

DSPM UNIVERSITY, RANCHI

RANCHI

Mathematics

[Syllabus for B.A./B.Sc]

[Under Choice Based Credit System]

UNIVERSITY DEPARTMENT OF MATHEMATICS, DSPMU, RANCHI
CBCS PATTERN SYLLABUS

Semester	Honours (Core Courses)		Allied (Elective Courses)		Ability Enhancement (Compulsory Courses)	
	Code	14 Papers	Code	8 Papers	Code	4 Papers
I	C1 C2	Analytic Geometry 2D, Higher Algebra & Trigonometry + T Differential Calculus & Vector Calculus + T	GE1	Refer Table No. AI-2.1 04 Papers from Interdisciplinary Subject	Compulsory Language Communication ENG/ HINDI/ NH+MB	
II	C3 C4	Analysis I + T Integral Calculus & Analytic Geometry 3D + T	GE2		EVS	Environmental Science
III	C5 C6 C7	Theory of Real Functions + T Group Theory & Mathematics + T Differential Equations + T	GE3		SEC1	Elementary Computer Application Software + T
IV	C8 C9 C10	Analysis II + T Mathematics I + T Ring Theory + T	GE4		SEC2	Operating System + Practical
V	C11 C12	Analysis III {Matric space & Complex Theory Analysis) + T Linear Algebra + T	DSE1 DSE2	Number Theory + T Special Function		
VI	C13 C14	Mathematics II + T Numerical Analysis + T	DSE3 DSE4	Linear Programming + T Fluid Mechanics + T		

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SEMESTER I			
Core Course 1	Mat/Sem I/ C 1	Analytical Geometry 2D & Trigonometry	Theory – 4 Credits Assignment – 1 Credit Tutorial – 1 Credit
Core Course 2	Mat/Sem I/ C 2	Differential Calculus & Vector Calculus	Theory – 4 Credits Assignment – 1 Credit Tutorial – 1 Credit
Ability Enhancement Compulsory Course 1	Mat/ Sem I/ AECC 1	Environmental Science/(English/MIL/Regional Languages Communication)	Theory – 2 Credit
Generic Elective 1	Mat/ Sem I / GE 1		Theory – 4 Credits Assignment – 1 Credit Tutorial – 1 Credit

SEMESTER II			
Core Course 3	Mat/Sem II/ C 3	Analysis I	Theory – 4 Credits Assignment – 1 Credit Tutorial – 1 Credit
Core Course 4	Mat/Sem II/ C 4	Integral Calculus & Analytic Geometry 3D	Theory – 4 Credits Assignment – 1 Credit Tutorial – 1 Credit
Ability Enhancement Compulsory Course 2	Mat/ Sem II/ AECC 2	Environmental Science/(English/MIL/Regional Languages Communication)	Theory – 2 Credits
Generic Elective 2	Mat/ Sem II / GE 2		Theory – 4 Credits Assignment – 1 Credit Tutorial – 1 Credit

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SEMESTER III			
Core Course 5	Mat/Sem III/ C 5	Theory of Real Functions	Theory – 4 Credits Assignment – 1 Credit Tutorial – 1 Credit
Core Course 6	Mat/Sem III/ C 6	Group Theory & Matrices	Theory – 4 Credits Assignment – 1 Credit Tutorial – 1 Credit
Core Course 7	Mat/SemI III/ C 7	Differential Equations	Theory – 4 Credits Assignment – 1 Credit Tutorial – 1 Credit
Skill Enhancement Course 1	Mat/SemI III/ SEC 1	Elementary Computer Application Software	Theory – 1 Credits Assignment/Tutorial – 1 Credit
Generic Elective 3	Mat/ Sem III / GE 3		Theory – 4 Credits Assignment – 1 Credit Tutorial – 1 Credit
SEMESTER IV			
Core Course 8	Mat/Sem IV/ C 8	Analysis II	Theory – 4 Credits Assignment – 1 Credit Tutorial – 1 Credit
Core Course 9	Mat/Sem IV/ C 9	Mechanics I	Theory – 4 Credits Assignment – 1 Credit Tutorial – 1 Credit
Core Course 10	Mat/Sem IV/ C 10	Ring Theory	Theory – 4 Credits Assignment – 1 Credit Tutorial – 1 Credit
Skill Enhancement Course 2	Mat/SemI IV/ SEC 2	Operating System	Theory – 1 Credit Assignment/Tutorial – 1 Credit
Generic Elective 3	Mat/ Sem IV / GE 4		

