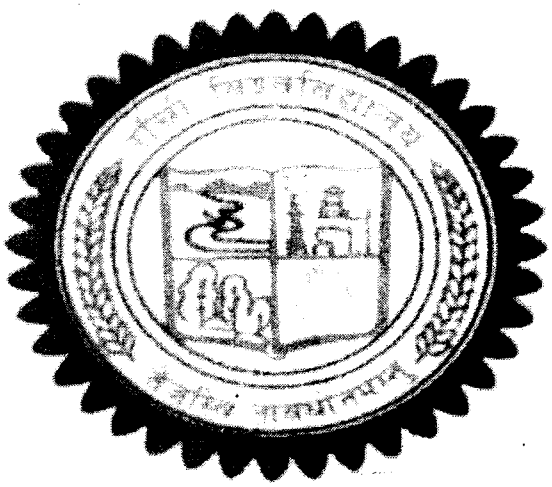
RANCHI UNIVERSITY

RANCHI

UNDER GRADUATE MATHEMATICS (HONS.)/ GENERAL

SYLLABUS W.E.F. 2016-17

(UNDER CHOICE BASED CREDIT SYSTEM)



UNIVERSITY DEPARTMENT OF MATHEMATICS

RANCHI UNIVERSITY

RANCHI

Course Structure

SEMESTER I			
Core Course 1	UCCMATH 101	Analytic Geometry 2D, Higher Algebra & Trigonometry	Theory – 4 Credits Assignment – 1 Credit Tutorial – 1 Credit
Core Course 2	UCCMATH 102	Differential Calculus & Vector Calculus	Theory – 4 Credits Assignment – 1 Credit Tutorial – 1 Credit
Ability Enhancement Compulsory Course 1	UAECC 101	Environmental Science/(English/MIL/Regional Languages Communication)	Theory – 2 Credit
Generic Elective 1	UGEMATH 101	Differential Calculus & coordinate Geometry 2D	Theory – 4 Credits Assignment – 1 Credit Tutorial – 1 Credit
SEMESTER II			
Core Course 3	UCCMATH 203	Analysis I	Theory – 4 Credits Assignment – 1 Credit Tutorial – 1 Credit
Core Course 4	UCCMATH 204	Integral Calculus & Analytic Geometry 3D	Theory – 4 Credits Assignment – 1 Credit Tutorial – 1 Credit
Ability Enhancement Compulsory Course 2	UAECC 202	Environmental Science/(English/MIL/Regional Languages Communication)	Theory – 2 Credits
Generic Elective 2	U GEMATH 202	Integral Calculus, Vector Calculus & Trigonometry	Theory – 4 Credits Assignment – 1 Credit Tutorial – 1 Credit

SEMESTER III			
Core Course 5	UCCMATH 305	Theory of Real Functions	Theory – 4 Credits Assignment – 1 Credit Tutorial – 1 Credit
Core Course 6	UCCMATH 306	Group Theory & Matrices	Theory – 4 Credits Assignment – 1 Credit Tutorial – 1 Credit
Core Course 7	UCCMATH 307	Differential Equations	Theory – 4 Credits Assignment – 1 Credit Tutorial – 1 Credit
Skill Enhancement Course 1	USECMATH 301	Logic and Sets	Theory – 1 Credits Assignment/Tutorial – 1 Credit
Generic Elective 3	UGEMATH 303	Real Analysis I, Group Theory &	Theory – 4 Credits Assignment – 1 Credit

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		Differential Equations	Tutorial – 1 Credit
SEMESTER IV			
Core Course 8	UCCMATH 408	Analysis II	Theory – 4 Credits Assignment – 1 Credit Tutorial – 1 Credit
Core Course 9	UCCMATH 409	Mechanics I	Theory – 4 Credits Assignment – 1 Credit Tutorial – 1 Credit
Core Course 10	UCCMATH 410	Ring Theory	Theory – 4 Credits Assignment – 1 Credit Tutorial – 1 Credit
Skill Enhancement Course 2	USECMATH 402	Graph Theory	Theory – 1 Credit Assignment/Tutorial – 1 Credit
Generic Elective 3	UGEMATH 404	Real Analysis II, Complex Variable, Set Theory & Matrices	Theory – 4 Credits Assignment – 1 Credit Tutorial – 1 Credit

SEMESTER V			
Core Course 11	UCCMATH 511	Analysis III (Metric Space & Complex Analysis)	Theory – 4 Credits Assignment – 1 Credit Tutorial – 1 Credit
Core Course 12	UCCMATH 512	Linear Algebra	Theory – 4 Credits Assignment – 1 Credit Tutorial – 1 Credit
Discipline Specific Elective 1	UDSEMATH 501	Number Theory **Or** Portfolio Optimization **Or** Analytic Geometry	Theory – 4 Credits Assignment – 1 Credit Tutorial – 1 Credit
Discipline Specific Elective 2	UDSEMATH 502	Probability & Statistics **Or** Boolean Algebra & Automata Theory **Or** Special Functions	Theory – 4 Credits Assignment – 1 Credit Tutorial – 1 Credit
SEMESTER VI			
Core Course 13	UCCMAT 613	Mechanics II	Theory – 4 Credits Assignment – 1 Credit Tutorial – 1 Credit
Core Course 14	UCCMATH 614	Numerical Analysis	Theory – 4 Credits Assignment – 1 Credit

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			Tutorial – 1 Credit
Discipline Specific Elective 3	UDSEMATH 603	Linear Programming **Or** Theory Of Equations **Or** Bio - Mathematics	Theory – 4 Credits Assignment – 1 Credit Tutorial – 1 Credit
Discipline Specific Elective 4	UDSEMATH 604	Fluid Mechanics **Or** Mathematical Modeling **Or** Differential Geometry	Theory – 4 Credits Assignment – 1 Credit Tutorial – 1 Credit

Semester wise distribution of credits and marks .

