.

B. Systemic pathology

10. Hematology – [5 hrs]
    - Constituents of blood and bone marrow, Regulation of hematopoiesis. Anemia: Classification, clinical features & lab diagnosis.
    - Nutritional anemias: Iron deficiency anemia, Folic acid, Vit. B 12 deficiency anemia including pernicious anemia. Hemolytic Anemias: Classification and Investigations. Hereditary hemolytic anemias: Thalassemia, Sickle cell anemia, Spherocytosis and Enzyme deficiencies.
    - Acquired hemolytic anemias
    - Alloimmune, Autoimmune
    - Drug induced, Microangiopathic Pancytopenia - Aplastic anemia.
    - Hemostatic disorders, Vascular and Platelet disorders & lab diagnosis. Coagulopathies –
    - Inherited

- Acquired with lab diagnosis.
- Leukocytic disorders: Leukocytosis, Leukopenis, Leukemoid reaction.
- Leukemia: Classification, clinical manifestation, pathology and Diagnosis. Multiple myeloma and disproteinemias.
- Blood transfusion; Grouping and cross matching, untoward reactions, transmissible infections including HIV & hepatitis, Blood-components & plasma-pheresis.

11. Respiratory System [2 hrs]
    - Pneumonia, Bronchitis, Bronchiectasis, Asthma, Tuberculosis, Carcinoma of lungs, Occupational lung diseases
12. Cardiovascular Pathology [3 hrs]
    - Congenital Heart disease: Atrial septal defect, Ventricular septal defect, Fallot's tetralogy, Patent a ductus arteriosus.
    - Endocarditis. Rheumatic Heart disease.
    - Vascular diseases: Atherosclerosis, monckeberg's medial calcification, Aneurysm and Arteritis and tumours of Blood vessels.
    - Ischemic heart Disease: Myocardial infarction. Hypertension and hypertensive heart Disease.
13. Alimentary tract: [3hrs]
    - Oral Pathology: Ulcers, leukoplakia, Carcinoma, oral cavity diseases and tumour of salivary gland & esophagus and precancerous lesions, Esophagus inflammatory, functional disorders and tumours.
    - Stomach: Gastritis, Ulcer & Tumours.
    - Tumours and tumour like condition of the small and large Intestine: Polyps, carcinoid, carcinoma, Lymphoma.
    - Pancreatitis and pancreatic tumours : I) Exocrine, ii) Endocrine Salivary gland tumours : Mixed, Warthin's
14. Hepato – biliary pathology [3 hrs]
    - Jaundice: Types, aetio-pathogenesis and diagnosis. Hepatitis: Acute, Chronic, neonatal.
    - Alcoholic liver disease
    - Cirrhosis: Post necrotic, Alcoholic, Metabolic and Portal hypertension Liver abscesses; Pyogenic, parasitic and Amoebic. Tumours of Liver
15. Lymphatic System [3 hrs]
    - Diseases of the gall bladder: Cholecystitis, Cholelithiasis, Carcinoma. Lymphadenitis - Nonspecific and granulomatous. Causes of Lymph Node enlargements. Reactive Hyperplasia, Primary Tumours - Hodgkin's and Non-Hodgkin’s Lymphomas, Metastatic Tumours.
    - Causes of Splenic Enlargements.
16. Musculoskeletal System [3 hrs]
    - Osteomyelitis, acute, chronic, tuberculous, mycetoma
    - Metabolic diseases: Rickets/Osteomalacia, osteoporosis, Hyper parathyroidism, Paget's disease.

- Tumours Classification: Benign, Malignant, Metastatic and synovial sarcoma. Arthritis: Suppurative, Rheumatoid. Osteoarthritis, Gout, Tuberculous.

17. Endocrine pathology [3 hrs]
    - Diabetes Mellitus: Types, Pathogenesis, Pathology, Laboratory diagnosis Non-neoplastic lesions of Thyroid: Iodine deficiency goiter, autoimmune Thyroiditis, Thyrotoxicosis, myxedema, Hashimoto's thyroiditis.
    - Tumours of Thyroid: Adenoma, Carcinoma: Papillary, Follicular, Medullary, Anaplastic. Adrenal diseases: cortical hyperplasia, atrophy, tuberculosis, tumours of cortex and medulla.
18. Neuropathology [3 hrs]
    - Inflammations and Infections: TB Meningitis, Pyogenic Meningitis, viral meningitis and Brain Abscess
    - Tuberculosis, Cysticercosis
    - CNS Tumors, Astrocytoma, Neuroblastoma, Meningioma, Medulloblastoma
19. Dermatopathology [2 hrs]
    - Skin tumors: Squamous cell carcinoma, Basal cell carcinoma, Melanoma

STUDENT LEARNING OUTCOMES/ OBJECTIVES:

At the end of the semester, the student will be able to:

- To know the nature of disease, it’s causes, development, and consequences.
- To identify the various pathological conditions for various systems.

Recommended Textbooks

- Text book of pathology: Harsh Mohan
- General systemic pathology: Churchill Livingstone
- Text book of Pathology: Robbins

MICROBIOLOGY

SUBJECT DESCRIPTION –

Microbiology involves the study of common organisms causing diseases including nosocomial infections and precautionary measures to protect one from acquiring infections. The knowledge and understanding of Microbiology of diseases is essential to institute appropriate treatment or suggest preventive measures to the patient. Particular effort is made in this course to avoid burdening the student.

THEORY [45hrs.]

1. General Microbiology [5hrs]
    - Definitions: infections, parasite, host, vector, fomite, contagious disease, infectious disease, epidemic, endemic, pandemic, Zoonosis, Epizootic, Attack rate.
    - Normal flora of the human body.
    - Routes of infection and spread; endogenous and exogenous infections; source at reservoir of infections.
    - Bacterial cell. Morphology limited to recognizing bacteria in clinical samples Shape, motility and arrangement. Structures, which are virulence, associated.
    - Physiology: Essentials of bacterial growth requirements.
    - Sterilization, disinfection and universal precautions in relation to patient care and disease prevention. Definition of asepsis, sterilization, disinfection.
    - Antimicrobials: Mode of action, interpretation of susceptibility tests, resistance spectrum of activity.
2. Immunology [5hrs]
    - Basic principles of immunity immunobiology: lymphoid organs and tissues. Antigen, Antibodies, antigen and antibody reactions with relevance to pathogenesis and serological diagnosis.
    - Humoral immunity and its role in immunity Cell mediated immunity and its role in immunity. Immunology of hypersensitivity, measuring immune functions.
3. Bacteriology [13hrs]
    - To be considered under the following headings
    - Morphology, classification according to pathogenicity, mode of transmission, methods of prevention, collection and transport of samples for laboratory diagnosis, interpretation of laboratory reports.
    - Staphylococci, Streptococci and Pneumococci.
    - Mycobacteria: Tuberculosis, M.leprae, atypical mycobacteria, Enterobacteriaceae,
    - Vibrois: V. cholerae and other medically important vibrios, Campylobacters and Helicobacters, Pseudomonas.
    - Bacillus anthracis, Sporing and non-sporing anaerobes: Clostridia, Bacteroides and Fusobacteria.

4. General Virology [5hrs]
    - General properties: Basic structure and broad classification of viruses. Pathogenesis and pathology of viral infections. Immunity and prophylaxis of viral diseases. Principles of laboratory diagnosis of viral diseases. List of commonly used antiviral agents.
5. Mycology [5hrs.]
    - General properties of fungi. Classification based on disease: superficial, subcutaneous, deep mycosel opportunistic infections including Mycotoxins, systemic mycoses. General principles of fungal diagnosis, Rapid diagnosis. Method of collection of samples. Antifungal agents.
6. Clinical/Applied Microbiology [12 hrs]
    - Streptococcal infections: Rheumatic fever and Rheumatic heart disease, Meningitis.
    - Tuberculosis,
    - Pyrexia of unknown origin, leprosy,
    - Sexually transmitted diseases, Poliomyelitis,
    - Hepatitis,
    - Acute-respiratory infections, Central nervous System infections, Urinary tract infections,
    - Pelvic inflammatory disease, Wound infection, Opportunistic infections, HlV infection,
    - Malaria, Filariasis, Zoonotic diseases.

STUDENT LEARNING OUTCOMES/ OBJECTIVES:-

At the end of the semester, the student will be able to:

- To identify the microorganisms and their activities in various diseases.
- To know the differential diagnosis of various diseases.

Recommended Textbooks:

- Short text book of Medical Microbiology by Sathish Gupta
- Text book of Microbiology by Jayaram Panicker
- Microbiology & Parasitology by Rajeshwar Reddy
- Text book of Microbiology by Anantha Narayanan
- Microbiology by Baveja
- Text book of microbiology by Chakraborty

INTRODUCTION TO QUALITY AND PATIENT SAFETY

SUBJECT DESCRIPTION –

In this course, the student will learn the basic concepts of quality in health care and develop skills to implement sustainable quality management program with respect to patient safety.

THEORY [30 Hrs.]

1 Quality assurance and management - The objective of the course is to help students understand the basic concepts of quality in health Care and develop skills to implement sustainable quality assurance program in the health system. [5 hrs.]

- Concepts of Quality of Care
- Quality Improvement Approaches
- Standards and Norms
- Quality Improvement Tools
- Introduction to NABH guidelines

2 Basics of emergency care and life support skills - Basic life support (BLS) is the foundation for saving lives following cardiac arrest. Fundamental aspects of BLS include immediate recognition of sudden cardiac arrest (SCA) and activation of the emergency response system, early cardiopulmonary resuscitation (CPR), and rapid defibrillation with an automated external defibrillator (AED). Initial recognition and response to heart attack and stroke are also considered part of BLS. The student is also expected to learn about basic emergency care including first aid and triage. Topics to be covered under the subject are as follows: [8 hrs.]

- Vital signs and primary assessment
- Basic emergency care – first aid and triage
- Ventilations including use of bag-valve-masks (BVMs)
- Choking, rescue breathing methods
- One- and Two-rescuer CPR
- Using an AED (Automated external defibrillator).
- Managing an emergency including moving a patient

At the end of this topic, focus should be to teach the students to perform the maneuvers in simulation lab and to test their skills with focus on airways management and chest compressions. At the end of the foundation course, each student should be able to perform and execute/operate on the above mentioned modalities.

3 Bio medical waste management and environment safety- The aim of this section will be to help prevent harm to workers, property, the environment and the general public. Topics to be covered under the subject are as follows: [6 hrs.]

- Definition of Biomedical Waste
- Waste minimization
- BMW – Segregation, collection, transportation, treatment and disposal (including color coding)

- Liquid BMW, Radioactive waste, Metals / Chemicals / Drug waste
- BMW Management & methods of disinfection
- Modern technology for handling BMW
- Use of Personal protective equipment (PPE)
- Monitoring & controlling of cross infection (Protective devices)

4 Infection prevention and control - The objective of this section will be to provide a broad understanding of the core subject areas of infection prevention and control and to equip AHPs with the fundamental skills required to reduce the incidence of hospital acquired infections and improve health outcomes. Concepts taught should include – [6 hrs.]

- Evidence-based infection control principles and practices [such as sterilization, disinfection, effective hand hygiene and use of Personal protective equipment (PPE)],
- Prevention & control of common healthcare associated infections,
- Components of an effective infection control program, and
- Guidelines (NABH and JCI) for Hospital Infection Control

5 Antibiotic Resistance- [5 hrs.]

- History of Antibiotics
- How Resistance Happens and Spreads
- Types of resistance- Intrinsic, Acquired, Passive
- Trends in Drug Resistance
- Actions to Fight Resistance
- Bacterial persistence
- Antibiotic sensitivity
- Consequences of antibiotic resistance
- Antimicrobial Stewardship- Barriers and opportunities, Tools and models in hospitals

6 Disaster preparedness and management- The objective of this section will be to provide knowledge on the principles of on-site disaster management. Concepts to be taught should include- [6 hrs.]

- Fundamentals of emergency management,
- Psychological impact management,
- Resource management,
- Preparedness and risk reduction,
- Key response functions (including public health, logistics and governance, recovery, rehabilitation and reconstruction), information management, incident command and institutional mechanisms.

STUDENT LEARNING OUTCOMES/OBJECTIVES:-

At the end of the semester the student will be able to:

- To understand the basic concepts of quality in health care and patient safety.
- To understand the basics of emergency care and activation of appropriate response system.
- To understand the management of biomedical waste.
- To understand the core areas of infection prevention.
- To understand the principles of on-site disaster management.

Recommended Textbooks:

- Hospital Administration by C.N.Francis, 3rd edition; Jaypee Publications.
- Hospital Administration & Human Resource Management by D.K.Sharma; 5th edition.
- First aid & emergency nursing by N.N.Yalayyaswamy; CBS, CBS Publisher and Distributers.
- Cash's Textbook of Chest, Heart and Vascular Disorders for Physiotherapists by PatriciA.Downie, 4th edition.
- Patient Safety by Charles Vincent, 2ndEdition, Wiley Blackwell Publications.

Reference books:

- Understanding Patient Safety by Robert Wacher, 2nd edition, McGraw-Hill Education Publishers.
- Applying Quality Management in the Healthcare: A Process for improvement by Diane L. Kelly, Neha Publishers and Distributers.

Fourth Semester

EXERCISE THERAPY

SUBJECT DESCRIPTION- After the course on exercise therapy student will be able to understand the different types of exercise for the benefit of patient in different situations and conditions both in health and disease or disorder.

THEORY [60 hrs.]

1. Specific exercise regimens [5 hrs]
    a. Isotonic: de Lormes, Oxford, MacQueen, Circiut weight training
    b. Isometric: BRIME (Brief Resisted Isometric Exercise), Multiple Angle
    c. Isometrics Isokinetic regimens
2. Proprioceptive Neuromuscular Facilitation [5 hrs]
    a. Definitions & goals
    b. Basic neurophysiologic principles of PNF: Muscular activity, Diagonals patterns of movement: upper limb, lower limb
    c. Procedure: components of PNF
    d. Techniques of facilitation
    e. Mobility: Contract relax, Hold relax, Rhythmic initiation
    f. Strengthening: Slow reversals, repeated contractions, timing for emphasis, rhythmic stabilization Stability: Alternating isometric, rhythmic stabilization
    g. Skill: timing for emphasis, resisted progression Endurance: slow reversals, agonist reversal
3. Suspension Therapy [3 hrs]
    a. Definition, principles, equipments & accessories, Indications & contraindications,
    Benefits of suspension therapy
    b. Types of suspension therapy: axial, vertical, pendular Techniques of suspension therapy for upper limb Techniques of suspension therapy for lower limb
4. Functional Re-education [3 hrs]
    a. Lying to sitting: Activities on the Mat/Bed, Movement and stability at floor level; Sitting activities and gait; Lower limb and Upper limb activities.
5. Aerobic Exercise [3 hrs]
    a. Definition and key terms; Physiological response to aerobic exercise, Examination and evaluation of aerobic capacity – Exercise Testing, Determinants of an Exercise Program, The Exercise Program, Normal and abnormal response to acute aerobic exercise, Physiological changes that occur with training, Application of Principles of an Aerobic conditioning program for patients – types and phases of aerobic training.
6. Stretching [5 hrs]
    a. Definition of terms related to stretching; Tissue response towards immobilization and elongation, Determinants of stretching exercise, Effects of stretching, Inhibition and relaxation procedures, Precautions and contraindications of stretching, Techniques of stretching.
7. Manual Therapy & Peripheral Joint Mobilization [5 hrs]
    a. Schools of Manual Therapy, Principles, Grades, Indications and Contraindications,

Effects and Uses – Maitland, Kaltenborn, Mulligan

b. Biomechanical basis for mobilization, Effects of joint mobilsation, Indications and contraindications, Grades of mobilization, Principles of mobilization, Techniques of mobilization for upper limb, lower limb, Precautions.

8. Balance – Definition [2 hrs]
    a. Physiology of balance: contributions of sensory systems, processing sensory information, generating motor output
    b. Components of balance (sensory, musculoskeletal, biomechanical)
    c. Causes of impaired balance, Examination & evaluation of impaired balance, Activities for treating impaired balance: mode, posture, movement, Precautions & contraindications, Types Balance retraining.
9. Co-ordination Exercise [2 hrs]
    a. Anatomy & Physiology of cerebellum with its pathways Definitions: Co-ordination,
    Inco-ordination
    b. Causes for Inco-ordination, Test for co-ordination: equilibrium test, non-equilibrium test Principles of co-ordination exercise.
    c. Frenkel's Exercise: uses of Frenkel's exercise, technique of Frenkel's exercise,
    progression, home exercise.
10. Posture [3 hrs]
    a. Definition, Active and Inactive Postures, Postural Mechanism, Patterns of Posture, Principles of re-education: corrective methods and techniques, Patient education.
11. Walking Aids [2 hrs]
    a. Types: Crutches, Canes, Frames; Principles and training with walking aids
12. Basics in Manual Therapy & Applications with Clinical reasoning [13 hrs]
    a. Examination of joint integrity
        i. Contractile tissues
        ii. Non contractile tissues
    b. Mobility - assessment of accessory movement & End feel
    c. Assessment of articular & extra-articular soft tissue status
        i. Myofascial assessment
        ii. Acute & Chronic muscle hold
        iii. Tightness
        iv. Pain-original & referred
    d. Basic principles, Indications & Contra-Indications of mobilization skills for joints & soft tissues.
        i. Maitland
        ii. Mulligan
        iii. Mckenzie
        iv. Muscle Energy Technique
        v. Myofascial stretching
        vi. Cyriax
        vii. Neuro Dynamic Testing
13. Hydrotherapy [4 hrs]
    a. Definitions, Goals and Indications, Precautions and Contraindications, Properties of water, Use of special equipment, techniques, Effects and uses,

merits and demerits

14. Individual and Group Exercises [5 hrs]
    a. Advantages and Disadvantages, Organization of Group exercises, Recreational Activities and Sports

PRACTICAL [120 hrs.]

The students of exercise therapy are to be trained in Practical Laboratory work for all the topics discussed in theory. The student must be able to evaluate and apply judiciously the different methods of exercise therapy techniques on the patients. They must be able to

1. Demonstrate the technique of measuring using goniometry
2. Demonstrate muscle strength using the principles and technique of MMT
3. Demonstrate the techniques for muscle strengthening based on MMT grading
4. Demonstrate the PNF techniques
5. Demonstrate exercises for training co-ordination – Frenkel's exercise
6. Demonstrate the techniques of massage manipulations
7. Demonstrate techniques for functional re-education
8. Assess and train for using walking aids
9. Demonstrate mobilization of individual joint regions
10. Demonstrate to use the technique of suspension therapy for mobilizing and strengthening joints and muscles
11. Demonstrate the techniques for muscle stretching
12. Assess and evaluate posture and gait
13. Demonstrate techniques of strengthening muscles using resisted exercises
14. Demonstrate techniques for measuring limb length and body circumference.

STUDENT LEARNING OUTCOMES/OBJECTIVES:

At the end of the semester the student will be able to:

- Acquire the skill of assessment of isolated and group muscle strength subjectively and objectively.
- Analyse normal human posture and its associated problems, its management.
- Analyse the various normal musculoskeletal movements during gait and daily living and daily living activities and in terms of biomechanical and physiological principles.
- To plan the exercises for various conditions and do the advanced intervention.
- To perform various manual therapy techniques.

Recommended Textbooks

- Therapeutic exercise by Carolyn Kisner
- Principles of exercise therapy by M.Dena Gardiner
- Practical Exercise therapy by Hollis Margaret
- Therapeutic exercise by Sydney Litch

Reference books:

- Therapeutic exercise by Hall & Brody
- Therapeutic exercise by Basmajjian
- Physical Rehabilitation by O'Sullivan.
- Therapeutic massage by Sinha

- Principles of muscle testing by Hislop
- Manual Therapy NAGS, SNAGS, MWMS etc. by Brian R Mulligan, 6th Edition, Plane view services.
- Peripheral Manipulation by G D Maitland, 3rd Edition.

ELECTROTHERAPY

SUBJECT DESCRIPTION - In this course the student will learn the Principles, Techniques, Effects, Indication, Contra-Indication and the dosage parameter for various indications of electro therapeutic modalities in the restoration of physical function. The objective of this course is that after 240hrs of lectures, demonstration, practical and clinics the student will be able to list the indications, contra indications, dosages of electro therapy modalities, demonstrates the different techniques, and describe their effects on various conditions.

THEORY [60 hrs.]

Section II A - Low frequency Currents

1. Basic types of current [1 hr.]
    a. Direct Current: types, physiological &therapeutic effects.
    b. Alternating Current
2. Types of Current used in Therapeutics [3 hrs.]
    a. Modified D.C
        i. Faradic Current
        ii. Galvanic Current
    b. Modified A.C
        i. Sinusoidal Current
        ii. Diadynamic Current.
3. Faradic Current: [1 hrs]
    - Definition, Modifications, Techniques of Application of Individual, Muscle and Group Muscle stimulation, Physiological & Therapeutic effects of Faradic Current, Precautions, Indications & Contra-Indications, Dangers.
4. Galvanic Current: [1 hrs]
    - Definition, Modifications, Physiological & Therapeutic effects of Galvanic Current, Indications & Contra-Indications, Dangers, Effect of interrupted galvanic current on normally innervated and denervated muscles and partially denervated muscles.
5. Sinusoidal Current & Diadynamic Current in Brief. [1 hr]
6. HVPGS – Parameters & its uses [2 hr]
7. Ionization / Iontophoresis: Techniques of Application of Iontophoresis, Indications, Selection of Current, Commonly used Ions (Drugs) for pain, hyperhydrosis, would healing.
8. Cathodal / Anodal galvanism. [1 hr]
9. Micro Current & Macro Current [1 hr]
10. Types of Electrical Stimulators [1 hr]
    a. NMES- Construction component.
    b. Neuro muscular diagnostic stimulator- construction component.
    c. Components and working Principles
11. Principles of Application: [3 hrs]
    - Electrode tissue interface, Tissue Impedance, Types of Electrode, Size & Placement of Electrode – Waterbath, Unipolar, Bi-polar, Electrode coupling, Current flow in tissues, Lowering of Skin Resistance.
12. Nerve Muscle Physiology: [3 hrs]
    - Action Potential, Resting membrane potential, Propagation of Action Potential,

Motor unit, synapse, Accommodation, Stimulation of Healthy Muscle, Stimulation of Denervated Muscle, and Stimulation for Tissue Repair.

13. TENS: [3 hrs]
    - Define TENS, Types of TENS, Conventional TENS, Acupuncture TENS, Burst TENS, Brief & Intense TENS, Modulated TENS. Types of Electrodes & Placement of Electrodes, Dosage parameters, Physiological & Therapeutic effects, Indications & Contraindications.
14. Pain: [1 hrs]
    - Define Pain, Theories of Pain (Outline only), Pain Gate Control theory in detail.

Section II B - Electro-diagnosis

1. FG Test [1 hr.]
2. SD Curve: [2 hrs.]
    - Methods of Plotting SD Curve, Apparatus selection, Characters of Normally innervated Muscle, Characters of Partially Denervated Muscle, Characters of Completely denervated Muscle, Chronaxie & Rheobase.
3. Nerve conduction velocity studies [1 hr.]
4. EMG: Construction of EMG equipment. [1 hr.]
5. Bio-feedback. [1 hr].

Section II C - Medium Frequency

1. Interferential Therapy: [2 hrs.]
    - Define IFT, Principle of Production of IFT, Static Interference System, Dynamic Interference system, Dosage Parameters for IFT, Electrode placement in IFT, Physiological & Therapeutic effects, Indications & Contraindications.
2. Russian Current [1 hr.]
3. Rebox type Current [1 hr.]

Section III - Thermo & Actinotherapy (High Frequency Currents)

1. Electro Magnetic Spectrum. [1 hr.]
2. SWD: [4 hrs.]
    - Define short wave, Frequency & Wavelength of SWD, Principle of Production of SWD, Circuit diagram & Production of SWD, Methods of Heat Production by SWD treatment, Types of SWD Electrode, Placement & Spacing of Electrodes, Tuning, Testing of SWD Apparatus, Physiological & Therapeutic effects, Indications & Contraindications, Dangers, Dosage parameters.
3. Pulsed Electro Magnetic Energy: [1 hr.]
    - Principles, Production & Parameters of PEME, Uses of PEME.
4. Micro Wave Diathermy: [1 hr.]
    - Define Microwave, Wave length & Frequency, Production of MW, Applicators, Dosage Parameters, Physiological & Therapeutic effects, Indications & Contraindications, Dangers of MWD.
5. Ultrasound: [4 hrs.]
    - Define Ultrasound, Frequency, Piezo Electric effects: Direct, Reverse, Production of US, Treatment Dosage parameters: Continuous& Pulsed mode, Intensity, US Fields: Near field, Far field, Half value distance, Attenuation,

Coupling Media, Thermal effects, Non-thermal effects, Principles & Application of US: Direct contact, Water bag, Water bath, Solid sterile gel pack method for wound. Uses of US, Indications & Contraindications, Dangers of Ultrasound. Phonophoresis: Define Phonophoresis, Methods of application, commonly used drugs, Uses. Dosages of US.

6. IRR: [1 hr.]
    - Define IRR, wavelength & parameters, Types of IR generators, Production of IR, Physiological & Therapeutic effects, Duration & frequency of treatment, Indication & Contraindication.
7. UVR: [4 hours]
    - Define UVR, Types of UVR, UVR generators: High pressure mercury vapour lamp, Water cooled mercury vapour lamp, Kromayer lamp, Fluorescent tube, Theraktin tunnel, PUVA apparatus. Physiological & Therapeutic effects. Sensitizers & Filters. Test dosage calculation. Calculation of E1, E2, E3, E4 doses. Indications, contraindications. Dangers. Dosages for different therapeutic effects, Distance in UVR lamp
8. LASER: [4 hrs.]
    - Define LASER. Types of LASER. Principles of Production. Production of LASER by various methods. Methods of application of LASER. Dosage of LASER. Physiological & Therapeutic effects of LASER. Safety precautions of LASER. Classifications of LASER. Energy density & power density

<u>Section IV – Superficial heating Modalities</u>

1. Wax Therapy: [1 hr.]
    - Principle of Wax Therapy application – latent Heat, Composition of Wax Bath Therapy unit, Methods of application of Wax, Physiological & Therapeutic effects, Indications & Contraindication, Dangers.
2. Contrast Bath: [1 hr.]
    - Methods of application, Therapeutic uses, Indications & Contraindications.
3. Moist Heat Therapy: [1 hr.]
    - Hydro collator packs – in brief, Methods of applications, Therapeutic uses, Indications & Contraindications.
4. Cyclotherm: [1 hr.]
    - Principles of production, Therapeutic uses, Indications & Contraindications.
5. Fluidotherapy: [1 hr.]
    - Construction, Method of application, Therapeutic uses, Indications & Contraindications.
6. Whirl Pool Bath: [1 hr.]
    - Construction, Method of Application, Therapeutic Uses, Indications & Contraindications.
7. Magnetic Stimulation: [1 hr.]
    - Principles, Therapeutic uses, Indications & contraindication.
8. Cryotherapy: [1 hr.]
    - Define- Cryotherapy, Principle- Latent heat of fusion, Physiological & Therapeutics effects, Techniques of Applications, Indications & Contraindications, Dangers, Methods of application with dosages.

