Gauhati University
Guwahati – 14
Revised syllabus of Mathematics (General and Major)
for
Three Year Degree Course
(Ist year, 2nd Year and 3rd year)

Course Structure : Mathematics (General and Major)

	General	**Major**
Ist year	**Paper I**	
A. Classical Algebra and Trigonometry (70)		
B. Abstract Algebra (30)		
Paper 1 : A. Algebra and Trigonometry (50)		
B. Calculus (50)		
Paper II: A. Co-ordinate Geometry (60)		
B. Differential equation –I (40)\		
2nd year	**Paper II**	
A. Calculus – Methods and applications (75)		
B. Differential equations(25)		
	Paper III	
A. Coordinate Geometry(50)		
B. Vector Analysis(25)		
C. Statics(25)		
Paper III : A. Abstract Algebra (40)		
B :Real Analysis (60)		
Paper IV A. Mechanics (70)		
B. Vector (30)		
3rd year	**Paper IV**	
A. Dynamics (40)		
B. Numerical Methods (25)		
C. Spherical Astronomy (35)		
Paper V		
A. Linear Algebra(40)		
B. Advanced Calculus including Complex Analysis (60)		
Paper V		
A. Real Analysis and Complex Analysis (70)		
B. Linear Algebra (30).		
Paper VI		
A. Differential Equation –II (50).		
B. Metric space, Topology and Functional Analysis (50).		
PaperVII:		
A Numerical Analysis (50).		

B. ProgramminginC/SphericalAstronomy(50).

Paper VIII:

Probability and Optimization theory (100)

Paper IX:

Mechanics and Hydrostatics (100)

Paper X

Discrete Mathematics (100).

NOTE: **Minimum number of Classes for a paper of 100 marks (General Course) is 75 .**

Minimum number of Classes for a paper of 100 marks (Major) is 90

GAUHATI UNIVERSITY

Revised syllabus of Mathematics (General and Major)
for
Three Year Degree Course
I+I+I

(General Mathematics)

FIRST PAPER (Part I)

Paper I:Group A : Classical Algebra and Trigonometry (70 marks)
Group B : Abstract Algebra (30 marks)

Group A

Unit 1 (Inequalities): Inequalities involving arithmetic, geometric and harmonic means. Cauchy Schwarz Inequality. (5 marks)

Unit 2 (Sequence and Series): Sequence of real numbers, Bounded, Convergent and Non-convergent sequences. Uniqueness of the limit and boundedness of a convergent sequence. Cauchy sequence, Cauchy's General Principle of convergence (Proof of the necessary part only). Subsequences . convergence and Divergence of monotonic sequences. Algebraic operations of limit (statements of the theorems without proof). Sandwich theorem. Infinite series, Statements of basic properties of infinite series (without proof). Absolute and conditional convergence, Tests for Convergence :Comparison test, Ratio test, Raabe's test. Leibnitz's test.

(15 marks)

Unit 3 (Trigonometry): Geometrical representation of complex numbers – the Argand plane. Polar form of a complex number. Modulus, amplitude and their various properties. Complex

equations of straight line and circle. De Moivre's theorem. Expansion of cosx and sinx in positive integral powers of x. Exponential and Trigonometric function of a complex variable. Euler's expansion for cosine and sine. Gregory's series. Hyperbolic functions.

(25 marks)

Unit 4 (Relations between roots and co-efficients): Relations between roots and coefficients of a polynomial equation of degree n with special reference to cubic equations. Symmetric functions of roots. Cardon's method of solution of a cubic equation. (10 marks)

Unit 5 (Matrices); Types of matrices; Algebra of matrices; Adjoint and Inverse of a matrix; its existence and uniqueness, Rank of a matrix, Invariance of rank of a matrix under elementary transformations (Proofs are not required). Solution of a system of linear equations by matrix method.

(15 marks)

Text Book

1. S K Mapa: Higher Algebra (Classical) Ashoke Prokasan, Calcutta
2. Das and Mukherjee: Higher Trigonometry (U N Dhur and Sons)
3. A.R. Vasishtha, Matrices: Krishna Prakasan Mandir, Meerut

Reference Books

1. Chandrika Prasad : A text book on Algebra and Theory of Equations – Pothisala Pvt. Ltd.
2. R S Verma : Text book on Trigonometry : Pothisala Pvt. Ltd.

GROUP – B

Abstract Algebra (30 marks)

Unit 6 (Group Theory): Definitions and examples of groups. Permutation Groups. Cyclic Groups. Subgroups, Cosets, Lagrange's Theorem on the order of a subgroup of a finite group. Normal subgroups. Quotient Groups. Idea of Homomorphism and Isomorphism of groups. (20 marks)

Unit 7 (Ring Theory): Definition, examples and simple properties of Rings. Integral Domains, Fields and their elementary properties. (10 marks)

Text Book

1. V K Khanna and S K Bhambri : A course in Abstract Algebra : Vikas Publ.House Pvt. Ltd. New Delhi.
2. S.Singh and Q.Zameerruddin : Modern Algebra, Vikas Publ.House Pvt. Ltd. New Delhi.

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Ist Year (Part I)

MATHEMATICS (MAJOR)

Paper - I

A. Algebra and Trigonometry (Marks : 50)

B. Calculus (Marks : 50)

Group A : Algebra and Trigonometry (Marks 50)

Unit : 1 Relations, Equivalence relations; Mapping, Binary composition Groups, Subgroups, Cosets, Lagrange's theorem on order of a subgroup of a finite group, Euler's Theorem, Fermat's Theorem, Subgroup generated by a set. Cyclic groups, Permutation groups, Normal subgroups, Quotient groups.

Marks 15

Unit 2. Complex numbers as ordered pairs of real numbers. Geometrical representation and polar form of complex numbers. Modulus and argument and their properties. Complex equations of straight line and circle.

De'Moiver's theorem. Expansion of cosx and sinx in positive integral pairs of x. Logarithm of a complex number. Exponential and Trigonometric functions of a complex variable. Euler's expansion for cosine and sine. Hyperbolic functions. Inverse functions. Gregory's series.

Marks 15

Unit 3: Relation between the roots and coefficients of a general polynomial equation in one variable. Transformation of equations. Descarte's rule of signs. Symmetric functions of roots. Solution of cubic equation by Cardon's method .