Semester I			
Paper Code	credits	Max. Marks	
		UNIV. EXAM.	MID SEM
UCCMATH 101	6	70	30
UCCMATH 102	6	70	30
UAECC 101	2	50	-
UGEMATH 101/UGDSCMATH101	6	100	-

Semester II			
Paper Code	credits	Max. Marks	
		UNIV. EXAM.	MID SEM
UCCMATH 203	6	70	30
UCCMATH 204	6	70	30
UAECC 202	2	50	-
UGEMATH202/ UGDSCMATH202	6	100	-

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Semester III			
Paper Code	credits	Max. Marks	
		UNIV. EXAM.	MID SEM
UCCMATH 305	6	70	30
UCCMATH 306	6	70	30
UCCMATH 307	6	70	30
USECMATH 301	2	50	-
UGEMATH303/ UGDSCMATH303	6	100	-

Semester IV			
Paper Code	credits	Max. Marks	
		UNIV. EXAM.	MID SEM
UCCMATH 408	6	70	30
UCCMATH 409	6	70	30
UCCMATH 410	6	70	30
USECMATH 402	2	50	-
UGEMATH404/ UGDSCMATH404	6	100	-

Semester V			
Paper Code	credits	Max. Marks	
		UNIV. EXAM.	MID SEM
UCCMATH 511	6	70	30
UCCMATH 512	6	70	30
UDSEMATH 501	6	70	30

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UDSEMATH 502	6	70	30
UGDSEMATH 501 (For General Students)	6	100	-

Semester VI			
Paper Code	credits	Max. Marks	
		UNIV. EXAM.	MID SEM
UCCMATH 613	6	70	30
UCCMATH 614	6	70	30
UDSEMATH 603	6	70	30
UDSEMATH 604	6	70	30
UGDSEMATH602 (For General Students)	6	100	-

Note: For Core or Discipline Specific Courses having practical the breaks up of marks will be as follows:

Univ. Exam – 50, Practical (Univ.Exam) – 25, and Mid Sem. Exam – 25.

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Paper Code: UCCMATH 101

Analytic Geometry 2D, Higher Algebra &Trigonometry

Credits: 6, Full Marks: 70, Time: 3 Hours

Nine questions will be set. Candidates will be required to answer 5 questions. Question 1 will be compulsory, consisting of 10 short answer type questions covering entire syllabus uniformly. Candidates will be required to answer any 7 out of these 10 questions; each question will be of 2 marks. Out of the remaining 8 questions, candidates will be required to answer any 4 questions selecting at least one from each group. Questions may contain two parts of equal marks.

UNIT I - ANALYTICAL GEOMETRY OF 2D

Change of rectangular axes. Conditions for the general equation of second degree to represent parabola, ellipse, hyperbola and reduction into standard forms, Equations of tangent and normal (Using Calculus). (2 Questions)

Equations of 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.

(2 Questions)

UNIT II - HIGHER ALGEBRA & TRIGONOMETRY

Statement and proof of binomial theorem for any index, exponential and logarithmic series.
De Moivre's theorem and its applications. (1 Questions)

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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Paper Code: UCCMATH 102

Differential Calculus and Vector Calculus

Credits: 6, Full Marks: 70, Time: 3 Hours

Nine questions will be set. Candidates will be required to answer 5 questions. Question 1 will be compulsory, consisting of 10 short answer type questions covering entire syllabus uniformly. Candidates will be required to answer any 7 out of these 10 questions; each question will be of 2 marks. Out of the remaining 8 questions, candidates will be required to answer any 4 questions selecting at least one from each group. Question may contain two parts of equal marks.

UNIT I - DIFFERENTIAL CALCULUS

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

UNIT II - VECTOR CALCULUS

Product of three and four vectors, work done, moment of a vector about a point and a line.

(2 Questions)

Scalar and vector point functions, differentiation of a vector function of scalar variables. Gradient, Divergence and Curl, second order operators in Cartesian coordinate system.

(2 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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Paper Code: UCCMATH 203

Analysis I

Credits: 6, Full Marks: 70, Time: 3 Hours

Nine questions will be set. Candidates will be required to answer 5 questions. Question 1 will be compulsory, consisting of 10 short answer type questions covering entire syllabus uniformly. Candidates will be required to answer any 7 out of these 10 questions; each question will be of 2 marks. Out of the remaining 8 questions, candidates will be required to answer any 4 questions selecting at least one from each group. Question may contain two parts of equal marks.

UNIT I – ANALYSIS - I

Axioms 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). (2 Questions)

Sequences, bounded sequence, convergent sequence, monotonic sequence, subsequence, Cauchy sequence and Cauchy's general principle of convergence. (2 Questions)

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

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Paper Code: UCCMATH 204

Integral Calculus and Analytic Geometry 3D

Credits: 6, Full Marks: 70, Time: 3 Hours

Nine questions will be set. Candidates will be required to answer 5 questions. Question 1 will be compulsory, consisting of 10 short answer type questions covering entire syllabus uniformly. Candidates will be required to answer any 7 out of these 10 questions; each question will be of 2 marks. Out of the remaining 8 questions, candidates will be required to answer any 4 questions selecting at least one from each group. Question may contain two parts of equal marks.

UNIT I – INTEGRAL CALCULUS

Integration of rational and irrational functions. (1 Question)

Evaluation of definite integrals, Special integrals, differentiation and integration under the sign of integration (Beta and Gamma functions are excluded), reduction formulae. (2 Questions)

Point of inflexion, double point, curve tracing. Length of plane curve, area bounded by plane curves. Volume and surface area of solid of revolution.

(2 Questions)

UNIT I – ANALYTICAL GEOMETRY 3D

Rectangular, spherical-polar and cylindrical co-ordinates, direction cosines.
(1 Question)

Angle between two straight lines, equation of planes and straight lines, shortest distance between two lines. (1 Question)

Sphere. (1 Question)

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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Paper Code: UCCMATH 305

Theory of Real Functions

Credits: 6, Full Marks: 70, Time: 3 Hours

Nine questions will be set. Candidates will be required to answer 5 questions. Question 1 will be compulsory, consisting of 10 short answer type questions covering entire syllabus uniformly. Candidates will be required to answer any 7 out of these 10 questions; each question will be of 2 marks. Out of the remaining 8 questions, candidates will be required to answer any 4 questions selecting at least one from each group. Question may contain two parts of equal marks.

UNIT I

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.
(2 Questions)

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. (2 Questions)

UNIT II

Riemann Integration: Definition, Darboux theorem I and II, integrability conditions. Particular classes of bounded integrable functions, Primitive, Fundamental theorem, First and Second Mean value theorems. (4 Questions)

Books Recommended:

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

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Paper Code: UCCMATH 306

Group Theory & Matrices

Credits: 6, Full Marks: 70, Time: 3 Hours

Nine questions will be set. Candidates will be required to answer 5 questions. Question 1 will be compulsory, consisting of 10 short answer type questions covering entire syllabus uniformly. Candidates will be required to answer any 7 out of these 10 questions; each question will be of 2 marks. Out of the remaining 8 questions, candidates will be required to answer any 4 questions selecting at least one from each group. Question may contain two parts of equal marks.

UNIT I - GROUP THEORY

Groups: Definitions, Preliminary results, equivalent definitions, Subgroups, Cyclic Group and its subgroups, Cosets of a subgroup in a group, Lagrange's Theorem and it's applications.