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SEMESTER V			
Core Course 11	Mat/Sem V/ C 11	Analysis III	Theory – 4 Credits Assignment – 1 Credit Tutorial – 1 Credit
Core Course 12	Mat/Sem V/ C 12	Linear Algebra	Theory – 4 Credits Assignment – 1 Credit Tutorial – 1 Credit
Discipline Specific Elective 1	Mat/Sem V/ DSE 1	Number Theory Or Portfolio Optimization Or Analytic Geometry	Theory – 4 Credits Assignment – 1 Credit Tutorial – 1 Credit
Discipline Specific Elective 2	Mat/Sem V/ DSE 2	Probability & Statistics Or Boolean Algebra & Automata Theory Or Special Functions	Theory – 4 Credits Assignment – 1 Credit Tutorial – 1 Credit
SEMESTER VI			
Core Course 13	Mat/Sem VI/ C 13	Mechanics II	Theory – 4 Credits Assignment – 1 Credit Tutorial – 1 Credit
Core Course 14	Mat/Sem VI/ C 14	Numerical Analysis	Theory – 4 Credits Assignment – 1 Credit Tutorial – 1 Credit
Discipline Specific Elective 3	Mat/Sem VI/ DSE 3	Linear Programming Or Theory Of Equations Or Bio – Mathematics	Theory – 4 Credits Assignment – 1 Credit Tutorial – 1 Credit
Discipline Specific Elective 4	Mat/Sem VI/ DSE 4	Fluid Mechanics Or Mathematical Modeling Or Differential Geometry	Theory – 4 Credits Assignment – 1 Credit Tutorial – 1 Credit

**UNIVERSITY DEPARTMENT OF MATHEMATICS, DSPMU, RANCHI
CBCS PATTERN SYLLABUS**

Semester I

Mat/ Sem I/ C 1 – Analytical Geometry 2D, Trigonometry

Instruction: -

Ten questions will be set. Candidates will be required to answer **Seven Questions**.

Question no. 1 will be **Compulsory** consisting of 10 short answer type covering entire syllabus uniformly. Each question will be of 2 marks. Out of remaining 9 questions candidates will be required to answer 6 questions selecting at least one from each group. Each question will be of 10 marks.

GROUP - A

ANALYTICAL GEOMETRY OF TWO DIMENSIONS

Change of rectangular axes. Condition for the general equation of second degree to represent parabola, ellipse, hyperbola and reduction into standard forms. Equations of tangent and normal (Using Calculus). Chord of contact, Pole and Polar. Pair of tangents in reference to general equation of conic. Axes, centre, director circle in reference to general equation of conic. Polar equation of conic. **5 Questions**

GROUP - B

HIGHER ALGEBRA & TRIGONOMETRY

Statement and proof of binomial theorem for any index, exponential and logarithmic series. **1 Question**

De Moivre's theorem and its applications. Trigonometric and Exponential functions of complex argument and hyperbolic functions.

Summation of Trigonometrical series.

Factorisation of $\sin \theta$, $\cos \theta$. **3 Questions**

Books Recommended:

1. Analytical Geometry & Vector Analysis – B. K. Kar, Books & Allied Co., Kolkata
2. Analytical Geometry of two dimension – Askwith
3. Coordinate Geometry – S L Loney.
4. Trigonometry – Das and Mukherjee
5. Trigonometry - Dasgupta

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Semester I

Mat/ Sem II/ C 2 – Differential Calculus and Vector Calculus

Instruction: -

Ten questions will be set. Candidates will be required to answer **Seven Questions**.

Question no. 1 will be **Compulsory** consisting of 10 short answer type covering entire syllabus uniformly. Each question will be of 2 marks. Out of remaining 9 questions candidates will be required to answer 6 questions selecting at least one from each group. Each question will be of 10 marks.

GROUP - A

DIFFERENTIAL CALCULUS

Successive differentiation, Leibnitz's theorem. Maclaurin and Taylor series expansion.

1 Question

Partial differentiation, Euler's theorem for functions of two variables, Total differential, Jacobian.

2 Questions

Tangent and normal, curvature. Asymptotes, Maxima and Minima of functions of two variables, Lagrange's multipliers.

2 Questions

GROUP - B

VECTOR CALCULUS

Product of three and four vectors, work done, moment of a vector about a point and a line. Scalar and vector point functions, differentiation of a vector function of scalar variables. Gradient, Divergence and Curl, second order operators in Cartesian coordinate system.

4 Questions

Books Recommended:

1. Calculus – G B Thomas & R L Finney.
2. Differential Calculus – Das & Mukherjee.
3. Vector Calculus – Dasgupta.
4. Vector Calculus – Shanti Narayan

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Mat/ Sem1/ GE 1 – MATHEMATICS – I F.M: - 150

Instruction for Generic Elective: - 7x10

Eleven Questions will be set. Candidates will be required to answer **Eight Questions.**

Question no. 1 will be **Compulsory** consisting of 10 short answer type covering entire syllabus uniformly. Each question will be of 3 marks. Out of remaining 10 questions will be required to answer 7 questions selecting at least one from each group. Each question will be of 10 marks.