Marks 10

Unit 4 Symnmetric, skew symmetric, Hermitian and skew Hermitian matrices. Elementary operations on matrices, Adjoint and inverse of a matrix, Rank of a matrix. Invariance of rank under elementary operations. Normal form. Solution of a system of linear equations by matrix method

Marks 10

Text : 1. Higher Algebra (classical) - S.K.Mapa, Asoke Prakashan Calcutta (for unit 2 & 3)

2.Higher Trigonometry - Das and Mukherjee : Dhur and Sons.

3. A course in Abstract Algebra – Khanna and Bhambri (for Unit 1)

4. Matrices- Ayers, Schaum's series (for Unit 4).

Group B : Calculus (Marks 50)

Unit 5 : Successive differentiation. Standard results on nth order derivatives and Leibnitz's theorem. Partial differentiation. Partial derivatives of 1st and higher orders for

functions of two and three variables. Euler's theorem on homogeneous functions.

Marks 10

Unit 6: Tangents and Normals - Angle of intersection of two curves. Length of tangent, normal, subtangent and subnormal, pedal equations, angle between radius vector and tangent. Length of perpendicular from pole to the tangent, lengths of polar subtangent and polar subnormal. Pedal equation of a curve from its polar equation. Concavity and points of inflexion and their criteria.

Curvature - definition of curvature and radius of curvature, derivation of arc, formula for radius of curvature, circle of curvature.

Asymptotes - definition and working rules for determination of asymptotes (in case of Cartesian equations).

Singular points - double points, cusp, node, conjugate point, multiple point, determination of multiple points of the curve f(x, y) = O.

Curve tracing - tracing of catenary, cissoid , astroid, cycloid, folium of Descartes, cardioide, lemniscate. **Marks 15**

Unit 7: Integrals of the form

and

Integration of rational functions of sinx and cosx. Reduction formulae for integration of the following functions.

$x^n e^{ax}$, x^m sinnx , x^m cosnx, $x^n (\log x)^m$, $1/(x^2 + k^2)^n$, $\sin^n x$, $\cos^n x$,

$\sin^p x \cos^q x$ (p>0, q>0), $\tan^n x$, $\text{cosec}^n x$, $\cos^m x \cos nx$

Properties of definite integrals **Marks 15**

Unit 8: Rectification, Quadrature, Volume and surface area of solids of of revolution

Marks 10

Text Books : 1. Differential Calculus – Shanti Narayan: S Chand and Co.

2. Integral Calculus – Das and Mukherjee : S Chand Co.

References :

1. Differential and Integral Calculus Frank Ayres and E Mendelson: Schaum's Outline Series
2. Integral Calculus (An Intro. to Aalysis) Maity and Ghosh, New Central book Agency.

TDC PART I

MATHEMATICS (MAJOR)

PAPER II

A. Coordinate Geometry (Marks 60)

B. Differential Equation -I (Marks 40)

Group A : Coordinate Geometry (Marks 60)

Unit 1 : Transformation of coordinate axes. Pair of straight lines. **(Marks 10)**

Unit 2: Parabola, parametric coordinates, tangent and normal. Ellipse and its conjugate diameters with properties. Hyperbola and its asymptotes. General conics : tangent, condition of tangency, pole and polar, centre of a conic, equation of pair of tangents, Reduction to standard forms, central conics, Equation of the axes and length of the axes. Polar equation of a conic, tangent and normal and properties.

(**Marks 20)**

Unit 3 Plane, straight line and shortest distance. (**Marks 10)**

Unit 4: Sphere, Cone and Cylinder, Central Conicoids, Ellipsoid, Hyperboloid of one and two sheets, Diametral planes, tangent lines, Director sphere, polar plane, section with a given centre. Enveloping cone and cylinder.

(Marks 20)

Text Books :

(i)R.M.Khan- Analytical Geometry of two and three dimension and vector analysis, New Central Book Agency.

(ii) Analytical Geometry by R.J.T. Bell

Reference book:Analytical Geometry by

1. Askwith 2. B.Das
3. Shanti Narayan 4. S.L.Loney 5. J.M.Kar
6. Bansilal 7.R S Soni(C G two dim)
8.Zameeruddin and Khanna (Solid Geometry)

Group B: Differential Equation – I (Marks : 40)

Unit 5. Origin of ordinary differential equations. Degree and order of Ordinary . Differential equations. Equations of 1^{st} order and 1^{st} degree. First order and differential equations of higher degree. Methods of solving higher degree equations solvable for x,y and p. Clairaut's form and singular solutions. Orthogoal trajectories.

Marks 10

Unit 6. Linear ordinary differential equations with constant co-efficients. Exact ordinary differential equations, Homogeneous linear ordinary differential equations and Bernoulli's equations.

Marks 10

Unit 7: Linear differential equations of 2^{nd} order with variable co-effecients. Standard methods: Transformation of the equation by changing the dependent variable, the independent variable, Method of variation of parameters.

Marks 10

Unit 8. : Simultaneous linear differential equations. Total differential equations.

Marks 10

Text book :

1. Differential Equation - Piaggio
2. Theory and problems of Differential Equation - Frank Ayres

Reference books:

1. An introduction to ordinary differential equation : E A Codington ,Prentice Hall of India.
2. Elementary Differential Equation and Boundary Value Problem : W R Boyce and P C Diprima, John Wiley
3. Ordinary and Partial Differential Equation : M D Raisinghaania., S.Chand and Co.

