Shiksha Mandal's
Bajaj College of Science, Wardha (Autonomous)
Department of Mathematics
B.Sc. Sem-V

SYLLABUS

DSC-V : Complex Analysis

UNIT-I: Analytic functions**:** Definition of Functions of complex variable, Limit, Continuity, Differentiability, Analyticfunction, Necessary and sufficient conditions for f(z) to be analytic, C-R equations in polarform. Orthogonal curves, Harmonic function, Method to find the conjugate function, Milne Thomson method.

UNIT-II: Transformations: Conformal transformation, Linear, Magnification, Rotation, Inversion, Reflection transformations and their combinations, Bilinear transformation. Cross ratio, Fixed points, Inverse points and Critical points of mappings.

UNIT-III: Complex Integration Part-I: Complex line integral, Cauchy's integral theorem, Extension of Cauchy's theorem, Cauchy's integral formula and its generalized form, Morera Theorem, Cauchy's inequality, Liouville's theorem.

UNIT-IV: Complex Integration Part-II: Convergence of a series of complex terms, Taylor's theorem, Laurent's theorem, Zero of a function, Singular points, types of singularities, Residue at a pole, Residue at infinity, Cauchy's residue theorem, Evaluation of real definite integrals of the type integration around unit circle and $\int_{-\infty}^{\infty} f(z)dz$ (where f(z) has no poles on the real line by contour integration).

Text Books:

1. Functions of a Complex Variable: Goyal & Gupta, Pragati Prakashan, 2010.
2. Advanced Engineering Mathematics: H. K. Das, S. Chand and Co. Ltd, New Delhi (2009).

Reference Books:

1.Complex Variables and Applications (5th Edition): R. V. Churchil and J. W. Brown, McGraw Hill, New York, 1990
2. Complex Analysis, B.Sc. Semester V: Vijay Soni, R.K. Agrawal, N.T. Katre, R.T. Katre & Sanjay Deshpande, Himalaya Publishing House, Nagpur.
3.Theory of Complex Variables: Shanti Narayan, S. Chand & Co. Ltd., New Delhi.
4. Complex Variables (Introduction and Applications): Mark J. Ablowitz and A. S. Fokas, Cambridge University Press, South Asian Edition, 1998

List of Practical:

1. Determination of Harmonic and Conjugate function.
2. Construction of analytic function.
3. Determination of Fixed points, Inverse points, and Critical points of the transformations.
4. Determination of image of any figure of z-plane into w-plane under conformal transformation.
5. Determination of bilinear transformations.
6. Evaluation of Complex line integral
7. Evaluation of Complex integral by using Cauchy's integral formula.
8. Expansion of functions by using Taylor's and Laurent's theorems.
9. Evaluation of Complex integral by using Cauchy's residue theorem.
10. Evaluation of real definite integrals by using contour integration.

DSC-VI: Discrete Mathematics

UNIT-I: Algebraic Systems: Definitions, Examples and general properties of algebraic systems, Semigroups and Monoids, Homomorphism of semigroups and monoids. Congruence relation and Quotient semigroups. Sub-semigroups and sub-monoids.

UNIT-II: Lattices: Partial order relation, Partial ordered set, Lattices as Partially ordered set, Some properties of Lattices, Lattices as algebraic systems, Sub-Lattices, Direct product and homomorphism, Isomorphism of Lattices, Some special Lattices: Complete, Complemented and Distributive Lattices.

UNIT-III: Boolean Algebra: Definition and examples of Boolean algebra, Sub-algebra, Direct product and homomorphism, Boolean functions, Boolean forms and free Boolean algebra, Values of Boolean expressions and Boolean functions, Representation of Boolean functions, Minimization of Boolean functions, Karnaugh map, Applications of Boolean algebra in switching circuits.

UNIT-IV: Graph Theory: Basic concepts, Isomorphism of graphs, Path, Reachability and connectedness, Matrix representation of graphs, Trees, Sub-trees and theirrepresentation.