GROUP - A

DIFFERENTIAL CALCULUS I

Successive differentiation, **n^{th} order derivative** of some standard functions. Leibnitz's theorem. n^{th} derivative of rational functions. Taylor's and Maclaurin's series expansions of functions. Applications of Taylor's and Maclaurin's series. Tangent and Normal, their equations in the Cartesian form, parametric form, Tangents at the origin. Angle between two curves. Length of tangent, normal, sub tangent, subnormal in Cartesian forms. **2 Questions**

INTEGRAL CALCULUS I

Integration of rational and irrational functions. Integration by partial fractions, Integration by transformations, Integration by substitution, Integration by parts. **2 Questions**

GROUP - B

VECTORS I

Scalar and Vector point functions, vector function of a scalar variables, Continuity of a vector function. differentiation of a vector with respect to the scalar variable "t". Differentiation of a vector function. Derivatives of a sum of vectors, derivatives of a product of vectors (both scalar and vector products.) **2 Questions**

COORDINATE GEOMETRY OF TWO DIMENSION I

Change of rectangular axes, Rotation and Shifting of origin. Transformation of the general equation of the second degree. Conditions for the general equation of second degree to represent a parabola, ellipse and hyperbola. Equations of the tangent and normal to a given curve using calculus. **2 Questions**

REAL ANALYSIS I

Sequence: Definition, Bounds, Limit of a sequence, Monotonic Sequences and their Convergence, Algebraic operations and limits, Cauchy Sequence, General principle of convergence of a sequence. **2 Questions**

BOOKS RECOMMENDED

1. Differential Calculus : A Das Gupta & S B Prasad
2. Integral Calculus : A Das Gupta
3. Vector Analysis : Lalji Prasad/ A Das Gupta & S B Prasad
4. Coordinate Geometry : A Das Gupta
5. Real Analysis : Lalji Prasad

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Semester II

Mat/ Sem II/ C 3 – Analysis I

Instruction: -

Ten questions will be set. Candidates will be required to answer **Seven Questions**.

Question no. 1 will be **Compulsory** consisting of 10 short answer type covering entire syllabus uniformly. Each question will be of 2 marks. Out of remaining 9 questions candidates will be required to answer 6 questions selecting at least one from each group. Each question will be of 10 marks.

GROUP - A

Analysis I

The axiom of least upper bound and greatest lower bound in R . The completeness property of R , Archimedean property, density of rational and irrational numbers in R . Neighbourhoods and limit point of a set, open and closed sets, isolated points, Bolzano – Weierstrass theorem for sets (Statement only). Sequences, bounded sequence, convergent sequence, monotonic sequence, subsequence, Cauchy sequence and Cauchy's general principle of convergence. **5 Questions**

GROUP - B

Infinite series, Convergence and divergence of infinite series of real numbers, Pringsheim's theorem, Comparison test, Cauchy's root test, D'Alembert's ratio test, Raabe's test, De-Morgan's and Bertrand's test, Gauss's ratio test, Cauchy's condensation test, Integral test, Alternating Series, Leibnitz test, Absolute and conditional convergence. **4 Questions**

Books Recommended:

1. Elements of Real Analysis – Shanti Narayan & M D Raisinghania.
2. Higher Algebra – S Bernard & J M Child

Semester II

Mat/ Sem II/ C 4 – Integral Calculus and Analytic Geometry 3D

Instruction: -

Ten questions will be set. Candidates will be required to answer **Seven Questions**.

Question no. 1 will be **Compulsory** consisting of 10 short answer type covering entire syllabus uniformly. Each question will be of 2 marks. Out of remaining 9 questions candidates will be required to answer 6 questions selecting at least one from each group. Each question will be of 10 marks.

GROUP - A

Integral Calculus – Integration of rational and irrational functions. Evaluation of definite integrals, Special integrals, differentiation and integration under the sign of integration (Beta and Gamma functions are excluded), Reduction formula. Point of inflexion, double point, curve tracing. Length of plane curve and area bounded by plane curves. Volume and surface area of solid of revolution. **5 Questions**

GROUP - B

3D – Rectangular, spherical-polar and cylindrical co-ordinates, Direction cosines. Angle between straight lines, equation of planes and straight lines, shortest distance between the lines. Sphere. **4 Questions**

Books Recommended:

1. Calculus – G B Thomas & R L Finney.
2. Integral Calculus – Das & Mukherjee.
3. Integral Calculus – Lalji Prasad.
4. Coordinate Geometry of 3D – J T Bell
5. Analytical Geometry of 3D – Lalji Prasad.

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Mat/ Sem II/ GE 2 – MATHEMATICS – II

Instruction for Generic Elective: -

Eleven Questions will be set. Candidates will be required to answer **Eight Questions**.