SECOND PAPER (General) (PART II)

Group A : Calculus – Methods and Applications (75 marks)
Group B : Differential Equations (25 marks)

Group A

Calculus

Unit 1 Familiarity with the properties of continuous functions without proof. Differentiation, Successive Differentiation, Leibnitz's Theorem. Tangents and Normals.
(14 marks)

Unit 2: Rolle's Theorem, Lagrange's Mean Value Theorem, Meaning of the sign of derivative, Cauchy's Mean value Theorem, Taylor's Theorem. Maclaurin's Theorem, Maclaurin's infinite power series for a given function; expansions of e^x, sinx, cosx, log(1+x). and allied functions. Indeterminate Forms, Maxima and Minima (single variable) (18 marks)

Unit 3 : Working knowledge of the limit and continuity of a function of two or more variables. Partial differentiation. Euler's theorem on homogenous functions

(two varables) ,Total differentials and differentiation of composite functions (statements of formulae without proof). Maxima and Minima of a function of two variables and working rules (without proof) for their determination.
(10 marks)

Unit 4 :Curvature of plane curves. Asymptotes. Working rules for finding asymptotes parallel to the coordinate axes. (8 marks)

Unit 5 Integrals of the form : $\int(px+q)\ (ax^2 + bx + c)^n\ dx$;$(n = \pm 1, \pm \frac{1}{2})$;. Integration by partial fractions. Integration of trigonometric functions.
(10 marks)

Unit 6 Reduction Formulae. Properties of definite Integral.s (10 marks)

Unit 7 Quadrature of plane areas. Rectification of plane curves. (5 marks)

Text Book

1. Shanti Narayan : Differential Calculus, 1996 Edn. S Chand and Co. New Delhi.
2. Shanti Narayan: Integral Calculus – S Chand and Co. New Delhi
3. K C Maity and R Ghosh : Integral Calculus,New Central Book Agency.

Reference Book

1. Frank Ayres : Theory and problems of Diff. and Integral Calculus Schaum Publ. Series.
2. Das and Mukherjee : Differential Calculus : U N Dhur and Sons Pvt. Ltd
3. Das and Mukherjee : Integral Calculus , U N Dhur and Sons Pvt. Ltd.

Group B

Differential Equations (25 marks)

Unit 8 Differential Equations of first order and first degree; solution by variable separable method; Homogeneous equations; Linear equations and equations reducible to linear forms; Exact differential equations; First order higher degree equations solvable for x,y & p. Clairaut's form and singular solutions
(10 marks)

Unit 9 Linear differential equation with constant coefficients.
Homogeneous linear ordinary diferential equations (10 marks)

Unit 10 Simple applications of ordinary differential equations. (5 martks)

Text book :

1. Piaggio : Differential Equations
2. B C Deka : Ordinary Differential Equation
3. Raisinghania : Ordinary Differential Equation, S.Chand

THIRD PAPER (General) (PART II)

Group A Coordinate Geometry (50 marks)
Group B Vector Analysis (25 marks)
Group C Statics (25 marks)

GROUP A

Coordinate Geometry of Two dimension and Three Dimension (50 marks)

Two-dimensional Geometry

Unit 1 Transformation of coordinate axes. Pair of straight lines. (8 marks)

Unit 2 , Circle: Parametric form, Tangent and Normal, Pole and Polar,Orthogonal circle. Condition of orthogonality of circles, Equation of Parabola and its parametric form, tangent and normal (7 marks)

Unit 3 Ellipse, tangent and normal, conjugate diameters. Hyperbola and its asymptotes

(8 marks)

Unit 4 General equation of second degree and the conditions for representing a pair of straight lines, a parabola, an ellipse and a hyperbola, the equation of tangent, condition of tangency of a line, centre and reduction to standard forms. Polar equations of conics.

(7 marks)

Three dimensional Geometry

Unit 5 Plane, straight lines in three dimensions, Shortest distance. (10 marks)

Unit 6 Sphere, circle in three dimensions. (5 marks)

Unit 7 Cone and cylinder (Elementary Concepts only) (5 marks)

Text book

1. S L Loney : The Elements of Coordinate Geometry : Macmillan
2. B Das : Analytical Coordinate Geometry
3. J M Kar : Analytical Geometry of the Conic section: The Globe Library.

Reference book :

1. Gorakh Prasad and Gupta : Coordinate Geometry: Pothisala Pub . House
2. Dass, Saxena, Raisinghanaia : Solid Geometry : S Chand.

GROUP B

Vector Analysis (25 marks)

Unit 8 Scalar triple product. Vector Triple product, product of four vectors
(a x b).(cxd), (a x b)x(c x d) (10 marks)

Unit 9 : Vector point function, continuity and differentiation of vector point function.
Partial derivatives of vectors, Curl, Grade, Divergence and identities
(Cartesian co-ordinates only). (15 marks)

Text Book

1. M R Spiegel : Vector Analysis – Schaum's outline series

Reference book

1. N Saran and S N Nigam : Introduction. to Vector Analysis : Pothisala Publ. Ltd
2. A R Vasishtha : Vector Analysis : Krisna Prakasan
3. M D Raisinghania : Vector Analysis: S Chand and Co.

GROUP C

Statics (25 marks)

Unit 10 Parallel forces,Couple, System of coplanar forces and conditions of equilibrium. 10 marks)

Unit 11:Centre of gravity of plane curves and areas, arc and sector of a circle and a parabola (5 marks)

Unit 12 Friction, laws of friction, Cone of friction, Angle of friction, Limiting Friction, Equilibrium of a particle on a rough inclined plane . (5 mark)

Unit 13 Machines, Mechanical advantage, Velocity ratio, Three systems of pulleys (5 marks)

Text Book

1. Das and Mukherjee : Stastics: U N Dhar and Sons.
2. S L Loney : Statics : Cambridge Univ. Press
3. R S Verma : A text book of Statics

TDC Part II
MATHEMATICS (MAJOR)
PAPER-III
Group A: Abstract Algebra (Marks : 40)
Group B: Real Analysis (Marks : 60)

GROUP A (Abstract Algebra)

Unit 1: Homomorphisms of Groups, Fundamental Theorems of homomorphisms, Cayley's theorem
(Marks 10)

Unit 2: Rings, Integral domains, Division rings and fields. Subrings, Characteristic of a ring. Idempotent and nilpotent elements in a ring. Principal, prime, maximal ideals. Simple rings. Definition and examples of vector space and its subspaces.
(Marks 10)

Unit 3. Inner automorphisms. Automorphism groups. Conjugacy relation. Normaliser. Centre of a group. Class equation and Cauchy's theorem. Sylow's theorems. (Statement and applications)
(Marks 10)

Unit 4: Ring homomorphisms. Quotient rings. Field of quotients of an integral domain. Euclidean rings. Polynomial rings. **(Marks 10)**

Text Book:

1. A course in abstract Algebra : Khanna and Bhambri, Vikas Publ House
2. Algebra Vol. I (Group), Vol 2 (Ring) : I S Luther and passi, Narosa publ.

