UG Semester VI

Paper 12: Advanced Algebra

Credit: 4 T:04

Course Outcomes:

1. Give the structure of an abelian group of a given order.
2. Construct the splitting field extension of a given polynomial.
3. Understand the interplay of group theory and field theory.
4. Determine the minimal polynomial of an algebraic element.

Unit I

Series of groups, Schreier theorem, Jordan Holder theorem, solvable groups, Nilpotent groups, Insolvability of Sn for n>5,

Unit II

Finite Abelian groups, primary decomposition theorem, basis theorem, fundamental theorem of finite Abelian group, elementary divisors and invariant factors,

Unit III

Field extensions: finite extension, finitely generated extension, algebraic extension, simple extension, transcendental extension, finite field.

Unit IV

Splitting field, algebraically closed field, normal extension, separable extension, primitive element theorem. Galois theory- Galois group, Galois extension, Fundamental theorem of Galois theory, Artin's theorem, Fundamental theorem of algebra (Algebraic Proof)

References:

Text Books:

1. V. Sahai & V. Bist: Algebra, Fourth Edition, Narosa.
2. J. A. Gallian, Contemporary Abstract Algebra, 4th edition, Narosa
3. DJS Robinson, An Introduction to Abstract Algebra, Hindustan Book Agency.

Suggested Readings:

4. J. B. Fraleigh: A first course in Abstract algebra, Narosa
5. S. Lang: Algebra, Addison Wesley.

Web References:

Digital platforms web links: NPTEL/SWAYAM/ MOOCS/Openstax.org

https://openlearninglibrary.mit/edu/courses

http://heecontent.upsdc.gov.in/SearchContent.aspx

https://www.lkouniv.ac.in/en/article/e-content-faculty-of-science

Paper 13: Differential Geometry & Tensor Analysis

Credit: 4 T:04

Course Outcomes:

1. Explain the concept of differentiable geometry.
2. Understand the concepts of tensors in differentiable geometry.
3. Apply various concept of differential calculus in tensors.

Unit I

Local theory of curves-Space curves, Examples, Plane Curves, tangent and normal and binormal, Osculating Plane, normal plane and rectifying plane, Helices, Serret-Frenet apparatus, contact between curve and surfaces, tangent surfaces, involutes and evolutes of curves, Bertrand curves, Intrinsic equations, fundamental existence theorem for space curves.

Unit II

Metric-first fundamental form and arc length, Direction coefficients, families of curves, intrinsic properties, geodesics, canonical geodesic equations, normal properties of geodesics, geodesics curvature, Gauss-Bonnet theorem, Gaussian curvature, normal curvature, Meusneir's theorem, mean curvature, Gaussian curvature, umbilic points, lines of curvature, Rodrigue's formula,Euler's theorem.

Unit III

Tensor algebra: Vector spaces, the dual spaces, tensor product of vector spaces, transformation formulae, contraction, special tensor, inner product, associated tensor.

Tensor Analysis: Contravariant and covariant vectors and tensors, Mixed tensors, Symmetric and skew-symmetric tensors, Algebra of tensors, Contraction and inner product, Quotient theorem, Reciprocal tensors, Christoffel's symbols, Covariant differentiation.

Unit IV

Gradient of scalars, Divergence of a contra-variant vector, covariant vector and conservative vectors, Laplacian of an invariant, curl of a covariant vector, irrotational vector, Riemannian space, Riemannian curvatures and their properties, Ricci tensor, and scalar curvature, Einstein space and Einstein tensor, Geodesics.

References:

Text books:

1. T.J. Willmore, An introduction to Differential Geometry,Dover Publication 2012.
2. S.Lang., Fundamentals of Differential Geometry; Springer, 1999.
3. B. O'Neil, Elementary Differential Geometry, 2nd Edition, Academic press, 2006.
4. R.S. Mishra, A Course in Tensors with Application to Riemannian Geometry, Pothishala 1988.