PRACTICAL [120 hr.]

The student of Electrotherapy must be able to demonstrate the use of electrotherapy modalities applying the principles of electrotherapy with proper techniques, choice of dosage parameters and safety precautions.

1. Demonstrate the technique for patient evaluation – receiving the patient and positioning the patient for treatment using electrotherapy.
2. Collection of materials required for treatment using electrotherapy modalities and testing of the apparatus.
3. Demonstrate placement of electrodes for various electrotherapy modalities
4. Electrical stimulation for the muscles supplied by the peripheral nerves
5. Faradism under Pressure for UL and LL
6. Plotting of SD curve with chronaxie and rheobase
7. Demonstrate FG test
8. Application of Ultrasound for different regions-various methods of application
9. Demonstrate treatment techniques using SWD, IRR and Microwave diathermy
10. Demonstrate the technique of UVR exposure for various conditions – calculation of test dose
11. Demonstrate treatment method using IFT for various regions
12. Calculation of dosage and technique of application of LASER
13. Technique of treatment and application of Hydrocollator packs, cryotherapy, contrast bath, wax therapy
14. Demonstrate the treatment method using whirl pool bath
15. Winding up procedure after any electrotherapy treatment method.

Equipment care –Checking of equipments

1. Arrangement of exercise therapy and electro therapy equipment.
2. Calibration of equipment
3. Purchase, billing, document of equipment.
4. Safety handling of equipments.
5. Research lab equipment maintenance.
6. Stock register, movement register maintenance

STUDENT LEARNING OUTCOMES/OBJECTIVES:

At the end of the semester the student will be able to:

- To identify the modalities required for treating various conditions.
- To know various methods of application of different modalities and care for patients.

Recommended Textbooks:

- **C**laytons Electrotherapy by Forster & Plastangs
- Electrotherapy Explained by Low & Reed
- Clinical Electrotherapy by Nelson
- Textbook of Electrotherapy by Jagmohan Singh

Reference books:

- Electrotherapy Evidence based practice by Sheila Kitchen
- Physical agents by Michele Cameroon
- Principles of Electrotherapy by Michele Cameroon
- Thermal agents by Susan Michlovitz.

BIO-PHYSICS

SUBJECT DESCRIPTION - To understand the concept and basic principles to know electrotherapy equipment is given under this topic. The student will be taught about physics related to electrotherapy and application on human body tissues.

THEORY [60 hrs.]

1. Physical principles [30 hrs.]
    a. Structure and properties of matter -solids, liquids and gases, adhesion, surface tension, viscosity, density and elasticity.
    b. Structure of atom, molecules, elements and compound
    c. Electricity: Definition and types. Therapeutic uses. Basic physics of construction.
    Working
    d. Importance of currents in treatment.
    e. Static Electricity: Production of electric charge. Characteristic of a charged body.
    f. Characteristics of lines of forces. Potential energy and factors on which it depends. Potential difference and EMF.
    g. Current Electricity: Units of Electricity: farad, Volt, Ampere, Coulomb, Watt
    h. Condensers: Definition, principle, Types- construction and working, capacity & uses.
    i. Magnetism: Definition. Properties of magnets. Electromagnetic induction. Transmission by contact. Magnetic field and magnetic forces. Magnetic effects of an electric field.
    j. Conductors, Insulators, Potential difference, Resistance and intensity
    k. Ohm's law and its application to DC and AC currents. Fuse: construction, working and application.
    l. Transmission of electrical energy through solids, liquids, gases and vacuum.
    m. Rectifying Devices-Thermionic valves, Semiconductors, Transistors, Amplifiers, transducer and Oscillator circuits.
    n. Display devices and indicators-analogue and digital.
    o. Transformer: Definition, Types, Principle, Construction, Eddy current, working uses
    p. Chokes: Principle, Construction and working, Uses
2. Effects of Current Electricity [[10 hrs.]
    a. Chemical effects-lons and electrolytes, lonisation, Production of an EMF by chemical actions.
    b. Ionization: Principles, effects of various technique of medical ionization.
    c. Electromagnetic Induction.
    d. Electromagnetic spectrum.
3. Electrical Supply [10 hrs.]
    a. Brief outline of main supply of electric current
    b. Dangers-short circuit, electric shocks: Micro/ Macro shocks
    c. Precaution-safety devices, earthing, fuses etc.
    d. First aid and initial management of electric shock
    e. Burns: electrical & chemical burns, prevention and management
4. Various agents [10 hrs.]

a. Thermal agents: Physical Principles of cold, Superficial and deep heat.
b. Ultrasound: Physical Principles of Sound
c. Electro- magnetic Radiation: Physical Principles and their Relevance to Physiotherapy Practice
d. Electric Currents: Physical Principles and their Relevance to Physiotherapy Practice.

STUDENT LEARNING OUTCOMES/OBJECTIVES:

At the end of the semester the student will be able to:

- Describe the fundamental of general physics and relate its application in physiotherapy.
- Demonstrate the mechanics related to human body function.
- Describe all the physical agents and their use in electrotherapy modalities.
- Understand basic concepts of electricity and electronics and its application into physiotherapy.

Recommended textbooks:

- Physics - Foundation & frontiers by George Cramow & John M. Cleveland
- Fundamentals of Biomedical Physics by Akil Saiyed & Babita Saiyed.

Reference books:

- Physics of the life sciences by Jay Newman. 2008.
- University physics for the physical and life sciences by Philip R. Kesten and David L First Edition, W. H. Freeman and Company. 2012.
- Physics for the biological sciences by Fredrick Ross Halett, Harcourt Canada. 2001.
- Text book of Sound – Brijlal and Subramanian

BASIC COMPUTERS AND INFORMATION SCIENCE

SUBJECT DESCRIPTION: The students will be able to appreciate the role of computer technology. The course has focus on computer organization, computer operating system and software, and MS windows, Word processing, Excel data worksheet and PowerPoint presentation.

THEORY [15 hrs.]

1. Introduction to computer: Introduction, characteristics of computer, block diagram of computer, generations of computer, computer languages. [1 hr.]
2. Input output devices: Input devices(keyboard, point and draw devices, data scanning devices, digitizer, electronic card reader, voice recognition devices, vision-input devices), output devices(monitors, pointers, plotters, screen image projector, voice response systems). [1 hr.]
3. Processor and memory: The Central Processing Unit (CPU), main memory. [1 hr.]
4. Storage Devices: Sequential and direct access devices, magnetic tape, magnetic disk, optical disk, mass storage devices. [1 hr.]
5. Introduction of windows: History, features, desktop, taskbar, icons on the desktop, operation with folder, creating shortcuts, operation with windows (opening, closing, moving, resizing, minimizing and maximizing, etc.). [2 hrs.]
6. Introduction to MS-Word: introduction, components of a word window, creating, opening and inserting files, editing a document file, page setting and formatting the text, saving the document, spell checking, printing the document file, creating and editing of table, mail merge. [2 hrs.]
7. Introduction to Excel: introduction, about worksheet, entering information, saving workbooks and formatting, printing the worksheet, creating graphs. [1 hr.]
8. Introduction to power-point: introduction, creating and manipulating presentation, views, formatting and enhancing text, slide with graphs. [1 hr.]
9. Introduction of Operating System: introduction, operating system concepts, types of operating system. [1 hr.]
10. Computer networks: introduction, types of network (LAN, MAN, WAN, Internet, Intranet), network topologies (star, ring, bus, mesh, tree, hybrid), components of network. [2 hrs.]
11. Internet and its Applications: definition, brief history, basic services (E-Mail, File Transfer Protocol, telnet, the World Wide Web (WWW)), www browsers, use of the internet. [2 hrs.]
    - Application of Computers in clinical settings.

PRACTICAL: Practical on fundamentals of computers – [30 hrs]

1. Learning to use MS office: MS word, MS PowerPoint, MS Excel.
2. To install different software.
3. Data entry efficiency

STUDENT LEARNING OUTCOMES/OBJECTIVES:

At the end of the semester, the student will be able to:

- The student will learn the fundamentals of computers, basic operating procedures, internet and their utilization in the field of Physiotherapy.

- To learn the applied aspect of the subject for physiotherapy practice.

Recommended Text Books -

- Basic computer application: Parvez Faruki, Manoj Parmar and Nandu Fatak; Mahajan Publishing house.
- P.C. Software for Windows 98 made simple: Taxali R.K.; Tata McGraw-Hill Publishers.
- Computer fundamentals: Pradeep K. Sinha and Priti Sinha; BPB publication.

Reference:

- Manuals available with the software
- MS Office: Pierce; Prentice Hall, New Delhi

Fifth Semester

CLINICAL ORTHOPEDICS & TRAUMATOLOGY -

SUBJECT DESCRIPTION - This subject follows the basic science subjects to provide the knowledge about Orthopedic conditions the therapist would encounter in their practice. The objective of this course is that after completion of the lectures and discussion the student will be able to demonstrate an understanding of orthopedic conditions causing disability, list the etiology, clinical features and methods of investigations and management.

THEORY [75 HRS.]

1. Introduction [1 hr.]
    a. Introduction to orthopedics.
    b. Clinical examination in an orthopedic patient.
    c. Common investigative procedures.
    d. Radiological and Imaging techniques in Orthopedics.
    e. Inflammation and repair, Soft tissue healing.
2. Traumatology [1 hr.]
    a. Fracture: definition, types, signs and symptoms.
    b. Fracture healing.
    c. Complications of fractures.
    d. Conservative and surgical approaches.
    e. Principles of management – reduction (open/closed, immobilization etc.).
    f. Subluxation/ dislocations – definition, signs and symptoms, management (conservative and operative).
3. Fractures and Dislocations of Upper Limb [10 hrs.]
    a. Fractures of Upper Limb - causes, clinical features, mechanism of injury, complications, conservative and surgical management of the following fractures:
        i. Fractures of clavicle and scapula.
        ii. Fractures of greater tuberosity and neck of humerus.
        iii. Fracture shaft of humerus.
        iv. Supracondylar fracture of humerus.
        v. Fractures of capitulum, radial head, olecranon, coronoid, and epicondyles.
        vi. Side swipe injury of elbow.
        vii. Both bone fractures of ulna and radius.
        viii. Fracture of forearm – monteggia, galaezzi fracture –dislocation.
        ix. Chauffer's fracture.
        x. Colle's fracture.
        xi. Smith's fracture.
        xii. Scaphoid fracture.
        xiii. Fracture of the metacarpals.
        xiv. Bennett's fracture.
        xv. Fracture of the phalanges. (Proximal and middle.)
    b. Dislocations of Upper Limb –

i. Anterior dislocation of shoulder – mechanism of injury, clinical feature, complications, conservative management (Kocher's and Hippocrates maneuver), surgical management (putti plat, bankart's) etc.
ii. Recurrent dislocation of shoulder.
iii. Posterior dislocation of shoulder – mechanism of injury, clinical features and management.
iv. Posterior dislocation of elbow – mechanism of injury, clinical feature, complications & management.

4. Fracture of Spine [5 hrs.]
   a. Fracture of Cervical Spine - Mechanism of injury, clinical feature, complications (quadriplegia); Management- immobilization (collar, cast, brace, traction); Management for stabilization, management of complication (bladder and bowel, quadriplegia).
      i. Clay shoveller's fracture.
      ii. Hangman's fracture.
      iii. Fracture odontoid.
      iv. Fracture of atlas.
   b. Fracture of Thoracic and Lumbar Regions - Mechanism of injury, clinical features, and management— conservative and surgical of common fractures around thoracic and lumbar regions.
   c. Fracture of coccyx.
   d. Fracture of Rib Cage - Mechanism of injury, clinical features, management for Fracture Ribs, Fracture of sternum.
5. Fractures and Dislocations of Lower Limb [8 hrs.]
   a. Fracture of Pelvis and Lower Limb - causes, clinical features, mechanism of injury, complications, conservative and surgical management of the following fractures:
      i. Fracture of pelvis.
      ii. Fracture neck of femur – classification, clinical features, complications, management - conservative and surgical.
      iii. Fractures of trochanters.
      iv. Fracture shaft femur—clinical features, mechanism of injury, complications, management-conservative and surgical.
      v. Supracondylar fracture of femur.
      vi. Fractures of the condyles of femur.
      vii. Fracture patella.
      viii. Fractures of tibial condyles.
      ix. Both bones fracture of tibia and fibula.
      x. Dupuytren's fracture
      xi. Maisonneuve's fracture.
      xii. Pott's fracture – mechanism of injury, management.
      xiii. Bimalleolar fracture
      xiv. Trimalleolar fracture
      xv. Fracture calcaneum – mechanism of injury, complications and management.
      xvi. Fracture of talus.
      xvii. Fracture of metatarsals—stress fractures jone's fracture.

xviii. Fracture of phalanges.

b. Dislocations of Lower Limb - mechanism of injury, clinical features, complications, management of the following dislocations of lower limb.
   i. Anterior dislocation of hip.
   ii. Posterior dislocation of hip.
   iii. Central dislocation of hip.
   iv. Dislocation of patella.
   v. Recurrent dislocation of patella.

6. Soft Tissue Injuries - Define terms such as sprains, strains, contusion, tendinitis, rupture, tenosynovitis, tendinosis, bursitis. [2 hrs.]
   a. Mechanism of injury of each, clinical features, managements- conservative and surgical of the following soft tissue injuries:
      i. Meniscal injuries of knee.
      ii. Cruciate injuries of knee.
      iii. Medial and lateral collateral injuries of knee.
      iv. Lateral ligament of ankle.
      v. Wrist sprains.
      vi. Strains- quadriceps, hamstrings, calf, biceps, triceps etc.
      vii. Contusions- quadriceps, gluteal, calf, deltoid etc.
      viii. Tendon ruptures-Achilles, rotator cuff muscles, biceps, pectorals etc.
7. Hand Injuries - mechanism of injury, clinical features, and management of the following – [2 hrs.]
   a. Crush injuries.
   b. Flexor and extensor injuries.
   c. Burn injuries of hand.
8. Amputations - Definition, levels of amputation of both lower and upper limbs, indications, complications. [1 hrs.]
9. Traumatic Spinal Cord Injuries - Clinical features, complications, medical and surgical management of Paraplegia and Quadriplegia. [2 hrs.]
10. Deformities - clinical features, complications, medical and surgical management of the following Congenital and Acquired deformities. [8 hrs.]
    a. Congenital Deformities –
       i. CTEV.
       ii. CDH.
       iii. Torticollis.
       iv. Scoliosis.
       v. Flat foot.
       vi. Vertical talus.
       vii. Hand anomalies- syndactyly, polydactyly and ectrodactly. Arthrogryposis multiplex congenita (amyoplasia congenita).
       viii. Limb deficiencies- Amelia and Phocomelia. Klippel feil syndrome. Osteogenesis imperfecta(fragile ossium).
       ix. Cervical rib.
    b. Acquired Deformities –
       i. Acquired Torticollis.
       ii. Scoliosis.
       iii. Kyphosis.

iv. Lordosis.
v. Genu varum.
vi. Genu valgum.
vii. Genu recurvatum
viii. Coxa vara.
ix. Pes cavus.
x. Hallux rigidus.
xi. Hallux valgus.
xii. Hammer toe.
xiii. Metatarsalgia.

11. Disease of Bones and Joints: Causes, Clinical features, Complications, Management- medical and surgical of the following conditions: [4 hrs.]
    a. Infective conditions: Osteomyelitis (Acute / chronic). Brodie's abscess. TB spine and
       major joints like shoulder, hip, knee, ankle, elbow etc.
    b. Arthritic conditions: Pyogenic arthritis. Septic arthritis. Syphilytic infection of joints.
    c. Bone Tumors: classification, clinical features, management - medical and surgical of the following tumors: Osteoma. Osteosarcoma, Osteochondroma. Enchondroma. Ewing's sarcoma. Gaint cell tumor. Multiple myeloma. Metastatic tumors.
    d. Perthes disease, Slipped Capital Femoral Epiphysis and Avascular Necrosis.
    e. Metabolic Bone Diseases: Rickets. Osteomalacia, Osteopenia. Osteoporosis.
12. Inflammatory and Degenerative Conditions: causes, clinical feature, complications, deformities, radiological features, management- conservative and surgical for the following conditions: [4 hrs.]
    a. Osteoarthritis. Rheumatoid arthritis. Ankylosing spondylitis Gouty arthritis. Psoriatic arthritis. Hemophilic arthritis. Still's disease (juvenile rheumatoid arthritis). Charcot's joints.
    b. Connective Tissue Disorders- Systemic Lupus Erythematosis, Scleroderma, Dermatomyositis, Poliomyelitis, Mixed connective tissue Disease (MCTD)
13. Syndromes: Causes, Clinical features, complications, management- conservative and surgical of the following: [4 hrs.]
    a. Cervico brachial syndrome. Thoracic outlet syndrome. Vertebro- basilar syndrome. Scalenus syndrome. Costo clavicular syndrome. Levator scapulae syndrome. Piriformis syndrome.
14. Neuromuscular Disorders: Definition, causes, clinical feature, complications, management. (Multidisciplinary approach) medical and surgical of the following conditions: [6 hrs.]
    a. Cerebral palsy.
    b. Poliomyelitis.
    c. Spinal Dysraphism.
    d. Leprosy.
15. Cervical and Lumbar Pathology: Causes, clinical feature, patho-physiology, investigations, management-Medical and surgical for the following: [6 hrs.]
    a. Prolapsed interverbral disc (PID),
    b. Spinal Canal Stenosis.

c. Spondylosis (cervical and lumbar)
d. Spondylolysis.
e. Spondylolisthesis.
f. Lumbago/ Lumbosacral strain.
g. Sacralisation.
h. Lumbarisation.
i. Coccydynia.
j. Hemivertebra.

16. Orthopedic Surgeries: Indications, Classification, Types, Principles of management of the following Surgeries: [5 hrs.]
    a. Arthrodesis.
    b. Arthroplasty (partial and total replacement).
    c. Osteotomy,
    d. External fixators.
    e. Spinal stabilization surgeries (Harrington's, Luque's, Steffi plating) etc ,
    f. Limb re attachments.
17. Regional Conditions: Definition, Clinical features and management of the following regional conditions. [5 hrs.]
    a. Shoulder: Periarthritic shoulder (adhesive capsulitis). Rotator cuff tendinitis. Supraspinatus Tendinitis. Infraspinatus Tendinitis. Bicipital Tendinitis. Subacromial Bursitis.
    b. Elbow: Tennis Elbow. Golfer's Elbow. Olecranon Bursitis (student's elbow). Triceps Tendinitis.
    c. Wrist and Hand: De Quervain's Tenosynovitis. Ganglion. Trigger Finger/ Thumb.
    Mallet Finger, Carpal Tunnel Syndrome, Dupuytren's Contracture.
    d. Pelvis and Hip: IT Band Syndrome. Piriformis Syndrome. Trochanteric Bursitis.
    e. Knee: Osteochondritis Dissecans. Prepatellar and Suprapatellar Bursitis. Popliteal Tendinitis. Patellar Tendinitis. Chondromalacia Patella. Plica Syndrome. Fat Pad Syndrome (Hoffa's syndrome).
    f. Ankle and Foot: Ankle Sprains. Plantar Fasciitis / Calcaneal Spur. Tarsal Tunnel
    Syndrome. Achilles Tendinitis. Metatarsalgia. Morton's Neuroma.

STUDENT LEARNING OUTCOMES/OBJECTIVES:-

At the end of the semester the student will be able:

- To understand causes, mechanism of injuries for traumatic conditions and also the intervention for those conditions.
- To identify the problems and their clinical signs and correlate with the other findings.

Recommended Textbooks:

- Outline of Fractures—John Crawford Adams.
- Outline of Orthopedics. — John Crawford Adams.
- Text book of Orthopedics.—Maheswari.
- Apley's Orthopedics.
- Textbook of Orthopedics and Traumatology— M.N.Natarajan

GENERAL SURGERY INCLUDING BURNS, PLASTIC SURGERY AND OBSTETRICS AND GYNECOLOGY

SUBJECT DESCRIPTION - This subject follows the basic science subjects to provide the knowledge about relevant aspects of general surgery. The student will have a general understanding of the surgical conditions the therapist would encounter in their practice.

GENERAL SURGERY INCLUDING BURNS AND PLASTIC SURGERY

THEORY [45 HRS.]

1. Fluid, Electrolyte and Acid-Base disturbances – diagnosis and management ; Nutrition in the surgical patient ; Wound healing – basic process involved in wound repair, basic phases in the healing process, clinical management of wounds, factors affecting wound healing, Scars – types and treatment. Hemostasis – components, hemostatic disorders, factors affecting bleeding during surgery. Transfusion therapy in surgery – blood components, complications of transfusion ; Surgical Infections ; General Post – Operative Complications and its management. [5 hrs.]
2. Reasons for Surgery; Types of anaesthesia and its affects on the patient; Types of Incisons; Clips Ligatures and Sutures; General Thoracic Procedures – Radiologic Diagnostic procedures, Endoscopy – types, Biopsy – uses and types. Overview and Drainage systems and tubes used in Surgery. [5 hrs.]
3. Causes, Clinical Presentation, Diagnosis and treatment of the following Thoracic Trauma situations – Airway obstruction, Pnuemothorax, Hemothorax, Cardiac Tamponade, Tracheobronchial disruption, Aortic disruption, Diaphragmatic disruption, Esophageal disruption, Cardiac and Pulmonary Contusions. [5 hrs.]
4. Surgical Oncology – Cancer – definition, types, clinical manifestations of cancer, Staging of Cancer, surgical procedures involved in the management of cancer.[5 hrs.]
5. Disorders of the Chest Wall, Lung and Mediastinum [3 hrs.]
6. Thoracic surgeries – Thoracotomy – Definition, Types of Incisions with emphasis to the site of insision, muscles cut and complications. Lung surgeries: Pnumonectomy, Lobectomy, segmentectomy – Indications, Physiological changes and Complications; Thoracoplasty, Pleurectomy, Pleurodesis and Decortication of the Lung. Cardiac surgeries – An overview of the Cardio-Pulmonary Bypass Machine – Extracardiac Operations, Closed Heart surgery, Open Heart surgery. Transplant Surgery – Heart, Lung and Kidney – Indications, Physiological changes and Complications. [5 hrs.]
7. Diseases of the Arteries and Veins : Definition, Etiology, Clinical features, signs and symptoms, complications, management and treatment of following diseases : Arteriosclerosis, Atherosclerosis, Aneurysm, Buerger's disease, Raynaud's Disease, Thrombophlebitis, Deep Vein Thrombosis, Pulmonary Embolism, Varicose Veins. [5 hrs.]
8. Definition, Indication, Incision, Physiological changes and Complications following Common operations like Cholecystectomy, Colostomy, Ileostomy, Gastrectomy, Hernias, Appendicectomy Mastectomy, Neprectomy, Prostectomy. [5 hrs.]
9. Burn: Definition, Classification, Causes, Prevention, Pathological changes, Complications, Clinical Features and Management. Skin Grafts – Types, Grafting Procedures, Survival of Skin Graft ; Flaps – Types and uses of Flaps. [3 hrs.]

10. ENT: Common problems of ear, otitis media, Otosclerosis, functional achonia and deafness, management facial palsy classification, medical and surgical management of lower motor neuron type of facial palsy. [2 hrs.]
11. Ophthalmology: Ophthalmologic surgical conditions, refraction's, conjunctivitis, glaucoma, corneal ulcer, iritis, cataract, retinitis, detachment of retina, defects of extra-ocular muscles- surgical management. [2 hrs.]

STUDENT LEARNING OUTCOMES/OBJECTIVES:

At the end of the semester the candidate will be able to:

- Gain knowledge regarding various Surgeries; with emphasis on Cardio-Thoracic Surgeries, events accompanying Surgeries, Anaesthesia, Blood Transfusion etc.
- Gain knowledge regarding the Indication of various Surgeries, their outcome, post-operative Complications and Treatment.
- Gain knowledge regarding Management of Sequelae of various conditions like Head Injury and Spinal Cord Injury; Management of Complication of following Immobilization and Bed Rest.

Recommended Textbooks:

- General Surgical Operations – by Kirk / Williamson
- Surgery by Nan
- Bailey and Love's – Short Practice of Surgery
- Chest Disease by Crofton and Douglas.
- Patrica A Downie, Text book of Heart, Chest Vascular Disease for physiotherapists, JP Bros.

<u>OBSTETRICS AND GYNECOLOGY</u>

At the end of the course the candidate will be able to:

1. Describe the normal and abnormal physiological events during the puberty, labor, puerperium, post – natal stage and menopause.
2. Discuss the various complications during pregnancy, labour, puerperium and post – natal stage, pre and post-menopausal stage and various aspects of urogenital dysfunction and their management in brief.
3. Acquire the skill of clinical examination of pelvic floor
4. Acquire the skill of clinical examination of pregnant woman.

THEORY [30 HRS.]

1. Anatomy and physiology of the female reproductive organs. Puberty dynamics [1 hr.]
2. Physiology of menstrual cycle –[3 hrs.]
    a. ovulation cycle,
    b. uterine cycle,
    c. Cx cycle,
    d. duration,
    e. amount
    f. Hormonal regulation of menstruation,
3. Hormonal disorders of females-obesity and female hormones [1 hr.]
4. Pregnancy [4 hrs.]
    a. Diagnosis of pregnancy
    b. Abortion

c. Physiological changes during pregnancy
d. Importance of antenatal care exercise
e. High risk pregnancy, prenatal common complications – investigation and Management
f. Musculoskeletal disorders during pregnancy
g. Multiple child birth
h. Normal labor

5. Child birth complications, investigation and management [1 hr.]
6. Normal puerperium, lactation and importance of post-natal exercises [2 hrs.]
7. Family planning. [1 hr.]
8. Medical termination of pregnancy [1 hr.]
9. Infection of female genital tract including sexually transmitted diseases, low backache [2 hrs.]
10. Prolapse of uterus and vagina [2 hrs.]
11. Principle of common gynaecological operations – hysterectomy, D&C, D&E, Pop smear [2 hrs.]
12. Menopause: Its effect on emotions and musculoskeletal system [1 hr.]
13. Urogenital dysfunction – pre and post-natal condition [1 hr.]
14. Sterility: Pathophysiology, investigations, management, Malnutrition and deficiencies in females.[2 hrs.]
15. Surgical procedures involving child birth. [2 hrs.]
    a. Definition, Indications and Management of the following surgical procedures – pelvic repair, caesarian section, nephrectomy, Hysterosalphyngography, Dilatation and Curettage, Laproscopy, Colposopy, Hysterectomy.
16. Carcinoma of female reproductive organs – surgical management in brief Mastectomy – Simple, radical. Hysterectomy. [2 hrs.]
17. Incontinence – Types, Causes, Assessment and Management. [2 hrs,]

STUDENT LEARNING OUTCOMES/OBJECTIVES:

At the end of the semester the candidate will be able to:

- Evaluation and assessment of pelvic muscles.
- The etiology, pathophysiology, signs and symptoms, clinical evaluation, management of the various gynecological condition and important surgical procedures.
- Detection of pregnancy various stages of labour its complications.
- Termination of pregnancy and family planning.
- Importance of physiotherapy in antenatal and post-natal period.
- Evaluation and assessment of child.
- Etiology, signs and symptoms, management of various child disorders.