Question no. 1 will be **Compulsory** consisting of 10 short answer type covering entire syllabus uniformly. Each question will be of 3 marks. Out of remaining 10 questions will be required to answer 7 questions selecting at least one from each group. Each question will be of 10 marks.

GROUP - A

Differential Calculus II

Partial Differentiation, Curvature, Asymptotes, Maxima and Minima of functions of two variables. **2 Questions**

Integral Calculus II

Evaluation of definite integrals, reduction formulae, curve tracing, length and area, Surface area and volume of solids of revolution. **2 Questions**

GROUP - B

Vector II

Gradient, Divergence and curl and second order vector differential operators in Cartesian coordinates systems. **2 Questions**

Co- ordinate geometry of two dimensions II

Reduction of the general equation of second degree to the standard forms, Chord of Contact, Polar and pair of tangents in reference to general equation of conic, Polar equation. **2 Questions**

Real Analysis II

Series: Definition, Convergent Series, Divergent Series, Pringsheim's theorem, Comparison tests, Cauchy,s root test , D'Alembert's ratio test, Alternating series and Leibnitz test, Absolutely convergent series. **2 Questions**

Semester III

Mat/ Sem III/ C 5 – Theory of Real Functions

Instruction: -

Ten questions will be set. Candidates will be required to answer **Seven Questions**.

Question no. 1 will be **Compulsory** consisting of 10 short answer type covering entire syllabus uniformly. Each question will be of 2 marks. Out of remaining 9 questions candidates will be required to answer 6 questions selecting at least one from each group. Each question will be of 10 marks.

GROUP - A

Limit of functions: Limit, algebra of limit of functions. Continuity and discontinuities, algebra of continuous functions. Intermediate value theorem, location of roots theorem, preservation of intervals theorem. Uniform continuity, functions of bounded variations. **3 Questions**

GROUP - B

Derivability: Derivability, relationship with continuity, Rolle's theorem, Lagrange's and Cauchy Mean value theorem, Taylor's theorem, Maclaurin's theorem, remainder after n terms, power series expansion of $(1+x)^n$, $\sin x$, $\cos x$, e^x , $\log x$ using suitable remainder after n terms. **3 Questions**

GROUP - C

Riemann Integration: Definition, Darboux theorem I and II, integrability conditions. Particular classes of bounded integrable functions. Primitive, Fundamental theorem, First and Second Mean value theorem. **3 Questions**

Books Recommended:

1. Introduction to Real Analysis- R Bartle & D R Sherbert
2. Elements of Real Analysis- Shanti Narayan & M D Raisinghania.

Semester III

Mat / Sem III / C6 - Group Theory & Matrices

Instruction: -

Ten questions will be set. Candidates will be required to answer **Seven Questions**.

Question no. 1 will be **Compulsory** consisting of 10 short answer type covering entire syllabus uniformly. Each question will be of 2 marks. Out of remaining 9 questions candidates will be required to answer 6 questions selecting at least one from each group. Each question will be of 10 marks.

GROUP - A

5 Questions

Groups: Preliminary results, equivalent definitions, sub groups, Cyclic Group and its subgroups, Cosets of a subgroups, Lagrange's Theorem and it's applications.

Normal subgroups, Quotient group and homomorphism, Fundamental theorem of homomorphism.

Permutations, Permutation group, Symmetric and Alternating group. Caylay's Theorem.

GROUP - B

4 Questions

Different types of Matrices, Algebra of Matrices, Adjoint and inverse of a Matrix, different ways of finding inverses.

Elementary row and column operations. Elementary matrices, equivalent matrices, Rank of a matrix, Invariance of rank through elementary row/column operations, rank of sum and product of matrices and related theorems.

Solution of a system of linear equations via matrix methods, Consistency, Inconsistency.

Books Recommended :

1. John B. Fraleigh, *A First Course in Abstract Algebra*, 7th Ed., Pearson, 2002.
2. Joseph A. Gallian, *Contemporary Abstract Algebra*, 4th Ed., Narosa Publishing House, New Delhi, 1999.
3. Topics in Algebra : I N Herstein .
4. Basic Abstract Algebra: P B Bhattacharya, Cambridge Univ. Press.
5. Matrices – Shanti Narayan.
6. Matrices – A R Vashishtha.

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Mat / Sem III / C7 – Differential Equation

Instruction: -

Ten questions will be set. Candidates will be required to answer **Seven Questions**.

Question no. 1 will be **Compulsory** consisting of 10 short answer type covering entire syllabus uniformly. Each question will be of 2 marks. Out of remaining 9 questions candidates will be required to answer 6 questions. Each question will be of 10 marks.