Reference books:

1. Modern Algebra-Surjit Singh and Zamiruddin, Vikash Publ.House
2. Fundamentals of Abstract Algebra: Malik and Morderson and Sen, Mc Graw Hill
3. A First Course in Abstract Algebra: J. B. Fraleigh

Group B:(Real Analysis)

Unit 5: Characterisation of the real number system R as a complete Archimedian ordered field. Neighbourhoods. Open set. Closed set, limit point of a set. Bolzano- Weierestrass theorem for a set. Nested interval theorem

Sequence of real numbers. Bounded and unbounded sequences. Subsequences. Limit of a sequence. Bolzanno-Weierestrass theorem for bounded sequences. Limit superior and limit inferior. Convergent and divergent sequence. Cauchy sequences. Cauchy's principle of convergence. Convergency and divergency of monotonic sequences. Algebraic operations on limits. Sandwich theorem. Cauchy theorems on limit.

(Marks 15)

Unit 6: Infinite series. Convergence, divergence and Cauchy's general principle of convergence. Introduction and removal of brackets. Multiplication of series and

double series. Comparison test, Cauchy's root test, D'Alembert's ratio test (with proofs).Statements (without proofs) of Raabe's test. Logarithmic test, Gauss's test. Cauchy's Codensation test, Cauchy's integral test for testing the convergence of series of positive terms. Abel's theorem. Alternating series and Leibnitz's test. Absolute and Conditional convergence. Statement and application of Riemmann's theorem and Dirichlet's theorem (without proof) on the rearrangement of terms of an infinite series.

(Marks 15)

Unit 7: (ε, δ) definition of limit and continuity of a function of single variable.

Properties of continuous functions in closed interval. Sequential continuity.

Inverse function and monotonic function. Uniform continuity.

(**Marks 10)**

Unit 8: Derivability of a function of a single variable. Algebra of derivatives.

Darboux's theorem. Intermediate value theorem for derivatives. Roll's theorem. Mean value theorems. Indeterminate forms. Taylor's theorem. Taylor's and Maclaurin's infinite series. Expansion of e^x, sinx, cosx, log(1+x) and $(1+x)^m$.

Maxima-minima of a function of single variable and of two variables (reducible to single variable)

(Marks 20)

Text books

1. Principles of real Analysis : S C Malik : New Age International.
2. A course of mathematical Analysis,Shanti Narayan : S Chand and Co.
3. Real Analysis : S.K.Wason and R.Prakash, Tata Mc Graw Hill

Reference :

1. Differential Calculus- Maity and Ghose,New Central Book Agency, Calcutta
2. Real Analysis- S.K.Mapa
3. Principle of Mathematical Analysis : Walter Rudin. .

TDC Part II
MATHEMATICS (MAJOR)
PAPER - IV
Group A: Mechanics (Marks : 70)
Group B: Vector (Marks : 30)

GROUP A (Mechanics)

Unit 1: Parallel forces, Couples, Reduction of coplanar forces. Analytical conditions of equilibrium of coplanar forces. Friction. **12 Marks**

Unit 2: Centre of gravity of a plane area, arc and a sector of a curve. C.G. of solids and surface of revolution. C.G. of areas bounded by given curve. **8 Marks**

Unit 3: Principle of virtual work in two dimensions. Forces in 3 dimensions. Poinsot's central axis. Wrenches. Null lines and planes. **12 Marks**

Unit 4: Stable and unstable equilibrium. **8 Marks**

Unit 5: Velocities and acceleration along radial and transverse directions and along tangential and normal directions. Motion in a straight line under variable acceleration.. Simple harmonic motion and elastic string.

12 Marks

Unit 6: Motion on smooth and rough plane curves. Motion in resisting medium. Motion of particles of varying mass. **10 Marks**

Unit 7 : Central orbit and Kepler's laws of planetary motion.

8 Marks

Group B (Vector)

Unit 8 : Scalar triple product. Vector triple product. Product of four vectors. **10 Marks**

Unit 9: Continuity and derivability of a vector point function. Partial derivatives of vector function. Gradient, curl and divergence. Identities. **10 Marks**

Unit 10: Vector integration. Line, surface and Volume integrals. Green, Stokes and Gauss' Theorems. **10 Marks**

Text books:

1. Statics-S.L. Loney, C.U.P.
2. Dynamics-S.L. Loney C.U.P. and Macmillan
3. Dynamics (Part 1)- Ramsay
4. Vector analysis-Spiegel, Schaum Series.

Reference books:

1. Theoretical Mechanics-Besant and Ramsay
2. A Text book on Statics : R S Verma
3. Theoretical Mechanics- Schaum Series.
4. Dynamics- M Ray, S Chand and Co
5. Calculus and Analytic Geometry, George B Thomas & Ross L Finney, Addision Wesley.
6. Vector Analysis – M.D.Raisinghania, S.Chand and Co.

TDC PART - III, Third Year
FOURTH PAPER (General)

Group A : Dynamics (40 marks)
Group B : Numerical Methods (25 marks)
Group C : Spherical Astronomy (35 marks)

GROUP – A Dynamics 40 Marks

Unit 1 : Components of velocity and acceleration along radial and transverse direction and along tangential and normal directions. Angular velocity and its relation with linear velocity, Relative velocity. **8 Marks**

Unit 2 : Rectilinear motion with variable acceleration., vertical motion, under inverse square law and other laws of force. . **8 Marks**

Unit 3 : Simple harmonic motion **5 Marks**

Unit 4 : Motion of a Projectile, range on an inclined plane. **6 Marks**

Unit 5 : Impulse, impulsive forces, work and energy, conservation of linear momentum and conservation of energy. **8 Marks**

Unit 6 : Impact of elastic bodies (direct impact only). **5 Marks**

Text Book

1. Das and Mukherjee : Analytical Dynamics: Dhur and Sons.
2. M Ray : A text book on Dynamics : S Chand and Company.
3. S L Loney : An elementary treatise on the Dynamics of a particle and Rigid bodies : CUP London and Macmillan and Co. London.

GROUP B Numerical Methods 25 Marks

Unit 7 : Finite Difference Operators and their operations on functions of a single variable **7 Marks**

Unit 8 : Interpolation with equal intervals, Newton's forward and backward formula , Divided difference, Lagrange's Interpolation formula. **8 Marks**

Unit 9 : Roots of algebraic and transcendental equations (Geometric methods for initial approximation of roots), Bisection method, Iteration method, Newton -Raphson method for non-repeated roots **10 Marks**

Text Book

1. Goyal and Mittal : Numerical Analysis
2. H C Saxena : Finite Difference and numerical analysis : S Chand and Co.
3. M K Jain, Iyengar : Numerical methods, Problem and Solutions.