Recommended Textbooks:

- Gynecology: five teachers by R. Latif Khan
- Obstetrics & gynecology by – Polden
- Women's health. Sapsfond, Saxton, Markwell, WB Saunders.
- Physiotherapy in Obstetrics & Gynecology, Margaret Polden and Jill Mantle, Jaypee Brothers.
- Role of Physiotherapist in Obstetric & Gynecological conditions, Purvi K c hangela.

GENERAL MEDICINE INCLUDING PAEDIATRICS AND PSYCHIATRY -

SUBJECT DESCRIPTION - This subject follows the basic science subjects to provide the knowledge about relevant aspects of general medicine. The student will have a general understanding of the diseases the therapist would encounter in their practice.

THEORY[75 HRS.]

1. Infection : Effects of Infection on the body – Pathology – source and spread of infection –
   vaccinations – generalized infections – rashes and infection – food poisoning and gastroenteritis sexually transmitted diseases – HIV infections and Aids. [6 hrs.]
2. Poisoning: Clinical features – general management – common agents in poisoning
   pharmaceutical agents – drugs of misuse – chemical pesticides – Envenomation. [5 hrs.]
3. Food and Nutrition: Assessment – Nutritional and Energy requirements; Deficiency diseases – clinical features and treatment; Protein – Energy Malnutrition: Clinical features and treatment; Obesity and its related disorders: Causes – Complications – benefits of weight loss – management of Obesity – diet, exercise and medications.[4 hrs.]
4. Endocrine diseases: Common presenting symptoms of Endocrine disease – common classical disease presentations, clinical features and its management; Diabetes Mellitus: Etiology and pathogenesis of diabetes – clinical manifestations of the disease – management of the disease – Complications of diabetes. [4 hrs.]
5. Diseases of the blood: Examinations of blood disorders – Clinical manifestations of blood disease; Anemia – signs and symptoms – types and management ; Hemophilia - Cause – clinical features severity of disease – management – complications due to repeated hemorrhages – complications due to therapy. [5 hrs.]
6. Diseases of the digestive system : Clinical manifestations of gastrointestinal disease – Etiology, clinical features, diagnosis, complications and treatment of the following conditions : Reflux Oesophagitis, Achlasia Cardia, Carcinoma of Oesophagus, GI bleeding, Peptic Ulcer disease, Carcinoma of Stomach, Pancreatitis, Malabsorption Syndrome, Ulcerative Colitis, Peritonitis, Infections of Alimentary Tract ; Clinical manifestations of liver diseases - Aetiology, clinical features, diagnosis, complications and treatment of the following conditions : Viral Hepatitis, Wilson's Disease, Alpha-antitrypsin deficiency, Tumors of the Liver, Gall stones, Cholecystitis. [15 hrs.]
7. Skin: Examination and clinical manifestations of skin diseases; Causes, clinical features and management of the following skin conditions: Leprosy, Psoriasis, Pigmentary Anomalies, Vasomotor disorders, Dermatitis, Coccal and Fungal Parasitic and Viral infections. [6 hrs.]
8. Pediatrics : Problems and management of LBW infants, Perinatal problems and management, Congenital abnormalities and management, Respiratory conditions of childhood, Cerebral Palsy
   – causes, complications, clinical manifestations, treatment ; Spina Bifida – management and treatment, Epilepsies – types, diagnosis and treatment; Recognizing developmental delay, common causes of delay ; Orthopedic and Neuromuscular disorders in childhood, clinical features and management ; Sensory disorders –

problems resulting from loss of vision and hearing ; Learning and behavioural problems – Hyperactivity, Autism, Challenging behaviours, Educational delay, The Clumsy Child. [15 hrs.]

9. Psychiatric Disorders: Classifications, Causes, Clinical manifestations and treatment methods used in Psychiatry. Modalities of psychiatric treatment, Psychiatric illness and physiotherapy, Brief description of Etio-pathogenesis, manifestations, and management of psychiatric illnesses -. Anxiety neurosis, Depression, Obsessive compulsive neurosis, Psychosis, Maniac-depressive psychosis, Post-traumatic stress disorder, Psychosomatic reactions: Stress and Health, theories of Stress – Illness. [15 hrs.]

   Etio-pathogenesis, manifestations, and management of psychiatric illness

   a. Drug dependence and alcoholism,
   b. Somatoform and Dissociate Disorders – conversion reactions, Somatization, Dissociate Amnesia, and Dissociate Fugue,
   c. Personality disorders
   d. Child psychiatry - manifestations, and management of childhood disorders - attention deficit syndrome and behavioral disorders.
   e. Geriatric psychiatry.

STUDENT LEARNING OUTCOMES/OBJECTIVES:

At the end of the semester the candidate will be able to:

- List the etiology, pathology, clinical features and treatment methods for various medical conditions.
- Gain knowledge regarding assessment of various General Medical conditions, with emphasis on 'Cardio respiratory' assessment & various diagnostic procedures used.
- Gain knowledge regarding Aetiology, Pathology, and Clinical Features & Treatment of various diseases & their Resultant Functional Disabilities.
- Understand the limitations imposed by the diseases on any Therapy that may be prescribed.
- Understand about the goals of Pharmacological & Surgical Therapy imparted in the diseases in which Physical or Occupational Therapy will be important component of overall treatment.

Recommended Textbooks:

- Davidson's Principles and Practice of Medicine
- Textbook of medicine by Golwala
- Essential pediatrics 5th edition – O.P. Ghai Mehta publications.
- A hand book of pediatrics, Complied by Avinash G. Desai.
- A Handbook of Pediatrics- Dr AG Desai, Dr Usha Desai

Reference books:

- Harrison's Internal Medicine
- Practical medicine by – P J Mehta
- Preparatory Manual of Medicine by – Sandip Chatwal, 1st Edition, Jaypee Publications

COMMUNITY MEDICINE

SUBJECT DESCRIPTION - This subject follows the basic science subjects to provide the knowledge about conditions the therapist would encounter in their practice in the community.

THEOPRY [75 Hrs.]

1. Health and Disease: Definitions, Concepts, Dimensions and Indicators of Health, Concept of well-being, Spectrum and Determinants of Health, Concept and natural history of Disease, Concepts of disease control and prevention, Modes of Intervention, Population Medicine, The role of socio-economic and cultural environment in health and disease. [5 hrs.]
2. Epidemiology, definition and scope. Principles of Epidemiology and Epidemiological methods: Components and Aims, Basic measurements, Methods, Uses of Epidemiology, Infectious disease epidemiology, Dynamics and modes of disease transmission, Host defenses and Immunizing agents, Hazards of Immunization, Disease prevention and control, Disinfection. Screening for Disease: Concept of screening, Aims and Objectives, Uses and types of screening. [10 hrs.]
3. Epidemiology of communicable disease: Respiratory infections, Intestinal infections, Arthropod-borne infections, Zoonoses, Surface infections, Hospital acquired infections Epidemiology of chronic non-communicable diseases and conditions: Cardio vascular diseases: Coronary heart disease, Hypertension, Stroke, Rheumatic heart disease, Cancer, Diabetes, Obesity, Blindness, Accidents and Injuries. [10 hrs.]
4. Public health administration- an overview of the health administration set up at Central and state levels. The national health programme-highlighting the role of social, economic and cultural factors in the implementation of the national programmes. Health problems of vulnerable groups- pregnant and lactating women, infants and pre-school children, occupational groups. [4 hrs.]
5. Health programmes in India: Vector borne disease control programme, National leprosy eradication programme, National tuberculosis programme, National AIDS control programme, National programme for control of blindness, Iodine deficiency disorders (IDD) programme, Universal Immunisation programme, Reproductive and child health programme, National cancer control programme, National mental health programme. National diabetes control programme, National family welfare programme, National sanitation and water supply programme, Minimum needs programme. [8 hrs.]
6. Demography and Family Planning: Demographic cycle, Fertility, Family planning-objectives of national family planning programme and family planning methods, A general idea of advantage and disadvantages of the methods. [4 hrs.]
7. Preventive Medicine in Obstetrics, Paediatrics and Geriatrics: MCH problems, Antenatal, Intranatal and post-natal care, Care of children, Child health problems, Rights of child and National policy for children, MCH services and indicators of MCH care, Social welfare programmes for women and children, Preventive medicine and geriatrics. [6 hrs.]
8. Nutrition and Health: Classification of foods, Nutritional profiles of principal foods, Nutritional problems in public health, Community nutrition programmes.[4 hrs.]
9. Environment and Health: Components of environment, Water and air pollution and public health: Pollution control, Disposal of waste, Medical entomology. [4 hrs,]

10. Hospital waste management: Sources of hospital waste, Health hazards, Waste management. [4 hrs.]
11. Disaster Management: Natural and man-made disasters, Disaster impact and response, Relief phase, Epidemiologic surveillance and disease control, Nutrition, Rehabilitation, Disaster preparedness. [4 hrs.]
12. Occupational Health: Occupational environment, Occupational hazards, Occupational diseases, Prevention of occupational diseases. Social security and other measures for the protection from occupational hazard accidents and diseases. Details of compensation acts. [4 hrs.]
13. Mental Health: Characteristics of a mentally healthy person, Types of mental illness, Causes of mental ill health, Prevention, Mental health services, Alcohol and drug dependence. Emphasis on community aspects of mental health. Role of Physiotherapist in mental health problems such as mental retardation. [4 hrs.]
14. Health Education: Concepts, aims and objectives, Approaches to health education, Models of health education, Contents of health education, Principles of health education, Practice of health education. [4 hrs.]

STUDENT LEARNING OUTCOMES/OBJECTIVES:

At the end of the semester the candidate will be able to:

- Gain knowledge regarding concept of Health and Diseases prevailing in the Society.
- Demonstrate an understanding of the influence of Social and Environmental factors on Health of the Individual and Society.
- Understand the role of various medical professionals in the Rehabilitation of patients in Community

Recommended Textbooks:

- Textbook of Preventive & Social Medicine, Dr. J E Park
- Principles of Community Medicine by Rao, 4th Edition, AITBS publications
- Textbook of Preventive and Social Medicine by Gupta, 3rd Edition, Jaypee
- Synopsis in Preventive & Social Medicine by Vijaya, 4th Edition, National Book Depot

EVALUATION METHODS AND OUTCOME MEASURES [15 hrs]

Implement methods to assess individual and collective outcomes of patients/clients with disorders of the musculoskeletal, neuromuscular, cardiovascular-pulmonary and integumentary systems using valid and reliable measures that take into account the setting in which patients/clients receive services, the variables of cultural competence, and the effect of societal factors.

DIAGNOSTIC IMAGING FOR PHYSIOTHERAPIST

SUBJECT DESCRIPTION- This course covers the study of common diagnostic and therapeutic imaging tests. At the end of the course students will be aware of the indications and implications of commonly used diagnostic imaging tests as they pertain to patient's management. The course will cover that how X-Ray, CT, MRI, Ultrasound and Other Medical Images are created and how they help the health professionals to save lives.

THEORY [30 HRS.]

1. Image interpretation [4 hrs.]
    a. History
    b. A New Kind of Ray
    c. How a Medical Image Helps
    d. What Imaging Studies Reveal
    e. Radiography(x-rays)
    f. Fluoroscopy
    g. Computed Tomography (CT)
    h. Magnetic Resonance Imaging (MRI)
    i. Ultrasound
    j. Endoscopy.
2. Radiography and mammography [4 hrs.]
    a. Equipment components
    b. Procedures for Radiography & Mammography
    c. Benefits versus Risks and Costs
    d. Indications and contraindications.
3. Fluoroscopy [4 hrs.]
    a. What is Fluoroscopy?
    b. Equipment used for fluoroscopy
    c. Indications and Contra indications
    d. How it helps in diagnosis
    e. The Findings in Fluoroscopy
    f. Benefits versus Risks and Costs.
4. Computed tomography (CT) [4 hrs.]
    a. What is Computed Tomography?
    b. Equipment used for Computed Tomography
    c. Indications and Contra indications
    d. How it helps in diagnosis
    e. The Findings in Computed Tomography
    f. Benefits versus Risks and Costs.
5. Magnetic Resonance Imaging (MRI) [4 hrs.]
    a. What is MRI?
    b. Equipment used for MRI
    c. Indications and Contraindications
    d. How it helps in diagnosis
    e. The Findings in MRI
    f. Benefits versus Risks and Costs
    g. Functional MRI.

6. Ultrasound [2 hr.]
    a. What is Ultrasound?
    b. Equipment used for Ultrasound
    c. Indications and Contra indications
    d. How it helps in diagnosis
    e. The Findings in Ultrasound
    f. Benefits versus Risks and Costs.
7. Endoscopy [4 hrs.]
    a. What is Endoscopy?
    b. Equipment used for Endoscopy
    c. Indications and Contra indications
    d. How it helps in diagnosis
    e. The Findings in Endoscopy
    f. Benefits versus Risks and Costs.
8. Nuclear medicine [4 hrs.]
    a. What is Nuclear Medicine?
    b. Equipment used for Nuclear Medicine
    c. Indications and Contra indications
    d. How it helps in diagnosis.
    e. Benefits versus Risks and Costs.

STUDENT LEARNING OUTCOMES/OBJECTIVES: -

At the end of the semester the candidate will be able to:
• Know how X-Ray, CT, MRI, Ultrasound and Other Medical Images are created and how they help the health professionals to save lives.

Recommended Textbooks:

- Diagnostic Imaging for Physical Therapist - James Swain, Kenneth W Bush.
- Diagnostic Imaging, 7th Edition, Andrea Rockall, Andrew Hatrick, Peter Armstrong, Martin Wastie.
- Fundamentals of Diagnostic Radiology Volume I, 4th Edition, William E Brant, Clyde A Helms.
- Diagnostic Ultrasound, Vol. I & Vol. II, 4th Edition, Carol M Ramack, Stephanie R Wilson.
- Diagnostic and Surgical Imaging Anatomy Ultrasound, Ahuja.

Sixth Semester

PHYSIOTHERAPY IN ORTHOPEDICS & SPORTS

SUBJECT DESCRIPTION -The subject serves to integrate the knowledge gained by the students in orthopedics and traumatology with skills to apply these in clinical situations of dysfunction and musculoskeletal pathology.

THEORY [60 HRS.]

1. PT assessment for Orthopedic conditions - SOAP format. Subjective - history taking, informed consent, personal, past, medical and socioeconomic history, chief complaints, history of present illness. Pain assessment- intensity, character, aggravating and relieving factors, site and location. Objective- on observation - body built swelling, muscle atrophy, deformities, posture and gait. On palpation- tenderness-grades, muscle spasm, swelling-methods of swelling assessment, bony prominences, soft tissue texture and integrity, warmth and vasomotor disturbances. On examination – ROM – active and passive, resisted isometric tests, limb length-apparent, true and segmental , girth measurement, muscle length testing-tightness, contracture and flexibility, manual muscle testing, peripheral neurological examination- dermatomes, myotomes and reflexes, special tests and functional tests. Prescription of home program. Documentation of case records, and follow up. [5 hrs.]
2. Fractures - types, classification, signs and symptoms, complications. Fracture healing - factors affecting fracture healing. Principles of fracture management - reduction - open and closed, immobilization - sling, cast, brace, slab, traction - manual, mechanical, skin, skeletal, lumbar and Cervical traction, external fixation, functional cast bracing. PT management in complications - early and late - shock, compartment syndrome, VIC, fat embolism, delayed and mal union, RSD, myositis ossificans, AVN, pressure sores etc. Physiotherapy assessment in fracture cases. Aims of PT management in fracture cases - short and long term goals. Principles of PT management in fractures - Guidelines for fracture treatment during period of immobilization and guidelines for treatment after immobilization period. [3 hrs.]
3. Specific fractures and dislocations: PT assessment and management of upper limb fractures and dislocations. PT assessment and management of lower limb fractures and dislocations including pelvis. PT assessment and management spinal fractures. [2 hrs.]
4. Selection and application of physiotherapeutic techniques, maneuver's, modalities for preventive, curative and rehabilitative means in all conditions. [1 hr.]
5. Principles of various schools of thought in manual therapy. (Briefly Maitland and Mc kenzie). [2 hrs.]
6. Degenerative and inflammatory conditions: Definition, signs and symptoms, clinical features, path physiology, radiological features, deformities, medical, surgical management. Describe the PT assessment and management and home program for the following conditions – Osteoarthritis - emphasis mainly on knee, hip and hand, Rheumatoid Arthritis, Ankylosing spondylitis, Gout, Perthes disease, Periarthritic shoulder. [3 hrs.]
7. Infective conditions: Definition, signs and symptoms, clinical features,

pathophysiology, radiological features, medical, surgical management. Describe PT assessment and management for following conditions – Osteomyelitis – acute and chronic, Septic arthritis, pyogenic arthritis, TB spine and major joints - knee and hip. [3 hrs.]

8. Define, review the postural abnormalities of spinal column, clinical features, deformities, medical and surgical management. Describe PT assessment and management and home program. [2 hrs.]
9. Deformities: Review in detail the causes, signs and symptoms, radiological features, medical and surgical management. Describe the PT. assessment and management of the following conditions: Congenital: CTEV, CDH, Torticollis, pes planus, pes cavus and other common deformities. Acquired: scoliosis, kyphosis, coxa vara, genu varum, valgum and recurvatum. [3 hrs.]
10. Cerebral palsy: Definition, etiology, classification, clinical features, complications, deformities, medical and surgical management and home program with special emphasis on carrying techniques. PT management after surgical corrections. [3 hrs.]
11. Poliomyelitis: Definition, etiology, types, pathophysiology, clinical features, deformities, medical and surgical management. PT. assessment and management after surgical corrections and reconstructive surgeries - emphasis on tendon transfer and home program. [2 hrs.]
12. Leprosy: Definition, cause, clinical features, medical and surgical management. PT assessment, aims, and management after surgical procedures such as tendon transfer both pre and post operatively. [2 hrs.]
13. Amputations: Definition, levels, indications, types, PT assessment, aims, management pre and post operatively. PT management with emphasis on stump care and bandaging. Pre and post prosthetic training, checking out prosthesis, complications of amputations and its management. [2 hrs.]
14. Spinal conditions: Review the causes, signs and symptoms, investigations, radiological features, neurological signs. PT assessment, aims, and management and home program of the following conditions: Cervical spondylosis, Lumbar spondylosis, Spondylolisthesis, Spinal canal stenosis, Spondylolysis, Sacro-iliac joint dysfunction, Sacralisation, Lumbarisation, Intervertebral disc prolapse, Coccydynia, Spina bifida occulta. [3 hrs.]
15. Effects of spinal traction, types of traction, modes of application, indications for spinal traction, contraindications, precautions, limitations of traction. [2 hrs.]
16. Osteoporosis- causes, predisposing factors, investigations and treatment. [1 hr.]
17. Orthopedic surgeries: Pre and post-operative PT assessment, goals, precautions and PT management of following surgeries such as : Arthrodesis, Osteotomy, Arthroplasty-partial and total - Excision arthroplasty, excision arthroplasty with implant, interpositional arthroplasty and total replacement; Tendon transplant, Soft tissue release- tenotomy, myotomy, lengthening; Arthroscopy, Spinal stabilization, Re-attachment of limbs, External fixators, Synovectomy. [3 hrs.]
18. Shoulder joint: Shoulder instabilities, TOS, RSD, Impingement syndrome - conservative and post-operative PT management. Total shoulder replacement and Hemi replacement. - Post operative PT management. AC joint injuries - rehabilitation. Rotator cuff tears-conservative and surgical repair. Subacromial decompression - Post operative PT management. [3 hrs.]
19. Elbow and forearm: Excision of radial head - Post operative PT management.

Total elbow arthroplasty- Post operative PT management. [1 hr.]

20. Wrist and Hand: Total wrist arthroplasty. Repair of ruptured extensor tendons. Carpal tunnel syndrome. Flexor and extensor tendon lacerations - Post operative PT management. [2 hrs.]
21. Hip: Joint surgeries - hemi and total hip replacement - Post operative PT management Tendonitis and bursitis. - Management. [1 hr.]
22. Knee: Lateral retinacular release, chondroplasty- Post operative management. Realignment of extensor mechanism. ACL and PCL reconstruction surgeries - Post operative rehabilitation. Meniscectomy and meniscal repair - Post operative management. Plica syndrome, patellar dysfunction and Hoffa's syndrome- conservative management. TKR- rehabilitation protocol. Patellar tendon ruptures and Patellectomy- rehabilitation. [2 hrs.]
23. Ankle and foot: Ankle instability. Ligamentous tears- Post operative management. [1hr.]
24. Introduction to Bio-Engineering; Classification of Orthoses and prostheses; Biomechanical principles of orthotic and prosthetic application; Designing of upper extremity, lower extremity and spinal orthosis, indications and check out; Designing of upper extremity and lower extremity prostheses, indications and check out; Psychological aspects of orthotic and prosthetic application; prescription and designing of footwear and modifications; Designing and construction of adaptive devises. [2 hrs.]
25. Sports Physiotherapy: Physical fitness. Stages of soft tissue healing. Treatment guidelines for soft tissue injuries- Acute, Sub acute and chronic stages. Repair of soft tissues- rupture of muscle, tendon and Ligamentous tears. Soft tissue injuries- prevention and rehabilitation of, Lateral ligament sprain of ankle. Rotator cuff injuries. Collateral and Cruciate injuries of knee. Meniscal injuries of knee. Supraspinatus and Bicipital tendonitis. Pre patellar and Sub-acromial bursitis. Tennis and Golfer's elbow. Hamstring strains, Quadriceps contusion, TA rupture. Dequervain's tenosynovitis. Trigger and Mallet finger. Plantar fasciitis. Wrist sprains. [4 hrs.]
26. Applied Yoga in orthopedic conditions. [2 hrs.]

PRACTICAL [9 0 H R S .] - Practical shall be conducted for all the relevant topics discussed in theory in the following forms:

1. Bedside case presentations and case discussions
2. Lab sessions consisting of evaluation and assessment methods on student models, treatment techniques and practice sessions.

STUDENT LEARNING OUTCOMES/OBJECTIVES:

At the end of the semester the candidate will be able to:

- Identify disabilities due to musculoskeletal dysfunction, plan and set treatment goals and apply the skills gained in exercise therapy and electrotherapy in these clinical situations to restore musculoskeletal function.
- Identify, analyse & discuss various traumatic & non traumatic orthopaedic conditions & will be able to correlate them with provisional diagnosis & other investigations.
- Describe short term & long term goals & give treatment with help of various electrotherapy modalities & manual therapy techniques.

Recommended Textbooks

- Textbook of orthopedics- Cash.
- Orthopedic physiotherapy - Jayant Joshi.

Reference books:

- Clinical orthopedic rehabilitation- Brotzman.
- Tidy's physiotherapy.
- Physical Rehabilitation Assessment and Treatment – O'Sullivan Schmitz
- Sports physiotherapy- Maria Zuluaga

PHYSIOTHERAPY IN GENERAL MEDICINE & GENERAL SURGERY

SUBJECT DESCRIPTION –

In this subject, the student will learn about the concept of evidence based physiotherapy, various steps involved in it, critically appraising the research articles and its practical applications in the management of individual patient care.

THEORY [60 HRS.]

1. Physiotherapy in mother and child care – ante and post-natal management, early intervention and stimulation therapy in child care (movement therapy) [6 hrs.]
2. Applied Yoga in Obstetric and Gynecological conditions[6 hrs.]
3. Geriatrics – handling of old patients and their problems. [8 hrs.]
4. Complication common to all operations [6 hrs.]
5. Abdominal incisions. [3hrs.]
6. Physiotherapy in pre and post-operative stages. [4 hrs.]
7. Operations on upper G.I.T.- oesophagus, stomach, duodenum [4 hrs.]
8. Operations on large and small intestine – Appendisectomy, cholecystectomy, partial colectomy, ileostomy, hernia and herniotomy, hernioraphy, hernioplasty. [4 hrs.]
9. Physiotherapy in dentistry [4 hrs.]
10. Burns and its treatment – physiotherapy in burns, skin grafts, and reconstructive surgeries. [3 hrs.]
11. Management of wound ulcers- Care of ulcers and wounds - Care of surgical scars- U.V.R and other electro therapeutics for healing of wounds, prevention of Hyper-granulated Scars Keloids, Electrotherapeutics measures for relief of pain during mobilization of scars tissues. [4 hrs.]
12. Physiotherapy intervention in the management of Medical, Surgical and Radiation Oncology Cases. [4 hrs.]
13. Physiotherapy in dermatology -Documentation of assessment, treatment and follow up skin conditions. U.V.R therapy in various skin conditions; Vitiligo; Hair loss; Pigmentation; Infected wounds ulcers. Faradic foot bath for Hyperhydrosis. Massage maneuvers for cosmetic purpose of skin; use of specific oil as medium; Care of anesthetic hand and foot; Evaluation, planning and management of leprosy-prescription, fitting and training with prosthetic and orthotic devices. [4 hrs.]
14. ENT – sinusitis, non-suppurative and chronic suppurative otitis media, osteosclerosis, labrynthitis, mastoidectomy, chronic rhinitis, laryngectomy, pharyngeo – laryngectomy, facial palsy. [4 hrs.]

PRACTICAL – [90 HRS.]

- Practical shall be conducted for all the relevant topics discussed in theory in the following forms:
    1. Bedside case presentations and case discussions
    2. Lab sessions consisting of evaluation and assessment methods on student models, treatment techniques and practice sessions.