(2 Questions)

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

(1 Question)

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

(1 Question)

UNIT II - MATRICES

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

(1 Question)

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.

(2 Questions)

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

(1 Question)

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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Paper Code: UCCMATH 307

Differential Equations

Credits: 6, Full Marks: 70, Time: 3 Hours

Nine questions will be set. Candidates will be required to answer 5 questions. Question 1 will be compulsory, consisting of 10 short answer type questions covering entire syllabus uniformly. Candidates will be required to answer any 7 out of these 10 questions; each question will be of 2 marks. Out of the remaining 8 questions, candidates will be required to answer any 4 questions selecting at least one from each group. Questions may contain two parts of equal marks.

UNIT I

Differential equation of first order but not of first degree, Clairaut's form, Singular solutions. Differential equations with constant coefficients. (1 Question)

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

Solutions of Linear differential equations of higher order with constant coefficients. Differential equations with variable coefficients. (2 Questions)

UNIT II

Linear differential equations of second order by method of variation of parameter and by change of independent variable. (1 Question)

Total differential equation in three independent variables. (1 Question)

Partial differential equations: Lagrange's linear partial differential equations, Charpit's method. (2 Questions)

Books Recommended

1. Differential Equations – M D Raisinghania.

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Paper Code: USECMATH 301

LOGIC AND SETS

Credits: 2, Full Marks: 50, Time: $1\frac{1}{2}$ Hours

Five questions will be set. Candidates will be required to answer 3 questions. Question 1 will be compulsory, consisting of 6 short answer type questions covering entire syllabus uniformly. Candidates will be required to answer any 5 out of these 6 questions; each question will be of 2 marks. Out of the remaining 4 questions, candidates will be required to answer any 2 questions selecting at least one from each group. Questions may contain two parts of equal marks.

UNIT I

Statements, truth value of a statement, truth tables, negation, conjunction and disjunction. Conditional and Biconditionalstatements.Converse, inverse and contrapositive propositions.Tautologies and contradictions.Equivalent statements and law of duality.

(2 Questions)

UNIT II

Sets, subsets, Set operations and the laws of set theory and Venn diagrams.Examples of finite and infinite sets.Finite sets and counting principle. Empty set, properties of empty set. Power set of a set. (2 Questions)

Books Recommended:

1. Discrete Mathematics – M K Gupta

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Paper Code: UCCMATH 408

Analysis II

Credits: 6, Full Marks: 70, Time: 3 Hours

Nine questions will be set. Candidates will be required to answer 5 questions. Question 1 will be compulsory, consisting of 10 short answer type questions covering entire syllabus uniformly. Candidate will be required to answer any 7 out of these 10 questions; each question will be of 2 marks. Out of the remaining 8 questions, candidates will be required to answer any 4 questions selecting at least one from each group. Question may contain two parts of equal marks.

UNIT I

Convergence of improper integrals, comparison tests, absolute convergence, Abel's and Dirichlet's tests. (1 Question)

Frullani's Integrals . Definition & convergence of Beta & Gamma functions and their properties, duplication formula, inter-relation. (1 Question)

Evaluation of double and triple integrals. Multiple Integrals of Dirichlet's form, Liouville's extension. (2 Questions)

Change of order of integration and change of variables. (1 Question)

UNIT II

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. Higher Engineering Mathematics – B S Grewal
2. Elements of Real Analysis – Shanti Narayan & M D Raisinghania.
3. Mathematical Analysis – J N Sharma & A R Vashishtha.

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Paper Code: UCCMATH 409

Mechanics I

Credits: 6, Full Marks: 70, Time: 3 Hours

Nine questions will be set. Candidates will be required to answer 5 questions. Question 1 will be compulsory, consisting of 10 short answer type questions covering entire syllabus uniformly. Candidates will be required to answer any 7 out of these 10 questions; each question will be of 2 marks. Out of the remaining 8 questions, candidates will be required to answer any 4 questions selecting at least one from each group. Questions may contain two parts of equal marks.

UNIT I - STATICS

Reduction of system of coplanar forces, equation of resultant, condition for equilibrium. Astatic centre.
Laws, angles and cone of friction, equilibrium on a rough inclined plane, particle constrained to move on a rough curve under any given forces. (4 Questions)

UNIT II - DYNAMICS

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.
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.
(4 Questions)

Books Recommended:
1. Statics – S L Loney
2. Dynamics – S L Loney
3. Mechanics – Singh & Sen, Bharti Bhawan Publications.

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Paper Code: UCCMATH 410
Ring Theory

Credits: 6, Full Marks: 70, Time: 3 Hours

Nine questions will be set. Candidates will be required to answer 5 questions. Question 1 will be compulsory, consisting of 10 short answer type questions covering entire syllabus uniformly. Candidates will be required to answer any 7 out of these 10 questions; each question will be of 2 marks. Out of the remaining 8 questions, candidates will be required to answer any 4 questions selecting at least one from each group. Questions may contain two parts of equal marks.

UNIT I

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. (1 question)

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. (1 Question)

UNIT II

Polynomial rings over commutative rings, division algorithm and consequences, principal ideal domains, factorization of polynomials, reducibility tests, irreducibility tests, Eisenstein's criterion. (3 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 – I N Herstein

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Paper Code: USECMATH 402

GRAPH THEORY

Credits: 2, Full Marks: 50, Time: $1\frac{1}{2}$ Hours

Five questions will be set. Candidates will be required to answer 3 questions. Question 1 will be compulsory, consisting of 6 short answer type questions covering the entire syllabus uniformly. Candidate will be required to answer any 5 out of these 6 questions; each question will be of 2 marks. Out of the remaining 4 questions, candidates will be required to answer any 2 questions selecting at least one from each group. Questions may contain two parts of equal marks.

Unit-1

Definition, examples and basic properties of graphs, pseudo graphs, complete graphs, bi-partite graphs, isomorphism of graphs, paths and circuits. (2 Questions)

Unit-2

Eulerian circuits, Hamiltonian cycles, the adjacency matrix, weighted graph, travelling salesman's problem, shortest path, Dijkstra's algorithm. (2 Questions)

Books Recommended:

1. B.A. Davey and H.A. Priestley, *Introduction to Lattices and Order*, Cambridge University Press, Cambridge, 1990.

2. Edgar G. Goodaire and Michael M. Parmenter, *Discrete Mathematics with Graph Theory*, 2nd Edition, Pearson Education (Singapore) P. Ltd., Indian Reprint 2003.

