Syllabus
MAT-75T-311- Abstract Algebra & Three Dimensional Geometry

Semester	Code of the Course	Title of the Course/Paper			NHEQF Level	Credits
V	MAT-75T-311	Abstract Algebra & Three Dimensional Geometry			7	6
Level of Course	Type of the Course	Credit Distribution			Course Delivery Method	
		Theory	Practical	Total		
High Level Course	MJR	6	0	6	Lectures	

Regular Students-

Type	Paper code and Nomenclature	Duration of Examination	Maximum Marks (CA + EoSE)	Minimum Passing Marks (CA + EoSE)
Theory	MAT-75T-311 Abstract Algebra & Three Dimensional Geometry	CA- 1Hrs EoSE -3Hrs	CA- 30 Marks EoSE- 120 Marks	CA- 12 Marks EoSE-48 Marks

Objectives of the Course:	The objective of the course on Group Theory, Ring Theory, and three dimensional geometry, as outlined in the syllabus, is to provide students with a thorough understanding of fundamental algebraic structures, their applications and basic three dimensional geometrical shapes.

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Detailed Syllabus

[UG0105-MAT-75T-311] - [Abstract Algebra & Three Dimensional Geometry]

Unit - I

Binary operations, Algebraic structure, Groups, Order of group, finite and infinite order groups and their order specific theorems, Subgroups and their properties, Permutation group, Cyclic group. Cosets, Lagrange's theorem.

(22 Lectures)

Unit - II

Morphism of groups, Cayley's theorem. Normal subgroups and Quotient groups. Fundamental theorems of Homomorphism.

(23 Lectures)

Unit -III

Definition and simple properties of Rings and Subrings. Morphism of rings. Integral domain and field. Characteristics of a Ring and Field.

(22 Lectures)

Unit-IV

Sphere: Equation of Sphere, Plane section of sphere, intersection of a sphere by a line, tangent line and tangent plane of a sphere, angle of intersection of two spheres. Cone: Equation of cone, tangent plane of a cone, right circular cone, enveloping cone. Cylinder: Equation of cylinder, enveloping cylinder, right circular cylinder.

(23 Lectures)

Suggested Books and References –

1. Kenneth Hoffman, Ray Alden Kunze, Linear Algebra 2nd Ed., Prentice-Hall Of India Pvt. Limited, 1971.
2. I.N.Herstein, Topics in Algebra, Wiley-Eastern Ltd., New Delhi.
3. Joseph A. Gallian, Contemporary Abstract Algebra (4th Edition), Narosa Publishing House, New Delhi, 1999.(IX Edition 2010).
4. N.S.Gopalkrishnan, University Algebra, New Age International, 1986.
5. G.C.Sharma, Modern Algebra, Shivlal Agrawal & Co., Agra,1998.
6. S.L. Loney, The Elements of Coordinate Geometry, Macmillan and co. London, 1895.
7. R.J.T. Bell, Elementary Treatise on Co-ordinate geometry of three dimensions, Macmillan India Ltd., 1994.

Suggested E-resources:

1. **Online Lecture Notes and Course Materials:**

Course Learning Outcomes:

By the end of the course, students should be able to:

1. Develop a theoretical foundation in algebraic structures including groups, rings,integral domains and fields.
2. Apply theoretical concepts to solve problems involving group theory and ring theory.
3. Analyze and differentiate algebraic structures and their interrelations.
4. Understand the applications of algebraic structures in various mathematical and scientific disciplines.

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Syllabus

MAT-75T-312- Optimization Techniques-II

Semester	Code of the Course	Title of the Course/Paper			NHEQF Level	Credits
V	MAT-75T-312	Optimization Techniques-II			7	6
Level of Course	Type of the Course	Credit Distribution			Course Delivery Method	
		Theory	Practical	Total		
High Level Course	MJR	6	0	6	Lectures	

Regular Students-

Type	Paper code and Nomenclature	Duration of Examination	Maximum Marks (CA + EoSE)	Minimum Passing Marks (CA + EoSE)
Theory	MAT-75T-312 Optimization Techniques-II	CA- 1Hrs EoSE -3Hrs	CA- 30 Marks EoSE- 120 Marks	CA- 12 Marks EoSE-48 Marks

Objectives of the Course:	The objective of the course "Optimization Techniques-II" with the outlined syllabus is to equip students with a comprehensive understanding and practical skills in solving optimization problems using advanced mathematical techniques.