GROUP C Spherical Astronomy 35 Marks

Unit10 : Spherical triangle and its properties, polar triangle and its properties, sine and cosine formulae, four parts formula, sine-cosine formulae. **8 Marks**

Unit 11: Celestial sphere – three coordinate systems and their relations, Examples **8 Marks**

Unit 12: Altitude of a body on the meridian, Altitude of the celestial pole, rising and setting of stars, Circumpolar stars, signs of zodiac. **6 Marks**

Unit 13 : Planetary motion and Kepler's laws, deduction of Kepler laws from Newton's law of gravitation, the equation of orbit, Velocity of a planet in its orbit. :Examples **7 Marks**

Unit 14: Parallex: geocentric and annular parallax. **6 Marks**

Text Book

1. Gorakh Prasad : Astronomy
2. K K De : A text book on Astronomy (Book Syndicate Pvt. Ltd. Calcutta
3. S Malik : Spherical Astronomy, Kedar Nath, Ram Nath: Meerut.

PART - III
FIFTH PAPER (General)

Group A : Linear Algebra 40 Marks

Group B : Advanced calculus including elements of complex variables 60 Marks

GROUP A Linear Algebra 40 Marks

Unit 1 : Definition and examples of vector spaces. Elementary properties of R^n and C^n as vector spaces. Subspaces of a vector space. Union, intersection and sum of two subspaces. Subspace generated by a subset of a vector space. **10 Marks**

Unit 2 : Definition, example and elementary properties of Linearly dependent and independent set. Basis and dimension of a vector space. Examples of finite dimensional and infinite dimensional vector space. Finitely generated space **10 Marks**

Unit 3 : Linear mapping – Definition and Examples. Algebraic properties of linear mappings. **5 Marks**

Unit 4 : Elementary transformation. Reduction to echelon and normal form. Determination of the rank of a matrix by elementary transformation **5 Marks**

Unit 5 : Eigenvalues, Eigen vectors, characteristic equation. Statement of Cayley-Hamilton Theorem. Verification of Cayley-Hamilton theorem and determination of the inverse of a matrix with the help of it. **10 Marks**

Text Book :

1. A.R. Vasishtha : Modern Algebra: Krisna Prakasan;
2. A.R. Vasishtha : Matrices : Do
3. Bhattacharya and Jain : Linear Algebra
4. H C Saxena and M.D.Raisinghania : Matrices: S. chand and Co.

Reference Book :

1. Linear Algebra : M. R. Speigel, Schaum outline series.

GROUP B Advanced Calculus 60 Marks

Unit 6: Metric space : Definition and examples ; R, R^2,R^3, R^n as metric spaces, Neighbourhoods, open spheres , open sets, limit points, closed spheres, closed sets, closure and interior of a set. Bolzan-Weirstrass theorem for bounded infinite sets of **R;** Cauchy sequences in a metric space, Definition and simple examples of complete metric spaces. **12 Marks**

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Unit 7 : Riemann Intergal upto fundamental theorem of Integral calculus. **10 Marks**

Unit 8 : Elementary idea of Improper Integrals. Beta and Gamma functions **10 Marks**

Unit 9 : Definition of double and triple integrals; working knowledge about the methods of their calculations including change of variables. (Theorems to be assumed without proof). Application of Beta and Gamma functions in determination of area and volume. **10 Marks**

Unit 10: Complex variable and single valued function of a complex variable. The elementary functions. Limit and continuity and theorems on them.Uniform continuity. Derivatives. Analytic functions. Cauchy-Riemann equations (Proof of only necessary part). Harmonic function. **12 Marks**

Unit 11 : Rectifiable curves, Integral along an oriented curve, Fundamental Cauchy theorem. Cauchy integral formula. **6 Marks**

Text book :

1. Seymour Lipschutz : General topology : Schaum's Outline Series.
2. Shanti Narayan : A course of Mathematical Analysis, S Chand and Co
3. Schaum's Series : Advanced Calculus
4. S C Malik : Principles of real Analysis : New Age International
5. Spiegel : Complex Variable – Schaum's Series
6. J N Sharma : Functions of a Complex Variable

TDC Part - III
Mathematics (Major)
Paper - V

A : Real and Complex Analysis (70)
B : Linear Algebra (30)

A : Real and Complex Analysis 70 Marks

Unit 1: Limit and Continuity of a function of several variables. Partial derivatives. Differentiability. Young's and Schwarz's theorems. Differentials of higher orders. Differentiation of composite functions. Change of variables. Taylor's theorem for two variables. Implicit functions. Only statement of implicit theorem on two variables with its applications.

Jacobians. Maxima and Minima. Lagrange's method of multipliers.

16 Marks

Unit 2: Riemann Integral. Integrability Conditions. Riemann integral as limit. Some classes of integrable functions. The fundamental theorem of integral calculus. Statement and application of M.V. theorems of Integral calculus. **12 Marks**

Unit 3: Improper integrals and their convergence. Various forms of comparison tests. Absolute and conditional convergence. Abel's and Dirichlet's tests. Beta and Gamma functions. Frullani's integral. Integral as a function of parameter (excluding improper integrals). Continuity, derivability and integrability of an integral as a function of a parameter.
Double and triple integrals. Iterated integrals, evaluation of double and triple integrals. **16 Marks**

Unit 4: Theorem on limit and continuity of a function of complex variable. Uniform continuity. Differentiability of a function of complex variable. Analytic functions. Cauchy Riemann equations. Harmonic functions. Differentials. Derivatives of elementary functions. L' Hospital's rule. Stereographic projection. **14 Marks**

Unit 5: Rectifiable curves, integral along an oriented curve, Fundamental Cauchy Theorem (Proof applying Green's Theorem), Cauchy Integral formula. Mobius transformation. Fixed points. Inverse points and critical mappings. Conformal mappings. **12 Marks**

Group B: Linear Algebra 30 Marks

Unit 6 : Sums and direct sum of subspaces. Linear span. Linear dependence and independence and their basic properties. Basis. Finite dimensional vector spaces. Existence theorem for bases. Invariance of the number of elements of a basis. Dimensions. Existence of complementary subspace of a subspace of finite dimension. Dimension of sum of subspaces. Quotient spaces and its dimension **10 Marks**

Unit 7: Linear transformations and their representation as matrices. The algebra of linear transformations. The rank nullity theorem. Change of basis. Dual spaces. **8 Marks**

Unit 8: Eigenvalues, Eigenvector, characteristic equation of a matrix. Cayley Hamilton theorem. Minimal polynomial. Characteristic and minimal polynomial of linear operators. Existence and uniqueness of solution of a system of linear equations.