Text Books:

1. Discrete Mathematical Structures with Applications to Computer Science: J. P.

Tremblay, R. Manohar, Tata McGraw-Hill Pub Company, New Delhi (1997)

2. Elements of Discrete Mathematics: C. L. Liu, Tata McGraw-Hill Pub Company, New Delhi (1997)

Reference Books:

1. Discrete Mathematical Structures: Bernard Kolman, Robert Busby, Sharon Ross, Prentice-Hall of India Pvt.

New Delhi (2001).

2. Discrete Mathematics: J. K. Sharma, Macmillan India Ltd (2003).

3. Metric Space, Boolean Algebra & Graph Theory, B.Sc. Semester V: Vijay Soni, R.K. Agrawal, N.T. Katre,

R.T. Katre & Sanjay Deshpande; Himalaya Publishing House, Nagpur.

List of Practical:

1. Determination of homomorphism and isomorphism from the algebraic systems.
2. Determination of composition table.
3. Determination of algebraic systems as semigroup or monoids.
4. Graphical representation of partially ordered set.
5. Determination of sublattices and direct product of the lattices.
6. Determination of sum of products and product of sum canonical forms of the Boolean expressions.
7. Determination of Karnaugh map for the Boolean function.
8. Determination of outdegree, indegree, total degree and node-base of graphs.
9. Determination of isomorphic graphs.
10. Determination of binary tree from the given tree.

DSE-I: Statistics (Optional)

UNIT-I: Basics of Statistics: Definition and scope of Statistics, limitations of statistics, frequency distributions, continuous frequency distribution, graphicalrepresentationincluding histogram, frequency polygon.

UNIT-II: Measures of Central Tendency: Mean, median and mode. Measures of Dispersion: range, quartile deviation, mean deviation, standard deviation, coefficient of variation, Moments, absolute moments, factorial moments, skewness, and kurtosis.

UNIT-III: Curve Fitting and Principle of least squares: Curve fitting, fitting of a straight line, fitting of a second-degree parabola, fitting of a polynomial, change of origin, fitting of power curve, fitting of exponential curves, fitting of orthogonal polynomials,

UNIT-IV: Correlation and Regression: Bivariate distribution, correlation, scatter diagram, Karl Pearson coefficient of correlation, rank correlation. Regression, lines of regression, regression curves, regression coefficient, partial and multiple correlation, Plane of regression.

Text Books:

1. Fundamentals of Mathematical Statistics, 4thEdition (Reprint):S. C. Gupta and V.K. Kapoor, (2008), Sultan Chand &Sons.

Reference Books:

1. Basic Statistics, 2nd edition: B. L. Agrawal, Wieley Eastern Ltd. New Delhi.

2. Advanced Engineering Mathematics: H. K. Dass, S.Chand publication.

3. Fundamentals of Statistics, Vol. I & II, 8th Edn.: A.M. Goon., M.K. Gupta and B. Dasgupta (2002),the World Press, Kolkata.

4. Fundamentals of Statistics, 10th Edn.: D.N. Elhance , (1969), Kitab Mahal,15, Allahabad.

5. Mathematical Statistics, 7th Edn.: J.N. Kapoor, H.C. Saxena (1989), Sultan Chand &Sons.

DSE-I: Differential Geometry (Optional)

UNIT-I: Curves in Space: Parametric representation and definition of curve in space, arc length, Tangent at a given point to a curve, Osculating plane, Normal Plane, Principal normal and binormal, Rectifying plane, Fundamental planes, Curvature of curve, Torsion of curve, Serret-Frenet Formulae, Helices, Locus of the Centre of curvature, Oscillating sphere.

UNIT-II: Fundamental theorem for space curves, Involute and Evolute, the curvature and torsion of the involute and evolute, Bertrand curves, Surfaces, Envelopes, and characteristics relating to one parameter family of surfaces, Developable surfaces.

