

Sardar Patel University  
Vallabh Vidyanagar  
T. Y. B. Sc. (Mathematics)  
Four periods per week (3 hours-100 Marks)  
(With effect from June 2004)

M-301 Analysis

Unit 1

Field structure, order structure, bounded and unbounded sets, Supremum and infimum, completeness and order completeness in  $\mathbb{R}$ , Archimedean property of real numbers, axioms of a complete ordered field, absolute values, exponential functions, logarithmic functions, generalized power functions, trigonometric functions, inverse trigonometric functions.

Unit 2

Sequences, bounds of a sequence, convergence of sequences, limit Point of a sequence, Bolzano-Weierstrass theorem, limit superior and Limit inferior of a sequence, convergent and divergent sequences, Cauchy's general principle of convergence, Cauchy sequences, Algebra of sequences, monotonic sequences.

Unit 3

Neighbourhood of a point, interior points, interior of a set, limit points of a set, Bolzano-Weierstrass theorem, closed sets, closure of set.

Unit 4

Riemann integrals definitions and existence, inequalities for integrals, Refinement of partitions, Darbox's theorem for integrals, conditions of integrability, integrability of the sum, difference, product, quotient and modulus of functions.

Unit 5

Integral as the limit of sums (Riemann sums), some integrable Functions, integration and differentiation, the primitive, the fundamental theorem of integral calculus, mean value theorems of integral, second mean value theorem.

Unit 6

Periodic functions, Fourier series, Euler formulae, even and odd Functions, half range expansions.

Recommended Texts:

- Malik, S.C. principles of Real Analysis, Revised Edition, New Age International, New Delhi 2000
- Chapter 1(Except 4.3,4.4,4.6), chapter 2, chapter 3(Except 10.1)
- Chapter 8(except 1),chapter 9.
- Kreyszig, E., Advanced Engineering Mathematics chapter 10(10.1 to 10.5)

Reference Books:

- Malik, S.C. and Arora

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M-302: Graph Theory

Unit 1:

Graph, applications of graph; finite and infinite graph; Incidence and Degree; isolated vertex; pendant vertex and null graph; isomorphism; Sub graphs; walks, paths and circuits; connected and disconnected Graphs; components; Euler graphs; operation on graph; more on Euler graphs; Hamiltonian paths and circuits; the traveling salesman Problem.

Unit 2:

Trees and their properties, pendant vertices in a tree; distance and centers in a tree; rooted and binary trees; counting trees; spanning Trees; fundamental circuits; finding all spanning trees of a graph; Spanning trees in a weighted graphs

Unit 3:

cut-sets and their properties; all cut-sets in a graph; fundamental circuits and cutsets; connectivity and separability; network flows; first and second isomorphisms.

Unit 4:

Combinatorial Vs. Geometric graphs, planar graphs, kuratowski's Two graphs, different representations of a planar graphs, detection of Planarity, geometric and combinatorial duals; more on criteria of Planarity; thickness and crossings.

Unit 5:

Modular arithmetic and Galois fields; vectors and vector spaces, Vector spaces associated with a graph; basis vectors of a graph; Circuit and cut-sets subspaces; orthogonal vectors and spaces; Intersection and Join of  $W$  and  $W$ 's.

Unit 6:

Incidence matrix, sub matrices of  $A(G)$ , circuits matrix, fundamental Circuits and rank of  $B$ , An application to switching network, cut-set Matrix, relationship among reduced incidence matrix, fundamental Circuit Matrix and Fundamental cut-set Matrix; path matrix.

Recommended Texts:

Clark Narsingh, Graph theory with application to engineering and Computer science, Fourth printing, prentice Hall of India, 1987.  
Chapter 1 (1.1 to 1.5), chapter 2(except 2.3), chapter 3, chapter 4, chapter 5, chapter 6(except 6.1 and 6.2), chapter 7(except 7.9)

Reference Books:

Clark J. and Holton A.D., A first look at Graph Theory, First Indian Reprint. Allied Publishers,1995.  
West, D.B., Introduction to graph theory, prentice Hall of India, New Delhi, 1999.

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M-303: Topology of Metric spaces and Convergence

Unit 1:

Equivalence, countability, convergence and divergence, series with Nonnegative terms, alternating series, conditional convergence and Absolute convergence, rearrangements of series, tests for absolute Convergence.

Unit 2:

Pointwise convergence of sequences of functions, uniform convergence of sequence of functions, consequences of uniform convergence.

Unit 3:

Convergence and uniform convergence of series of series of function, integration and differentiation of series of functions, Abel summability.

Unit 4:

Metric spaces, Limit in metric spaces, continuous functions on a Metric space, open and closed sets.

Unit 5:

More about open sets, connected sets, bounded and totally bounded Sets, complete metric spaces.

Unit 6:

Compact metric spaces, continuous functions on compact metric Spaces, continuity of the inverse function, uniform continuity.

Recommended texts:

Goldberg, R.R., Methods of Real Analysis, Oxford & IBH chapter 1 (1.5 only), chapter 3(3.1 to 3.6) chapter 4(4.2,4.3), chapter 5(5.3,5.4 5.5),chapter 6,chapter 9(9.1 to 9.6)

Reference Books :

1. Malik, S.C. and Arora, Savita, mathematical Analysis, second Edition New Age International Pvt. Ltd., New Delhi 2000.

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M-304 Abstract Algebra

Unit 1:

Equivalence relations and partitions; binary operations, Definition of Group, subgroups, cyclic groups, Langrange's theorem.