12 Marks

Text Books :

1. A course of Mathematical Analysis: - Shantinarayan: S Chand and Co.
2. Linear Algebra: - Hoffman and Kunze,
3. Complex Variable : Spiegel (Schaum's series)
4. Mathematical Analysis: - S.C. Malik & S Arora.,New Age International Publishers

Reference Books :

1. A first course in Mathematical Analysis- D.Soma Sundaram and B. Chaudhury
2. Integral Calculus: - Maity and Ghosh: New Central Book Agency, Calcutta.
3. Complex variable: - J.N.Sharma, Krishna Prakashan, Meerut

4. Matrix and Linear Algebra: K. B. Datta, Prentice Hall of India.
5. Linear Algebra: Bhattacharyee, Nagpal, Jain , Wiley.

TDC Part - III
Paper - VI

Group A: **Differential Equation – II** **50 Marks**

Group B: **Metric Spaces, Topological Spaces and Functional Analysis** **50Marks**

Group A : (Differential Equation – II)

Unit 1: (Special Functions) :

Series solution of differential equations. Power series method. Bessel, Legendre and Hypergeometric equations. Bessel, Legendre and Hypergeometric functions and their properties.

Convergence. Recurrence and generating functions. **15 Marks**

Unit 2: (Partial Differential Equation):

Partial differential equations of the first order. Lagrange's solutions. Some special types of equations, which can be solved easily by methods other than the general method. Charpit's general method of solution. **10 Marks**

Unit 3: (Laplace-Transform):

Linearity of the Laplace transformation. Statement of the Existence theorem , Laplace transforms. Shifting theorems. Differentiation and integration of transforms. Convolution theorem. Solution of Initial Value Problem involving Differential Equation using transformation. **10 Marks**

Unit 4: (Calculus of variation):

Variational problems with fixed boundaries-Euler's equation for functionals containing first order derivative and one independent variable. Extremals. Functionals dependant on higher order derivatives. Functionals dependent on more than one independent variable with first derivative only. **15 Marks**

Group B : Metric space and Topology : Metric Space:

Unit 1. Definition and examples of metric spaces. Neighborhoods. Limit points. Interior points. Open and closed sets. Closure and interior. Equivalent metrics. Subspace of a metric space. Cauchy sequences. Completeness. Cantor's intersection theorem. **10 Marks**

Unit 2: Dense subsets. Baire's category theorem. Separable, second countable and first countable spaces. Continuous functions. Extension theorem. Uniform continuity. Isometry and homeomorphism.. **10 Marks**

Unit 3: Compactness. Sequential compactness. Totally bounded spaces. Finite intersection property. Continuous functions and compact sets. Connectedness. Components. Continuous functions and connected sets. **10 Marks**

Topology and Functional Analysis :

Unit 4 :. Definition and examples of topological spaces. Metric topology. Closed sets. Closure, Kuratoski closure operator and neighbourhood systems.. Dense subsets. Neighborhoods. Interior, exterior and boundary. Accumulation points and derived sets. Bases and subbases. Subspaces and relative topology. Continuous functions and homeomorphism. **10 Marks**

Unit 5: Definition and examples of normed linear spaces, Banach spaces, inner product spaces and Hilbert space. Some elementary properties. **10 Marks**

Text Books :

1. Theory and problems of differential equation- Frank Ayers, Mc graw Hill
2. Introduction to topology and modern analysis- G.F.Simmons
3. Advance Differential equations: Raisinghania
4. Laplace Transform: Schaum Series

Reference books :

1. Adv. Engg. Maths: - Kreyszig.
2. Differential equation: - Murray, Orient Longman.
3. Calculus of variation: - A.S. Gupta.
4. Topology: - Munkres, Prentice Hall of India.
5. Theory and problems of differential equation: - Bronson.
6. Functional analysis: - B.V. Limaye
7. General Topology:- Schaum Series.
8. Calculus of Variation:-E.L. Elsgog.

TDC Part - III
Mathematics (Major)
Paper - VII

A: Numerical Analysis (50)

B: Programming in C (50)

Or

(C) Spherical Astronomy (Marks : 50)

(to opt either (B) or (C))

Group (A) is compulsory

Group A : Numerical Analysis

Unit 1: Normalized floating-point representation of real numbers and operations using it. Normalization and its consequence, Errors in arithmetic operations, absolute and relative error; truncation and round off errors; approximation and significant figures.

5 Marks

Unit 2: **Calculus of finite difference**: Different interpolation formulae with remainder terms. Finite Difference operators and their operations on function of a single variable. Interpolation with equal and unequal intervals. Newton's formulae, Lagrange's formula, Gauss, Bessel and Stirling's formula, Hermite interpolation.

15 Marks

Unit 3: **Numerical differentiation and integration**: Numerical differentiation with the help of different interpolation formulae. General quadrature formula. Trapezoidal rule. Simpson's one third and three eighth rule, Weddel's rule, Newton-Cote's formula, Gauss quadrature formula, Chebycheve's formula. **20 Marks**

Unit 4: **Solution of polynomial and transcendental equations**. Bisection method, Secant method, Regula Falsi method, Newton-Raphson method; Rate of convergence and comparison of the methods. **10 Marks**

Text Books :

1. Numerical Methods-S. Balachandra Rao and C.K. Santha, Univ. Press
2. Numerical Analysis- Schaum's series
3. Numerical Analysis- Kunz

Reference books :

1. Numerical Methods for Mathematics, Science and Engineering-J.H. Mathews.

Group B : Programming in C

Unit 1: Brief introduction of Central Processing, main memory, secondary memory, Input/Output devices; Operating system and its need; Representation of numbers and characters in computer, machine level language and high level language; compiler, interpreter, assembler, linker, loader, editor, debugger, algorithm, flowchart and computer programs; Decision table and trees; efficiency and analysis of algorithm. Introduction to C-requirement of programming language to solve problems. **8 Marks**

Unit 2: **Elementary Data types:**(Variables, constants and identifiers, integer, character, floating point and string constants, variable declaration, initialization of variables during declaration; constant data types.) **Syntax and semantics**; **Reserved Words; Expression in C** (Operator precedence and associatively, unary, binary and ternary operators; C arithmetic operators, assignment operators, relational operators, logical and bitwise operators; L-value and R-value; Expression statement, cast and size of operator, Automatic type conversion.