30.7.25

Detailed Syllabus

[UG0105-MAT-75T-312] - [Optimization Techniques-II]

Unit - I

Theory of Simplex method, two phase method, bounded variables problems in linear programming, The Dual Simplex method.

(22 Lectures)

Unit - II

Duality in linear programming: Concept of duality, General rules for converting any primal into its dual, Duality theorems, primal-dual correspondence, rules for obtaining dual optimal solution from that of primal and primal optimal solution from the dual.

(23 Lectures)

Unit -III

Integer linear programming: Definitions, Gomory's all integer programming technique: Construction of Gomory's constraint, Gomory's cutting plane algorithm for all integer programming problems, Branch and Bound method: Branch and bound algorithm and its geometrical interpretation.

(22 Lectures)

Unit-IV

Sensitivity analysis: Introduction, changes in the coefficients 'c_j' of the objective function, changes in the component 'b_i' of vector **b,** changes in the component 'a_{ij}' of matrix ***A***. Revised Simplex method: Introduction, Revised Simplex algorithm when artificial variables are not needed.

(23 Lectures)

Suggested Books and References –

1. Kanti Swaroop, P.K.Gupta and Manmohan, Operation Research, Sultan Chand & Sons., N.Delhi, 2007.
2. S.D.Sharma, Operations Research, Kedar Nath Ram Nath and co. Meerut, 2005.
3. F. S. Hillier and G. J. Lieberman, Introduction to Operations Research Concepts and Cases (9th Edition), Tata McGraw Hill, 2010.
4. G. Hadley, Linear Programming, Narosa Publishing House, New Delhi, 2002.
5. Hamdy A. Taha, Operations Research, An Introduction (9th edition), Prentice-Hall, 2010.

Suggested E-resources:

1. **Online Lecture Notes and Course Materials:**

Course Learning Outcomes:

By the end of the course, students should be able to:

1. Understand and apply the simplex method, two-phase method, and the dual simplex method to solve linear programming problems with bounded variables.
2. Grasp Duality concepts and solve Integer Programming Problems.
3. Perform Sensitivity analysis and utilise Revised Simplex method.

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Syllabus
MAT-76T-313- Complex Analysis & Mechanics

Semester	Code of the Course	Title of the Course/Paper			NHEQF Level	Credits
VI	MAT-76T-313	Complex Analysis & Mechanics			7	6
Level of Course	Type of the Course	Credit Distribution			Course Delivery Method	
		Theory	Practical	Total		
High Level Course	MJR	6	0	6	Lectures	

Regular Students-

Type	Paper code and Nomenclature	Duration of Examination	Maximum Marks (CA + EoSE)	Minimum Passing Marks (CA + EoSE)
Theory	MAT-76T-313 Complex Analysis & Mechanics	CA- 1Hrs EoSE -3Hrs	CA- 30 Marks EoSE- 120 Marks	CA- 12 Marks EoSE-48 Marks

Objectives of the Course:	The objective of the course is to enable students to understand and apply complex analysis, principles of equilibrium and work, and solve mechanical motion problems.

30.7.25

Detailed Syllabus

[UG0105-MAT-76T-313] - [Complex Analysis & Mechanics]

Unit - I

Complex valued function: Limits, Continuity and Differentiability. Analytic functions, Cauchy-Riemann equations. Harmonic functions, Construction of an analytic function. Complex integration, Complex line integrals, Cauchy integral theorem, Indefinite integral, Fundamental theorem of integral calculus for complex functions. Cauchy integral formula, Analyticity of the derivative of an analytic function.

(22 Lectures)

Unit - II

Taylor's theorem. Laurent's theorem. Maximum modulus theorem. Singularities of an analytic function, Branch point, Meromorphic and Entire functions, Residue at a singularity, Cauchy's residue theorem.

(23 Lectures)

Unit -III

Velocity and acceleration – along radial and transverse directions, along tangential and normal directions, Motion in resisting medium – Resistance varies as velocity and square of velocity, Motion on a smooth curve in a vertical plane.

(22 Lectures)

Unit-IV

Equilibrium of coplanar forces, moments, Friction, Virtual Work and catenary.