UNIT-III: Curves on a surface, Parametric Curves, two fundamental forms, Positive definiteness, Fundamental magnitudes for some important surfaces, Direction coefficients, orthogonal trajectories of given curves, The formulas of Gauss, Meunier's theorem, Lines of curvature as parametric curves, Euler's theorem on normal curvature, Rodrigues' formula, Third fundamental form.

UNIT-IV: Definition and the differential equations of Geodesic, Canonical equations for Geodesics, Geodesics on a surface of revolution, Normal property of Geodesics,Curvature and Torsion of Geodesic, Bonnet's formula, Geodesic curvature of the parametric curves, Liouville's formula for geodesic curvature, Gauss-Bonnet Theorem, Gaussian Curvature.

Text Books:

1. Three-dimensional Differential Geometry (Fifth Edition): Bansi Lal, Atma Ram & Sons.

2. An introduction to Differential Geometry: T. J. Willmore, Oxford University Press.

Reference Books:

1. Tensors and Differential Geometry: P.P.Gupta, G.S. Malik, and S.K.Pundir, Pragati Prakashan, Meerut.
2. Elementary Differential Geometry: B. O. Nell, Academic Press, 1966.
3. Differential Geometry:S. C. Mittal, D. C. Agrawal, Krishna Prakashan Mandir, Meerut.
4. Differential Geometry of Curves and Surfaces: M. Docarmo, Prentice Hall, 1976.

VSC-Linear Programming (2-Credits)

Course Content: Introduction, some definitions, optimization problems, programming problems, linear programming, solution of linear programming problems; graphical method, simplex method, duality method.

ReferenceBooks:

1 Linear programming: G. Hadley, Addision-Wesley publishing Company.

2. Advanced Engineering Mathematics: H. K. Dass, S. Chand publication.

List of Practical:

1. Formulation of linear programming problems.
2. Algorithm of graphical method.
3. Determination of optimal solution of LPP using graphical method.
4. Algorithm of simplex method.
5. Determination of optimal solution of LPP using simplex method.
6. Algorithm of duality method.
7. Determination of optimal solution of LPP using duality method.

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Syllabus: B.Sc. Sem-VI

DSC-VII: Linear Algebra

UNIT-I: Vector Spaces: Definition and examples of vector spaces, Sub-spaces, Linear dependence, Linear independence, Span of a set, More about sub-spaces, Dimensions and Basis.

UNIT-II: Linear Transformations: Definition and examples, Range and kernel of linear map, Rank-Nullity, Inverse of a linear transformation, Consequences of Rank-Nullity Theorem.

UNIT-III: The space L (U, V), Composition of linear maps, Operator equations, Applications to the theory of ordinary linear differential equations, Matrix associated to linear map, Linear map associated with matrix.

UNIT-IV: Linear Operations in Matrices, Matrix multiplication, Rank and Nullity of a matrix, Inner product spaces, Normed linear space, Orthogonal and orthonormal vectors, Gram-Schmidt orthogonalization process, Orthogonal and Unitary matrices, Application to reduction of quadrics.

Text Books:

1. An Introduction to Linear Algebra: V Krishnamurthy, V P Mainra and J L Arora, Affiliated East West Press Pvt. Ltd (1976).

2. Linear Algebra, B.Sc. Semester VI: Vijay Soni, R.K. Agrawal, N.T. Katre, R.T. Katre & Ashish Sastrakar; Himalaya Publishing House, Nagpur.

Reference Books:

1. Introduction to Linear Algebra: 2nd Ed., S. Lang, Springer, 2005.

2. Linear Algebra and its Applications: Gilbert Strang, Thomson, 2007.

3. Linear Algebra (A Geometrical Approach): S. Kumaresan: Prentice Hall of India, 2000

4. Basic Linear Algebra with MATLAB: S. K. Jain, A. Gunawardena and P. B. Bhattacharya, College Publishing (Springer-Verlag) 2001.