7 Marks

Unit 3 : **Conditional statement**: if, if-else, switch.

Iterative statement: while, do-while, for.

Arrays and pointers (preliminary ideas) **10 Marks**

Other statements : break, continue, goto, return, null statement, block statement.

Unit 4: **Function** (function declaration, calling a function by value, call by reference and its absence in C); **Storage class** (automatic, Register, static, external); **Recursion and how it works** (use of machine stack for storing return address, parameters and local variables), conversion of recursive programmes to non-recursive version. **10 Marks**

Programmes for practical : (Internal) 15 Marks

To evaluate an arithmetic expression. To find gcd, factorial, Fibbonacci number. Prime number generation, reversing digits of an integer, finding square root of a number, roots of a quadratic equation, sum of different algebraic and trigonometric series. Base conversion, Towers of Hanoi, Test for Palindrome. Addition, subtraction and multiplication of matrices. To find the greatest and smallest of a finite number of numbers.Interpolation and solution of transcendental Equation.

Text books :

1. Balaguruswamy E., Programming in ANSI C, Tata Mcgraw Hills
2. Balaguruswamy E , Programming with C, Schaum Series.
3. Let us C : Y Kanetkar, B P Publication.

Reference Book :

1. The C Programming Language : W Kernighan & D M Ritchie, PHI
2. How to solve it by Computer-R G Dromey, PHI
3. The spirit of C: Mullis, Cooper, Jaico Publishing House, Mumbai.

N.B. A Concerned College should conduct a separate Practical Examination internally for duration of one hour preferably on the following basis:

(i) Take the practical on two problems out of the problems mentioned in the syllabus [10 marks]

(ii) 5 marks for practical book and viva-voce test.

After taking the practical, marks of the practical of the candidates should be sent to the Controller of Examinations, Gauhati University.

Group C. Spherical Astronomy

Unit 1: Section of a sphere by a plane, spherical triangles, properties of spherical and polar triangles. Fundamental formulae of spherical triangles, sine formula, cosine formula, sine-cosine formula, cot formula. Napier's rule of circular parts. **10 Marks**

Unit 2: The standard (or geocentric) celestial sphere, system of coordinates, conversion of one coordinate system to the another system. Diurnal motion of heavenly bodies. Sidereal time, Solar time (mean), rising and setting of stars, Circumpolar stars, Dip of the horizon, rate of change of zenith distance and azimuth. Examples. **12 Marks**

Unit 3: Planetary motion: Annual motion of the sun, Planetary motion, Synodic period, orbital period, Kepler's law of planetary motion, Deduction of Kepler's laws from Newton's law of Gravitation. The equation of the orbit, velocity of a planet in its orbit, Components of linear velocity perpendicular to the radius vector and to the major axis, direct and retrograde motion in a plane. Laws of refraction: refraction for small zenith distance, general formula

for refraction. Cassini's hypothesis. Differential equation for refraction. Effect of refraction on sunrise, sunset, right ascension and declination, shape of the disc of the sun. **16 Marks**

Unit 4: Geocentric parallax. Parallax of the moon, right ascension and declination. Parallax on zenith distance and azimuth. Stellar or Annual parallax. Effect of parallax on the star's longitude and latitude. Effect of stellar parallax on right ascension and declination.
Lunar eclipses, section of the shadow cone at moon's geocentric distance, condition of lunar eclipse in terms of it; Solar eclipses, the angle subtended at the earth's center by the centers of the sun and the moon at the beginning or end of a solar eclipse. Condition of solar eclipse in terms of this angle, idea of ecliptic limits. Frequency of eclipses. **12 Marks**

Text Books :

1. Spherical Astronomy- W.M. Smart

Reference Books :

1. Spherical Astronomy-B. Sarma
2. Spherical Astronomy- S. Malik
3. Spherical Astronomy-G. Prasad
4. Spherical Astronomy-Ball

TDC Part III
Mathematics (Major)
Paper VIII

A: Probability Theory (50)

B: Optimization (50)

Group A :Probability Theory

Unit 1: Random experiment, Sample Space ,Events; Classical definition of probability and the theorems of total and compound probability based on this definition. Axiomatic approach to the notion of probability: important theorems based on this approach. Conditional Probability and independent events. Bay's theorem. **15 Marks**

Unit 2: Random variables, Discrete and continuous probability distributions. Probability function and Distribution function. Probability mass function and Probability Density function. Joint distributions. Marginal distribution. Independent random variables. Change of variables. Conditional distribution. **10 Marks**

Unit 3: Mathematical expectation; Basic theorems on expectation (proofs required only in case of discrete random variables) Variance and Standard deviation. Moments and moment generating functions. Covariance conditional expectation and conditional variance Chebyshev's inequality. Law of large numbers. **15 Marks**

Unit 4: Some important probability distributions: Binomial, Poison and Normal. **10 Marks**

Text Books :

1. Probability and Statistics by Spiegel (Schaum's outline series)

2. Elements of Probability and Statistics by A P Baisnab and M Das (Tata McGraw Hills)

Reference Books :

1. An Introduction to Probability Theory and its Applications by W Feller.
2. Introduction to Mathematical Probability by J V Uspensky.
3. Mathematical Statistics by Kapur and Saxena.