Suggested Readings:

5. David C. Kay, Tensor Analysis, Schaum's Outline series McGraw Hill 1988.

Web References:

Digital platforms web links: NPTEL/SWAYAM/ MOOCS/Openstax.org

https://openlearninglibrary.mit/edu/courses

http://heecontent.upsdc.gov.in/SearchContent.aspx

https://www.lkouniv.ac.in/en/article/e-content-faculty-of-science

Paper 14 A: Advanced Differential Equations

Credit: 4

Course Outcomes: T:04

1. Solve the system of 1st order differential equations, 2nd order differential equations, nth order differential equations, oscillatory equation, stability and unstability of linear and non-linear system of equations.
2. Conceptualize Green's functions and nature of critical points.
3. Prove advanced understanding of topics in applied mathematics, computational physics etc.

Unit I

Linear System- Introduction, properties of linear homogeneous systems, Abel-Liouville formula, Periodic linear System, Floquet's theorem, Solution of nth order linear homogeneous equation with variable coefficients.

Unit II

Inhomogeneous linear system, nth order linear non-homogeneous equation with variable coefficients, Hurwitz's theorem, Non-linear system, Volterra's prey & predator equation, Non linear equations: Autonomous system.

Unit III

The phase plane & its phenomena, types of critical points & Stability, Critical points & stability for linear system, stability by Liapunov's direct method. Green function, Construction of Green functions, Green function of homogeneous and non-homogeneous end conditions, Strum Liouville systems.

Unit IV

Second order differential equation: Introduction, Preliminary results, Boundedness of solutions, Oscillatory equation, number of zeroes, Pruffer's transformation, Strum theorem, Strum's comparison theorem.

References:

Text Books:

1. G. F. Simmons: Differential Equation, Tata McGraw-Hill
2. B. Rai, D. P. Chaudhary, H.I. Freedman: A course in Ordinary Differential Equations, Narosa Publishing House.
3. S. L. Ross: Differential Equations, Wiley Indian, 2004

Suggested Readings:

4. E. A. Coddington: An Introduction to Ordinary Differential Equations

Web References:

Digital platforms web links: NPTEL/SWAYAM/ MOOCS/Openstax.org

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http://heecontent.upsdc.gov.in/SearchContent.aspx

https://www.lkouniv.ac.in/en/article/e-content-faculty-of-science

Paper 14 B: Operations Research

Credit: 4 T:04

Course Outcomes:

1. Be able to understand the application of OR and frame a LP Problem with solution
2. Be able to build and solve Transportation and Assignment problems using appropriate method.
3. Be able to design and solve simple models of CPM and queuing to improve decision making and develop critical thinking and objective analysis of decision problems.
4. to take best course of action out of several alternative courses for the purpose of achieving objectives by applying game theory and sequencing models.

Unit I

Linear programming problems, Slack and surplus variables, Statement of general Linear programming Problems, Standard and matrix forms of linear programming problem, Basic feasible solution.

Unit II

Convex sets, Fundamental theorem of linear programming, Simplex method. Artificial variables, Big-M method, Two- phase method, Revised simplex method.

Unit III

Resolution of degeneracy, Duality in linear programming problems, Dual simplex method, Primal-dual relation analysis, integer programming.

UNIT IV

Transportation problems, assignment problems, Queuing Theory, Markov Chains, PERT and CPM, Optimization and constrained Optimization using Langrange's Multiplier.

References:

Text books:

1. Hamdy A. Taha, Operations Research: An Introduction, 10th Edition, Pearson
2. Kanti Swaroop, P. K. Gupta, Manmohan, Operations Research, Sultan Chand

Suggested Readings:

3. G. Hadley, Linear Programming

Web References:

Digital platforms web links: NPTEL/SWAYAM/ MOOCS/Openstax.org

https://openlearninglibrary.mit/edu/courses

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Minor Project

Credit :04