5. Matrix and Linear Algebra: K. B. Datta, M Prentice Hall of India Pvt., New Delhi, 2000

6. A Text Book of Modern Abstract Algebra: Shanti Narayan, S. Chand & Co.Ltd., New Delhi.

List of Practical:

1) Determination of subspace of a vector space.
2) Determination of linearly dependent and independent set.
3) Determination of Basis and Dimension of a vector space.
4) Determination of Range, Rank, Kernel and Nullity of a linear transformation.
5) Determination of Inverse of a linear transformation.
6) Determination of Composition of linear maps,
7) Determination of Matrix associated to linear map.
8) Determination of Linear map associated with a matrix.
9) Determination of Rank and Nullity of a matrix.
10) Determination of orthogonal and orthonormal vector to the given set of vectors.

DSC-VIII: Mechanics

UNIT-I: Forces acting at a point, Parallel forces, Moments, Couples, Coplanar forces, Reduction theorems and examples, Equilibrium under three forces, General conditions of equilibrium, Centre of gravity.

UNIT-II: Work and Energy, Virtual work, Flexible strings, Common catenary.

UNIT-III: Motion in a plane: Velocity and acceleration, Radial and transverse components of velocity and acceleration, Angular velocity and acceleration, Relation between angular and linear velocities, Tangential and normal components of velocity and acceleration, Newton's Laws of motion, Projectile.

UNIT-IV: Basics concept of Lagrange's Dynamics, Constraints, Generalized Coordinates, Principle of
Virtual work, D'Alembert principle, Lagrange's Equations, Reduction of two body central force problem to the equivalent one body problem, Central force and motion in a plane, Differential equation of an orbit, Inverse square law of force, Virial theorem.

Text Books:

1. Text Book of Statics: R S Varma, Pothishala Private Ltd. Allahabad (1996)

2. Mechanics, B.Sc. Semester V: Vijay Soni, R.K. Agrawal, N.T. Katre, R.T. Katre; Himalaya Publishing House, Nagpur.

Reference Books:

1. Classical Mechanics (Second Edition): Herbert Goldstein, Narosa Publishing House , New Delhi, 1998.

2. An Elementary statics and Dynamics: S.L. Loney, Cambridge University Press, 1956.

3. Classical Mechanics: J C Upadhyaya, Himalaya Publishing House, New Delhi, 2006.

4. Classical Mechanics: T. M. Karade, Sonu Nilu Publication.

List of Practical:

1) Determination of resultant force of the given forces acting on body.
2) Determination of magnitude of resultant and the equation of its line of action.
3) Determination of centre of gravity.
4) Determination of tension of a string or thrust in a rod.
5) Determination of Span and Sag between two points.
6) Determination of velocity and acceleration of a particle along the radius vector.
7) Determination of tangential and normal components of velocity and acceleration of a particle.
8) Construction of Lagrangian for a particle moving in a space and determination of equation of motion.
9) Determination of Lagrange's equation of motion for a given system.
10) Solution of Atwood's machine problem.

DSE-II: Special Theory of Relativity (Optional)

UNIT-I: Review of Newtonian Mechanics: Inertial frames, Speed of light and Galilean relativity, Relative character of space and time, Postulates of Special theory of relativity, Lorentz transformation
equations and its geometrical interpretation, Group properties of Lorentz transformations.

UNIT-II: Relativistic Kinematics: Composition of parallel velocities, Relativistic addition law for
velocities, Transformation equation for components of velocities and acceleration of a particle, Transformation of Lorentz contraction factor, length contraction and time dilation.

UNIT-III: Geometrical representation of Space-Time: Four dimensional Minkowskian space-time of
relativity, Space like and time like intervals, Proper time, Light cone or null cone World line of a particle, four vector and tensors in Minkowskian space-time.

UNIT-IV: Relativistic Mechanics and Electromagnetism: Variation of mass with velocity. Equivalence of mass and energy i.e., $E = mc^2$, Transformation equations for mass, momentum and energy. Relativistic force and transformation equations for its components. Relativistic Lagrangian and Hamiltonian. Maxwell's equation in vacuum, Propagation of electric and

magnetic field strengths, Four potential, Transformation equations for electromagnetic four potential vector. Transformation
equations for electric and magnetic field strengths.