Differential equation of first order but not of first degree, Clairaut's form, singular solutions. Differential equation with constant co-efficients. **2 Questions**

Orthogonal trajectories and its simple application in geometrical and mechanical problems. **1 Question**

Linear differential equations of higher order with constant coefficients. Differential equations with variable coefficients. **2 Questions**

Linear differential equations of second order by method of variation of parameter and by change of independent variable. **2 Questions**

Total differential equation in three independent variables. **1 Question**

Partial differential equation: Lagrange's linear partial differential equation, Charpit's method. **1 Question**

Books Recommended:

1. Differential Equations – M D Raisinghania.

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Mat/ Sem III/ GE 3 – MATHEMATICS – III

Instruction for Generic Elective: -

Eleven Questions will be set. Candidates will be required to answer **Eight Questions**.

Question no. 1 will be **Compulsory** consisting of 10 short answer type covering entire syllabus uniformly. Each question will be of 3 marks. Out of remaining 10 questions will be required to answer 7 questions selecting at least one from each group. Each question will be of 10 marks.

GROUP - A

REAL ANALYSIS III

Continuity & Derivability of function of one variable, relationship with continuity, Rolle's theorem, Lagrange's Mean Value theorem, Taylor's and Maclaurin's theorem with R_n .

2 Questions

SET THEORY I

Indexed family of sets, Generalised set of operations & Demorgan laws, Set mapping. Equivalence relation and related fundamental theorem of partition.

2 Questions

COMPLEX VARIABLE I

Real functions of two variables: Simultaneous and iterated limits: Continuity, partial derivatives, Differentiability and related necessary and sufficient conditions.

2 Questions

GROUP - B

ABSTRACT ALGEBRA I

Binary operations, Notion of group, Abelian group and non-Abelian group with examples. Uniqueness of identity element and inverse elements in a group, different ways of defining a group, concept of Subgroup and cyclic group, Cosets, Lagrange's theorem.

2 Questions

DIFFERENTIAL EQUATIONS

Differential equations of first order and higher degree, Clairaut's form, singular solution, orthogonal trajectories.

2 Questions

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Mat/ Sem IV/ C-8 – Analysis II

Instruction: -

Ten questions will be set. Candidates will be required to answer **Seven Questions**.

Question no. 1 will be **Compulsory** consisting of 10 short answer type covering entire syllabus uniformly. Each question will be of 2 marks. Out of remaining 9 questions candidates will be required to answer 6 questions selecting at least one from each group. Each question will be of 10 marks.

GROUP - A

Convergence of improper integrals, comparison tests, absolute convergence, Abel's and Dirichlet's tests, Frullani's Integrals. Definition & convergence of Beta & Gamma functions and their properties, duplication formula, inter-relation. **3 Questions**

GROUP - B

Evaluation of double and triple integrals. Multiple Integrals of Dirichlet's form, Liouville's extension, change of order of integration and change of variables.

3 Questions

GROUP - C

Vector integration: Line integral, surface integral, volume integral, Green's theorem in R^2 ,

Stoke 's theorem, Gauss Divergence theorem.

3 Questions

Books Recommended:

1. Elements of Real Analysis – Shanti Narayan & M D Raisinghania.
2. Mathematical Analysis – J N Sharma & A R Vashishtha.

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Mat/ Sem IV/ C 9 – Mechanics I

Instruction: -

Ten questions will be set. Candidates will be required to answer **Seven Questions**.

Question no. 1 will be **Compulsory** consisting of 10 short answer type covering entire syllabus uniformly. Each question will be of 2 marks. Out of remaining 9 questions candidates will be required to answer 6 questions selecting at least one from each group. Each question will be of 10 marks.

GROUP - A

Reduction of system of coplanar forces, equation of resultant, condition for equilibrium. Astatic centre. **1 Question**

Laws, angles and cone of friction, equilibrium on a rough inclined plane, particle constrained to move on a rough curve under any given forces. **2 Questions**

GROUP - B

Kinematics in two dimension: Tangential, normal, radial, transverse velocities and acceleration. Angular velocity and acceleration. Rectilinear motion and simple pendulum. S.H.M., compounding of two S.H.M. Repulsive motion. Motion under inverse square law. **3 Questions**

Rectilinear Motion (Kinetics): Newton's law, Work, K.E., work energy principle, Impulse, Torque and angular momentum, conservation of energy, momentum and angular momentum, Hooke's law, extension of an elastic string: Horizontal & vertical case. **3 Questions**

Books Recommended:

1. Degree level Mechanics – Singh & Sen

Mat / Sem IV / C 10 - Ring Theory

Instruction: -

Ten questions will be set. Candidates will be required to answer **Seven Questions**.

Question no. 1 will be **Compulsory** consisting of 10 short answer type covering entire syllabus uniformly. Each question will be of 2 marks. Out of remaining 9 questions candidates will be required to answer 6. Each question will be of 10 marks.