Group B: OPTIMIZATION 50 Marks

Unit 5: Partitioning of matrices; simultaneous equations; Basic solution Point sets, lines and hyperplanes; convex sets and their properties, convex functions, concave functions, convex cones. **10 Marks**

Unit 6: General linear programming problems, Mathematical formulation of a linear programming problem; Linear programming problem in matrix notation, Feasible solution, Basic solution, Degenerate basic solution; Necessary and sufficient condition for the existence of non-degenerate basic solution, graphical method for the solution of a linear programming problem. **10 Marks**

Unit 7: Simplex method: Fundamental theorem of linear programming problem, Basic feasible solution from feasible solution. Determination of improved basic feasible solution; optimality conditions; Alternative optimal solution, conditions for alternative optimal solution, Theory and application of the simplex method of solution of a linear programming problem, Charne's M-technique. The two-phase method. **10 Marks**

Unit 8: Principles of Duality in linear programming problem, Fundamental Duality theorem. Simple problems. **10 Marks**

Unit 9: The Transportation and Assignment problems.
10 Marks

Text Book :

1. G Hadley: Linear Programming - Narosa Publ. House.
2 S L Gass : Linear Programming Methods and Applications (4^{th} edition) McGraw Hill, New York.
3 R K Gupta: Linear Programming
4 Kanti Swaroop, P K Gupta and Man Mohan: Operation Research: S Chand and Sons, New Delhi

TDC Part - III
Mathematics (Major)
Paper - IX

A: Mechanics (Marks – 50)

B: Hydrostatics (Marks- 50)

Group A : Mechanics 50 Marks

Unit 1: Moments and products of inertia. Parallel axes theorem, theorem of six constants. The Momental ellipsoid. Equimomental systems. Principal axes. **10 Marks**

Unit 2: D' Alembert's Principle. The general equation of motion of a rigid body. Motion of the center of inertia and motion relative to the center of inertia. **10 Marks**

Unit 3: Motion about a fixed axis. The compound pendulum. Centre of percussion. **8 Marks**

Unit 4: Motion of a body in two dimension under finite and impulsive forces. **10 Marks**

Unit 5: Conservation of Momentum and energy. Generalized coordinates. Lagrange's equations. Initial motions. **12 Marks**

Text books :

1. S.L. Loney: An elementary Treatise on the Dynamics of a particle and of Rigid bodies.
2. A.S. Ramsay: Dynamics Part I.
3. Theoretical Mechanics: Schaum Series.
4. Analytical Dynamics: F. Chorlton.

Group B : Hydrostatics 50 Marks

Unit 6: Pressure equation. Condition of Equilibrium. Lines of force. Homogenous and Heterogeneous fluids. Elastic Fluids. Surface of equal pressure. Fluid at rest under action of gravity. Rotating fluids. **15 Marks**

Unit 7: Fluid pressure on plane surfaces. Centre of pressure. Resultant pressure on curved surfaces. **10 Marks**

Unit 8: Equilibrium of a floating body. Curves of buoyancy , surface of buoyancy, Stability of equilibrium of floating bodies. Meta center. Work done in producing a displacement. Vessel containing a liquid. **15 Marks**

Unit 9: Gas law. Mixture of gases. Internal energy. Adiabatic expansion. Work done in compressing a gas. Isothermal atmosphere. Connective equilibrium. **10 Marks**

Text Books :

1. W.H. Besant and A.S. Ramsay: A treatise on Hydromechanics Part I, Hydrostatics.
2. J.M. Kar: Hydrostatics, K.P.Basu Publ. Co. Calcutta
3. M. Ray: Hydrostatics, S.Chand and Co.

TDC Part - III

Mathematics (Major) [Special Paper]

Paper - X

Discrete Mathematics

Unit 1: (Divisibility Theory): Pearno's Axiom, well ordered principle, Mathematical induction, Division Algorithm, the basis representation theorem, Prime numbers, Unique factorization theorem.

10 Marks

Unit 2: (Congruences): Basic properties of congruences, Residual systems, Linear conguences and their solutions, Special divisibility tests, the Chinese remainder theorem and its applications, Fermat's little theorem and Wilson's theorem, polynomial congruences.

15 Marks

Unit 3: (Diophontine Equation): Liner diophontine equation, the equation $x^2 + y^2 = z^2$ and $x^4 + y^4 = z^4$. Fermat's last theorem, Representation of a number by two or four squares.

10 Marks

Unit 4: (Number Theoretic function): Euler's phi function, Euler's theorem, combinatorial study of the Euler's ϕ-function, The function τ and σ, Basic theorems on $\tau(n)$ and $\sigma(n)$, The Mobious function, Multiplicative Arithmetic Function, Inversion formula, Greatest integer function

15 Marks

Unit 5: Countable and uncountable sets. Infinite sets and axiom of choice. Cardinal numbers and its arithmetic, cantor's set. Statements of the following Schroeder-Bernstein theorem, Cantor's theorem and continuum hypothesis, Zorn's lemma, well-ordering theorem.

10Marks

Unit 6: (Propositional calculus): Operation on statements, truth function, Laws of propositional logic, Boolean algebra of statement bundles, adequate system of connectives, Binary connectives 'Nor' and 'and' **10 Marks**

Unit 7: (Boolean Algebra) : disjunctive normal form (DNF), Complement of Boolean expression in DNF, construction of a Boolean function corresponding to a Boolean expression; conjunctive Normal form (CNF); complement of a Boolean expression in CNF, transformation of a normal form to the other form; Applications.

10 Marks

Unit 8: Elementary combinatorics, Rules of sum and product, two models of counting, sample and distribution model of counting. Examples and solution. Integer solution of an equational problem. **10 Marks**

Unit 9: (Graph theory): Graphs and planar graphs-Basic terminology, Multigraphs, Weighted graphs-paths and circuits, Shortest paths, Eulerian paths and circuits.

10 Marks

Text books :

1. Elementary Number theory (third edition)-David M. Burton, Universal Book Stall, New Delhi-110002
2. Introduction to discrete mathematics-M.K. Sen. Allied Publisher
3. Discrete Mathematics: Applied Combinatorics and Graph Theory-Michael Towusend

Reference Books :

4. Number theory-George E. Adrews, Hindustan Publishing Corporation (India), New Delhi.
5. Basic Number Theory-S.B. Malik, Vikash Publishing House Pvt. Ltd., New Delhi-110014
6. Number Theory-S.G. Telong edited by M.G. Nadkarni and J.B. Dani, Tata Mc Graw Hills, New Delhi.
7. A first course in number theory – K. C. Choudhury, Asian Books Pvt. Ltd. (in press).
8. Basic Graph Theory : K.R. Parthasarathi
9. Elements of discrete mathematics-C.L. Liu, Mc Graw Hill (International edition), Computer Science Series.

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