3. Discrete Mathematics – M K Gupta

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Paper Code: UCCMATH 511

Analysis – III (Metric Space & Complex Analysis)

Credits: 6, Full Marks: 70, Time: 3 Hours

Nine questions will be set. Candidates will be required to answer 5 questions. Question 1 will be compulsory, consisting of 10 short answer type questions covering the entire syllabus uniformly. Candidate will be required to answer any 7 out of these 10 questions; each question will be of 2 marks. Out of the remaining 8 questions, candidates will be required to answer any 4 questions selecting at least one from each group. Questions may contain two parts of equal marks.

UNIT I – METRIC SPACE

Metric spaces: Definition and examples of metric spaces. Sequences in metric space, Cauchy sequence, complete metric space. (1 Question)

Open and closed balls, neighborhood, open set, interior of a set. Limit point of a set, closed set. (1 Question)

Diameter of a set, Cantor's theorem. Subspaces, dense sets, perfect sets. Baire's Category theorem. (1 Question)

Continuous mappings, sequential criterion and characterizations of continuity by open sets, Homeomorphism. (1 Question)

UNIT II – COMPLEX ANALYSIS

Complex numbers, continuity and differentiability of functions of complex variable. Analytic function, Cauchy – Riemann differential equations in Cartesian and polar forms. (2 Questions)

Conformal representation , some general transformations, bilinear transformation. critical points, fixed points, cross ratio, preservance of cross ratio, fixed points of bilinear transformation. (2 Questions)

Books Recommended:

1. Introduction to Topology – G F Simmons.
2. Metric Spaces – P K Jain & Khalil Ahmad.
3. Complex variable – Churchil and Brown

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Paper Code: UCCMATH 512

Linear Algebra

Credits: 6, Full Marks: 70, Time: 3 Hours

Nine questions will be set. Candidates will be required to answer 5 questions. Question 1 will be compulsory, consisting of 10 short answer type questions covering entire syllabus uniformly. Candidates will be required to answer any 7 out of these 10 questions; each question will be of 2 marks. Out of the remaining 8 questions, candidates will be required to answer any 4 questions selecting at least one from each group. Questions may contain two parts of equal marks.

UNIT I

Vector spaces, subspaces, algebra of subspaces, linear combination of vectors, linear span, linear dependence and linear independence, basis and dimension, co-ordinate vector of a vector relative to a basis. Complement of a subspace, direct sum and quotient space. (2 Questions)

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 Queations)

UNIT II

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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Paper Code: UDSEMATH 501 A

NUMBER THEORY

Credits: 6, Full Marks: 70, Time: 3 Hours

Nine questions will be set. Candidates will be required to answer 5 questions. Question 1 will be compulsory, consisting of 10 short answer type questions covering entire syllabus uniformly. Candidates will be required to answer any 7 out of these 10 questions; each question will be of 2 marks. Out of the remaining 8 questions, candidates will be required to answer any 4 questions selecting at least one from each group. Questions may contain two parts of equal marks.

UNIT I

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

(1 Question)

Residue class, complete and reduced residue system, congruences and their properties, Fermat's theorem, Wilson's theorem. (1 Question)

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

(2 Questions)

Algebraic Congruence, solution by inspection, Solution of $ax \equiv b(\mathrm{mod}\, c)$, system of linear congruences, Chinese remainder theorem. (1 question)

UNIT II

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

Farey sequence, continued fractions, Pell's equation. (3 Questions)

Books Recommended:

1. Number Theory – G H Hardy & E M Wright.
1. Number Theory – S G Telang.
2. Number Theory - Harikisan

OR

Paper Code: UDSEMATH 501 B

FINANCIAL MATHEMATICS

Credits: 6, Full Marks: 70, Time: 3 Hours

Nine questions will be set. Candidates will be required to answer 5 questions. Question 1 will be compulsory, consisting of 10 short answer type questions covering entire syllabus uniformly. Candidates will be required to answer any 7 out of these 10 questions; each question will be of 2 marks. Out of the remaining 8 questions, candidates will be required to answer any 4 questions selecting at least one from each group. Questions may contain two parts of equal marks.

Portfolio Optimization

Financial markets. Investment objectives. Measures of return and risk. Types of risks. Risk free assets. Mutual funds. Portfolio of assets. Expected risk and return of portfolio. (2 Questions)

Diversification. Mean-variance portfolio optimization- the Markowitz model and the two-fund theorem, risk-free assets and one fund theorem, efficient frontier. Portfolios with short sales. Capital market theory. (3 Questions)

Capital assets pricing model- the capital market line, beta of an asset, beta of a portfolio, security market line. Index tracking optimization models. Portfolio performance evaluation measures. (3 Questions)

Books Recommended:

1. F. K. Reilly, Keith C. Brown, *Investment Analysis and Portfolio Management*, 10th Ed., South-Western Publishers, 2011.
2. H.M. Markowitz, *Mean-Variance Analysis in Portfolio Choice and Capital Markets*, Blackwell, New York, 1987.
3. M.J. Best, *Portfolio Optimization*, Chapman and Hall, CRC Press, 2010.
4. D.G. Luenberger, *Investment Science*, 2nd Ed., Oxford University Press, 2013.

OR

Paper Code: UDSEMATH 501 C

Credits: 6, Full Marks: 70, Time: 3 Hours

Nine questions will be set. Candidates will be required to answer 5 questions. Question 1 will be compulsory, consisting of 10 short answer type questions covering entire syllabus uniformly. Candidates will be required to answer any 7 out of these 10 questions; each question will be of 2 marks. Out of the remaining 8 questions, candidates will be required to answer any 4 questions selecting at least one from each group. Questions may contain two parts of equal marks.

Mechanics

25.05.16

Head
Department of Mathematics
Ranchi University, Ranchi

UNIT I

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. (2 Questions)

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. (3 Questions)

UNIT II

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. (3 Questions)

Books Recommended:

1. I.H. Shames and G. Krishna Mohan Rao, *Engineering Mechanics: Statics and Dynamics,* (4th Ed.), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education), Delhi, 2009.
2. R.C. Hibbeler and Ashok Gupta, *Engineering Mechanics: Statics and Dynamics,* 11th Ed., Dorling Kindersley (India) Pvt. Ltd. (Pearson Education), Delhi.

25.05.16

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Department of Mathematics
Ranchi University, Ranchi

Paper Code: UDSEMATH 502 A

PROBABILITY AND STATISTICS

Credits: 6, Full Marks: 70, Time: 3 Hours

Nine questions will be set. Candidates will be required to answer 5 questions. Question 1 will be compulsory, consisting of 10 short answer type questions covering entire syllabus uniformly. CandidateS will be required to answer any 7 out of these 10 questions; each question will be of 2 marks. Out of the remaining 8 questions, candidates will be required to answer any 4 questions selecting at least one from each group. Questions may contain two parts of equal marks.