STUDENT LEARNING OUTCOMES/OBJECTIVES: -

At the end of the semester the candidate will be able to:

- Identify discuss and analyze cardiovascular and pulmonary dysfunctions based on pathophysiological principles and arrive at appropriate functional diagnosis.
- Acquire knowledge of rationals of basic investigative approaches in the medical system and surgical intervention, regimes in general surgeries (special emphasis on abdominal surgeries)
- Execute effective physiotherapeutic measures (with appropriate clinical reasoning) and exercise, conditioning in general medical and surgical conditions.
- Acquire knowledge of the overview of patient's care in the I.C.U. for bronchial hygiene and continuous monitoring of the patient in I.C.U.
- Select strategies for cure, care and prevention, adopt restorative and rehabilitative measures for maximum possible functional independence of a patient at home, work and in community.
- Acquire the knowledge of evaluation and physiotherapeutic treatment for obstetric and gynecological conditions
- Acquire the knowledge of various conditions where physiotherapy plays a vital role in the rehabilitation (psychiatry, dermatology, geriatric and ENT conditions)
- Evaluate, grade and treat non healing wounds

Recommended Textbooks:

- Tidy's physiotherapy.
- Physiotherapy in Obstetrics and Gynaecology by Mantle. B & H Publications.
- Physical Rehabilitation Assessment and Treatment – O'Sullivan Schmitz
- Cash's Text book of General Medicine and Surgical conditions for Physiotherapists
- Cash's Text book of General Medicine and Surgical conditions for Physiotherapists

Reference books:

- Elements in Pediatric Physiotherapy – Pamela M Eckersley
- Essentials of Cardio Pulmonary Physical Therapy by Hillegass and Sadowsky
- Cardio pulmonary Symptoms in physical Therapy practice Cohen and Michel
- Chest Physiotherapy in Intensive Care Unit by Mackenzie
- Physiotherapy in Psychiatry
- Physical Therapy for the Cancer patient by M.C Garvey
- Physiotherapy in Obstetrics and Gynecology by Polden

CLINICAL NEUROLOGY & NEUROSURGERY

SUBJECT DESCRIPTION-This subject follows the basic science subjects to provide the knowledge about relevant aspects of neurology & neurosurgery. The student will have a general understanding of the diseases the therapist would encounter in their practice.

THEORY [60 HRS.]

1. Disorders of function in the context of Pathophysiology, Anatomy in Neurology and Cortical Mapping. [1 hr.]
2. Classification of neurological involvement depending on level of lesion. [1 hr.]
3. Neurological assessment: Principles of clinical diagnosis, higher mental function, assessment of brain & spinal cord function, evaluation of cranial nerves and evaluation of autonomic nervous system. [1 hr.]
4. Investigations: principles, methods, views, normal/abnormal values/features, types of following investigative procedures- skull x-ray, CT, MRI, evoked potentials, lumbar puncture, CSF examination, EMG, NCV. [1 hr.]
5. Neuro-ophthalmology: Assessment of visual function – acuity, field, colour vision, Pupillary reflex, accommodation reflex, abnormalities of optic disc, disorders of optic nerve, tract, radiation, occipital pole, disorders of higher visual processing, disorders of pupil, disorders of eye movements, central disorders of eye movement. [1 hr.]
6. Deafness, vertigo, and imbalance: Physiology of hearing, disorders of hearing, examination & investigations of hearing, tests of vestibular function, vertigo, peripheral vestibular disorders, central vestibular vertigo. [1 hr.]
7. Lower cranial nerve paralysis – Etiology, clinical features, investigations, and management of following disorders - lesions in trigeminal nerve, trigeminal neuralgia, trigeminal sensory neuropathy, lesions in facial nerve, facial palsy, bell's palsy, hemi facial spasm, Glossopharangial neuralgia, lesions of Vagus nerve, lesions of spinal accessory nerve, lesions of hypoglossal nerve. Dysphagia – swallowing mechanisms, causes of dysphagia, symptoms, examination, and management of dysphagia. [3 hrs.]
8. Cerebro-vascular diseases: Define stroke, TIA, RIA, stroke in evolution, multi infarct dementia and Lacunar infarct. Classification of stroke – Ischemic, hemorrhagic, venous infarcts. Risk factors, cause of ischemic stroke, causes of hemorrhagic stroke. Classification of hemorrhagic stroke, classification of stroke based on symptoms, stroke syndrome, investigations, differential diagnosis, medical and surgical management. [2 hr.]
9. Head injury: Etiology, classification, clinical signs & symptoms, investigations, differential diagnosis, medical management, surgical management and complications.[2 hr.]
10. Higher cortical, neuro psychological and neurobehavioral disorders: Causes of blackouts, physiological nature of Epilepsy, classification, clinical features, investigations, medical& surgical management of following disorders – Non-epileptic attacks of childhood, Epilepsy in childhood, Seizers, and Epilepsy syndromes in adult. Classification and clinical features of Dyssomnias, Parasomnias, Dementia, Obsessive-compulsive disorders. Neural basis of consciousness, causes &investigations of Coma, criteria for diagnosis of Brain death. Etiology, pathophysilogy, classification, clinical signs & symptoms, investigations, differential diagnosis, management of Perceptual disorders and Speech disorders. [3 hrs.]
11. Movement disorders: Definition, etiology, risk factors, pathophysilogy, classification, clinical signs & symptoms, investigations, differential diagnosis, medical management, surgical management and complications of following disorders – Parkinson's disease, Dystonia, Chorea, Ballism, Athedosis, Tics, Myoclonus and Wilson's disease. [4 hrs.]
12. Cerebellar and coordination disorders: Etiology, pathophysilogy, classification, clinical signs & symptoms, investigations, differential diagnosis, management of Congenital ataxia, Friedreich's ataxia, Ataxia talengiectasia, Metabolic ataxia, Hereditary cerebellar

ataxia, Tabes dorsalis and Syphilis. [4 hrs.]

13. Spinal cord disorders: Functions of tracts, definition, etiology, risk factors, pathophysilogy, classification, clinical signs & symptoms, investigations, differential diagnosis, medical management, surgical management and complications of following disorders – Spinal cord injury, Compression by IVD prolapse, Spinal epidural abscess, Transverse myelitis, Viral myelitis, Syringomyelia, Spina bifida, Sub acute combined degeneration of the cord, Hereditary spastic paraplegia, Radiation myelopathy, Progressive encephalomyelitis, Conus medullaris syndrome, Bladder & bowel dysfunction, and Sarcodosis. [3 hrs.]
14. Brain tumors and spinal tumors: Classification, clinical features, investigations, medical and surgical management. [2 hrs.]
15. Infections of brain and spinal cord: Etiology, pathophysilogy, classification, clinical signs & symptoms, investigations, differential diagnosis, medical management, surgical management and complications of following disorders – Meningitis, Encephalitis, Poliomyelitis and Postpolio syndrome. Complications of systemic infections on nervous system – Septic encephalopathy, AIDS, Rheumatic fever, Brucellosis, Tetanus, and Pertussis. [3 hrs.]
16. Motor neuron diseases: - Etiology, pathophysiology, classification, clinical signs & symptoms, investigations, differential diagnosis, medical management, and complications of following disorders - Amyotrophic lateral sclerosis, Spinal muscular atrophy, Hereditary bulbar palsy, Neuromyotonia and Post-irradiation lumbosacral polyradiculopathy. [3 hrs.]
17. Multiple sclerosis - Etiology, pathophysiology, classification, clinical signs & symptoms, investigations, differential diagnosis, medical management, and complications. [2 hrs.]
18. Disorders of neuromuscular junction – Etiology, classification, signs & symptoms, investigations, management, of following disorders Myasthenia gravis, Eaton-Lambert syndrome, and Botulism. [2 hrs.]
19. Muscle diseases: Classification, investigations, imaging methods, Muscle biopsy, management of muscle diseases, genetic counselling. Classification, etiology, signs & symptoms of following disorders – Muscular dystrophy, Myotonic dystrophy, myopathy, Non-dystrophic myotonia. [3 hrs.]
20. Polyneuropathy – Classification of Polyneuropathies, Hereditary motor sensory neuropathy, hereditary sensory and Autonomic neuropathies, Amyloid neuropathy, acute idiopathic Polyneuropathies. Guillain-Barre syndrome – Causes, clinical features, management of GBS, Chronic Idiopathic Polyneuropathies, diagnosis of polyneuropathy, nerve biopsy. [3 hrs.]
21. Focal peripheral neuropathy: Clinical diagnosis of focal neuropathy, neurotmesis, Axonotmesis, Neuropraxia. Etiology, risk factors, classification, neurological signs & symptoms, investigations, management, of following disorders – RSD, Nerve tumors, Brachial plexus palsy, Thoracic outlet syndrome, Lumbosacral plexus lesions, Phrenic & Intercostal nerve lesions, Median nerve palsy, Ulnar nerve palsy, Radial nerve palsy, Musculocutaneous nerve palsy, Anterior & Posterior interosseous nerve palsy, Axillary nerve palsy, Long thoracic nerve palsy, Suprascapular nerve palsy, Sciatic nerve palsy, Tibial nerve palsy, Common peroneal nerve palsy, Femoral nerve palsy, Obturator nerve palsy, Pudental nerve palsy. [3 hrs.]
22. Paediatric neurology: Neural development, Etiology, pathophysiology, classification, clinical signs & symptoms, investigations, differential diagnosis, medical management, surgical management and complications of following disorders - Cerebral palsy, Hydrocephalus, Arnold-chiari malformation, Basilar impression, Klippel-Feil syndrome, Achondroplacia, Cerebral malformations, Autism, Dandy walker syndrome and Down's syndrome. [3 hrs.]
23. Toxic, metabolic and environmental disorders: Etiology, risk factors, classification, neurological signs & symptoms, investigations, management, of following disorders – Encephalopathy, Alcohol toxicity, Recreational drug abuse, Toxic gases & Asphyxia,

Therapeutic & diagnostic agent toxicity, Metal toxicity, Pesticide poisoning, Environmental & physical insults, Pant & Fungal poisoning, Animal poisons, & Complications of organ transplantation. [4 hrs.]

24. Introduction, Indications and Complications of following Neuro surgeries: Craniotomy, Cranioplasty, Stereotactic surgery, Deep brain stimulation, Burr-hole, Shunting, Laminectomy, Hemilaminectomy, Rhizotomy, Microvascular decompression surgery, Endarterectomy, Embolization, Pituitary surgery, Ablative surgery - Thalamotomy and Pallidotomy, Coiling of aneurysm, Clipping of aneurysm, and Neural implantation.[3hrs.]

STUDENT LEARNING OUTCOMES/OBJECTIVES:

At the end of the semester the candidate will be able to:

- Do evaluation and assessment of various neurological conditions with interpretation of haematological investigations, chest X-ray, C.T. and MRI scans done for neurological conditions with NCV/EMG findings.
- Describe the aetiology, pathophysiology, signs and symptoms, clinical evaluation, their differential diagnosis, and management of the various neurological conditions.
- Describe functional disabilities caused by various neurological conditions

Recommended Textbooks:

- Davidson's Principles and Practice of Medicine
- Neurology and neurosurgery illustrated Kenneth w Lindsay. 4th edition
- Neurological examination by Fuller. 3rd edition. Churchill Livingstone.
- Clinical neurology by David. 5th edition McGraw hill.

Reference books:

- Textbook of Neurology- Victor Adams
- Brains Clinical Neurology.
- Illustrated Neurology & Neurosurgery
- Brains Diseases of Nervous System

PROFESSIONALISM AND VALUES

SUBJECT DESCRIPTION –

The module on professionalism will deliver the concept of what it means to be a professional and how physiotherapy profession is different from a usual vocation. It also explains how relevant is professionalism in terms of healthcare system and how it affects the overall patient environment.

THEORY [30]

1. Professional values- Integrity, Objectivity, Professional competence and due care, Confidentiality. Core values- Accountability, Altruism, Compassion/ caring, excellence, integrity, professional duties, social responsibility. [4 hrs.]
2. Personal values- ethical or moral values [4 hrs.]
3. Attitude and behavior- professional behavior, treating people equally [4 hrs.]
4. Code of conduct, professional accountability and responsibility, misconduct [4 hrs.]
5. Differences between professions and importance of team efforts [4 hrs.]
6. Cultural issues in the healthcare environment [4 hrs.]
7. Entry level health care practitioner, direct access, autonomy in profession, practitioner of practice and evidence based practice. [6 hrs.]

The five roles of the Physiotherapist -

a. The Physiotherapist as Patient/Client manager
    - Evaluation and diagnosis
    - Diagnosis as clinical decision making
    - Prognosis
    - Discharge planning and discontinuance of care
    - Discontinuance of care
    - Outcomes
    - Clinical decision making
    - Referral relationships
    - Interpersonal relationships
    - Ethical and legal issues
    - Informed consent
    - Managed care and fidelity.
b. The Physiotherapist as Consultant
    - Physiotherapy consultation
    - Building a consulting business
    - The consulting process
    - The skills of a good consultant
    - Trust in the consultant/client relationship
    - Ethical and legal issues in consultation
    - Components of a consulting agreement.

c. The Physiotherapist as Critical Inquirer
    - History of critical inquiry
    - Evidence-based practice
    - Outcomes research
    - Whose responsibility is research?
    - Roles of the staff physiotherapist in critical inquiry
    - Collaboration in clinical research
    - Ethical and legal issues in critical inquiry.
d. The Physiotherapist as Administrator
    - History of physiotherapy administration
    - Contemporary physiotherapy administration
    - Patient/client management
    - First-line management
    - Midlevel managers and chief executive officers
    - Leadership
    - Ethical and legal issues.
e. The Physiotherapist as Educator
    - History of physiotherapy education
    - Contemporary educational roles of the physiotherapist
    - Teaching opportunities in continuing education
    - Academic teaching opportunities
    - Theories of teaching and learning in professional education
    - Ethical and legal issues in physiotherapy education.

STUDENT LEARNING OUTCOMES/OBJECTIVES:-

At the end of the semester the student will be able to:

- Demonstrate professional practice with moral values and ethical principles.
- To know the basic ethical principles and moral values that has to be followed towards the health care profession.
- To know the basics in managerial and management skills and use of information technology in professional practice.

Recommended Textbooks:

- Code of members professional values and behavior by chartered society of Physiotherapy
- Values-driven leadership: Making ethics, morality, professionalism, the bedrock by Matthew Ashimolowo.

Seventh Semester-

PHYSIOTHERAPY IN NEUROLOGY & PSYCHOSOMATIC DISORDER

SUBJECT DESCRIPTION - The subject serves to integrate the knowledge gained by the students in neurology and neurosurgery with skills to apply these in clinical situations of dysfunction and neurological pathology.

THEORY [60 HRS.]

1. Neurological Assessment: Required materials for examination, Chief complaints, History taking – Present, Past, medical, familial, personal histories, Observation, Palpation, Higher mental function – Consciousness, Orientation, Wakefulness, memory, Speech, Reading, Language, Writing, Calculations, Perception, Left right confusion, Reasoning, and Judgment, Motor Examination – Muscle power, Muscle tone, Spasticity, Flaccidity, Reflexes – Developmental reflexes, deep tendon reflexes, Superficial reflexes, Sensory examination – Superficial, Deep and Cortical sensations, Special tests – Romberg's, Kernig's sign, Brudenzki sign, Tinels's sign, Slum test, Lehermitte's sign, Bells Phenomenon, Gower's sign, Sun set sign, Battle's sign, Glabellar tap sign, etc, Balance examination, coordination examination, Gait analysis – Kinetics & Kinematics (Quantitative & Qualitative analysis), Functional Analysis, Assessment tools & Scales – Modified Ashworth scale, Berg balance scale, FIM, Barthel index, Glasgow coma scale, Mini mental state examination, Rancho Los Amigos Scale for Head injury, APGAR score, ASIA scale, Reflex Grading. Differential diagnosis. [7 hrs.]
2. Neuro physiological Techniques – Concepts, Principles, Techniques, Effects of following Neurophysiological techniques: NDT, PNF, Vojta therapy, Rood's Sensory motor Approach, Sensory Integration Approach, Brunnstorm movement therapy, Motor relearning program, Contemporary task oriented approach, Muscle re-education approach and Constraint induced movement therapy. [5 hrs.]
3. Paediatric Neurology: Paediatric Examination, Developmental milestones, developmental reflexes, Neuro developmental screening tests. Evaluation & Management - History, Observation, Palpation, Milestone Examination, developmental reflex Examination, Higher mental function, Cranial nerve examination, Motor & Sensory examination, Reflex testing, differential Diagnosis, Balance & Coordination examination, Gait analysis, Functional analysis, List of Problems & Complications, short & Long Term goals, Management of systemic complications, Management of Mechanical Complications, Use of various Neurophysiological approaches & Modalities in Risk babies, Minimum brain damage, Developmental disorders, Cerebral palsy, Autism, Down's Syndrome, Hydrocephalus, Chorea, Spina bifida, and syringomyelia. [10 hrs.]
4. Evaluation and Management of Brain and Spinal Cord Disorders : History, Observation, Palpation, Higher mental function, Cranial nerve examination, Motor & Sensory examination, Reflex testing, differential Diagnosis, Balance & Coordination examination, Gait analysis, Functional analysis, List of Problems & Complications, short & Long Term goals, Management of systemic complications, Management of Mechanical Complications, Use of various Neurophysiological approaches& Modalities in Cerebro vascular Accident, Meningitis, Encephalitis, Head Injury, Brain Tumors, Perceptual disorders, Amyotrophic lateral sclerosis, and Multiple sclerosis. [10 hrs.]
5. Evaluation and Management of Cerebellar, Spinal Cord and Muscle Disorders : History, Observation, Palpation, Motor & Sensory examination, Reflex testing, differential Diagnosis, Balance & Coordination examination, Gait analysis, Functional analysis, List of Problems & Complications, short & Long Term goals, Management of systemic complications, Management of Mechanical Complications, Use of various Neurophysiological approaches& Modalities in Ataxia, Sensory Ataxia, Parkinson's disease, Muscular dystrophy (DMD), Myasthenia Gravis, Eaton-Lambert Syndrome, Spinal tumors, Spinal cord injury, Transverse myelitis, Bladder & Bowel Dysfunction,

Spinal muscular atrophies, Poliomyelitis, Post-Polio Syndrome. [6 hrs.]

6. Evaluation and Management of Peripheral Nerve Injuries and Disorders : History, Observation, Palpation, Motor & Sensory examination, Reflex testing, differential Diagnosis, Balance & Coordination examination, Gait analysis, Functional analysis, List of Problems & Complications, short & Long Term goals, Management of systemic complications, Management of Mechanical Complications, Use of various Neurophysiological approaches& Modalities in Hereditary motor sensory neuropathy, Guillain-Barre syndrome, Brachial plexus palsy, Thoracic outlet syndrome, Lumbosacral plexus lesions, Phrenic & intercostals nerve lesions, Median nerve palsy, Ulnar nerve palsy, Radial nerve palsy, Musculocutaneous nerve palsy, Anterior & Posterior interosseous nerve palsy, Axillary nerve palsy, Long thoracic nerve palsy, Suprascapular nerve palsy, sciatic nerve palsy, Tibial nerve palsy, Common peroneal nerve palsy, Femoral nerve palsy, Obturator nerve palsy, and Pudental nerve palsy. [8 hrs.]
7. Assessment and management of Neurological gaits: Quantitative and Qualitative (Kinetic & Kinematics) analysis, List of Problems, short & Long Term goals, Management of following Neurological Gaits - Hemiplegic gait, Parkinson gait, High step gait, Hyperkinetic gait, Hypokinetic gait, Waddling gait, Scissoring gait, Spastic gait, Choreaform Gait, Diplegic Gait, and Myopathic Gait. [5 hrs.]
8. Pre and post-surgical assessment and treatment following conditions - Spinal disc herniation, Spinal stenosis, Spinal cord trauma, Head trauma, Brain tumors, Tumors of the spine, Spinal cord and peripheral nerves, Cerebral aneurysms, Subarachnoid hemorrhages, epilepsy, Parkinson's disease, Chorea, Hemiballism, Psychiatric disorders, Malformations of the nervous system, Carotid artery stenosis , Arteriovenous malformations, and Spina bifida. [6 hrs.]
9. Applied Yoga in Neurological conditions. [3hrs.]

PRACTICAL: [90 HRS.]

- Practical shall be conducted for all the relevant topics discussed in theory in the following forms:
    1. Bedside case presentations and case discussions
    2. Lab sessions consisting of evaluation and assessment methods on student models, treatment techniques and practice sessions.

STUDENT LEARNING OUTCOMES/OBJECTIVES:

At the end of the semester the student will be able:

- To apply basic treatment evaluation and intervention outcome processes appropriate for neurological physiotherapy practice
- To understand and apply basic clinical reasoning skills and an evidence-based approach to decision making in neurological physiotherapy practice.
- Identify disabilities due to neurological dysfunction, plan and set treatment goals and apply the skills gained in exercise therapy and electrotherapy in these clinical situations to restore neurological function

Recommended Textbooks:

- Tidy's physiotherapy.
- Cash’s Textbook of Neurology for Physiotherapists
- Neurological Rehabilitation by D Umphred
- Physical Rehabilitation Assessment and Treatment – O’Sullivan Schmitz
- Elements of Pediatric Physiotherapy-Eckersley
- Physical therapy for children by Suzann K. Campbell, Robert J. Palisano, Darl W. Vander Linden, 5th edition.

Reference books:

- Motor Control: Theory and practical applications by Anne Shumway-Cook, Marjorie H. Woollacott, 3rd edition.
- Movement Science: Foundations for physical therapy in rehabilitation by Janet H. Carr and Roberta B. Shepherd.

CLINICAL CARDIOVASCULAR AND PULMONARY

SUBJECT DESCRIPTION - Following the basic science and clinical science course, this course introduces the Student in cardio-thoracic conditions which commonly cause disability.

THEORY [75 HRS.]

1. Anatomy and Physiology
    a. Respiratory system [10 hrs.]
        i. Upper respiratory tract
        ii. Lower respiratory tract – Trachea, Bronchial tree, Bronchopulmonary segments
        iii. Respiratory unit, hilum of lung.
        iv. Muscles of respiration
        v. Pleura, intra pleural space, intra pleural pressure, surfactant
        vi. Mechanics of respiration – Chest wall movements, lung & chest wall compliance
        vii. V/Q relationship, airway resistance
        viii. Respiratory centre, Neural & chemical regulation of respiration
        ix. Lung volumes and lung capacities, Spiro meter, lung function test
        x. Pulmonary circulation, Lung sounds, cough reflex b.
    b. Cardiovascular systems [8 hrs.]
        i. Chambers of heart, semi lunar and atria ventricular valves
        ii. Coronary circulation, conductive system of heart
        iii. Cardiac cycle, ECG, Heart sounds
        iv. Blood pressure, pulse, cardiac output 2.
2. Cardio Vascular system
    a. Define, etiology, pathogenesis, clinical features, complications, [2 hrs.]
    b. Conservative and surgical management of the following conditions [16 hrs.]
        i. Ischemia heart disease
        ii. Myocardial infarction
        iii. Heart failure
        iv. Cardiac arrest
        v. Rheumatic fever
        vi. Hypertension
        vii. Infective endocarditis
        viii. Myocarditis & cardiomyopathy c.
    c. Cardiovascular Disease : Examination of the Cardiovascular System Investigations : ECG, Exercise Stress Testing, Radiology ; Clinical manifestations of Cardiovascular disease ; Definition, Etiology, Clinical features, signs and symptoms, complications, management and treatment of following diseases and disorders of the heart : Pericarditis, Myocarditis, Endocarditis, Rheumatic Fever – resulting in valve disorders, Ischemic Heart Disease, Coronary Valve Disease, Congenital disorders of the Heart, Cardiac Arrest ; Examination and Investigations of diseases of arteries and veins ; Hypertension : Definition, causes, classification, types, assessment, investigations and management. [10 hrs.]
    d. Disorders of the Heart – Definition, Clinical features, diagnosis and choice of management for the following disorders : Congenital Heart diseases – Acyanotic congenital heart disease & Cyanotic congenital heart disease : Patent Ductus Arteriosus, Coarctation of Aorta, Atrial Septal Defect, Ventricular Septal Defect, Tetraology of Fallot, Transposition of Great Vessels ; Acquired Heart Disease – Mitral Stenosis & Insufficiency, Aortic Stenosis and Insufficiency, Ischemic Heart Disease – Coronary Artery Disease, Cardiac tumors. [10 hrs.]

3. Respiratory System
    a. Respiratory Disease : Examination of the Respiratory System – Investigations : Chest Radiographs, Pulmonary Function Testing, Arterial Blood Gas Analysis ; Clinical manifestations of Lung disease ; Patterns of lung disease – Chronic Obstructive Lung Disease and Restrictive Lung Disease ; Definition, Etiology, Clinical features, signs and symptoms, complications, management and treatment of following lung diseases : Chronic Bronchitis, Emphysema, Asthma, Bronchiectasis, Cystic Fibrosis, Upper Respiratory Tract Infections, Pneumonia, Tuberculosis, Fungal Diseases, Interstitial Lung Diseases, Diseases of the pleura, diaphragm and chest wall ; Respiratory failure – Definition, types, causes, clinical features, diagnosis and management. [10 hrs.]
    b. Chest wall disorders- Definition, Clinical features, diagnosis and choice of management for the following disorders – chest wall deformities, chest wall tumors, Spontaneous Pneumothorax, Pleural Effusion, Empyema Thoracis, Lung abscess, Bronchiectasis, Tuberculosis, Bronchogenic Carcinoma, Bronchial Adenomas, Metastatic tumors of the Lung, tracheal Stenosis, Congenital tracheomalacia, Neoplasms of the trachea, Lesions of the Mediastinum. Carcinoma of the female breast. [9 hrs.]

STUDENT LEARNING OUTCOMES/OBJECTIVES:

At the end of the semester the student will be able:

- Do evaluation and assessment of various neurological conditions with interpretation of hematological investigations, chest X-ray, C.T. and MRI scans done for cardio respiratory conditions with PFT findings.
- Describe the aetiology, pathophysiology, signs and symptoms, clinical evaluation, management of the various cardio vascular and respiratory conditions, their differential diagnosis. •
- To evaluate and management of various emergency conditions.

Recommended textbooks:

- Manual of Clinical Surgery, S. Das, 6th Edition, S.B. Publications
- Principles and practice of medicine by – Davidson, 20th Edition, Churchill Livingston
- Medicine for students, Golwalla

Reference books:

- Practical medicine by – P J Mehta, 16th Edition
- Textbook of Surgery by Bailey & Love, 25th Edition, Butterworth & Heinmann

BIOSTATISTICS & RESEARCH METHODOLOGY

SUBJECT DESCRIPTION –
The objective of this module is to help the students understand the basic principles of research and methods applied to draw inferences from the research findings.

THEORY [60 HRS.]

RESEARCH METHODOLOGY [30 HRS.]