(23 Lectures)

Suggested Books and References –

1. Brown JW, Churchill RV. Complex variables and applications. McGraw-Hill,; 2009.
2. Kasana HS. Complex variables: theory and applications. PHI Learning Pvt. Ltd.; 2005.
3. Ponnusamy S, Silverman H. Complex variables with applications. Springer Science & Business Media; 2007.
4. A.S.Ramsey, Statics, CBS Publishing & Distributors, New Delhi.
5. M. Ray, A Text Book of Dynamics, S. Chand & Co., 2003.
6. J.L. Synge & B.A. Griffith - Principles of Mechanics, Tata McGraw-Hill, 1959.
7. R.C. Hibbeler and Ashok Gupta, Engineering Mechanics: Statics and Dynamics (11th Edition), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education), Delhi.

Suggested E-resources:

1. **Online Lecture Notes and Course Materials:**

Course Learning Outcomes:

By the end of the course, students would have achieved the following:

1. Grasped the concepts of Taylor's and Laurent's theorems as they apply to complex functions.
2. Conducted analysis on the singularities of analytic functions, including branch points, meromorphic functions, entire functions, and residues at singularities using the Cauchy residue theorem.
3. Understand and calculate velocity and acceleration in various directions and analyze motion in resisting media.
4. Analyze the equilibrium of coplanar forces, calculate moments, and understand the effects of friction.
5. Apply the principles of virtual work to mechanical systems and analyze motion on smooth curves in vertical planes.
6. Mathematical treatment to the configuration called catenary.

Syllabus
MAT-76T-314- Linear Algebra & Differential Equations-II

Semester	Code of the Course	Title of the Course/Paper			NHEQF Level	Credits
VI	MAT-76T-314	Linear Algebra & Differential Equations-II			7	6
Level of Course	Type of the Course	Credit Distribution			Course Delivery Method	
		Theory	Practical	Total		
High Level Course	MJR	6	0	6	Lectures	

Regular Students-

Type	Paper code and Nomenclature	Duration of Examination	Maximum Marks (CA + EoSE)	Minimum Passing Marks (CA + EoSE)
Theory	MAT-76T-314 Linear Algebra & Differential Equations-II	CA- 1Hrs EoSE -3Hrs	CA- 30 Marks EoSE- 120 Marks	CA- 12 Marks EoSE-48 Marks

Objectives of the Course:	The objective of the course is to provide students with a foundation in the theory of vector spaces, linear transformations and to teach them the theory and methods for solving first-order PDEs.

30.7.25

Detailed Syllabus

[UG0105-MAT-76T-314] - [Linear Algebra & Differential Equations-II]

Unit - I

Introduction to Vector Spaces, Subspaces, Algebra of subspaces, Linear combination of vectors, Linear span, Linear independence, Bases and dimension, Dimension of subspaces. Linear and direct sum of subspaces.

(22 Lectures)

Unit - II

Linear transformations, Null space, Range, Rank and nullity of a linear transformation, Matrix representation of a linear transformation, Algebra of linear transformations, Invertibility and isomorphisms.

(23 Lectures)

Unit -III

Partial differential equations of the first order, Lagrange's linear equation, Non-linear partial differential equations of order one : various standard forms, Charpit's method.

(22 Lectures)

Unit-IV

Homogeneous and non-homogeneous linear partial differential equations with constant coefficients. Equations reducible to linear partial differential equations with constant coefficients.

(23 Lectures)

Suggested Books and References –

1. Sahai V, Bist V. Linear algebra. Alpha Science Int'l Ltd.; 2002.
2. Lipschutz S, Lipson M. Schaum's outline of theory and problems of linear algebra. Erlangga; 2001.
3. Spence LE, Insel AJ, Friedberg SH. Elementary Linear Algebra: A Matrix Approach. (No Title). 2008.
4. M.D. Raisinghania, Ordinary and Partial Differential Equations, S. Chand & Co., 2003.
5. M.Ray, A Text Book on Differential Equations, Students and Friends Co., Agra,1998.
6. I.N. Snedon, Elements of Partial Differential Equations, TMH, 2001.

Suggested E-resources:

1. **Online Lecture Notes and Course Materials:**

Course Learning Outcomes:

By the end of the course, students should be able to:

1. Apply theoretical concepts to solve complex problems involving vector spaces, linear transformations, and PDEs.
2. Connect abstract concepts from linear algebra to practical problems in engineering, physics, and other fields.
3. Develop a deeper understanding of the structure and properties of mathematical systems and their interrelationships.

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