UNIT I

Introduction to random variables (discrete and continuous), cumulative distribution function(c.d.f.), probability mass/density functions, joint p.d.f., joint p.m.f., marginal and conditional distributions, joint c.d.f. and its properties. (2 Questions)

Mathematical expectations, moments , moment generating function : limitations and properties, characteristic function. (2 Questions)

UNIT II

Discrete distributions: uniform, binomial & Poisson. Continuous distributions: uniform and normal. (2 Questions)

Properties of a Random Sample: Basic concepts of Random Sample, convergence in probability, almost sure convergence, convergence in distribution. Order statistics and their distributions. (2 Questions)

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. Fundamentals of Mathematical Statistics – S C Gupta & V K Kapoor.

OR

Paper Code: UDSEMATH 502 B

Boolean Algebra and Automata Theory

Credits: 6, Full Marks: 70, Time: 3 Hours

Nine questions will be set. Candidates will be required to answer 5 questions. Question 1 will be compulsory, consisting of 10 short answer type questions covering entire syllabus uniformly. Candidates will be required to answer any 7 out of these 10 questions; each question will be of 2 marks. Out of the remaining 8 questions, candidates will be required to answer any 4 questions selecting at least one from each group. Questions may contain two parts of equal marks.

UNIT I – BOOLEAN ALGEBRA

Definition, examples and basic properties of ordered sets, maps between ordered sets, duality principle, lattices as ordered sets, lattices as algebraic structures, sublattices, products and homomorphisms. (2 Questions)

Definition, examples and properties of modular and distributive lattices, Boolean algebras, Boolean polynomials, minimal forms of Boolean polynomials, Quinn-McCluskey method, Karnaugh diagrams, switching circuits and applications of switching circuits. (2 Questions)

UNIT II AUTOMATA THEORY

Introduction: Alphabets, strings, and languages. Finite Automata and Regular Languages: deterministic and non-deterministic finite automata, regular expressions, regular languages and their relationship with finite automata, pumping lemma and closure properties of regular languages. (1 Question)

Context Free Grammars and Pushdown Automata: Context free grammars (CFG), parse trees, ambiguities in grammars and languages, pushdown automaton (PDA) and the language accepted by PDA, deterministic PDA, Non- deterministic PDA, properties of context free languages; normal forms, pumping lemma, closure properties, decision properties. (1 Question)

Turing Machines: Turing machine as a model of computation, programming with a Turing machine, variants of Turing machine and their equivalence.
Undecidability: Recursively enumerable and recursive languages, undecidable problems about
Turing machines: halting problem, Post Correspondence Problem, and undecidability problems about CFGs. (2 Questions)

Books Recommended

1. B A. Davey and H. A. Priestley, *Introduction to Lattices and Order*, Cambridge University Press, Cambridge, 1990.
2. Edgar G. Goodaire and Michael M. Parmenter, *Discrete Mathematics with Graph Theory*, (2nd Ed.), Pearson Education (Singapore) P.Ltd., Indian Reprint 2003.
3. Rudolf Lidl and Günter Pilz, *Applied Abstract Algebra*, 2nd Ed., Undergraduate Texts in Mathematics, Springer (SIE), Indian reprint, 2004.
4. J. E. Hopcroft, R. Motwani and J. D. Ullman, *Introduction to Automata Theory, Languages, and Computation*, 2nd Ed., Addison-Wesley, 2001.
5. H.R. Lewis, C.H. Papadimitriou, C. Papadimitriou, *Elements of the Theory of Computation*, 2nd Ed., Prentice-Hall, NJ, 1997.
6. J.A. Anderson, *Automata Theory with Modern Applications*, Cambridge University Press,

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2006.

OR

Paper Code: UDSEMATH 502 C

SPECIAL FUNCTIONS

Credits: 6, Full Marks: 70, Time: 3 Hours

Nine questions will be set. Candidates will be required to answer 5 questions. Question 1 will be compulsory, consisting of 10 short answer type questions covering entire syllabus uniformly. Candidates will be required to answer any 7 out of these 10 questions; each question will be of 2 marks. Out of the remaining 8 questions, candidates will be required to answer any 4 questions selecting at least one from each group. Questions may contain two parts of equal marks.

UNIT I

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]. (1 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. (2 Questions)

UNIT II

Legendre's equation: Solution, Rodrigue's formula, Legendre's polynomials, generating function for $P_n(x)$, orthogonality of Legendre's polynomials. (2 Questions)

Hypergeometric Functions: Special cases, integral representation, summation theorem. (1 Question)

Laplace Transform: Definition, Laplace Transform of elementary functions, properties, uniqueness and inverse Laplace Transform, Laplace Transform of derivatives and integrals. (1 Question)

Multiplication by t^n, division by t. Convolution theorem, Application of Laplace transform to differential equations. (1 Question)

Books Recommended :

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1. Advance differential equations – M D Raisinghania.
2. Differential Equations – J N Sharma

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Department of Mathematics
Ranchi University, Ranchi

Paper Code: UCCMATH 613

Mechanics II

Credits: 6, Full Marks: 70, Time: 3 Hours

Nine questions will be set. Candidates will be required to answer 5 questions. Question 1 will be compulsory, consisting of 10 short answer type questions covering entire syllabus uniformly. Candidates will be required to answer any 7 out of these 10 questions; each question will be of 2 marks. Out of the remaining 8 questions, candidates will be required to answer any 4 questions selecting at least one from each group. Questions may contain two parts of equal marks.

UNIT I - STATICS

Condition of equilibrium of forces in three dimension. 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). (1 Question)

UNIT II - DYNAMICS

Motion of a particle under a central force, differential equations of central orbit in both polar and pedal co-ordinates. (1 question)

Newton's law of gravitation, planetary orbits, Keplar'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. 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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Paper Code: UCCMATH 614

Numerical Analysis

Credits: 6, Full Marks: 70, Time: 3 Hours

Nine questions will be set. Candidates will be required to answer 5 questions. Question 1 will be compulsory, consisting of 10 short answer type questions covering entire syllabus uniformly. Candidate will be required to answer any 7 out of these 10 questions, each question will be of 2 marks. Out of the remaining 8 questions, candidates will be required to answer any 4 questions selecting at least one from each group. Question may contain two parts of equal marks.

UNIT I

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. (1 Question)

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)

UNIT II

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 Methods – B S Grewal.
3. Numerical Analysis – G Shankar Rao, New Age Int. Publishers.