1. Introduction to Research methodology: Meaning of research, objectives of research, Motivation in research, Types of research & research approaches, Research methods vs methodology, Criteria for good research, Problems encountered by researchers in India. [3 hrs.]
2. Research problem: Statement of research problem., Statement of purpose and objectives of research problem, Necessity of defining the problem [3 hrs.]
3. Research design: Meaning of research design, Need for research design, Features for good design, Different research designs, Basic principles of research design [3 hrs.]
4. Sampling Design: Criteria for selecting sampling procedure, Implications for sample design, steps in sampling design, characteristics of good sample design, Different types of sample design [3 hrs.]
5. Measurement & scaling techniques: Measurement in research- Measurement scales, sources of error in measurement, Technique of developing measurement tools, Meaning of scaling, its classification. Important scaling techniques. [3 hrs.]
6. Methods of data collection: collection of primary data, collection data through questionnaires & schedules, Difference between questionnaires & schedules. [3 hrs.]
7. Sampling fundamentals, need for sampling & some fundamental definitions, important sampling distributions. [3 hrs.]
8. Processing & analysis of data: Processing operations, problems in processing, Types of analysis, Statistics in research, Measures of central tendency, Dispersion, Asymmetry, relationship. [3 hrs.]
9. Testing of hypothesis: What is hypothesis? Basic concepts concerning testing of hypothesis, Procedure of hypothesis testing, measuring the power of hypothesis test, Tests of hypothesis, limitations of the tests of hypothesis [3 hrs.]
10. Computer technology: Introduction to Computers, computer application in research, computers & researcher. [3 hrs.]

BIOSTATISTICS [30 HRS.]

1. Introduction: Meaning, definition, characteristics of statistics., Importance of the study of statistics, Branches of statistics, Statistics and health science including physiotherapy, Parameters and Estimates, Descriptive and inferential statistics, Variables and their types, Measurement scales. [5 hrs.]
2. Tabulation of Data: Basic principles of graphical representation, Types of diagrams – histograms, frequency polygons, smooth frequency polygon, cumulative frequency curve, Normal probability curve.[4 hrs.]
3. Measure of Central Tendency: Need for measures of central Tendency, Definition and calculation of mean – ungrouped and grouped, Meaning, interpretation and calculation of median ungrouped and grouped., Meaning and calculation of mode, Comparison of the mean, median and mode, Guidelines for the use of various measures of central tendency. [4 hrs.]
4. Probability and Standard Distributions: Meaning of probability of standard distribution, the binominal distribution, the normal distribution, Divergence from normality – skew ness, kurtosis. [4 hrs.]
5. Sampling techniques: Need for sampling - Criteria for good samples, Application of

sampling in community, Procedures of sampling and sampling designs errors, Sampling variation and tests of significance. [3 hrs.]

6. Analysis of variance & covariance: Analysis of variance (ANOVA), what is ANOVA? Basic principle of ANOVA, ANOVA technique, Analysis of Co variance (ANACOVA). [5 hrs.]
7. Format of scientific documents. (Structure of protocols, formats reporting in scientific journals, systematic reviews and meta-analysis). [5 hrs.]

STUDENT LEARNING OUTCOMES/OBJECTIVES:

At the end of the semester the student will be able:

- To know the basics of research and various research designs.
- To do the literature review for their project
- To prepare a research proposal.
- To know the basics of biostatistics in the application of research.
- To know the various tools, softwares and its usage towards research.

Recommended Textbooks:

- Rehabilitation research – Elizabeth Domholt.
- Carolin hicks – Research for physiotherapist.
- Methods in Biostatistics- B.K. Mahajan
- Elements of Health Statistics: Rao. N.S.N
- An introduction of Biostatistics: Sunder Rao. P.S.S.
- Methods in Bio-Statistics 6th Edition. 1997: B.K. Mahajan
- Biostatistics : A manual of Statistics Methods: K. Visweswara Rao
- Elementary Statistics 1st Edition, 1990. In Medical Workers: Inderbir Singh

Reference books:

- Darlene – Documenting functional outcomes in physical therapy
- Diana-Research for health professionals.
- Statistics in Psychology and education: Great and Henry
- An Introduction to Gupta C.B. Statistical Methods, 1972: Ram Prasad & Sons
- Basic Statistics, 3rd Edition: Simpsory G. Kaftha. P
- Research; Principles and Methods:L Denise F. Poli & Hungler
- Fundamentals of Research, 4th Edition.: David J. Fox

HEALTH PROMOTION, FITNESS AND WELLNESS

SUBJECT DESCRIPTION –

This course includes discussion on the theories of health and wellness, including motivational theory, locus of control, public health initiative, and psycho-Social, spiritual and cultural consideration. Health risks, screening, and assessment considering epidemiological principles are emphasized. Risk reduction strategies for primary and secondary prevention, including programs for special populations are covered.

THEORY [30 HRS.]

1. Prevention practice: a holistic perspective for physiotherapy [3 hrs.]
    a. Defining Health
    b. Predictions of Health Care
    c. Comparing Holistic Medicine and Conventional Medicine
    d. Distinguishing Three Types of Prevention Practice.
2. Healthy People [3 hrs.]
    a. Definition of healthy people
    b. Health education Resources
    c. Physiotherapist role for a healthy community.
3. Key concepts of fitness [3 hrs.]
    a. Defining & Measuring Fitness
    b. Assessment of Stress with a Survey
    c. Visualizing Fitness
    d. Screening for Mental and Physical Fitness
    e. Body Mass Index calculations.
4. Fitness training [3 hrs.]
    a. Physical Activities Readiness Questionnaire
    b. Physical Activities Pyramid
    c. Exercise Programs
    d. Evidence-Based Practice.
5. Health, fitness, and wellness issues during childhood and adolescence [1 hr.]
6. Health, fitness, and wellness during adulthood [1 hr.]
7. Women's health issues: focus on pregnancy[2 hrs.]
8. Prevention practice for older adults [2 hrs.]
9. Resources to optimize health and wellness[2 hrs.]
10. Health protection. [1 hr.]
11. Prevention practice for musculoskeletal conditions [2 hrs.]
12. Prevention practice for cardiopulmonary conditions [2 hrs.]
13. Prevention practice for neuromuscular conditions [2 hrs.]
14. Prevention practice for integumentary disorders [1 hr.]
15. Prevention practice for individuals with developmental disabilities [1 hr.]
16. Marketing health and wellness. [1 hr.]

STUDENT LEARNING OUTCOMES/OBJECTIVES:

At the end of the semester the student will be able:

- To review the basics health, Promotion & Fitness
- To understand the need of Health Promotion
- To understand basic concept of fitness
- To develop necessary skill to screen and assess basics of fitness

Recommended Textbooks

- Textbook of Preventive & Social Medicine- Dr. K. Park
- Textbook of community medicine: V. K. Mahajan
- Chiropractic, Health ,Promotion and Wellness –Meridel I.Gatterman MA, DC, Med
- Health ,Promotion and Wellness :evidence based guide to clinical preventive services—Cheryl Hawk & Will Evas
- Fitness and Health – 6th edition – Brian J Sharkey,PhD

Reference books:

- Principles and foundation of health promotion and education (2nd edition), J. Thomas Butler, Morton Publishing Company, Englewood, Colorado Foundations Of Health Education, R. M. Eberst, Editor, Coyote Press, San Bernardino: 1998-99
- Evaluation in health promotion – principles and perspective- WHO Regional Publications, European Series, No. 92 Principles and foundation of health promotion and education(5th edition) by Randall R. Cottrell, James T. Girvan, James F. McKenzie

PRINCIPLES OF MANAGEMENT

SUBJECT DESCRIPTION –
The course is intended to provide knowledge about the basic principles of Management.

THEORY [30]

1. Introduction to management [4 hrs.]
2. Strategic Management [4 hrs.]
3. Foundations of Planning [4 hrs.]
4. Planning Tools and Techniques [4 hrs.]
5. Decision Making, conflict and stress management [4 hrs.]
6. Managing Change and Innovation [2 hrs.]
7. Understanding Groups and Teams [2 hrs.]
8. Leadership [2 hrs.]
9. Time Management [2 hrs.]
10. Cost and efficiency [2 hrs.]

STUDENT LEARNING OUTCOMES/OBJECTIVES:
At the end of the semester the student will be able:

- To manage and plan the strategies for the benefit of the patient.
- To deal and guide the team members.

Recommended Textbooks: ¬

- Principles of Management by P C Tripathi.
- Principles of Management by Gupta

CRITIQUE ENQUIRY, CASE PRESENTATION AND CASE DISCUSSION

Practical- [30 HRS]

Eight Semester-

PHYSIOTHERAPY IN CARDIOVASCULAR, PULMONARY AND INTENSIVE CARE

SUBJECT DESCRIPTION –

The subject is designed to provide knowledge in assessing and planning physiotherapy interventions for various General, Medical and Surgical conditions.

THEORY – [60 HRS.]

1. Anatomical and Physiological differences between the Adult and Pediatric lung. [1 hr.]
2. Bedside assessment of the patient-Adult & Pediatric. [3 hrs.]
3. Investigations and tests – Exercise tolerance Testing – Cardiac & Pulmonary, Radiographs, PFT, ABG, ECG, Hematological and Biochemical Tests. [3 hrs.]
4. Physiotherapy techniques to increase lung volume – controlled mobilization, positioning, breathing exercises, Neurophysiological Facilitation of Respiration, Mechanical aids - Incentive Spirometry, CPAP,IPPB. [3 hrs.]
5. Physiotherapy techniques to decrease the work of breathing – Measures to optimize the balance between energy supply and demand, positioning, Breathing re-education – Breathing control techniques, mechanical aids – IPPB, CPAP, BiPAP. [3 hrs.]
6. Physiotherapy techniques to clear secretions – Hydration, Humidification & Nebulisation, Mobilisation and Breathing exercises, Postural Drainage, Manual techniques – Percussion, Vibration and Shaking, Rib Springing, ACBT, Autogenic Drainage, Mechanical Aids – PEP, Flutter, IPPB, Facilitation of Cough and Huff, Nasopharyngeal Suctioning. [3 hr.]
7. Drug therapy – Drugs to prevent and treat inflammation, Drugs to treat Bronchospasm, Drugs to treat Breathlessness, Drugs to help sputum clearance, Drugs to inhibit coughing, Drugs to improve ventilation, Drugs to reduce pulmonary hypertension, Drug delivery doses, Inhalers and Nebulisers. [1 hr.]
8. Neonatal and Pediatric Physiotherapy – Chest physiotherapy for children, The neonatal unit, Modifications of chest physiotherapy for specific neonatal disorders, Emergencies in the neonatal unit. [3 hrs.]
9. Physiotherapy in Obstructive lung conditions. [2 hrs.]
10. Physiotherapy in Restrictive lung conditions. [2hrs.]
11. Management of breathlessness. [2 hrs.]
12. Pulmonary Rehabilitation. [3 hrs.]
13. Physiotherapy following Lung surgeries. [3 hrs.]
14. Respiratory failure – Oxygen Therapy and Mechanical Ventilation. [3 hrs.]
15. Introduction to ICU : ICU monitoring –Apparatus, Airways and Tubes used in the ICU - Physiotherapy in the ICU – Common conditions in the ICU – Tetanus, Head Injury, Lung Disease, Pulmonary Oedema, Multiple Organ Failure, Neuromuscular Disease, Smoke Inhalation, Poisoning, Aspiration, Near Drowning, ARDS, Shock; Dealing with an Emergency Situation in the ICU. [2 hrs.]
16. Physiotherapy management following cardiac surgeries. [2 hrs.]
17. Cardiac Rehabilitation. [3 hrs.]
18. Physiotherapy management following PVD. [2hrs.]
19. Abdominal Surgeries - Management of Pulmonary Restorative Dysfunction following surgical procedures on Abdomen and Thorax. [3 hrs.]
20. Management of Amputations following Diabetes, PVD - Prosthesis in amputations of lower limbs following ulcers and gangrenes. [3 hrs.]
21. Home program and education of family members in patient care. [2 hrs.]
22. Treatment, Response to exercise and Implications of Physiotherapy in the following disease conditions: Hypertension, Diabetes, Renal Failure and Obesity. [5 hrs.]
23. Applied Yoga in Cardio-respiratory conditions [3 hrs.]

PRACTICAL: [90 HRS.]

- Practical shall be conducted for all the relevant topics discussed in theory in the following forms: 1.
    1. Bedside case presentations and case discussions
    2. Lab sessions consisting of evaluation and assessment methods on student models, treatment techniques and practice sessions.

STUDENT LEARNING OUTCOMES/OBJECTIVES:

At the end of the semester the student will be able:

- To identify, discuss & analyse cardio-vascular & pulmonary dysfunction, based on patho-physiological principles, & arrive at the appropriate functional diagnosis
- To select strategies for cure care & prevention; adopt restorative & rehabilitative measures for maximum possible functional independence of a patient.
- To execute the effective Physio Therapeutic measures (with appropriate clinical reasoning) with special emphases to Breathing retraining, nebulization humidification, bronchial hygiene, General Mobilisation & Exercise conditioning.
- To acquire Knowledge of the overview of patients care at the Intensive care area, artificial ventilation suctioning, positioning for bronchial hygiene & continuous monitoring of the patient at the Intensive care area.
- To acquire the skill of basic Cardio-pulmonary resuscitation.

Recommended Textbooks:

- Tidy's physiotherapy.
- Cash’s text book for Physiotherapists in Chest, Heart & Vascular disease
- Cash’s text book in General Medicine & Surgical conditions for Physiotherapists.
- Physiotherapy for Respiratory and Cardiac problems by Jennifer A Pryor
- The Brampton Guide to chest physiotherapy DU Gasket [Completed]
- Physical Rehabilitation Assessment and Treatment – O’Sullivan Schmitz
- Essentials of Cardio Pulmonary Physical Therapy by Hillegass and Sadowsky

Reference books:

- Physiotherapy in respiratory care by Alexandra Hough.
- Cardiopulmonary Physical Therapy by Irwin Scott.
- Chest Physical therapy & pulmonary rehabilitation by Donna Frown filter.
- ECG by P.J. Mehta.

COMMUNITY PHYSIOTHERAPY

SUBJECT DESCRIPTION - The subject serves to integrate the knowledge gained by the students in community medicine and other areas with skills to apply these in clinical situations of health and disease and its prevention.

THEORY – [60 HRS.]

1. Rehabilitation: Definition, Types. [2 hr.]
2. Community: Definition of Community, Multiplicity of Communities, The Community based approach, Community Entry strategies, CBR and Community development, Community initiated versus community oriented programme, Community participation and mobilization. [3 hrs.]
3. Introduction to Community Based Rehabilitation: Definition, Historical review, Concept of CBR, Need for CBR, Difference between Institution based and Community based Rehabilitation, Objectives of CBR, Scope of CBR, Members of CBR team, Models of CBR. [3 hrs.]
4. Principles of Community based Rehabilitation. W.H.O.`s policies-about rural health careconcept of primary /tertiary health centers-district hospitals etc-Role of P.T.- Principles of a team work of Medical person/P.T./O.T. audiologist/speech therapist /P.&O./vocational guide in C.B.R. of physically handicapped person , Agencies involved in rehabilitation of physical handicapped - Legislation for physically handicapped. Concept of multipurpose health worker. Role of family members in the rehabilitation of a physically handicapped. [6 hrs.]
5. Planning and management of CBR Programmes, CBR Programmed planning and management, Ownership and Governance, Decentralization and CBR, Management of CBR, Programmed sustainability, Communication and Coordination, Community participation, mobilization and awareness, CBR programme influence on promoting and developing public policies. [3 hrs.]
6. Disability: Definition of Impairment, Handicap and Disability, Difference between impairment, handicap and disability, Causes of disability, Types of disability, Prevention of disability, Disability in developed countries, Disability in developing countries. Disability Surveys: Demography. Screening: Early detection of disabilities and developmental disorders, Prevention of disabilities- Types and levels. [3 hrs.]
7. Disability Evaluation: Introduction, What, Why and How to evaluate, Quantitative versus Qualitative data, Uses of evaluation findings. [3 hrs.]
8. Role of Government in CBR: Laws, Policies, Programmes, Human Rights Policy, Present rehabilitation services, Legal aspects of rehabilitation. [3 hrs.]
9. Role of Social work in CBR: Definition of social work, Methods of social work, History of social work, Role of social worker in rehabilitation. [3 hrs.]
10. Role of voluntary Organizations in CBR: Charitable Organizations, Voluntary health agencies – National level and International NGO's, Multilateral and Bilateral agencies. International Health Organizations: WHO, UNICEF, UNDP, UNFPA, FAO, ILO, World bank, USAID, SIDA, DANIDA, Rockfeller, Ford foundation, CARE, RED CROSS. [4 hrs.]
11. National District Level Rehabilitation Programme: Primary rehabilitation unit, Regional training center, District rehabilitation center, Primary Health center, Village rehabilitation worker, Anganwadi worker. [3 hrs.]
12. Role of Physiotherapy in CBR: Screening for disabilities, Prescribing exercise programme, Prescribing and devising low cost locally available assisstive aids, Modifications physical and architectural barriers for disabled, Disability prevention, Strategies to improve ADL, Rehabilitation programmes for various neuro-musculoskeletal and cardiothoracic disabilities. [4 hrs.]

13. Screening and rehabilitation of paediatric disorders in the community: Early detection of high risk babies, Maternal nutrition and education, Rehabilitation of Cerebral Palsy, Polio, Downs Syndrome, Muscular Dystrophies etc., Prevention and rehabilitation of mental retardation and Behavioural disorders, Immunization programmes, Early intervention in high risk babies, Genetic counselling. [4 hrs.]
14. Extension services and mobile units: Introduction, Need, Camp approach. [3 hrs.]
15. Vocational training in rehabilitation: Introduction, Need, Vocational evaluation, Vocational rehabilitation services. [3 hrs.]
16. Geriatrics- Physiology of Aging /degenerative changes-Musculoskeletal /Neuromotor /cardio – respiratory-/Metabolic, Endocrine, Cognitive, Immune systems. Role of Physio Therapy in Hospital based care, Half-way homes, Residential homes, Meals on wheels etc. Home for the aged, Institution based Geriatric Rehabilitation. Few conditions:- Alzheimer's disease, Dementia, Parkinson's Disease, Incontinence, Iatrogenic drug reactions, etc. Ethics of Geriatric Rehabilitation. [5 hrs.]
17. Industrial Health & Ergonomics [10 hours] - Occupational Hazards in the industrial area - - Accidents due to [5 hrs]
    - **a.** Physical agents-e.g.-Heat/cold, light, noise, Vibration, U.V. radiation, Ionizing radiation,
    - **b.** Chemical agents-Inhalation, local action, ingestion,
    - **c.** Mechanical hazards-overuse/fatigue injuries due to ergonomic alteration & ergonomic evaluation of work place-mechanical stresses per hierarchy – i.
        - **i.** sedentary table work –executives, clerk,
        - **ii.** inappropriate seating arrangement- vehicle drivers
        - **iii.** constant standing- watchman- Defense forces, surgeons,
        - **iv.** Over-exertion in laborers,-common accidents –Role of P.T.-Stress management.
    - **d.** Psychological hazards- e.g.-executives, monotonicity & dissatisfaction in job, anxiety of work completion with quality, Role of P.T. in Industrial setup & Stress managementrelaxation modes.
    - **e.** Biological Hazards

PRACTICAL: **[60 HRS.]**

- This will consist of Field visits to urban and rural PHC's., Visits to regional rehabilitation training center, Regular mobile camps, Disability surveys in villages, Disability screening, Demonstration of Evaluation and Physiotherapy prescription techniques for musculoskeletal, neuromuscular, cardiorespiratory, paediatric, gynecological and geriatric problems in community, Demonstration of evaluation and prescription techniques for ambulatory and assistive devices, Fabrication of low cost assistive devices with locally available materials.

STUDENT LEARNING OUTCOMES/OBJECTIVES:

At the end of the semester the student will be able:

- To understand the role of rehabilitation team.
- To understand the community based rehabilitation at patient's doorstep.

Recommended Textbooks:

- Rehabilitation Medicine by Howard A Rusk.
- Rehabilitation Medicine by Joel A De Lisa
- Physiotherapy in Community Health and Rehabilitation by Waqar Naqvi
- Essentials of Community- based Rehabilitation by Satya Bhushan Nagar

Reference books:

- Community Based Rehabilitation of Persons with Disabilities by S Pruthvish

CLINICAL REASONING AND EVIDENCE BASED PHYSIOTHERAPY PRACTICE –

SUBJECT DESCRIPTION –

In this subject, the student will learn about the concept of evidence based physiotherapy, various steps involved in it, critically appraising the research articles and its practical applications in the management of individual patient care

THEORY –[15 HRS.]

1. Introduction to Evidence Based Practice: Definitions, Evidence Based Practice, [1 hr.]
2. Concepts of Evidence based Physiotherapy: Awareness, Consultation, Judgement, and Creativity [1 hr.]
3. Development of Evidence based knowledge, The Individual Professional, Professionals within a discipline, and Professionals across disciplines [1 hr.]
4. Evidence Based Practitioner: The Reflective Practitioner, The E Model, Using the E Model [1 hr.]
5. Finding the Evidence: Measuring outcomes in Evidence Based Practice, Measuring Health Outcomes, Measuring clinical outcomes, Inferential statistics and Causation [1hr.]
6. Searching for the Evidence: Asking Questions, Identifying different sources of evidence, Electronic Bibliographic databases and World Wide Web, Conducting a literature search. Step by-step search for evidence [1 hr.]
7. Assessing the Evidence: Evaluating the evidence; Levels of evidence in research using quantitative methods, Levels of evidence classification system, Outcome Measurement, Biostatistics, The critical review of research using qualitative methods [2 hrs.]
8. Systematically reviewing the evidence: Stages of systematic reviews, Meta-analysis, The Cochrane collaboration [1 hr.]
9. Economic evaluation of the evidence: Types of economic evaluation, conducting economic evaluation, critically reviewing economic evaluation, locating economic evaluation in the literature .[1 hr.]
10. Using the evidence: Building evidence in practice; Critically Appraised Topics (CATs), CAT format, Using CATs, Drawbacks of CATs [1 hr.]
11. Practice guidelines, algorithms, and clinical pathways: Recent trends in health care, Clinical Practice Guidelines (CPG), Algorithms, Clinical pathways, Legal implications in clinical pathways and CPG, Comparison of CPGs, Algorithms and Clinical Pathways [2 hrs.]
12. Communicating evidence to clients, managers and funders: Effectively communicating evidence, Evidence based communication in the face of uncertainty; Evidence based communication opportunities in everyday practice [1 hr.]
13. Research dissemination and transfer of knowledge: Models of research transfer, Concrete research transfer strategies, Evidence based policy [1 hr.]

PRACTICAL: **[30 HRS.]**

STUDENT LEARNING OUTCOMES/OBJECTIVES:

At the end of the semester the student will be able:

- To understand the concept of evidence based physiotherapy.
- To search the various medical literature databases and acquire relevant research articles.
- To critically appraise the research with respect to its relevance to physiotherapy practice.
- To apply the findings of the research in the management of individual patients.

Recommended Textbooks:

- Evidence-Based Practice in Nursing and Health Care: A Guide to Best Practice ,by Bernadette Melnyk (Editor), Ellen Fineout-Overholt (Editor)
- Evidence-Based Rehabilitation: A Guide to Practice, by Mary Law Achieving Evidence-Based Practice, by Susan Hamer, BA, MA, RGN, FETC(DIST),
- The Evidence-Based Practice by Stout, Randy A Hayes

ADMINISTRATION AND TEACHING SKILLS

SUBJECT DESCRIPTION –
In this subject, the student will learn about administration and its application in the field of Physiotherapy as well as will be skilled with various teaching methods.

THEORY- [15 HRS.]

1. Introduction: [10 hrs.]
    - **a.** Branches of administration, Nature and scope of administration, How to be an effective administrator, Planning hospital administration as part of a balanced health care program.
    - **b.** Principles of hospital administration and its applications to physiotherapy.
    - **c.** Planning and organization: Planning cycle, Principles of organizational charts, Resource and quality management, planning change -innovation
    - **d.** Financial issues including budget and income generation
    - **e.** Hospital administration: Organization, Staffing, Information, Communication, Coordination, Cost of services, Monitoring and evaluation.
    - **f.** Organization of physiotherapy department: Planning, Space, Manpower, Other basic resources.
    - **g.** Organizing meetings, committees, and negotiations
    - **h.** Personnel management: Personnel performance appraisal system, Quality care delivery from the staff.
2. Aims of physiotherapy education [5 hrs.]
    - **a.** Concepts of teaching and learning
    - **b.** Curriculum development
    - **c.** Principles and methods of academic and clinical teaching
    - **d.** Measurement and evaluation
    - **e.** Guidance and counseling
    - **f.** Faculty development program
    - **g.** Administration in clinical setting
    - **h.** Use of A-V aids in teaching
    - **i.** Taxonomy of education

PRACTICAL [30 HRS.]

- Micro teaching on various topics of Physiotherapy

STUDENT LEARNING OUTCOMES/OBJECTIVES:

At the end of the semester the student will be able:

- To know the basics in managerial and management skills and use of information technology in professional practice.

Recommended Text books:

- Francis C M – Hospital Administration
- Davies, R and Macaulay, BMC – Hospital Planning and Administration
- Health Services Management, Analysis& Application , Wadsworth Publishing Company, Belmont

Reference books:

- Hospital administration and human resource management by R. C. Goyal, 4 th Edition.

RESEARCH PROJECT- [30 HRS.]

The project may be a case study or of recent technique or literature reviews and etc. to make the student to have research mind and to facilitate for higher studies.

CLINICAL EDUCATION-

Students will be posted in rotation in the following areas/wards. The students will be clinically trained to provide physiotherapy care for the patients under supervision. They will be trained on bed side approach, patient assessment, performing special tests, identifying indications for treatment, ruling out contraindications, decision on treatment parameters, dosage and use relevant outcome measures under supervision. Evidence based practice will be part of training.

1. Physiotherapy OPD
2. Neurology, Neurosurgery & Neuro ICU
3. Community-PHC
4. Orthopedics
5. General Medicine & MICU
6. General Surgery & CTS ICU
7. Developmental Pediatrics & Child Guidance Clinic
8. OBG
9. Geriatric – Old Age Homes
10. Industrial Visits - Ergonomics

INTERNSHIP –

The internship time period provides the students the opportunity to continue to develop confidence and increased skill in simulation and treatment delivery. Students will demonstrate competence in beginning, intermediate, and advanced procedures in both areas. Students will participate in advanced and specialized treatment procedures. The student will complete the clinical training by practicing all the skills learned in classroom and clinical instruction. The students are expected to work for minimum 8 hours per day.