Ring: Definition and examples, commutative ring, ring with unity, unit in a ring, Matrix ring, Boolean ring, Ring of continuous functions. Direct product of rings, Properties of rings, subrings. **2 Questions**

Nilpotent element, idempotent element, zero divisors, integral domain, division ring and field. Characteristic of a ring. **1 Question**

Ideal, ideal generated by a subset of a ring, simple ring, factor rings, operations on ideals, prime and maximal ideals. **2 Questions**

Ring homomorphisms, properties of ring homomorphisms, Isomorphism theorems I, II and III, field of quotients. **2 Questions**

Polynomial rings over commutative rings, division algorithm and consequences, principal ideal domains, factorization of polynomials, reducibility tests, irreducibility tests, Eisenstein's criterion. **2 Questions**

Books Recommended:

1. John B. Fraleigh, A First Course in Abstract Algebra, 7th Ed., Pearson, 2002.
2. Joseph A. Gallian, Contemporary Abstract Algebra, 4th Ed., Narosa Publishing House, New Delhi, 1999.
3. C Musili, Introduction to Rings and Modules, 2nd edition, Narosa Publishing House.
4. Modern Algebra – Surjeet

Mat/ Sem4/ GE 4 – MATHEMATICS – IV

Instruction for Generic Elective: -

Eleven Questions will be set. Candidates will be required to answer **Eight Questions**.

Question no. 1 will be **Compulsory** consisting of 10 short answer type covering entire syllabus uniformly. Each question will be of 3 marks. Out of remaining 10 questions will be required to answer 7 questions selecting at least one from each group. Each question will be of 10 marks.

GROUP - A

REAL ANALYSIS IV

Riemann Integration, definition, Oscillatory sum and integrability condition. Integrability of monotonic and continuous functions. Fundamental theorem of integral calculus. **2 Questions**

SET THEORY II

Partial order relation and relate concepts of u.b., l.b., inf., sup, maximal element, minimal element and lattice (definition and examples only), statement of Zorn's lemma. **1 Question**

COMPLEX VARIABLE II

Functions of complex variables limit, Continuity, derivative, Cauchy-Riemann Equations, Analytic function, Harmonic function.

Import of some standard transformations e.g., $w=z+c$, $w=cz$, $w=1/z$, $w=(az+b)/(cz+d)$ bilinear). Conformal transformation as transformation effected by analytic function. Special conformal transformation $w=z^2$, $w=e^z$, $w=\sin z$. **2 Questions**

GROUP - B

ABSTRACT ALGEBRA II

Matrices, operations on matrices, matrix algebra, kinds of matrices, Transpose, adjoint and inverse of a matrix, solution of system of linear equations. **2 Questions**

DIFFERENTIAL EQUATIONS II

Linear Equation with constant co-efficients, Homogenous linear equations with variable coefficients. Simultaneous equation $s \frac{dx}{P} = \frac{dy}{Q} = \frac{dz}{R}$ and total differential equation $P dx + Q dy + R dz = 0$ together with their geometric significance.

3 Questions

Mat/Sem V/ C 11 – Analysis -III

Instruction: -

Ten questions will be set. Candidates will be required to answer **Seven Questions**.

Question no. 1 will be **Compulsory** consisting of 10 short answer type covering entire syllabus uniformly. Each question will be of 2 marks. Out of remaining 9 questions candidates will be required to answer 6 questions selecting at least one from each group. Each question will be of 10 marks.

GROUP - A

4 Questions

Metric spaces: Definition and examples of metric spaces. Sequences in metric space, Cauchy sequence, complete metric space. 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, perfect sets. Baire's Category theorem.

Continuous mappings, sequential criterion and characterizations of continuity by open sets, Homeomorphism.

GROUP - B

5 Questions

Complex Analysis: Complex numbers, Continuity and differentiability of functions of complex variable, Analytic functions, Cauchy- Riemann differential equations in Cartesian and polar forms.

Conformal representation: Transformation, Jacobian, conformal transformation, some general transformations, bilinear transformation. critical points, fixed points, cross ratio, preservice of cross ratio, fixed points of bilinear transformation.

Books Recommended:

1. Introduction to Topology – G F Simmons.
2. Metric Spaces – P K Jain & Khalil Ahmad.
3. Complex variable – J N Sharma.

Mat / Sem V / C 12 - Linear Algebra

Instruction: -

Ten questions will be set. Candidates will be required to answer **Seven Questions**.

Question no. 1 will be **Compulsory** consisting of 10 short answer type covering entire syllabus uniformly. Each question will be of 2 marks. Out of remaining 9 questions candidates will be required to answer 6 questions selecting at least one from each group. Each question will be of 10 marks.