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Paper Code: UDSEMATH 603 A

LINEAR PROGRAMMING

Credits: 6, Full Marks: 70, Time: 3 Hours

Nine questions will be set. Candidates will be required to answer 5 questions. Question 1 will be compulsory, consisting of 10 short answer type questions covering entire syllabus uniformly. Candidates will be required to answer any 7 out of these 10 questions; each question will be of 2 marks. Out of the remaining 8 questions, candidates will be required to answer any 4 questions selecting at least one from each group. Questions may contain two parts of equal marks.

UNIT I

Convex sets and their properties, Introduction to linear programming problem, solution by graphical method. (2 questions)

simplex method, optimality and unboundednes, artificial variables, two-phase method, Big-M method. Duality, formulation of the dual problem, primal-dual relationships, economic interpretation of the dual. (2 Questions)

UNIT II

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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OR

Paper Code: UDSEMATH 603 B

Theory of Equations

Credits: 6, Full Marks: 70, Time: 3 Hours

Nine questions will be set. Candidates will be required to answer 5 questions. Question 1 will be compulsory, consisting of 10 short answer type questions covering entire syllabus uniformly. Candidates will be required to answer any 7 out of these 10 questions; each question will be of 2 marks. Out of the remaining 8 questions, candidates will be required to answer any 4 questions selecting at least one from each group. Questions may contain two parts of equal marks.

UNIT I

General properties of polynomials, graphical representation of a polynomial, maximum and minimum values of a polynomial, general properties of equations, Descarte's rule of sign, Relation between the roots and the coefficients of equations. (2 Questions)

Symmetric functions of roots, their applications and Newton's theorem on the sums of powers of the roots, transformation of equations, discriminant and nature of roots, Cardon's solution of cubic equations. (3 questions)

UNIT II

Solution of biquadratic equation by Descarte's rule. (1 Question)

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. (2 Questions)

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.
2. Theory of Equations – Lalji Prasad.

OR

Paper Code: DSEMATH 603 C

Bio-Mathematics

Credits: 6, Full Marks: 70, Time: 3 Hours

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Department of Mathematics
Ranchi University, Ranchi

Nine questions will be set. Candidates will be required to answer 5 questions. Question 1 will be compulsory, consisting of 10 short answer type questions covering entire syllabus uniformly. Candidates will be required to answer any 7 out of these 10 questions; each question will be of 2 marks. Out of the remaining 8 questions, candidates will be required to answer any 4 questions selecting at least one from each group. Question may contain two parts of equal marks.

UNIT I

Mathematical Biology and the modeling process: an overview. Continuous models: Malthus model, logistic growth, Allee effect, Gompertz growth, Michaelis-Menten Kinetics, Holling type growth, Bacterial growth in a Chemostat, Harvesting a single natural population, Prey predator systems and Lotka Volterra equations, Populations in competitions, Epidemic Models (SI, SIR,SIRS, SIC), Activator-Inhibitor system, Insect Outbreak Model: Spruce Budworm, Numerical solution of the models and its graphical representation. Qualitative analysis of continuous models: Steady state solutions, stability and linearization, multiple species communities and Routh-Hurwitz Criteria, Phase plane methods and qualitative solutions, bifurcations and limit cycles with examples in the context of biological scenario. Spatial Models: One species model with diffusion, Two species model with diffusion, Conditions for diffusive instability, Spreading colonies of microorganisms, Blood flow in circulatory system, Travelling wave solutions, Spread of genes in a population.

(5 Questions)

UNIT II

Discrete Models: Overview of difference equations, steady state solution and linear stability analysis, Introduction to Discrete Models, Linear Models, Growth models, Decay models, Drug Delivery Problem, Discrete Prey-Predator models, Density dependent growth models with harvesting, Host-Parasitoid systems (Nicholson-Bailey model), Numerical solution of the models and its graphical representation. Case Studies: Optimal exploitation models, Models in Genetics, Stage Structure Models, Age Structure Models.

(3 Questions)

Books Recommended:

1. L.E. Keshet, *Mathematical Models in Biology*, SIAM, 1988.
2. J. D. Murray, *Mathematical Biology*, Springer, 1993.
3. Y.C. Fung, *Biomechanics*, Springer-Verlag, 1990.
4. F. Brauer, P.V.D. Driessche and J. Wu, *Mathematical Epidemiology*, Springer, 2008.
5. M. Kot, *Elements of Mathematical Ecology*, Cambridge University Press, 2001.

Paper Code: UDSEMATH 604 A

Fluid Mechanics

Credits: 6, Full Marks: 70, Time: 3 Hours

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Department of Mathematics
Ranchi University, Ranchi

Nine questions will be set. Candidates will be required to answer 5 questions. Question 1 will be compulsory, consisting of 10 short answer type questions covering entire syllabus uniformly. Candidates will be required to answer any 7 out of these 10 questions; each question will be of 2 marks. Out of the remaining 8 questions, candidates will be required to answer any 4 questions selecting at least one from each group. Question may contain two parts of equal marks.

UNIT I- HYDROSTATICS

Nature and properties of fluid pressure, pressure of heavy liquids. (1 Question)

Equilibrium of fluids under given system of forces. (1 Question)

Centre of pressure. (1 Question)

Thrust on plane and curved surfaces. (2 Questions)

UNIT II - HYDRODYNAMICS

Fluid Motion : Lagrangian and Eulerian methods. Equation of continuity in different forms. Euler,s equation of motion for perfect fluid. Bernoulli's theorem. (3 questions)

Book Recommended :

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

OR

Paper Code: DSEMATH 604 B

Mathematical Modelling

Credits: 6, Full Marks: 70, Time: 3 Hours

Nine questions will be set. Candidates will be required to answer 5 questions. Question 1 will be compulsory, consisting of 10 short answer type questions covering entire syllabus uniformly. Candidates will be required to answer any 7 out of these 10 questions, each question will be of 2 marks. Out of the remaining 8 questions, candidates will be required to answer any 4 questions selecting at least one from each group. Questions may contain two parts of equal marks.

UNIT I

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Power series solution of a differential equation about an ordinary point, solution about a regular singular point, Bessel's equation and Legendre's equation. (2 Questions)

Laplace transform and inverse transform, application to initial value problem up to second order. (2 Questions)

UNIT II

Monte Carlo Simulation Modeling: simulating deterministic behavior (area under a curve, volume under a surface), Generating Random Numbers: middle square method, linear congruence. (2 Questions)

Queuing Models: harbor system, morning rush hour, Overview of optimization modeling, Linear Programming Model: geometric solution algebraic solution, simplex method, Sensitivity analysis. (2 Questions)

List of Practicals (using any software)

(i) Plotting of Legendre polynomial for n = 1 to 5 in the interval [0,1]. Verifying graphically that all the roots of Pn (x) lie in the interval [0,1].
(ii) Automatic computation of coefficients in the series solution near ordinary points.
(iii) Plotting of the Bessel's function of first kind of order 0 to 3.
(iv) Automating the Frobenius Series Method.
(v) Random number generation and then use it for one of the following (a) Simulate area under a curve (b) Simulate volume under a surface.
(vi) Programming of either one of the queuing model (a) Single server queue (e.g. Harbor system) (b) Multiple server queue (e.g. Rush hour).
(vii) Programming of the Simplex method for 2/3 variables.