1. **Initial Assessment Documentation:** Clinical staff must document the following information: a.
    - **a.** Initial assessment documented based on SOAP format.
    - **b.** Subjective examination (symptomatic)
    - **c.** Objective examination (measureable, observable)
    - **d.** Action/Analysis (interpretation of current condition/intervention provided)
    - **e.** Plan of action
    - **f.** Written or verbal feedback to the client or other relevant careers
    - **g.** Discharge plan documented
    - **h.** Agreement to treatment plan by patient or “person responsible”

2. **Progress Documentation:** Progress documentation may include the following information:
    - **a.** Any individual intervention should be documented in SOAP format (including response to intervention/s using outcome measures)
    - **b.** Oral consent obtained and documented when there is a significant change in treatment/ treatment options/ status of patient’s health.
    - **c.** Written consent obtained for designated invasive procedures
    - **d.** Change in status or events that may affect discharge plans/goals
    - **e.** Documented consultation with key clinical team members

2019
DEPARTMENT OF ZOOLOGY
BODOLAND UNIVERSITY
1ST SEMESTER SYLLABUS

2019
NEW STRUCTURE
M.Sc. ZOOLOGY SYLLABUS
BODOLAND UNIVERSITY

SEMESTER - 1

Subject		Credit	Credits (L+T+P)	Marks (Internal + Final)
ZOO-101	Ecology and Environmental Biology	4	(3+1+0)	20+80=100
ZOO-102	Cell Structure and Function	4	(3+1+0)	20+80=100
ZOO-103	Endocrinology	4	(3+1+0)	20+80=100
ZOO-104	Evolutionary Biology and Biosystematics	4	(3+1+0)	20+80=100
ZOO-105	Practical	5	(0+0+5)	20+80=100
Open Elective ZOO-106-OE1 ZOO-106-OE2	OE1- Sericulture OE2- Apiculture	2	(2+0+0)	10+40=50
		23		550

(Theory/Tutorial)
1 credit = 15 contact hrs per semester
18 credits = 15 x 18 = 270 contact hrs per semester

(Practical)
1 credit = 2 Hrs = 2 x 15 = 30 contact hrs
5 credit = 30 x 5 = 150 contact hrs per semester
Total = 270+150 = 420 contact hrs per semester

SEMESTER – 2

Subject	Credit	Credits (L+T+P)	Marks (Internal + Final)	
ZOO-201	4	(3+1+0)	20+80=100	
ZOO-202	4	(3+1+0)	20+80=100	
ZOO-203	4	(3+1+0)	20+80=100	
ZOO-204	4	(3+1+0)	20+80=100	
ZOO-205 (P)	5	(0+0+5)	20+80=100	
Open Elective ZOO-206-OE1	2	(2+0+0)	50	
Total	23		550	

(Theory/Tutorial)
1 credit = 15 contact hrs per semester
18 credits = 15 x 18 = 270 contact hrs per semester

(Practical)
1 credit = 2 Hrs = 2 x 15 = 30 contact hrs
5 credit = 30 x 5 = 150 contact hrs per semester
Total = 270+150 = 420 contact hrs per semester

SEMESTER- 3

Subject	Credit	Credit (L+T+P)	Marks (Internal + Final)	
ZOO-301	4	(3+1+0)	20+80=100	
ZOO-302	4	(3+1+0)	20+80=100	
ZOO-303	4	(3+1+0)	20+80=100	
ZOO-304	4	(3+1+0)	20+80=100	
ZOO-305(P)	5	(0+0+5)	20+80=100	
Core Elective ZOO-306E1 ZOO-306E2	3	(2+1+0)	20+80=100	
	24		600	

(Theory/Tutorial)
1 credit = 15 contact hrs per semester
19 credits = 15 x 19 = 285 contact hrs per semester

(Practical)
1 credit = 2x15 = 30 contact hrs per semester
5 credit = 30 x 5 = 150 contact hrs per semester
Total = 285+150 = 435 contact hrs per semester

SEMESTER- 4

Subject	Credit	Credits (L+T+P)	Marks (Internal + Final)	
ZOO-401	4	(3+1+0)	20+80=100	
ZOO-402	4	(3+1+0)	20+80=100	
ZOO-403	4	(3+1+0)	20+80=100	
ZOO-404(P)	4	(0+0+4)	20+80=100	
ZOO-405 (Dissertation)	6	(0+0+6)	40+60=100	
	22		20+80=100	

(Theory/Tutorial)
1 credit = 15 contact hrs per semester
16 credits = 15 x 16 = 240 contact hrs per semester

(Dissertation & Practical)
1 credit = 2x15 = 30 contact hrs per semester
4 + 6 = 10 credit = 30 x 10 = 300 contact hrs per semester
Total = 240+300 = 420 contact hrs per semester

PAPER CODE: ZOO-101
ECOLOGY AND ENVIRONMENTAL BIOLOGY
4 CREDITS

UNIT- 1 **16 lectures**

Concepts of Ecology - Introduction to ecology, Organizational level of ecological systems, evolutionary ecology, environmental concepts-Abiotic and biotic environment, limiting factors, adaptation, aquatic and terrestrial ecosystem; Community ecology: community structure, species richness and evenness; keystone species concept, types of community changes, ecological succession- models, concept of climax; Ecosystem Bioenergetics: Tropical structure, food chain and food webs, energy flow, and Lindemann's trophic dynamics concepts, concept of productivity, energy flow through ecosystem, biogeochemical cycles.

Climatic Changes & ecosystem: Niche and Climate Change, Species Range Shifts, Tree Line Shift to Pole Wards and Up Slopes, Pest's and Pathogen's Range Shifts, Coral Bleeching, Extinctions, Impact on Timings of Biological Events and clocks, Signaling Changes; The biosphere concept, biomes and impact of climate on biomes, major biomes of India and the world, Ecosystem destruction: factors and management.

UNIT- 2 **14 lectures**

Population ecology: Characteristics of population, population parameters, and structure, population size and exponential growth, limits of population growth, population dynamics, life history pattern, fertility rate and age structure. Growth regulation, life tables & survivorship curve, density dependent & independent factors, Life history strategies-K or r selection, Age and Sex ratio, the concept of carrying capacity, interactions between populations. Logistic model of population growth, territoriality

Species interaction: intra-and inter-specific interactions, Niche concept, ecological niche, niche overlap and separation; Competition and coexistence, scramble and contest competition model, mutualism and commensalism, prey-predator interactions, Lotka-Voltera Model, competitive exclusion principle

UNIT- 3 **11 lectures**

Biodiversity and its Conservation: concepts, significance, magnitude and distribution; Biodiversity indices, Threats to biodiversity, IUCN threat categories, Red data book; threat to Wild Life; in-situ and ex-situ conservation strategies, habitat Conservation, acceleration of ecological succession, reintroduction of biota; Megadiversity zones and Hot spots. Captive Breeding, Development of Biological Reserves, National Parks, Forest Reserves, Wild Life Refuges and Biosphere Reserves. Legal Actions, Public Participation and Awareness, Traditional and Modern Approaches Used In India for Conservation. Project Tiger, Chipko Movement, Appiko Movement, Indian Biosphere Reserve Programme.

UNIT- 4 **11 lectures**

Environmental Pollution and its management: Air, water, soil; Pollutants: types and major sources, effects on physico-chemical and biological properties of surrounding atmosphere, water, soil; effects on human health; Noise pollution: major sources, permissible noise level standard. Radioactive and thermal pollution sources and their effects; Solid waste disposal and its effects on surrounding environment; Solid Waste management: Degradation, Composting. Infectious and Medical Waste Pollution and Management; Concepts of sustainable development: social environmental issues and urban problems related to energy, industrial ecology and recycling industry; Eco-marketing.

UNIT- 5 **08 lectures**

Environmental Legislation: Central and state Pollution boards: powers and functions. Wildlife Protection Act 1972, The Water (Prevention and Control of Pollution) Act 1974. Prevention and Control of Air Pollution Act 1981, Forest Conservation Act 1981, Environment (protection) Act 1986, Hazardous waste (Management and Handling) Rules, 1989, Bio-Medical Waste (Management and Handling) Rules, 1998; Duties and responsibilities of citizens for environmental protection; Environmental Impact Assessment

(EIA) international organization for standardization (ISO); Role of information technology in environmental conservation, current environmental issues in India and environmental ethics.

RECOMMENDED BOOKS

1. Elements of Ecology, Thomas M. Smith, Robert Leo Smith, 9th Edition. Pearson Education Publishers
2. Fundamentals of ecology, Eugene Odum, Garry W. Barret. Brooks/Cole;
3. Field Sampling: Principles and Practices in Environmental Analysis, Conklin, A.R. Jr., (2004), CRC Press.
4. Principles and Standards for Measuring Primary Production, Fahey, T.J. and Knapp, A.K., (2007), Oxford University Press, UK
5. Ecological Modeling, Grant, W.E. and Swannack, T.M., (2008), Blackwell.
6. Fundamental Processes in Ecology: An Earth system Approach, Wilkinson, D.M., (2007), Oxford University Press, UK.

PAPER CODE: ZOO-102
CELL STRUCTURE AND FUNCTION
4 CREDITS

UNIT – 1 **10 lectures**

Cell organization: Cell classification, cell variability (size, shape, complexity, functions), Prokaryotes - origin and evolution of metabolism, Viruses - structure and replication, Bacteriophage (Lambda phage, phi x 174), Animal DNA virus (SV 40), Retroviruses (HIV), Bacteria- Structure and reproduction of E. coli, Plasmid and their functions; Eukaryotes – origin of eukaryotes, development of multicellular eukaryotes; cells as experimental models

UNIT - 2 **14 lectures**

Cell Membrane and transport System: Models of cell membrane, fluid mosaic model of membrane, composition and organization of lipid bilayer and membrane proteins, fluidity of cell membrane; Transport across cell membrane – Channels and transporters, Diffusion, osmosis and measurement of osmotic pressure; ionic concentration and membrane potential; Active transport and ion transports- types, ATP powered pumps, Co-transport by symporters and antiporters; transcellular transport

UNIT - 3 **14 lectures**

Membrane Targeting and sorting of proteins: Signal peptide and SRP dependent targeting of translational complex; Processing of proteins in RER; Protein Modifications, Folding, and Quality Control in the ER; Processing through Golgi complex: targeting to plasma membrane and lysosome; Targeting of proteins to mitochondria and chloroplast; Secretory pathways – vesicle budding and fusion, stages of secretory pathway

UNIT - 4 **08 lectures**

Nucleus and nucleolus: Structure and organization of nucleus - nuclear membrane, nuclear lamina and nuclear pore complex – structure and function, organization of nuclear membrane during cell division, chromosome territory inside nucleus, selective transport of molecules into and out of the Nucleus; Nucleoskeleton and nuclear matrix; Nucleolus and its structure, Assembly and biogenesis of ribosomes

UNIT - 5 **14 lectures**

Cell signaling system – signal transduction and signaling molecules; types of receptors - nuclear receptors, membrane receptors (enzyme linked receptors, Ion channel receptors), Miscellaneous receptors (Toll like receptors TLR); Signal transduction: G-protein mediated signaling pathway, cytokine receptor – JAK/STAT, MAPK, Ras/Raf signaling pathway, receptor tyrosine kinase – sub-families, phosphatidylinositol signaling pathways, ubiquitinylation signaling pathways, signal amplification, Second messenger systems in cellular signaling

RECOMMENDED BOOKS

1. Lodish et al: Molecular Cell Biology. 8th edition 2016, W. H. Freeman and Company
2. Alberts et al: Molecular Biology of the Cell. 5th edition, 2008, Garland Science
3. Cooper and Hausman: The Cell. 4th edition, 2007; Sinauer Associates, USA
4. Lynne Cassimeris et al.: Lewin's cells. 3rd edition, 2015. Jones & Bartlett Learning, USA

PAPER CODE: ZOO-103
ENDOCRINOLOGY
4 CREDITS

UNIT - 1 12 lectures

Hormones: Chemical nature and classification of hormones, endocrine, paracrine and autocrine hormones; hormone receptors and target organs; Hormones as 2nd messengers, molecular basis of hormone action, structure and signal transduction mechanisms (steroid and peptide hormones); Hormonal regulation of ovulation, gestation, parturition and lactation, Hormonal regulation of spermatogenesis, Endocrine control of osmoregulation in fish

UNIT - 2 10 lectures

Endocrine physiology in vertebrates: Pituitary, thyroid, parathyroid, adrenal and pancreas, hormones of islets of langerhans and their functions, insulin and glucagon in carbohydrate metabolism, calcium regulating hormones, Biosynthesis of Insulin, T3 and T4, adrenal cortical and medullary hormones, their metabolic functions and metabolism.

UNIT - 3 12 lectures

Neuroendocrine systems in vertebrates, Tropic hormones and their feedback system and response to various stimuli (Tolerance to temperature, stress ,osmotic regulation etc); Endocrine drugs : Clinical Pharmacology of oxytocin, PRL, ADH, Insulin, GH, ACTH, Pharmacokinetics of hormones, Pathophysiology-pituitary dwarfism, gigantism and acromegaly ,Graves disease

UNIT - 4 12 lectures

Prostaglandins: Source, chemical nature, structure, functions, physiological significance and clinical implications,Pineal gland-structure and functions, diurnal variations of biosynthetic components of pineal gland, gastrointestinal hormones and their regulation and functions.

UNIT- 5 14 lectures

Neuroendocrine system of Insect: Nerosecretory cells of brain, neurohemal organs, Hormones produced by Neurosecretory cells and their functions: Prothoracicotropic hormone, Allatotropin, Allastanin, Diapause hormone, Bursicon, Eclosin hormone, Proctolin, Diuretic hormone and Heart beat accelerating factor. Chemical structure and function of JH, JH as a gonadotropin, Prothoracic gland and ring gland, Role of Juvenile hormone analogues and ecdysteroids in pest control, Pheromones: Classification, chemical nature, structure, functions, clinical applications

RECOMMENDED BOOKS:

1. Hadley: Endocrinology, Prentice hall. International Edition. 2000
2. Norris: Vertebrate Endocrinology (2nd Edition) Lea & Febriger. 1997.
3. Text book of Medical Physiology 11th Edition. By C. Guyton, M.DJohn E. Hall (2006)
4. Mammalian Endocrinology (4th edition), NCBA, by Ashoke kumar Boral (2011)
5. Insect Physiology and Biochemistry, 3rd Edition by James L. Florida, U.S.A. (2015)

PAPER CODE: ZOO-104
EVOLUTIONARY BIOLOGY AND BIOSYSTEMATICS
4 CREDITS

UNIT - 1 12 lectures

Evolutionary time scale and geological eras; Concept and theories of evolution; pre-biotic molecules and origin of life; evolution of prokaryotic and eukaryotic cells; evolution of cell organelles and genome; factors and forces of evolution - mutation, genetic variation, genetic drift and migration; Mendelian population – allele frequencies and genotype frequencies, Hardy-Weinberg equilibrium and conditions for its maintenance; the founder principle; bottleneck effect of genetic drift

UNIT - 2 12 lectures

Isolating and selection mechanisms: Classification of isolation – geographic isolation and reproductive isolation; pre-mating isolation – climatic, seasonal, habitat, ethological; Post-mating isolation – gametic mortality, zygotic mortality, Hybrid inviability, Hybrid sterility, Hybrid breakdown; Inbreeding and Heterosis; Selection – stabilizing, dispersive, frequency dependent and balancing selection

UNIT - 3 12 lectures

Origin and diversification of eukaryotes - origin of cells and first organisms; early fossilized cells; evolution of eukaryotic cell from prokaryotes - a symbiosis; evolution of eukaryotic genomes; gene duplication and divergence; Polymorphism in natural population - Chromosomal, DNA and alloenzyme polymorphism; genetic polymorphism; balanced polymorphism; Adaptive radiation; Biochemical evolution: metabolic pattern changes (autotrophic, heterotrophic, anaerobic and aerobic).

UNIT - 4 12 lectures

Speciation – mode of speciation; concept of speciation; factors responsible for speciation; tempo of evolution; Systematics - definition and role in biology; biological classification - theories and objectives, types of taxonomy; taxonomic diversity- definition and types; taxonomic characters; origination and extinction; rates of change in origination and extinction; causes of extinction; causes of differential rates of diversification; human evolution – history of human evolutionary, Evolution of anthropoid primates; placing humans on tree of life; genomics and humanness; current issues in human evolution.

UNIT - 5 12 lectures

The universal common ancestor and tree of life, three domain concept of living kingdom; molecular phylogeny – history, terms, definition and limitations, Molecular taxonomy and barcoding; construction of phylogenetic trees by using rRNA, ITS and COI gene sequences; molecular divergence and molecular clocks; Concept of neutral theory; origin of genomes by horizontal gene transfer; role of plasmid, transposons, integrons and genomic islands in DNA transfer; life and RNA world.

RECOMMENDED BOOKS

1) Futuyma DJ. (2009) Evolution. Publisher Sinauer Associates is an imprint of Oxford University Press; 4th edition.
2) Dobzhansky Th., FJ. Ayala, GL. Stebbins and JM. Balentine (1976) Evolution. Surjeet Publication, Delhi
3) Smith JM. (1998) Evolutionary Genetics. Oxford University Press. Oxford.
4) Rastogi VB. (2016) Organic Evolution. Publisher – MedTech, India
5) Stearns SC. and RF. Hoekstra (2000) Evolution: An Introduction. Oxford University Press, Oxford.
6) Strickberger MW. (1990) Evolution. Jones and Bartlett Publishers. Boston

OPEN ELECTIVE
PAPER CODE: ZOO-106-OE1
SERICULTURE
2 CREDITS

UNIT – 1 10 lectures

Introduction: Origin and history of Sericulture-Silk road
Sericulture map of India and World-Component of Sericulture
Sericulture practices in tropical and temperate climate
Classification and Characteristic features of sericigenous insect
Life cycle: Morphology of egg, larvae, pupa and adult, Host plants: Types, cultivation and maintenance; Chawki garden- importance and maintenance
Rearing of Silkworm: Selection of silkworm breeds/races-Rearing house models, Rearing appliances, disinfection procedure, Chawki rearing

UNIT – 2 20 lectures

Diseases: Types, occurrence, symptoms, etiology and preventive measures
Pest and predator of silkworms: types, prevention and control
Silkworm seed production: Organization, Legislation Act, Grainages, sex separation and synchronization
Silk Technology: cocoon processing-physical, chemical and biological properties, Degumming, Spinning / reeling
Value added products, by-products and technology, Silk dyeing-natural artificial
Employment generation sericulture-Role of women in Sericulture

RECOMMENDED BOOKS:

1) F.A.O. (1984). Manual on Sericulture published by Food and Agriculture Organization
2) S.B. Dandin, J. Jayaswal and K. Giridhar (2001). Handbook of Sericulture Technologies. Publisher-Central Silk Board, Bangalore.
3) Muga Culture. 2013. Author: RN Singh, CM Vaspayi, A. Tikader and B. Sarat Chandra. Publisher – APH Publishing Corporation, New Delhi.
4) Ericulture- A comprehensive Profile. Authors: MC Sarmah, BN Sarkar, SA Ahmed and J Dewry. 2013. Directorate of Sericulture, BTC
5) Silkworm Egg Production. 1997. Publisher – Oxford and IBH Publishing Co. Pvt. Lt.

PAPER CODE: ZOO-105
PRACTICAL
5 CREDITS

1) Preparation of Mitotic chromosomes.
2) Karyotyping of chromosome
3) Study of Barr body in human using buccal smear
4) Isolation of genomic DNA from blood/tissue
5) Demonstration of Agarose gel electrophoresis
6) Physico-chemical properties of soil and water (Dissolved Oxygen, Free Carbon dioxide, alkalinity, Hardness, sulphate)
7) Assessing influence of light, temperature and moisture on plant germination and growth/animal behaviour and growth.
8) Assessment of density, frequency and abundance of plants/animal in a community using various techniques i.e. transect, quadrate etc.
9) Understanding ecosystem succession by studying various stages of vegetation / community assemblages development.
10) Insect diversity in soil.
11) Identification of aquatic organisms of different trophic levels and construction of food chain and food web.
12) Study of Ecological apparatus and their applications
13) Demonstration of endocrine organs in vertebrates.
14) Neuroendocrine system of cockroach - Dissection and display
15) Prothoracic gland of cockroach - Dissection and display and mounting
16) Thyroid and parathyroid gland of mouse/chicken - dissection and display
17) Pituitary gland of mouse/fish - Dissection and display
18) Histological study of pituitary, adrenal, testis, ovary, corpus luteum, pancreas and thyroid gland (Permanent slide)
19) Histology of ovary/accessory glands/corpus allatum/brain in insects
20) Pattern of evolution from museum specimen
21) Study of Mendelian Inheritance and gene interactions (Non Mendelian Inheritance) using suitable examples. Verify the results using Chi-square test
22) Evolutionary significance of Isozyme analysis
23) Construction of molecular of phylogenetic tree using ITS/COI/rRNA
24) Study of population genetics problems
25) Taxonomic Study: Insect spider model, Fish Model

PAPER CODE – ZOO-201
REPRODUCTIVE AND DEVELOPMENTAL BIOLOGY
4 CREDITS

UNIT-1 12 lectures

Ovarian and testicular physiology: Folliculogenesis and their control mechanisms, steroidogenesis and its hormonal regulation, menstrual cycle and its regulation, Female reproductive disorder, estrus cycle and its regulation, sertoli cell: structure and function; function of leydig cell.

UNIT-2 12 lectures

Fertilization- pre and post fertilization events: spermatogenesis and oogenesis, Structure of mammalian gametes mammals, Mechanism of implantation, organogenesis, Capacitation, Signal transduction pathway in acrosome reaction,placental hormones and their functions in mammals, Prevention of Polyspermy,contraception: hormonal and immune-contraception.

UNIT-3 12 lectures

Cell specification: The developmental dynamics of the cell specification, Cell commitment and differentiation, Development of gonands, totipotency and pluripotency, stem cells: Embryonic stem cells and adult stem cells, Haemopoietic stem cells : Blood cells formation, stem cell disorders and modes of cell type specification and their characteristics.

UNIT-4 12 lectures

Morphogenesis and cell adhesion molecules, Concept of morphogen gradients, role of paracrine factors in development, Hormonal control of amphibian metamorphosis, Embryonic induction, formation of organ rudiments and nucleo-cytoplasmic interaction in development.

UNIT-5 12 lectures

Introduction to assisted reproduction technologies: IVF, ICSI, GIFT and ZIFT, Teratogenesis and its principle, Teratogens and its effect in development,Contribution of teratology to developmental biology, Role of maternal contribution in early embryonic development in droshopila: maternal effect genes and zygotic genes, vulva formation in *Caenorhapdits elegans*, homeotic genes, and hox genes in development

RECOMMENDED BOOKS

1. Gilbert F. Scott, Developmental Biology, (9th Edition), 2010 (Sinauer Associates), Sunderland, Massachutts, USA.
2. Arora. P, Mohan and Arora, Himanshu, Embryology, 5th edition, 2017. Himalaya Publishing House.
3. Bruce A. White, Susan P. Porterfield, Endocrine and Reproductive Physiology, (4th edition), 2013, ISBN: 978-0-323-08704-9, Elsevier (MOSBY.
4. Arhtur. C. Guyton and John E. Hall, Textbook of Medical Physiology, (12th edition), 2006, Elsevier (Saunders) ISBN: 978-1-4160-4574-8.
5. E. Hadley, Mac , Levine. E, Endocrinology, International Edition. 2007 ISBN: 0131876066, 9780131876064 (Prentice hall).
6. Kumar Boral, Ashok, Mammalian endocrinology (4th edition), NCBA.

PAPER CODE: ZOO-202
GENES AND GENOMICS
4 CREDITS

UNIT 1: 12 Lectures

Structure and Organization genome – Nucleic acids as genetic material; DNA vs. RNA as genetic material; concept of gene and gene families; non-coding genes; concept of intron; C-value paradox, Secondary structure of DNA and conformation flexibilities, Unusual secondary structure of DNA; Interrupted genes and their evolution; Repetitive DNA; Tertiary structure and super-coiling of DNA; DNA packaging – nucleosome and higher order structure of chromatin, virus and bacterial genomes; organelle genome - mitochondrial genome and chloroplast DNA; RNA based genomes; Chromatin structure regulation.

UNIT 2: 12 Lectures

DNA replication, recombination and repair – General features of prokaryotes and eukaryotes replication; Directions and types of replication; Stahl and Meselson experiment; Enzymes of DNA replication; energetic of nucleic acid polymerization; accuracy during flow of genetic information; proof- reading activity; replication in mt and ct-DNAs; telomere maintenance, telomerase and aging; DNA damage and Errors; types of DNA repair mechanisms; cellular response to DNA damage, Double strand break repairs.

UNIT 3: 12 Lectures

Transcription process - Prokaryotic Transcription; Transcription unit; Promoters- Constitutive and Inducible; Operators; Regulatory elements; Initiation; Attenuation; Termination-Rho-dependent and independent; Antitermination; Transcriptional regulation-Positive and negative; Operon concept-lac, trp, and gal operons; Transcriptional control in lambda phage; Eukaryotic transcription and regulation; RNA polymerase structure and assembly; RNA polymerase - I, II, III; Eukaryotic promoters and enhancers; General Transcription factors; TBP and TAF; Activators and repressors.

UNIT 4: 12 Lectures

Post-Transcriptional Processing - Processing of hnRNA, tRNA, rRNA; 5'-Cap formation; 3'-end processing and polyadenylation; splicing Mechanisms; Trans splicing; RNA editing; Nuclear export of mRNA; mRNA stability; Catalytic RNA; Transcriptional and post-transcriptional gene silencing by microRNA.

UNIT 5: 12 Lectures

Translation and transport - Translation machinery; Ribosomes; Composition and assembly; Universal genetic code; Degeneracy of codons; Termination codons; Isoaccepting tRNA; Wobble hypothesis; Mechanism of initiation, elongation and termination; Co- and post-translational modifications; Genetic code in mitochondria; Transport of proteins and molecular chaperones; Protein stability; Protein turnover and degradation.

RECOMMENDED BOOKS

1. Watson et al. 2014. Molecular Biology of the Gene, 7th edition
2. Lizabeth A. Allison et al. 2007. Fundamental Molecular Biology. 1st edition
3. T.A. Brown. 2007. Genome 3. 3rd edition
4. Robert F. Weaver. 2012. Molecular Biology. 5th Edition.
5. Jocelyn E. Krebs et al. 2014. Lewin's GENES XI. 11th edition

PAPER CODE: ZOO-203
BIOCHEMISTRY AND METABOLISM
4 CREDITS

UNIT-1 10 lectures

Protein structure and functions: Classification and structural features of amino acids; Peptides and peptide bonds; primary and higher order structures of proteins; Protein denaturation and Folding; Protein Structure and function (ribonuclease A, myoglobin, etc).

UNIT-2 12 lectures

Sugars and lipids: General characteristics; mono, polysaccharides and Glycoproteins: structure and functional significance - cellular structure, energy storage, signaling; Glycosylation and its importance; lipid – structure and properties of important members of storage and membrane lipids; lipoproteins.

UNIT-3 12 lectures

Enzymatic Catalysis – General properties of enzymes; principles of enzyme catalysis; enzyme kinetics and mechanism of enzyme action, Effect of substrate, pH, temperature; Michaelis-Menten kinetics; enzyme inhibition: types and mechanism; regulation of enzyme activity; Enzymes as drug targets.