GROUP - A

Vector spaces, subspaces, algebra of subspaces, linear combination of vectors, linear span, linear dependence and linear independence, basis and dimension, coordinate vector of a vector relative to a basis. Complement of a subspace, direct sum and quotient space.

3 Questions

GROUP - B

Linear transformations, null space, range, rank and nullity of a linear transformation, Sylvester's law of nullity. Matrix representation of a linear transformation, algebra of linear transformations. Isomorphism, isomorphism theorems, invertibility and isomorphism, change of coordinate matrix.

3 Questions

GROUP - C

Linear functional, dual spaces, dual basis, double dual, transpose of a linear transformation and its matrix in the dual basis. Characteristic polynomial and characteristic values of a linear operator, diagonalizability, Cayley-Hamilton theorem and its applications.

3 Questions

Books Recommended:

1. Linear Algebra – K Hoffman & R Kunze.
2. Higher Algebra – S K Mapa.
3. Linear Algebra – A R Vashishtha.

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Mat / Sem V /DSE1- NUMBER THEORY

Instruction for Generic Elective: -

Eleven Questions will be set. Candidates will be required to answer **Seven Questions**.

Question no. 1 will be **Compulsory** consisting of 10 short answer type covering entire syllabus uniformly. Each question will be of 2 marks. Out of remaining 9 questions will be required to answer 6. Each question will be of 10 marks.

Divisibility and primes, H.C.F., Euclid's Algorithm, unique factorization, perfect numbers. **2 Questions**

Residue class, complete and reduced residue system, congruences and their properties, Fermat's theorem, Wilson's theorem. **2 Questions**

Arithmetical functions, Euler's and Mobius function, Mobius inversion formula. **2 Questions**

The Diophantine equations: $ax + by = c$, $x^2 + y^2 = z^2$. **1 Question**

Algebraic Congruence, solution by inspection, Solution of $ax \equiv b \pmod{c}$, system of linear congruences, Chinese remainder theorem. **1 Question**

Farey sequence, continued fractions, Pell's equation. **1 Question**

Books Recommended:

1. Number Theory – G H Hardy & E M Wright.
2. Number Theory – S G telang.
3. Number Theory – Harikisan
4. Number Theory – S. B. Malik

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Mat/ Sem V/ DSE 2 – SPECIAL FUNCTION

Instruction for Generic Elective: -

Eleven Questions will be set. Candidates will be required to answer **Seven Questions**.

Question no. 1 will be **Compulsory** consisting of 10 short answer type covering entire syllabus uniformly. Each question will be of 2 marks. Out of remaining 9 questions will be required to answer 6 questions selecting at least one from each group. Each question will be of 10 marks.

GROUP - A

Series Solution: Ordinary point, singular point(regular), general methods and forms of series solution (Indicial equation –Frobenius method) [N.B.: Results of analysis regarding validity of series solution are taken to be granted]

2 Question

Bessel's equation: Solution, recurrence formula for $J_n(x)$, Generating function for $J_n(x)$, equations reducible to Bessel's equation, Orthogonality of Bessel's function

1 Question

Legendre's equation: Solution, Rodrigue's formula, Legendre's polynomials, generating function for $P_n(x)$, orthogonality of Legendre's polynomials

1 Questions

Hypergeometric Functions: Special cases, integral representation, summation theorem.

1 Question

GROUP - B

Laplace Transform: Definition, Laplace Transform of elementary functions, properties, uniqueness and inverse Laplace Transform, Laplace Transform of derivatives and integrals,

Multiplication by t^n , division by t. Convolution theorem, Application of Laplace transform to differential equations.

4 Questions

Books Recommended:

1. Advance differential equations – M D Raisinghania.
2. Differential Equations – J N Sharma
3. Laplace Transform – Goyal & Gupta

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CBCS PATTERN SYLLABUS

Mat/ Sem VI/ C 13- Mechanics II

Instruction: -

Ten questions will be set. Candidates will be required to answer **Seven Questions**.

Question no. 1 will be **Compulsory** consisting of 10 short answer type covering entire syllabus uniformly. Each question will be of 2 marks. Out of remaining 9 questions candidates will be required to answer 6 questions selecting at least one from each group. Each question will be of 10 marks.

GROUP - A

Condition of equilibrium of forces in three dimension.	1 Question
Central axis, Wrench, Pitch, Null lines.	1 Question
Principle of virtual work and its application in two dimensional cases.	1 Question
Common Catenary	1 Question
Stable equilibrium, energy test of stability (problems involving one variable only).	
Motion of a particle under a central force, differential equations of central orbit in both polar and pedal co-ordinates.	1 Question

GROUP - B

Newton's law of gravitation, planetary orbits, Kepler's laws of motion.	1 Question
Motion of a projectile under gravity in a non-resisting medium.	1 Question
Motion of mass centre and motion relative to mass centre, D' Alembert's principle.	1 Question
Two dimensional motion of a rigid body, compound pendulum.	1 Question

Books Recommended :

1. Statics – S L Loney.
2. Statics – Goyal & Gupta
3. Dynamics – S L Loney.
4. Dynamics – R K Gupta & D C Agarwal.

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Mat/ Sem VI/ C 14 – Numerical Analysis

Instruction: -

Ten questions will be set. Candidates will be required to answer **Seven Questions**.