Books Recommended

1. Tyn Myint-U and Lokenath Debnath, *Linear Partial Differential Equation for Scientists and Engineers*, Springer, Indian reprint, 2006.
2. Frank R. Giordano, Maurice D. Weir and William P. Fox, *A First Course in Mathematical Modeling*, Thomson Learning, London and New York, 2003.

OR

Paper Code: UDSEMATH 604 C

Differential Geometry

Credits: 6, Full Marks: 70, Time: 3 Hours

Nine questions will be set. Candidates will be required to answer 5 questions. Question 1 will be compulsory, consisting of 10 short answer type questions covering entire syllabus uniformly. Candidate will be required to answer any 7 out of these 10 questions, each question will be of 2 marks. Out of the remaining 8 questions, candidates will be required to

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answer any 4 questions selecting at least one from each group. Question may contain two parts of equal marks.

UNIT I

Theory of Space Curves: Space curves, Planer curves, Curvature, torsion and Serret-Frenet formulae. Osculating circles, Osculating circles and spheres. Existence of space curves. Evolutes and involutes of curves. (1 question)
Theory of Surfaces: Parametric curves on surfaces. Direction coefficients. First and second Fundamental forms. Principal and Gaussian curvatures. Lines of curvature, Euler's theorem. Rodrigue's formula, Conjugate and Asymptotic lines. (2 questions)

Developables: Developable associated with space curves and curveson surfaces, Minimal surfaces. (1 Question)

UNIT II

Geodesics: Canonical geodesic equations. Nature of geodesics on a surface of revolution. Clairaut's theorem. Normal property of geodesics. Torsion of a geodesic. Geodesic curvature. Gauss-Bonnet theorem. Surfaces of constant curvature. Conformal mapping. Geodesic mapping. Tissot's theorem. (2 Questions)

Tensors: Summation convention and indicial notation, Coordinate transformation and Jacobian, Contra-variant and Covariant vectors, Tensors of different type, Algebra of tensors and contraction, Metric tensor and 3-index Christoffel symbols, Parallel propagation of vectors, Covariant and intrinsic derivatives, Curvature tensor and its properties, Curl, Divergence and Laplacian operators in tensor form, Physical components.
(2 Questions)

Books Recommended

1. T.J. Willmore, *An Introduction to Differential Geometry*, Dover Publications, 2012.
2. B. O'Neill, *Elementary Differential Geometry*, 2nd Ed., Academic Press, 2006.
3. C.E. Weatherburn, *Differential Geometry of Three Dimensions*, Cambridge University Press,2003.
4. D.J. Struik, *Lectures on Classical Differential Geometry*, Dover Publications, 1988.
5. S. Lang, *Fundamentals of Differential Geometry*, Springer, 1999.
6. B. Spain, *Tensor Calculus: A Concise Course*, Dover Publications, 2003.

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26.05.16
Head
Department of Mathematics
Rajshahi University, Rajshahi

For B. Sc. General Science Students having Mathematics as one of the subjects.

Paper Code: UGEMATH 101/ UGDSCMATH101

DIFFERENTIAL CALCULUS & COORDINATE GEOMETRY 2D

Credits: 6, Full Marks: 100, Time: 3 Hours

Nine questions will be set. Candidates will be required to answer 5 questions. Question 1 will be compulsory, consisting of 12 short answer type questions covering entire syllabus uniformly. Candidate will be required to answer any 10 out of these 12 questions, each question will be of 2 marks. Out of the remaining 8 questions, candidates will be required to answer any 5 questions selecting at least one from each group. Question may contain two parts of equal marks.

UNIT I - DIFFERENTIAL CALCULUS

Successive differentiation, n^{th} order derivative of some standard functions. Leibnitz's theorem. Taylor's and Maclaurin's series expansions of functions. Applications of Taylor's and Maclaurin's series. (2 Questions)

Tangent and Normal, their equations in the Cartesian form, parametric form. Angle between two curves. Length of tangent, normal, sub tangent, subnormal in Cartesian forms. Partial Differentiation, Euler's theorem. Curvature. Asymptotes. Maxima and Minima of functions of two variables. (3 Questions)

UNIT II - COORDINATE GEOMETRY 2D & TRIGONOMETRY

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. Polar equation. (3 Questions)

Books Recommended:

1. Differential Calculus: A Das Gupta & S B Prasad.
2. Differential Calculus: Lalji Prasad.
3. Coordinate Geometry: A Das Gupta.

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4. Coordinate Geometry: Lalji Prasad.

Paper Code: UGEMATH 202/ UGDSCMATH202

INTEGRAL CALCULUS, VECTOR CALCULUS & TRIGONOMETRY

Credits: 6, Full Marks: 100, Time: 3 Hours

Nine questions will be set. Candidates will be required to answer 5 questions. Question 1 will be compulsory, consisting of 12 short answer type questions covering entire syllabus uniformly. Candidate will be required to answer any 10 out of these 12 questions, each question will be of 2 marks. Out of the remaining 8 questions, candidates will be required to answer any 5 questions selecting at least one from each group. Question may contain two parts of equal marks.

UNIT I - INTEGRAL CALCULUS

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

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

UNIT II – VECTOR CALCULUS & TRIGONOMETRY

Scalar and Vector point functions, vector function of 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 question)

Gradient, Divergence and curl and second order vector differential operators in Cartesian coordinates systems. (1 question)

Demoivre's Theorem and applications. (1 question)

Books Recommended;

1. Integral Calculus: Dasgupta & Prasad.
2. integral Calculus: Lalji Prasad.
3. Vector Calculus: Dasgupta & Prasad.
4. Vector calculus: Lalji Prasad.
5. Trigonometry : Dasgupta & Prasad.
6. Trigonometry : lalji Prasad.

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Paper Code: UGEMATH 303/ UGDSCMATH303

REAL ANALYSIS I, GROUP THEORY & DIFFERENTIAL EQUATIONS

Credits: 6, Full Marks: 100, Time: 3 Hours

Nine questions will be set. Candidates will be required to answer 5 questions. Question 1 will be compulsory, consisting of 12 short answer type questions covering entire syllabus uniformly. Candidate will be required to answer any 10 out of these 12 questions, each question will be of 2 marks. Out of the remaining 8 questions, candidates will be required to answer any 5 questions selecting at least one from each group. Question may contain two parts of equal marks.