UNIT-4 12 lectures

Bioenergetics: Principles of Bioenergetics, Equilibria, free energy; High energy compounds; Phosphoryl Group Transfers and ATP; Coupled reactions; Biological Oxidation-Reduction Reactions; Reducing power and Redox potential; Glycolytic pathways and rate limiting reactions; Kreb's cycle; Oxidative phosphorylation; electron transport chain; Fo-F1 ATP synthase

UNIT-5 14 lectures

Metabolism and its regulation: Overview of metabolism, metabolic flux, metabolism of primary metabolites – monosaccharides, lipids, essential amino acids and nucleotides. Mammalian fuel metabolism integration and regulation: Tissue-Specific Metabolism: The Division of Labour, Hormonal Regulation of Fuel Metabolism, metabolic homeostasis, metabolic disorders.

RECOMMENDED BOOKS

1. Lehningers Principles of Biochemistry, Nelson and Cox, Sixth Edition or recent edition, Macmillan Press.
2. Principles of Biochemistry, Voet, Voet and Pratt, 5th edition (2012) or recent edition, Wiley International Publications.
3. Harper's Illustrated Biochemistry, Murray, Granner and Rodwell, (27th Ed.), McGraw Hill, New York, USA.
4. Practical Biochemistry – Principles and Techniques, Wilson and Walker, Cambridge University Press, Cambridge [Latest edition]

PAPER CODE: ZOO-204
BIOINFORMATICS AND BIOSTATISTICS
4 CREDITS

Unit-1 12 Lectures

Introduction to bioinformatics; computational biology vs. bioinformatics; basics of genomics and proteomics; biological databases – protein and nucleic acid databases; correlation between databases; NCBI, EBI; BLAST and FASTA; File formats and its importance; Database submission; retrieval; relationship between sequence and biological functions; Sequence searching using BLAST and FASTA; Alignment of gene sequences; local and global alignment

Unit-2 12 Lectures

Analysis of DNA sequence: Finding and calculating core nucleotide sequence, Predicting ORFs; location of transcription start point and end point; getting polypeptide sequence of the extracted core nucleotide sequence; designing primers of specific gene; generation of restriction maps; Molecular Phylogenetic study using bioinformatics; Generating phylogenetic trees based on DNA sequence and evolutionary relationship.

Unit-3 12 Lectures

Analysis of proteins: Protein classification, Proteins-structure, folding and function studies; homology modeling, trading, prediction of protein structure (secondary and 3 dimensional), tools for structure prediction, validation and visualization; Computer assisted drug design- concept, methods and practical approaches, various computational methods applied to design the drugs: molecular docking; ligplot analysis; QSAR and 3DQSAR.

Unit-4 12 Lectures

Basic principles of Biostatistics - population, sample, variable, parameter, primary and secondary data; screening and representation of data - frequency distribution, tabulation, bar diagram, histograms, pie diagram, mean, median, mode, quartiles and percentiles; variance; standard deviation; standard error; coefficient of variation; Probability and distributions - definition of probability; independent events; Addition and multiplication rules, conditional probability.

Unit-5 12 Lectures

Regression analysis- Fitting of lines of regression, regression coefficient, coefficient of determination; hypothesis, critical region, and error probabilities, tests for proportion, equality of proportions, equality of means of normal populations when variances known and when variances are unknown: chi-square test for independence, P- value of the statistic, T-test analysis, confidence limits, introduction to one way and two-way analysis of variance.

RECOMMENDED BOOKS

1. Jin Xiong 2006. Essential Bioinformatics. 1st edition
2. Andreas D. Baxevanis and B. F. Francis Ouellette. 2001. BIOINFORMATICS: A Practical Guide to the Analysis of Genes and Proteins. 2nd edition.
3. Pavel Pevzner and Rhon Shamir. 2011. Bioinformatics for Biologists. 1st edition.
4.

PAPER CODE: ZOO-206-OE1
AQUACULTURE
2 CREDITS

1. Aquatic Resources; Inland Water resources as an environment for aquatic communities, global water balance and research of aquatic resources, conservation and management of water resources for the use of aquatic communities, Classification of diversity of aquatic resources, Characteristic features of fresh water, brackish water and marine water environment, Origin and types of lake basins.
2. Aquatic ecosystem (abiotic profile, different components, light attenuance characters and role of visible ray, thermal profile, salinity, ionic concentration, dissolved oxygen, carbon dioxide and nutrients; their role in maintenance of ecosystem; trophies state index.
3. Aqatic biocoenosis; concept of aquatic communities, attributes of planktons, nektons, sestons, periphytons, benthos, macroinvertebrates and macrophytes; their role in aquatic biotopes, classification of plankton, seasonal and diurnal variation of planktons.
4. Aquatic productivity: Principle, concept and measurement technique of primary and secondary productivity, classification of lakes based on productivity, ontogeny of Lake Environment; process and impact on biotopes.

PAPER CODE: ZOO-206-OE2
PARASITE BIOLOGY
2 CREDITS

1. Introduction to parasitology; animal associations and host – parasite relationship; Recognition and entry processes of different pathogens like bacteria, viruses into animal and plant host cells, alteration of host cell behavior by pathogens, virus-induced cell transformation, pathogen-induced diseases in animals and plants, cell-cell fusion in both normal and abnormal cells.
2. Distribution of diseases and Zoonosis caused by animal parasites; neglected tropical diseases; morphology, lifecycle, mode of infection of *Plasmodium*, molecular biology of *Plasmodium* – drug targets, mechanism of drug resistance, vaccine strategies and proteomic approaches.
3. Morphology, life-cycle, mode of infection of *Leishmania*, molecular biology of *Leishmania* – drug targets, drug resistance and vaccine strategies; Morphology, biology, life-cycle, mode of infection of *Entamoeba*, morphology, biology, life-cycles, mode of infection of *Giardia*; gastro-intestinal nematodes, morphology, biology, life-cycles, modes of entry of *Schistosoma*, *Wuchereria*, *Brugia*, *Ancylostoma*, *Trichinella* and *Dracanculus*.
4. Molecular biology of nematodes, vaccine strategies, Immune response and self-defense mechanisms, immune evasion and biochemical adaptations of parasites; parasites of veterinary importance; Parasites of insects and their significance; morphology, biology, lifecycle and infection of crop plants by plant parasitic nematodes, plant parasitic nematodes, host parasite interactions, Chemotherapeutic targets in external covering and neuromuscular structures of helminth parasites.

PAPER CODE: ZOO-205
PRACTICAL
5 CREDITS

1. Study of different types of eggs.
2. In vitro culture of chick embryo.
3. Study of developmental stages of frog/chick embryos from permanent slide.
4. Dissection of male/female reproductive system of cockroach/Grasshopper
5. Identification of invertebrates.
6. Identification of larval forms of invertebrates.
7. Study of chromosome banding techniques
8. Extraction of DNA from mammalian tissue
9. Extraction and detection of chromatin from mammalian tissue.
10. Spectrophotometric analysis of DNA
11. Spectrophotometric analysis of DNA
12. Preparation of solutions of different normality, molarity, and dilutions.
13. Preparation of a 'Good' buffer.
14. Estimation of protein by Lowry's method.
15. Enzyme assay of any one enzyme.
16. Physico-chemical or Kinetic characterization of enzyme.
17. Web–based tools for sequence searches and data mining
18. Downloading and visualizations of protein structures
19. Study of Ramachandran plot using 3D protein molecules.
20. Protein structure building and Protein Homology Modeling
21. Analysis and validation of protein structure using bioinformatics tools
22. Construction of phylogenetic trees for DNA and proteins.

THIRD SEMESTER

PAPER: ZOO-301: BIOLOGICAL TOOLS AND TECHNIQUES (4 CREDITS)

Unit-1

Microtomy and Microscopy: Basics of Microtomy - Tissue fixation, dehydration, clearing, infiltration, embedding for paraffin method, sectioning, mounting, staining - specific and differential staining; Eosin and Hematoxylin staining; Cryopreservation and Cryotomy; Histochemistry - principles and methodology; Microscopy – Basics of simple and compound microscopes, Types of microscopes - Simple, Compound, Confocal, Fluorescence, and Electron microscopes and their working principles; Flowcytometry - working principle.

Unit-2

Separation techniques: Centrifugation - principles and types of centrifugation, Low and high speed centrifuges, density gradient centrifugation, ultracentrifuge; Applications of centrifugation - preparative techniques, analytical measurements; care of Centrifuges and rotors; Chromatography – principles and types (paper chromatography, thin layer chromatography, gas chromatography, gel permeation chromatography, ion-exchange chromatography, high pressure liquid chromatography, affinity chromatography); Isolation of biomolecule using chromatography techniques, Separation of molecules using Soxhlet and Clevenger apparatus.

Unit-3

Tools for biological assays and electrophoresis: Basics of mole, molarity, and normality; Principle of colorimeter and spectrophotometer; Molecular analysis using UV/visible spectrophotometer; concept of blank solution and reference; preparation of solutions, buffers, and standard curves; concept of IC_{50} and LD_{50}; Electrophoresis: types and working principles (Paper, PAGE, SDS-PAGE, Agarose gel electrophoresis, Pore gradient, 1D and 2D electrophoresis, Isoelectric Focusing); Staining and visualizations of gels (for both protein and nucleic acids); Troubleshooting in gel running

Unit-4:

PCR and Blotting techniques: Basics of nucleic acids and replication; Fidelity and processivity of enzymes; principles and types of PCR; PCR primer designing – specific and degenerate primers; Enzymes for PCR; Rolling cycle amplification; Blotting techniques – Southern, Northern, and Western Blot analysis; Basics of probes; DNA fingerprinting; Gel retardation assay; RNase protection assay; Hybridization techniques – FISH, GISH, and Colony hybridization.

Unit-5

Gene manipulation and sequencing techniques: Principle and application of gene silencing; Gene knockouts and Gene Therapy; Creation of knockout mice; Gene replacement; Gene targeting and disruption; CRISPER method of gene editing; DNA sequencing – Enzymatic and Chemical basis, Automated DNA sequencing, RNA sequencing, Chemical Synthesis of oligonucleotide.

PAPER: ZOO-302: ANIMAL PHYSIOLOGY AND IMMUNOLOGY (THEORY) 4 CREDITS

UNIT I: Circulation and Respiration

Blood: Haemostasis, Haemoglobin: Role in oxygen and Co_2 transport, Oxygen dissociation curve and their physiological significance, Heart: Origin and conduction of cardiac impulse, cardiac cycle, ECG, Neurogenic and myogenic hearts, Respiratory centers: organization and function, Surfactant, Basal metabolic rate and its measurement, Respiratory adjustments, Hypoxia, Dyspnea, High altitude: decreased pressure of gas.

UNIT II : Muscle, Nutrition and Excretion

Ultra structure of skeletal muscle fibers: Proteins of the myofilaments, actin-myosin interaction, sarcoplasmic reticulum and role of calcium in contraction, energetics of muscle contraction.
Absorption of macronutrients, Gastrointestinal hormones and regulation, Obesity and starvation.
Tubular reabsorption and secretion, RAS and hormonal regulation of urine formation, Acid-base balance and homeostasis.

UNIT III: Nervous system, Vision and hearing

Axonal transmission: Motor neuron and other types of neurons, Synaptic transmission, Types of synapses and synaptic knobs, Excitatory and inhibitory post-synaptic potential, Chemical transmission, neurotransmitters.
Eye: Retinal components, Photoreceptors: Ionic basis of potential generation, Ear: Basilar membrane, and organ of Corti: Genesis of action potential in afferent nerve fibers.

UNIT IV: Overview of the immune system, structure and function of antibodies and MHC

Cells and organs of immune system, Components of the immune system, principles of innate and adaptive immunity, antigen and immunogenicity, antigen and its properties, super antigens, epitopes, antigen recognition by B and T- cells, clonal selection theory.

Antibodies: Major classes of antibody, structure and biological activities, antibody diversity, Class switching.
structure and function of MHC complex; antigen processing and presentation to T lymphocytes— antigen presenting cells, Innate Immunity– pattern recognition in the innate immune system, role of TLRs in innate immune response, complement system.

UNIT V: Effector mechanisms and regulation of immune responses, immunity in health and disease
Cell mediated and humoral immune response, production of effector T- cells, cytotoxic T- cell effector mechanisms; immunological memory.
Innate and adaptive immunity to infection, evasion of the immune response by pathogens; immunodeficiency diseases: inherited immunodeficiency diseases, acquired immune deficiency syndrome; Allergy and hypersensitivity: IgE and hypersensitivity diseases; Tolerance and Autoimmunity: General features and mechanisms of immunologic tolerance, vaccines, transplantation rejection.

ZOO-303: GENETICS, CYTOGENETICS AND GENETIC ENGINEERING (THEORY) 4 CREDITS

Unit I: Cytogenetic

Chromatin Structure; Chromosome organization; Organelle genome organization: Origin and genome organization of mitochondria and chloroplast; Telomere; Centromere, Euchromatin and Heterochromatin, Karyotyping, Chromosome Banding, Chromosomal aberration/anomalies, mutation and cancer (CML,and Burkitt's Lymphoma).

Unit II: Principle of Genetics

Mendelism and its extension (multiple alleles, incomplete dominance, co-dominance, gene interactions, epistasis, pleiotropy, essential and lethal genes, gene action from genotype to phenotype- penetrance and expressivity), Chromosomal Theory of Heredity, Sex Linkage, Sex-limited, Sex-influernced Characters, Sex Determination, Dosage compensation, Mechanism and types of crossing over, Chromosome segregation and gene mapping; Epigenetic and Epigenetic inheritance.

Unit III: Population genetics

Genotype and allele frequency, Hardy-Weinberg's law of equilibrium, Factors affecting Hardy-Weinberg's law; Genetic Variation; Genetic hitchhiking; Role of genetics in conservational biology, Genetic basis of speciation.

Unit IV: Quantitative Genetics

Genetic analysis of complex traits - complex pattern of inheritance, Quantitative traits, Continuous traits, Threshold traits; Inbreeding, Heritability, Statistical method, Phylogeny, Response of Selection.

Unit V: Genetic Engineering

Restriction enzymes; DNA modifying enzymes; Linkers; Adaptors; Labeling of DNA: Nick translation, Random priming, Radioactive and non-radioactive probes; Cloning, expression cloning, identifying specified clones; Vectors; Transformation and Transfection techniques; Construction of libraries, cDNA and genomic libraries, jumping libraries; Isolation of mRNA and total RNA; Somatic and germ-line therapy- *in vivo* and *ex-vivo*; Y2H; Phage display; Transgenic.

PAPER ZOO-304:
Applied Entomology and Fishery (Theory)
4 CREDITS

Unit 1. Introduction to Entomology: Characteristics of class insecta, Classification of insects up to orders with Salient features and common examples. Morphological features and types of: Eyes, antennae, Mouth parts, Appendages. Social life in insects, Aquatic insects, Economic importance of insects, Food grain pests, Integrated Pest management. 10 h

Unit 2. Beneficial Insects: Parasitic and predatory insects and their role in weed management and pollination, insects as decomposers and their role in nutrient recycling. Life cycle, commercial culture, and commercial products of Honey Bee, Lac insect and Silkworm. 8 h

Unit 3. Medical Entomology: Insects as vectors of important diseases in Humans and animals. Insects Adaptation as vectors; Orders with insects as vectors (Diptera, Siphonaptera, Siphunculata, Hemiptera); External morphology, Life cycle, medical importance and control of *Anopheles*, *Aedes* and *Culex*; Phelbotomine sandly; Flea and Human louse (head, body and pubic louse) as disease vectors; Bugs as insect vectors; Blood sucking bugs; Chagas disease; Control and prevention methods. 12 h

Unit 4. Introduction to Fishery: General anatomy: Internal and External features; Basic osteology, Types of scales and fins, locomotion. Food and feeding habits of cultivable fishes; Feeding habits and habitat adaptations, Length-Weight Relationship and Condition Factor. Taxonomy and Classification of fishes. 8 h

Unit 5. Fisheries Resources of India: Status, diversity and distribution of freshwater fishes of India and Northeast India. Exotic food fishes of India-history, importance and impact to local environment, Ornamental fishes. Riverine fisheries- important river systems, dams and their impact, fish ladders. Cold water fisheries - ecology of hill streams, biology of important cold water fishes of India, recreational fishing. Estuarine fisheries- major estuarine systems of India. Marine fisheries – coastal and deep sea fisheries. 12 h

Unit 6. Fishing Technology, Management and Conservation: Fishing crafts and gears, Technologies for localizing catches- remote sensing, sonar, radar. Stock assessment and management - Natural and Applied markers- marking and tagging. Post harvest technology; Fish spoilage, rigor mortis, rancidity, enzymatic spoilage, microbial spoilage; Fish preservation and processing- principles and methods, fishery by-products. Methods of Genetic selection and hybridization of cultured species, Concept of cryopreservation and transgenic species, live gene bank and its importance in conservation. Fishing laws and regulations. Extension services. 10 h

References:

1. A general text book of entomology, Imms , A. D., Chapman & Hall, UK.
2. Introduction to the study of insects, Borror, D. J., Triplehorn, C. A., and Johnson, N. F.,M Saunders College Publication, USA
3. The Insects: Structure and function, Chapman, R. F., Cambridge University Press, UK.
4. Service, M.W. (1980) A Guide to Medical Entomology. Macmillan Press.
5. Fish and Fisheries of India. V.G. Jhingran. Hindustan Publishing Corporation, India.
6. The Physiology of Fishes. 2013. Evans, D. H. and Claiborne, J. D., Taylor and Francis
7. Handbook of Fisheries and Aquaculture. 2013. Indian Council of Agricultural Research, ICAR, DIPA, New Delhi, India. Group, CRC Press, UK.
8. Biology of Fishes. 2008. Bone, Q. and Moore, R., Talyor and Francis Group, CRC Press, U.K.

PAPER ZOO-306 E: (THEORY) **3 CREDITS**

Open Elective-I

Nutrition, Health and Diseases

1. Introduction: Concept of food and nutrition, balanced diet, Nutritional status, malnutrition, nutrients composition, nutrient density and importance; Nutritional care, physiological, social and psychological functions of food. Human Energy System, Total Energy Requirement, Body Composition: Fatness and Leanness, Body mass index. 8 h
2. Nutritional Biochemistry: Nature, Classification, Importance, Functions, Recommended Intake and imbalance intake of Carbohydrates. Fiber - non digestible component of carbohydrate. Lipids - Physical and Chemical Nature, Fatty Acids - essential non-essential, MUFA, PUFA and Triglycerides, Food Lipids and Health, Lipid-Related Compounds. Proteins - Physical and Chemical Nature, amino acids, Functions of Protein, Protein and Nitrogen Balance, Protein Quality, Requirements and Intake. Digestion, absorption and metabolism of proteins, carbohydrates and lipids. Vitamins – Fat soluble, water soluble, Minerals and Trace elements. Water and electrolytes: requirements, forces controlling distribution, water balance and influencing factors, role of water in the body. 12 h
3. Nutritional Disorders: Definition, meaning and causes, Diabetes, Protein energy malnutrition, hypertension, hypervitaminosis and hypovitaminosis, Deficiency diseases of minerals and trace elements. Obesity - Meaning, Development of Obesity, Obesity as a Disease and its treatment. 10 h
4. Clinical nutrition and diet therapy: Role of Nutrition in Clinical Care, Nutritional requirements of newborn, young, adolescents, adults and pregnant mothers. Nutritional needs of patients undergoing treatment, injuries, surgeries; drug-nutrient interactions, nutritional assessment and requirements in diabetes, coronary heart and pulmonary diseases, renal diseases, AIDS, cancer, Alcoholism and its effects. 10 h

References and further readings:

1. Williams' Essentials of Nutrition and Diet Therapy. Eleanor D. Schlenker and Joyce Gilbert. 11th Edition. Gilbert Mosby, an imprint of Elsevier Inc. an affiliate of Elsevier Inc. ISBN: 978-0-323-18580-6.
2. Lippincott's Biochemistry Seventh Edition Denise R. Ferrier,
3. Fundamentals of Foods, Nutrition and Diet Therapy, Sumati R. Mudambi and M.V. Rajagopal. 5th Edition. New Age International (P) Ltd., Publishers, New Delhi-110002.
4. Vander et al.: Human Physiology: The Mechanism of Body Function, Eighth Edition, The McGraw−Hill Companies.
5. Harper's Illustrated Biochemistry, Murray, Granner and Rodwell, (27th Ed.), McGraw Hill, New York, USA.

FOURTH SEMESTER
SPECIALISATION: MOLECULAR BIOLOGY AND IMMUNOLOGY

PAPER CODE: ZOO-401C: GENE MANIPULATION AND GENETIC ENGINEERING 4 CREDITS

Unit1: Molecular Basis of Life

DNA, RNA and proteins, Molecular interactions in nucleic acids and proteins, molecular stability; Protein – structural hierarchy and structural conformations, motifs and domains, membrane proteins and stability; Ramachandran plot and backbone conformation; Free energy and thermodynamics, Thermodynamics of molecular interactions – molecular recognition, specificity, ultra-sensitivity of molecular interactions, Structure-function relationship

Unit 2: Molecular Cloning

Cloning methodology: Basic biology of cloning vectors: restriction enzymes; cutting and joining DNA molecules – Cohesive and blunt end ligation; Linkers; Adaptors, homopolymer tailing; cloning vectors - plasmids, phages, single stranded DNA vectors, high capacity vectors, retroviral vectors, yeast vectors; expression vectors and other advanced vectors in use; Plant based vectors; Ti and Ri as vectors; Methodologies - Insertion of Foreign DNA into Host Cells; Transformation; creating and screening of DNA library; Isolation of mRNA and total RNA; cDNA and genomic libraries; Jumping and hopping libraries; cDNA and genomic cloning; Southwestern and Far-western cloning; Expression cloning; Principles in maximizing gene Expression; Gene cloning and DNA analysis; Gene cloning in Medicine and forensic

Unit 3: Mutagenesis and Protein Engineering

Mutation – types, and repair mechanisms; Mutagenesis: Site specific mutagenesis; PCR in molecular diagnostics - Viral and bacterial detection; PCR based mutagenesis; Mutation detection techniques: SSCP, DGGE, RFLP, Oligo Ligation Assay (OLA), Mismatch Chemical Cleavage (MCC), Allele-Specific Amplification, Protein Truncation Test; Protein engineering – introduction of new amino acids, creation of disulfide bonds, increasing or decreasing enzyme activity - Zinc-finger nucleases (ZFNs), Transcription activator-like effector nucleases (TALEN); Cre-Lox technology; CRISPR/Cas9-system

Unit 4: Animal Cell culture

Brief history of animal cell culture; Basic requirement for animal cell culture; cell culture media, serum and reagents; Culture of mammalian cells; tissue and organs; Primary and secondary cell culture; Continuous cell lines; Suspension culture; Common cell culture contaminants; Application of animal cell culture for toxicity study and production of vaccines and pharmaceutical proteins; Stem cells and their application

Unit 5: Comparative Genomics and Genome Mapping

Identification and classification of organisms using molecular markers - 16S rRNA typing/sequencing, single nucleotide polymorphism; Molecular markers as tools for mapping, restriction enzymes, restriction fragment length polymorphism, randomly amplified polymorphic DNA, simple sequence length polymorphism, amplified fragment length polymorphism; entire genome expression analysis - microarrays, expressed sequence tags, serial analysis of gene expression,

PAPER ZOO-402C: MOLECULAR BIOLOGY OF THE CELL 4 CREDITS

UNIT 1: Membrane and membrane Transport

Transport - recapitulation of the plasma membrane; mechanism of diffusion, facilitated diffusion, active transport with suitable examples; movement of water; Donnan equilibrium; ion movements and cell function: acidification of cell organelles and stomach; transepithelial transport; maintenance of cellular pH; cell excitation; bulk transport: receptor mediated endocytosis; protein sorting and targeting to organelles; molecular mechanism of the secretory pathway; secretion of neurotransmitters

UNIT 2: Cell motility and energetics

Cellular shape, motility and energetics- cytoskeletal elements in cell shape and motility: structure and dynamics; role in cell locomotion and mitosis; Intercellular communication: extracellular matrix; cell- cell and cell-matrix adhesion; gap junctions; cellular energetics: oxidation of glucose and fatty acids; shuttles across mitochondria; the proton motive force; F0F1 ATP synthase; mechanism and regulation of ATP synthesis.

UNIT 3: Cell Cycle

Life cycle of a cell - cell cycle and its regulation; checkpoints in the mammalian cell cycle; tumor suppressors and role of helicases; regulation of cell proliferation and differentiation by hormones, neuropeptides and growth factors; cell differentiation; apoptosis; turnover of cellular components: targeting of proteins to lysosomes for degradation; degradation of cytosolic proteins; cells in culture: requirements for cell culture; aseptic technique; primary culture; cell lines; organotypic cultures; cytotoxicity assays.

UNIT 4: Mutations; Oncogenes and Tumor suppressor genes

Nonsense, missense and point mutations; Intragenic and Intergenic suppression; Frameshift mutations; Physical, chemical and biological mutagens; Normal and cancer cells, Oncogenes - viral and cellular oncogenes (Proto-oncogenes, tumor suppressor genes and genome maintenance gene), Oncogenes as transcriptional activators; Tumor suppressor genes from humans; mutation and mis-regulation of cell growth and cell cycle; Function of pRB and p53 tumor suppressor proteins; Molecular approaches to cancer treatment

UNIT 5: Cell Growth and Apoptosis

Overview of the birth, lineage, and death of cells, fate of early embryo, Embryonic and Induced Pluripotent Stem Cells, Differentiation of stem cells and niche, Cell polarity and asymmetric division, Apoptosis – apoptotic pathways (intrinsic and extrinsic) and their evolutionary conservation, Caspase and apoptosis, role of mitochondria in apoptosis, Pro-apoptotic and antiapoptotic proteins.

PAPER: ZOO-403C: MOLECULAR IMMUNOLOGY (THEORY) 4 CREDITS

UNIT 1: Overview of Immune System

Introduction- immunity- types- innate and acquired; Cell and organs involved in defense mechanisms of the body, Primary and Secondary lymphoid organs; Immunoreactive cells- structure and functions- macrophages, granulocytes, NK cells, T and B lymphocytes, lymphocyte subpopulation in humans, CD nomenclature.

UNIT 2: Immune responses generated by B and T lymphocytes

Immunoglobulins- assembly and secretion of immunoglobulins, Ig superfamily, antigenic determinants, organization of multigene, variable region gene arrangement, and expression of Immunoglobulin genes, class switching, diversity isotype, allotype, idiotype, differentiation and maturation, BCR; T-Cell organization, expression of genes, activation, differentiation, and maturation, TCR, Functional T-Cell Subsets; Cell-mediated immune responses, Antibody mediated effectors mechanisms.