Question no. 1 will be **Compulsory** consisting of 10 short answer type covering entire syllabus uniformly. Each question will be of 2 marks. Out of remaining 9 questions candidates will be required to answer 6 questions selecting at least one from each group. Each question will be of 10 marks.

GROUP - A

Solution of algebraic and transcendental equations: Bisection method, Regula-Falsi method, Newton-Raphson method. **1 Question**

Solution of simultaneous equations: Gauss's elimination method, Matrix inversion by triangularization method. **1 Question**

Calculus of finite difference: The operators Δ, ∇, E , factorial notation, their properties and inter-relation between them, Fundamental theorem of difference calculus, divided differences. **2 Questions**

GROUP - A

Interpolation: Newton's forward and backward difference interpolation formula, Lagrange's interpolation formula, central difference interpolation, Gauss's forward, backward and central difference interpolation formula. **2 Questions**

Numerical differentiation: Derivative using forward, backward and central difference interpolation formulae. **1 Question**

Numerical integration: General quadrature formula, Simpson's one-third and three - eighth rule, Weddle's rule, Newton-Cote's method. **1 Question**

Solution of ordinary differential equations: Picard's method of successive approximations, **1 Question**

NB : USE OF SCIENTIFIC CALCULATOR ALLOWED.

Books Recommended:

1. Numerical Analysis – J B Scarborough.
2. Numerical Analysis – G S Mallik
3. Numerical Analysis – G Shankar Rao, New Age Int. Publishers.
4. Numerical Methods – B S Grewal.

Mat / Sem VI /DSE 3 - LINEAR PROGRAMMING

Instruction for Generic Elective: -

Eleven Questions will be set. Candidates will be required to answer **Seven Questions**.

Question no. 1 will be **Compulsory** consisting of 10 short answer type covering entire syllabus uniformly. Each question will be of 2 marks. Out of remaining 9 questions will be required to answer 6 questions selecting at least one from each group. Each question will be of 10 marks.

GROUP - A

Convex sets and their properties, Introduction to linear programming problem, solution by graphical method, simplex method, optimality and unboundedness, artificial variables, two-phase method, Big-M method. **4 Questions**

Duality, formulation of the dual problem, primal-dual relationships, economic interpretation of the dual. **1 Question**

GROUP - B

Transportation problem and its mathematical formulation, northwest-corner method, least cost method and Vogel approximation method for determination of starting basic solution, algorithm for solving transportation problem. **2 Questions**

Assignment problem and its mathematical formulation, Hungarian method for solving assignment problem. **2 Questions**

Books Recommended:

1. Mokhtar S. Bazaraa, John J. Jarvis and Hanif D. Sherali, *Linear Programming and Network Flows*, 2nd Ed., John Wiley and Sons, India, 2004.
2. F.S. Hillier and G.J. Lieberman, *Introduction to Operations Research*, 9th Ed., Tata McGraw Hill, Singapore, 2009.
3. Hamdy A. Taha, *Operations Research, An Introduction*, 8th Ed., Prentice-Hall India, 2006.
4. G. Hadley, *Linear Programming*, Narosa Publishing House, New Delhi, 2002.
5. Operations Research – S D Sharma.
6. Linear Programming Problems – R K Gupta.

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Mat/ Sem VI/ DSE 4 – Fluid Mechanics

Instruction for Generic Elective: -

Eleven Questions will be set. Candidates will be required to answer **Seven Questions**.

Question no. 1 will be **Compulsory** consisting of 10 short answer type covering entire syllabus uniformly. Each question will be of 2 marks. Out of remaining 9 questions will be required to answer 6 questions selecting at least one from each group. Each question will be of 10 marks.

GROUP - A

Nature and properties of fluid pressure, pressure of heavy liquids.
Equilibrium of fluids under given system of forces.
Centre of pressure.
Thrust on plane and curved surfaces.

5 Questions

GROUP - B

Fluid Motion: Lagrangian and Eulerian methods. Equation of continuity in different forms. Euler's equation of motion for perfect fluid. Bernoulli's theorem. **4 Questions**

Book Recommended:

1. Hydrostatics – M Rahman
2. Hydrostatics – J P Sinha
3. Hydrodynamics – Shanti Swaroop
4. Hydrodynamics – M D Raisinghania