UNIT I – REAL ANALYSIS

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.

(1 Question)

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)

UNIT II - GROUP THEORY & DIFFERENTIAL EQUATIONS

GROUP THEORY

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. (1 Questions)

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.

(2 Questions)

Books Recommended:

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1. Real Analysis: Shanti Narayan & M D Raisinghania.
2. Real Analysis: Lalji Prasad.
3. Abstract algebra: A R vashishtha
4. Modern Algebra: Lalji Prasad.
5. Differential Equations: M D Raisinghania.

Paper Code: UGEMATH 404/ UGDSCMATH404
REAL ANALYSIS II, COMPLEX VARIABLE, SET THEORY & MATRICES

Credits: 6, Full Marks: 100, Time: 3 Hours

Nine questions will be set. Candidates will be required to answer 5 questions. Question 1 will be compulsory, consisting of 12 short answer type questions covering entire syllabus uniformly. Candidate will be required to answer any 10 out of these 12 questions, each question will be of 2 marks. Out of the remaining 8 questions, candidates will be required to answer any 5 questions selecting at least one from each group. Question may contain two parts of equal marks.

UNIT I – REAL ANALYSIS II & COMPLEX VARIABLE

REAL ANALYSIS II

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

COMPLEX VARIABLES

Real functions of two variables: Simultaneous and iterated limits: Continuity, partial derivatives, Differentiability and related necessary and sufficient conditions. Functions of complex variables limit, Continuity, derivative, Cauchy-Riemann Equations, Analytic function, Harmonic function. (2 Questions)

Standard transformations w=z+c, w=cz, w=1/z, w=(az+b) / (cz+d) (bilinear). Conformal transformation as transformation effected by analytic function. (1 Question)

UNIT II – SET THEORY & MATRICES

SET THEORY

Indexed family of sets, Generalised set of operations & Demorgan laws, Set mapping. Countable and uncountable sets, partition of a set, equivalence relation and related

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fundamental theorem of partition. Partial order relation and relate concepts of u.b., l.b., inf., sup, maximal element, minimal element and lattice (definition and examples only).

(2 Questions)

MATRICES

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

(2 Questions)

Books recommended:

1. Real Analysis: Shanti Narayan & M D Raisinghania.
2. Real Analysis: Lalji Prasad.
3. Complex Variables: J N Sharma.
4. Set Theory: K K jha.
5. Matrices: A R Vashishtha.

Paper Code : UGDSEMATH 501 A

NUMERICAL ANALYSIS

Credits: 6, Full Marks: 100, Time: 3 Hours

Nine questions will be set. Candidates will be required to answer 5 questions. Question 1 will be compulsory, consisting of 12 short answer type questions covering entire syllabus uniformly. Candidate will be required to answer any 10 out of these 12 questions, each question will be of 2 marks. Out of the remaining 8 questions, candidates will be required to answer any 5 questions selecting at least one from each group. Question may contain two parts of equal marks.

UNIT I

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

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

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UNIT II

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. (2 Questions)

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 methods – B S Grewal.
2. Numerical Analysis – G S Mallik
3. Numerical Analysis – G Shankar Rao, New Age Int. Publishers.

OR

Paper Code : UGDSEMATH 501 B

PROBABILITY AND STATISTICS

Credits: 6, Full Marks: 100, Time: 3 Hours

Nine questions will be set. Candidates will be required to answer 5 questions. Question 1 will be compulsory, consisting of 12 short answer type questions covering entire syllabus uniformly. Candidate will be required to answer any 10 out of these 12 questions, each question will be of 2 marks. Out of the remaining 8 questions, candidates will be required to answer any 5 questions selecting at least one from each group. Question may contain two parts of equal marks.

UNIT I

Introduction to random variables (discrete and continuous), cumulative distribution function(c.d.f.), probability mass/density functions, joint p.d.f., joint p.m.f., marginal and conditional distributions, joint c.d.f. and its properties. Mathematical expectations, moments , moment generating function : limitations and properties, characteristic function. (4 Questions)

UNIT II

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Discrete distributions: uniform, binomial & Poisson. Continuous distributions: uniform and normal.
(2 Questions)

Properties of a Random Sample: Basic concepts of Random Sample, convergence in probability, almost sure convergence, convergence in distribution. Order statistics and their distributions.
(2 Questions)

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. Fundamentals of Mathematical Statistics – S C Gupta & V K Kapoor.

Paper Code : UGDSEMATH 602 A

LINEAR PROGRAMMING

Credits: 6, Full Marks: 100, Time: 3 Hours

Nine questions will be set. Candidates will be required to answer 5 questions. Question 1 will be compulsory, consisting of 12 short answer type questions covering entire syllabus uniformly. Candidate will be required to answer any 10 out of these 12 questions, each question will be of 2 marks. Out of the remaining 8 questions, candidates will be required to answer any 5 questions selecting at least one from each group. Question may contain two parts of equal marks.

UNIT I

Convex sets and their properties, Introduction to linear programming problem, solution by graphical method, simplex method, optimality and unboundednes, Big-M method.
(2 Questions)

Duality, formulation of the dual problem, primal-dual relationships.
(2 Question)

UNIT II

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)

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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.

OR

Paper Code : UGDSEMATH 602 B

Theory of Equations

Credits: 6, Full Marks: 100, Time: 3 Hours

Nine questions will be set. Candidates will be required to answer 5 questions. Question 1 will be compulsory, consisting of 12 short answer type questions covering entire syllabus uniformly. Candidate will be required to answer any 10 out of these 12 questions, each question will be of 2 marks. Out of the remaining 8 questions, candidates will be required to answer any 5 questions selecting at least one from each group. Question may contain two parts of equal marks.

UNIT I

General properties of polynomials, graphical representation of a polynomial, maximum and minimum values of a polynomial, general properties of equations, Descarte's rule of sign, Relation between the roots and the coefficients of equations. (2 Questions)

Symmetric functions of roots, their applications and Newton's theorem on the sums of powers of the roots, transformation of equations, discriminant and nature of roots, Cardon's solution of cubic equations. (3 Question)

UNIT II

Solution of biquadratic equation by Descarte's rule. (1 Questions)

Separation of the roots of equations, Strums theorem, Applications of Strum's theorem,

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Conditions for reality of the roots of an equation and biquadratic. Solution of numerical equations. (2 Questions)

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.
3. Theory of Equations – Lalji Prasad.

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