Text Books:

The Theory of Relativity: C. Molar, Oxford Clarendon Press, 1952

Reference Books:

1. Theory of Relativity: J.K. Gupta, K.P. Gupta, Krishna Prakashan Media (P) Ltd.

2. Lectures on Special Relativity: T. M. Karade, K.S. Adhav, M.S. Bendre, Sonu Nilu

3. Special Theory of Relativity, B.Sc. Semester VI: Vijay Soni, R.K. Agrawal, N.T. Katre, R.T. Katre; Himalaya Publishing House, Nagpur.

4. Introduction to The Theory of Relativity: P.G. Bergman, Prentice Hall of India Pvt. Ltd., 1969

5. Special Theory of Relativity: Banerjee, Sriranjan, Prentice Hall of India Pvt. Ltd.

DSE-II: Probability Theory (Optional)

UNIT-I: Probability functions: Definition, Sample space and Events, axioms of Probability, Some elementary theorems, Conditional Probability, Bayes theorem, Random variables, Probability distribution functions, Probability density functions, Mathematical expectation and Moments, Moment generating function, Characteristic function.

UNIT-II: Univariate Discrete and Continuous distributions: Discrete Distribution-Binomial distribution, Geometric distribution and Poisson distribution, Continuous distributions- Gamma, Exponential, Uniform and Normal distribution; Uniform and Normal density function.

UNIT-III: Bivariate Distribution: Joint probability distribution, Joint cumulative distribution function, Joint probability density function, Marginal distributions, marginal probability density function, Conditional probability distribution and density function.

UNIT-IV: Random Process or Stochastic Process: Introduction, Classification of Random process, Probabilistic structure, Stationarity, Time averages, Ergodic process, Markov process, Poisson process, Binomial process, Sine wave process Birth and Death process.

Text Book:

1. Probability Statistics and Queueing Theory: P. Kandasamy, K. Thilagavathi, K. Gunavathi; S. Chand & Company Ltd., New Delhi.

Reference Books:

1. Probability and Statistics for Engineers (6^{th} ed.): I.R. Miller, John Freund, R. A. Johnson, Pearson Education Pte. Ltd.

2. A first course in Probability (3^{rd} ed.): Sheldon Ross, MacMillan Publishing Company, New York.

3. Probability, Random Variables and Random Processes: HWEI P.HSU, Tata McGraw Hill Publishing Company Ltd, New Delhi.

4. Fundamentals of Mathematical Statistics (4^{th} ed.): S. C. Gupta and V.K. Kapoor, (2008), Sultan Chand &Sons.

5. Fundamentals of Statistics, (10^{th} ed.): D.N. Elhance,(1969), Kitab Mahal,15, Allahabad.

VSC-IV : Mathematical Modelling (2 Credits)

Course Content: Modelling: Electrical circuits model e.g. RC, LC, LCR series circuits, Population growth model, Mechanical system model, Free Oscillations (mass-spring system), Forced Oscillations model, Vibrating string model (wave equation), One dimensional heat flow model (Heat equation).

References: 1. Advanced Engineering Mathematics: Erwin Kreyszig; John wiley and sons INC.

2. Advanced Engineering Mathematics: H. K. Dass; S. Chand & Company Ltd., New Delhi.

List of Practical:

1) Construction of RC, LC, LCR series circuits model
2) Determination current and charge in the given circuits.
3) Construction of Mechanical system model.
4) Determination of displacement and velocity of a body falling from rest.
5) Determination of displacement of simple pendulum.
6) Determination of period of oscillation for simple pendulum
7) Construction of vibrating string model.
8) Determination of displacement of vibrating string.
9) Construction of one-dimensional heat flow model.
10) Determination of temperature distribution in the rod.