UNIT 3: Regulation of Immune Response

Cytokines- Properties, receptors and cytokine antagonists, Cytokine secretion by TH 1 and TH 2 subsets, cytokine-related diseases, Therapeutic uses of cytokines and their receptors, Cytokines in Hematopoiesis; Complement system- function, components, activation and regulation of complement systems; Major Histocompatibility Complex (MHC)- Organization, types, distribution and regulation, MHC and immune-responsiveness- Processing of intracellular antigen for presentation by Class I MHC, Processing of antigen for Class-II MHC presentation follows a different pathway.

UNIT 4: Antigen – Antibody Interactions

Immuno-chemistry of Antigens- Immunogen, Immunogenicity and Antigenicity, haptens, hapten carrier system, Superantigen, Toxiods, Adjuvants, Immune modulators; Hybridomas, monoclonal, polyclonal; Antigen-Antibody interaction- Principles and applications, Thermodynamics and binding strength of Ag-Ab interaction- affinity, cross-reactivity, specificity; T cell B cell antigenic properties, epitope mapping, Precipitation, Agglutination; Advanced immunological techniques- RIA, ELISA, Western blotting, ELISPOT assay and Immunofluorescence.

UNIT 5: Clinical Immunology and Vaccinology

Immunity to Infection: Bacteria, viral, fungal and parasitic infections; Inflammation; Hypersensitivity–Type I-IV; Autoimmunity– type, mechanism and its treatment; Transplantation-Immunological basis of graft rejection, general and specific immunosuppressive therapy; Tumor immunology- Tumor antigens, Immune response to tumors and immune evasion by the tumor; Immunodeficiency- Primary and acquired immunodeficiency; Immunization- Active and Passive Immunization, Vaccinology- Rationale vaccine designs; Transfusion of immuno-competent cells; Stem cell therapy.

PAPER: ZOO-404C (P): PRACTICAL **4 CREDITS**

1. Antigen-Antibody interaction: Single Radial Immuno-Diffusion/ Double Immuno-diffusion.
2. Comparative genomic DNA from fish, insect or blood.
3. PCR amplification using a universal primer
4. Protein profiling using SDS-PAGE electrophoresis.
5. HPTLC profiling of secondary metabolites from plants or animal source
6. Chromosome staining from different species.
7. Study of cell cycle.
8. Cell viability and toxicity assay.
9. Free radical scavenging assays.
10. In silico study of protein interaction with foreign substances.

PAPER: ZOO-405C: DESSERTATION/ PROJECT **6 CREDITS**

Suggested Reading

Cooper GM, Hausman RE (2013). The Cell-A molecular Approach. 6th Edition, Sinauer Associates Inc.

Watson, J.D., Tania, A.B., Stephen, P.B., Alexander, G., Michael, L., Richard, L. (2017). *Molecular Biology of the Gene*. 7th Edition, Cold Spring Harbor Laboratory Press, New York.

Brown, T.A. (2007). *Genome 3*. Garland Science Publishing

Clerk, D.P. (2010). *Academic Cell - Molecular Biology*. Publisher - Elsevier Science

Delves, P.J., Martin, S.J., Burton, D.R., Roit, I.M. (2011). *Essential Immunology*. 12th Edition, Wiley Blackwell Publishing.

Glick, B.R., Pasternak, J.J., Patten, C.L. (2010). *Molecular Biotechnology: Principles and Application of r-DNA*. 4th edition, ASM Press, USA

Primrose, S.B., Twyman, R.M. (2006). *Principles of Gene Manipulation*. 7th edition, Blackwell Publishing, USA.

Goldsby, R.A., Kindt, T.J., Osborne, B.A., Kuby, J. (2003). *Immunology*. 5th edition, W. H. Freeman and Company, New York.

Department of Zoology Bodoland University,
Kokrajhar Assam
Syllabus for M.Sc. Sem IV Special Paper - Fish and Fisheries Science

Course structure:

Sl. No.	Paper Code	Title of Paper	Full Marks (Exam+Internal)	Credits
1.	ZOO-401F:FFI (Theory)	Anatomy and Physiology of Fish	80+20	4
2.	ZOO-402F FF-II (Theory)	Fish Diversity and Aquatic Resources	80+20	4
3.	ZOO-403F: FF-III (Theory)	Culture and Nutrition of Fish	80+20	4
4.	ZOO-404F: FF-IV (Practical)	Practical	80+20	5
5.	ZOO-405F: FF-V (Dissertation)	Dissertation	60+40	5

ZOO-401F:FFI (Theory): Anatomy and Physiology of Fish **4 Credits**

UNIT I: Feeding, Digestion and Gas exchange in Fish 12hours

Categories of food, Feeding habits and intensity. Structure of digestive system in different fishes; Associate digestive gland and their functions, Modifications of Digestive system in fish. Physiology of Digestion and absorption of food. Role of enzymes and hormones in the regulation of digestion. Structure of respiratory system in fin fishes: structure and function of gills; pseudobranch, Air breathing organs and their structures. Mechanism of gas exchange. Swim bladder and its modification (Dipnoi, teleostei), Gas secretion complex, weberian ossicle: structure, arrangement and functions. Bouyancy in fish.

UNIT II: Fish Circulatory and Excretory System 12hours

Hematology of fin fishes, Cardiovascular physiology of fin fishes, Gas transport, Acid balance. Comparative anatomy of Kidney in different fishes, rectal gland, chloride cell; Nitrogen excretion and metabolism, osmoregulation of fin fishes: osmotic regulation in freshwater and marine teleosts.

UNIT III: Reproductive and Endocrine System 12 hours

Structure and physiology of reproductive system of fin fishes, physiological adaptation for reproduction. Endocrine glands of fin fishes and their hormonal regulation, Neuroendocrine system of fin fishes. 2

UNIT IV: Bioluminescence and reception in fish 12 hours

Sources of colour: chromatophores; iridiocytes; control of chomatophores; effect of diet and water quality on colouration, structure of luminous organs or photophore; types of luminescence and contol of luminescence; mechanism of light production from luminous organs; biological significance of luminescence; Families of light producing fishes. Important sensory organs in fish, electric organ, chemoreception etc. Lateral line system: structure and function.

UNIT V: Immunity, Stress and Diseases in Fish 12 hours

Phylogeny of fish immune system. Lymphoid tissues and cellular components of immune system. Basic principles of immune system in fishes, Endocrine control of immune system. Principles of stress resistance; stress tolerance, stress indicators in fish, Phagocytic systems; Antigen processing and MHC; Immunostimulant, immunomodulation. Parasitic and nutritional diseases: Infectious bacterial and viral diseases, water, soil, environmental parameters and their effects on fish health.

Suggested readings:

1. Pandey and Shukla (2010) Fish and fisheries, Rastogi publications.
2. Schreck, C.B.(2016) BIOLOGY OF STRESS IN FISH: Fish Physiology (Anthony P. Farrell and Colin J. Brauner) Academic Press(Elsevier) 125 London Wall.
3. Samantaray (2015) Physiology of Finfish &Shellfish, New India publishing agency.pp-
4. Moyle, P.B and Cech,J.J.(2011)Fishes: An introduction to Icchthyology(5th ed.)PHI learning private limited,New Dehli-110001.
5. Khanna, S.S and Singh, H.R. (2009) A text book of fish biology and fisheries.NPH,New Delhi110006.
6. Bone, Q. and Moore, R.H.(2008) Biology of fishes (3rd ed). Taylore and Francis Group,USA & UK.
7. Secombes, C.J.,et al.(2009) Fish Defenses Volume 1: Immunology (Giacomo Zaccone ,A. GarcíaAyala,B.G. Kapoor) Published by Science Publishers, Enfield, NH, USA (printed in India).
8. Roberts, R.J et al.(2012)Fish Pathology (4thed) (Ronald J. Roberts).A John Wiley & Sons, Ltd., Publication.
9. von der Emde, R., Mogdans, J. and Kapoor, B.G. 2004. The Senses of Fish Adaptations for the Reception of Natural Stimuli. Narosa Publishing House, New Delhi, India.

ZOO-402F: FF-II (Theory): Fish Diversity and Aquatic Resources 4 Credits

Unit I. Diversity, Distribution and behavior of fish. 14 h

Classification and Identification of Fish. Methods employed in Phylogenetic Studies. Evolutionary Strategies. Diversity and Biogeographical distribution of major groups of fishes. Feeding, schooling, migration, courtship, mating and parental care in fish. Dams and their effect on fish migration. Larvivorous fishes. Impact of exotic fish species and GMOs on aquatic biodiversity. Biotechnology in fish conservation.

Unit II. Fisheries resources of India 12 h

Aquatic resource and livelihood. Riverine fisheries, Cold water fisheries, Estuarine fisheries (Chilka lake and backwater lagoons in Kerala), Marine fisheries of India. Ecology and fisheries of beels. Biology of commercially important fishes of India (sardine, mackerel, hilsa, mahseer). Development, Exploitation and management of Reservoirs. Impact of interlinking of rivers on fisheries.

Unit III. Morphometry, Fishing Techniques, Stock Assessment and Management. 12 h

Morphometric study of fish and its significance. Determination of age in fishes; Absolute and relative growth, growth curve, length-weight relationship, condition factor and their significance, Fecundity estimation. Fishing Techniques: Remote sensing, sonar, radar; crafts and gears. Fishways and screens. Marking, Tagging and Population enumeration. Fishing technology in India: Scope and present status. Types of fishing crafts and gears in marine and inland waters.

Unit IV. Fish preservation, by-product and extension services. 10 h

Fish and fisheries products, status and significance. Useful products from fish and its processing wastes. Causes of fish spoilage: biochemical changes during fish spoilage; Principle and practice of fish preservation; Fishery by-products. Fish conservation and Fishing laws. Extension services. and agencies involved in fisheries extension.

Unit V. Aquatic toxicology 12 h

Definition and principles. Bioavailability of chemicals. Bioaccumulation and biomagnifications. Factors influencing toxicity, Measurement and evaluation of the effects of toxicants; key target organs systems, Metabolism of toxic substances by aquatic organisms, toxicokinetics and biotransformation. Acute poisons and accumulative.. Toxicity Testing - Microcosm and Mesocosm Tests, Dose-Response Relationships, Toxicity Bioassay, genotoxicity assay, Biomarkers. Some case studies.

Suggested Literature:

1. Bone, Q. and Moore, R. 2008. Biology of Fishes. Talyor and Francis Group, CRC Press, U.K.
2. Helfman, G.S., Collette, B.B. and Facey, D.E. (Eds). 1994. The Diversity of Fishes. Blackwell Sceince, USA.
3. Love, M.S. and Cailliet, G.M. (eds). 1979. Readings in Ichthyology. Prentice-Hall of India.
4. Jayaram, K.C. 2009. Fundamentals of Fish Taxonomy. Narendra Publishing House,; 1st edition (1 January 2009)
5. Jhingran V.G. 1997. Fish and Fisheries of India. Hindustan Publications, Delhi, India. 6. ICAR (2018). Handbook of fish and fisheries of India. ICAR Publications, New Delhi India.
7. Nikinmaa, M. 2014. An Introduction to Aquatic Toxicology. Academic Press; 1st edition (8 August 2014)
8. Di Giulio, R.T. Hinton, D.E. (Eds.) 2008. The Toxicology of Fishes. CRC Press Taylor & Francis Group, 6000 Broken Sound Parkway NW, Suite 300. Boca Raton, FL 33487-2742.
9. Wetzel, R. 2001. Limnology Lake and River Ecosystems. Third Edition, Academic Press.

10. Vishwanath, W., Lakra, W.S. and Sarkar, U.K. Fishes of North East India, NBFGR Publication, Lucknow. 4. D. Kapoor, R. Dayal and A.G. Ponniah: Fish Biodiversity of India, NBFGR Publication, Lucknow. 11. Srivastava, C.B.L. A Text Book of Fishery Science and Indian Fisheries, Kitab Mahal , Allahabad

ZOO-403F: FF-III (Theory): Culture and Nutrition of Fish **4 Credits**

Unit I. Introduction to Aquaculture 12 h

Definition and basis, history and present state. Site and species selection. Important aquaculture species. Water-quality criteria for Aquaculture: Role of temperature, pH, salinity, dissolved oxygen, ammonia, nitrite, nitrate, phosphate. Types of culture systems. Race ways, recirculating system, cage, pen. Fish-cum-livestock farming, paddy-cum-fish farming. Aquatic weed management, predatory and weed fish, aquatic insects and their controls. Recent developments in aquaculture research and technology.

Unit II. Breeding and Culture of Fish 14 h

Fish Seed: natural collection, Bundh breeding, Induced breeding, Cryopreservation of gametes. Construction and layout of fish ponds. Ecology of fish pond: Abiotic and biotic components; Food chain; productivity and its measurement. Concept of brood fish pond, hatchery, nursery and grow out ponds. Care and stocking rate, water quality management. Breeding and culture of carps. Ecology of swamps and their use for culture of air breathing fishes (Heteropneustus, Clarius, Channa and Anabas). Ornamental fish culture. Fish stock improvement through selective hybridization, selective breeding, gynogenesis, androgenesis, polyploidy. Production of monosex population, sex reversal, transgenic fish. Common diseases and its management in aquaculture. Fish quarantine.

Unit III. Nutrition in Aquaculture 10 h

Concept of feeding the fish, Principles of fish nutrition and terminologies. Nutritional requirements of commercially important fish. Bioavailability of nutrients. Food and feeding habits of cultivable fishes. Nutritional Physiology of food digestion in fish, Digestibility: significance and estimation. Broodstock and Larval nutrition. Types and components of artificial feed. Natural food and its importance, Bioenrichment. Biofloc and its significance. Food, fish growth and fish yield relationship.

Unit IV. Nutritional biochemistry and Bioenergetics 12 h

Classification, nutrient quality, requirement and evaluation of proteins, lipids and carbohydrates in fish nutrition. Protein to energy ratio, nitrogen balance index, protein sparing effect. Bioenergetics of fish, Energy Utilization and Requirements. Concept of Gross energy, digestible energy, Urinary, Branchial Energy and Metabolizable Energy. Factors Affecting Metabolic Waste Output.

Unit V. Feed Resources and Nutritional pathology 12 h

Types of feed resources. Nutritional value of feed ingredients. Non conventional feed resources. Artificial diet and its formulation. Novel feed and feeding mechanism. Feed additives (attractants, growth stimulants, probiotics, prebiotics and binders). Antinutritional factors and antimetabolites, microbial toxins, methods of elimination, nutrient deficiency and symptoms. Storage of aquafeeds and ingredients.

Suggested Literature:

1. Pillay, T.V.R. 2005. Aquaculture Principles and Practices. Second edition, Blackwell Publishing, USA.
2. Dunham, R.A. 2011. Aquaculture and Fisheries Biotechnology Genetic Approaches. CABI Publishing, USA.

3. ICAR (2018). Handbook of fish and fisheries of India. ICAR Publications, New Delhi India.
4. Jhingran V.G. 1997. Fish and Fisheries of India. Hindustan Publications, Delhi, India.
5. De Silva, S.S., Anderson, T.A. 1995. Fish Nutrition in Aquaculture. Chapman and Hall Aquaculture Series, London.
6. Lovell, R.T. 1998. Nutrition and Feeding of Fishes. Kluwer Academic Publishers.
7. Evans, D.H., Claiborne, J.B. 2006. The Physiology of Fishes. CRC Press
8. Halver, J.E. and Hardy, R. W. 2002. Fish Nutrition. Academic Press, London.

ZOO-404F: FF-IV (Practical) **5 Credits**

1. Identification and study of some important Indian common fish faunal resources (cold, warm, brackish, marine, ornamental).
2. Study of different Types of scales, fins and otoliths.
3. Dissection, display and study of the following in fish: a) Weberian ossicles and their association with internal ear and air bladder b) visceral organs c) cranial nerves of selected fishes.
4. Preparation of fish skeleton; alizarine preparation.
5. Determination of age and growth, Hepatosomatic Index, Gastrosomatic Index and Gonadosomatic Index.
6. Length-weight relationship and condition factor determination.
7. Comparative study of feeding habits of different fish by gut content analysis.
8. Comparative study of digestive enzymes of herbivore, carnivore and omnivore fishes.
9. Accessory respiratory organ of the some air breathing fish (Clarias, Heteropneustes, Anabas, Channa).
10. Demonstration of surgical procedures (hypophysectomy/gonadectomy) of fish.
11. Preparation of formulated diets for fish larvae and adult.
12. Physico-chemical parameters (temperature, pH, conductivity, turbidity, transparency, dissolved oxygen, Free CO2, alkalinity, hardness, nitrite-nitrate, phosphate) of freshwater/pond water.
13. Study of phytoplankton, zooplankton and benthic macroinvertebrates from natural resources.
14. Collection and identification of aquatic weeds and aquatic insects.
15. Identification and study of various types of fishing gears and nets.
16. Simulated experiments on population enumeration.
17. Estimation of species diversity, richness and evenness.
18. Demonstration of Induced breeding of Indian major carps/catfishes.
19. Visit to a local fish market and survey of fish and shellfish species.
20. Visit to freshwater fish farm/breeding ponds and hatcheries/marine fish farm/reservoir/biofloc facility.

ZOO-405F: FF –V (Dissertation) **5 Credits**

The students will take up a project/survey/review/experimental work based on topics of relevance to the subject specialization and in consultation with their respective supervisor/guide to be completed within the period of the course. The work shall be based on proper methodology and protocols, and submitted in appropriate format to the department within stipulated time. The guidelines for the dissertation work may be notified by the department from time to time. The final submission of hard bound thesis, presentation and viva voce shall carry 60% marks, and 40% marks are to be evaluated internally by the supervisor which may consist of (but not necessarily restricted to) the following: rationality, scientific validity, methodology punctuality, timely progress, internal test/examinations etc.

FOURTH SEMESTER

SPECIALISATION: WILDLIFE ECOLOGY

PAPER: ZOO-401: WE-I (Theory): Basics about Wildlife Ecology

4 Credits (Marks: 20 + 80)

Unit I

Introduction to wildlife: definition, concept, importance and values of wildlife; Biogeographical concepts: ecology of dispersal and faunal exchange, biogeographical process, endemism, biogeographical realms, provinces and ecoregions. The biogeographic affinities of the fauna and flora of the Indian subcontinent; island biogeography, metapopulation concept.

Unit II

Taxonomy and Systematics of Animals: classification and nomenclature issues of vertebrates, Taxonomy as a basic tool in wildlife research; natural selection and speciation: biological, phylogenetic, evolutionary and ecological species concepts; Classification up to order of major taxa: insects, fishes, amphibia, reptiles, aves and mammals.

Unit III

Concept of biodiversity: Species diversity, Genetic diversity and Ecosystem biodiversity; biodiversity hotspots, measurement of biodiversity: species richness, evenness; Factors governing species diversity; Threats to biodiversity, causes and consequences of biodiversity loss and decline; Urban Wildlife diversity, case studies.

Unit IV

Habitat Ecology: concept of habitats, major habitats of animals; habitat fragmentations and gap formation; Landscape Ecology: Fundamentals of Landscape Ecology, Ecological and Spatial Scales, Drivers of Landscape Change. Wetland ecology: Definition of wetlands, classification and values of wetlands; streams and rivers and important wetlands of Assam; Urban Ecology: Ecological aspects of urbanization.

Unit V

Animals Diversity and Distribution: Diversity and distribution of butterflies in northeast India, seasonal and altitudinal migration; Ichthyogeography and diversity of freshwater fishes of India with special reference to Assam; Zoogeography of amphibians and reptiles, Factors affecting distribution and abundance of amphibian and reptilian fauna of the Indian sub-continent. Biogeographic patterns in Indian avifauna and their affinities; Diversity and distribution of Indian mammals.

PAPER: ZOO-402: WE-II (Theory): Conservation Biology

4 Credits (Marks: 20 + 80)

Unit I

Population Ecology: monitoring of wildlife population other demographic parameters, different population estimation techniques; Population dynamics: population regulation, natality, fecundity, density, mortality; Predator-Prey Dynamics; Occupancy Modelling. Animal dispersion: immigration, emigration, migration in different taxa with examples in details.

Unit II

Community Ecology: Community structure, organization and its stability (guilds, resource partitioning, niche, competitive exclusion). Social organization in invertebrates and vertebrates; socio-biology of insects, birds and mammals with examples in details. Group living: costs, benefits and optimal group size.

Unit III

Behavioural Ecology: Concept of Ethology; Pattern of behavior: Innate behavior, learned behavior; Adaptation; Evolution of unsocial behaviour; Altruism; Communication in animals and their methods; Sexual selection: parental care and mating systems, polygyny, polyandry, promiscuity; Foraging ecology of animals: optimal foraging theory; home range, territory.

Unit IV

Conservation Ecology: Viable population, Population and Habitat Viability Assessment (PHVA), carrying capacity; Conservation Assessment and Management Plan (CAMP); Biological Invasion: exotic, invasive and introduced species of plants and animals; Bioindicators: bioindicator species of plants and animals; Animal corridor; Ecotone and Edge effect; Wildlife Health: emerging wildlife and zoonotic diseases, Wildlife-livestock interface and conservation, Determinants of disease and disease transmission. Climate change: Effects of climate change on wildlife.

Unit V

Wildlife Biology Case Studies: Introduction to threatened species of butterflies, fishes, herpetofauna, birds and mammals of Northeast India. Biology of butterflies and moths, host plants and nectar plants, mud puddling; Ecology and adaptation of fishes in different ecosystems; Biology of major Indian amphibians and reptiles; Biology of endangered bird species of India; Biology of endangered mammal species of India.

PAPER: ZOO-403: WE-III (Theory): Applied Wildlife Science

4 Credits (Marks: 20 + 80)

Unit I

Conservation of Wildlife and management: Wildlife (Protection) Act 1972; Conservation Practices in NE Region of India: In-situ and Ex-situ conservation; Introduction, reintroduction and translocation of wild animals; Concept of Keystone, Flagship and Umbrella species; IUCN Criteria of Threatened Wildlife; Conservation Breeding Programme with few successful case studies in India; Wildlife Management Plan, controlled burning.

Unit II

Protected area network: reserve forest, wildlife sanctuary, national park, Biosphere Reserve, Conservation and Community Reserves, Community Conserved Areas (CCA) wildlife outside PAs, Tiger Reserve, Elephant Reserve, Important bird and Biodiversity Areas (IBA) in India, eco-sensitive zones. Major International and National Organizations in Wildlife Conservation: IUCN, UNDP, FAO, WWF; BNHS, SACON, National Biodiversity Authority (NBA), Convention on Biological Diversity (CBD), Central Zoo Authority (CZA); Convention on wetlands of international importance: Ramsar Convention.

Unit III

Human dimensions in Wildlife Management: Human-wildlife conflict, case studies in India with special reference to northeast India; Wildlife crime: Wildlife trade, hunting, poaching; CITES, TRAFFIC; Sustainable Biodiversity Conservation: Ecosystem people; Sacred groves, home garden; Citizen science: e-bird, Birdcount India; Ecotourism: definition and scope, wildlife tourism; Environment Impact Assessment (EIA): Basic concepts & objectives of EIA, Relationship between EIA and wildlife conservation;

Unit IV

Modern technology in wildlife research: Overview of research methods, techniques and application; Introduction to Remote Sensing: Definitions, concepts and types of remote sensing and advantages of remote sensing; Principles of GIS and GPS: Basic concepts of GIS, Components of GIS, Data structure and formats Spatial data models; Fundamentals of GPS, Components of global positioning system; Mark-release-recapture technique, Camera trapping; Bird Ringing, Use of Transmitters, PTT; Radio telemetry, Micro Chips, Radio collar; Satellite tracking.

UnitV

Conservation Genetics: Application of genetics for wildlife conservation; PCR, DNA Sequencing, DNA Finger Printing, Loss of genetic diversity, Genetical Depression, Demographic bottlenecks. Wildlife forensics: Overview, various forensic protocols for species identification, Molecular markers used in wildlife forensics; Wildlife forensics based on DNA analysis and morphometry; Scat/dung analysis techniques, hair and feather analysis techniques.

PAPER: ZOO-404: WE-IV (Practical): Applied Wildlife Ecology

4 Credits (Marks: 20 + 80)

1) Research questions and research hypotheses designing. Research methodology exercise.
2) Concept of data collection, datasheet preparation, work plan designing.
3) Sampling approaches: Complete Random Design, Stratified Random Design, and Sampling methods for estimation of terrestrial vegetation: the nearest individual method, point-centred quarter method, line intercept method, quadrat sampling method, crown-canopy estimation method, estimation of canopy cover using ocular method. Species-area curve.
4) Estimation of quantitative and qualitative characteristics of plant community: frequency, density, abundance, basal area and phenology. Estimation of Important Value Index (IVI)
5) Wildlife population estimation by: Line transect method, point count method, belt transect method, marked-recaptured technique; encounter rate; Indirect Methods: Pellet Group counting methods, scat/dung analysis, sign survey analysis.
6) Analysis of species diversity: Shannon-Wiener Index, Simpson's Index; Similarity Index.
7) Methods of behavioural observation: focal animal, all-occurrence and one-zero sampling, Scan animal sampling; collection and analysis of behavioural data on some common availability species; time-activity budgets and preparation of ethograms of studied animal species.
8) Identification test of wildlife specimen.
9) Collection of location data by hand-held GPS; False colour composition (FCC) interpretation; manual landscape mapping.
10) Questionnaire and Schedule preparation. Analysis of pressure and resource dependency of local communities upon PAs; and Community survey methods including participatory learning methods.
11) Excursions to nearby forests, grasslands and wetlands under various management regimes; visit to wildlife sanctuary and national park for proper orientation with wildlife diversity; Field report preparation.
12) Statistical analyses of data collected during field exercise.
13) Seminar presentation and viva-voce.

References

David Ford. E. 2000. Scientific method for ecological research. Cambridge University Press

Javed, Salim and Kaul, Rahul 2002. *Field Methods for Bird Surveys*. Bombay Natural History Society; Department of Wildlife Sciences, Aligarh Muslim University, Aligarh and World Pheasant Association, South Asia Regional Office (SARO), New Delhi, India.

Lillesand. M. Kiefer, R.W. and Chapman, J.W. 2008. *Remote Sensing and Image Interpretation*. John Wiley and sons.

Marten, P. and Bateson, P. 1986. *Measuring Behaviour-An introductory guide*, Cambridge University Press.New York, Collier Macmillan Publishers.

Michael, P. 1984. Ecological Methods for field and laboratory investigation. Tata McGraw-Hill, New Delhi.

Misra, R. 1968. Ecology Work Book, Oxford and IBH Publishing Co. Calcutta.

Moore, P.D. and Chapman, S.B. 1986. Methods in Plant Ecology. Blackwell Scientific Publications.

Morrison, M.L. et al. 2001. Wildlife study design. Springer-Velag, New York, NY

Southwood, T.R.E. and Henderson, P.A. 2000 (third edition) *Ecological Methods*. Blackwell Science.