Unit 2:

Isomorphisms, Homomorphism, Quotient groups, Direct products, Permutation groups.

Unit 3:

Rings, Integral domains, Isomorphism, Homomorphism, Quotient fields, Ideals, quotient rings, prime and maximal ideals.

Unit 4:

Factorization, Euclidean domain, principal ideal domain, Unique Factorization domain, Polynomial rings, roots of polynomials, factorization of polynomials.

Unit 5:

Vector spaces, subspaces, linear dependence, independence and bases.

Unit 6:

Linear transformations, matrices and linear transformations, Trace and Rank of a matrix and linear transformation.

Recommended texts:

Gopalakrishnan, N.S., University Algebra, second Edition, Wiley Eastern Ltd., New Delhi 1994.  
Chapter 1(Except 1.12, 1.13 and 1.14), chapter 2, chapter 3(Except 3.6 and 3.7), chapter 5(5.3, 5.4(trace only), 5.5)

Reference Books:

Herstein, I.N., Topics in algebra.  
Singal, Asha Rani, Algebraic structures,  
Whitesitt, J. Principles of modern algebra.

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M-305 Number Theory and Complex Analysis

Unit 1:

Divisibility, the division algorithm, g.c.d., Euclidean algorithm for Determining the g.c.d. of two integers, l.c.m. prime, prime and Composite numbers, fundamental theorem of arithmetics, Eclild's Proof for infinitude of primes, general familiarity of Goldbach Conjecture and the twin prime problem.

Unit 2:

Congruences, congruence modulo  $m$ , algebraic properties of congruences, complete and reduced residue system(mod  $m$ ), Euler's function  $\Phi(n)$ , Fermat, Euler, Wilson's theorems, solution of linear congruences, Chinese remainder theorem.

Unit 3:

Special numbers, perfect numbers, Mersenne numbers, Fermat numbers, Fibonacci numbers, Numerical functions, greatest integer function, sum-divisor function, Mobius function ( $\mu$ ). Diophentine equations, linear Diophentine equation  $x^2 + y^2 = z^2$ . The Diophentine equation  $x^4 + y^4 = z^4$  (fermat's last theorem  $n=4$ ).

Unit 4:

Functions of complex variable limits, and their properties; involving the point at infinity; continuity, derivatives, differentiation formula, Cauchy-Riemann equations.

Unit 5:

Sufficient conditions for analyticity, analytic and harmonic function; The exponential function and its properties, trigonometric, hyperbolic and Logarithmic functions, branches of Logarithmic function.

Unit 6:

Inverse trigonometric and hyperbolic functions, Linear functions, the Function  $1/z$ , linear fractional transformations, mappings of the upper Half plane, the transformations  $w = \exp z$  and  $w = \sin z$ .

Recommended texts:

Hsiung, C., Y., Elementary Theory of numbers, Allied publishers Ltd. (1992) chapter 1, chapter 2, chapter 3(only 3.1 and 3.2),chapter 4 (only4.1), chapter 7(7.2(problem 3 and 4 only)).  
Churchill, R.V., Brown, J.W., Complex Variables and Applications, Fifth edition, McGraw-Hill Book Co.,1990.  
Articles9,11,12,13,14,15,16,17,18,19,20,21,22,23,24,25,26,29,64,65,66,67,68(exponent only),69.

Reference Books:

Burton D., elementary Number Theory, Universal Book stall, new Delhi  
Niven I. And Zuckermar H., An Introduction to the theory of Numbers, Wiley-Eastern Publication.  
Barnard S. and Child J.N., Higher Algebra, Mc Millan & Co. Ltd.  
Conway, J.B., Functions of one complex variables, Narosa publ. House, New Delhi,1973.

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M-306 Mechanics

Unit 1:

Ingredients of mechanics, position vector, velocity vector, acceleration vector, gradient vector, Fundamental laws of Newtonian mechanics, the theory of dimensions. Plane statics, equilibrium of a particle, equilibrium of systems of particles, moment of force about a line, necessary and sufficient condition for equilibrium.

Unit 2:

Couples, work and potential energy, principle of virtual work, application, in plane statics, mass center and center of gravity, gravitational potential.

Unit 3:

Flexible cables, cable in contact with smooth and rough curve, plane Kinematics, kinematics of a particle, motion of a rigid body parallel to a plane.

Unit 4:

Methods of plane dynamics, motion of a particle, motion of a system of a system of particles, applications in plane dynamics projectile with and without resistance.

Unit 5:

Motion under central force, planetary orbits, kinetic energy and angular momentum of rigid body, moment of inertia of a rigid body.

Unit 6:

Rotational motion about a fixed line, impulsive motion, general theory of plane, impulsive motion, collision.

Recommended texts:

Synge, J.L and Griffith, B.A., principles of Mechanics, chapter 1, chapter 2 (2.2,2.3,2.4), chapter 3(3.1 to 3.4) chapter 4(4.1,4.2), chapter 5 (5.1,5.2),chapter 6(6.1 to 6.5), chapter 7(7.1,7.2),chapter 8(8.1,8.2).

Reference Books:

Chatterjee, P.N., Statics and Dynamics.

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M-307 Mathematics Practicals 1

1. Recognition of the properties of functions from their graphs
2. Constructions with a ruler and compass only
3. Verification of geometric results
4. Conics, string construction and verification of properties
5. Construction of some curves and finding areas by various methods
6. Symmetries in space and planes
7. Network scheduling
8. Mathematical Modelling of problems in natural and social sciences
9. Objective questions
10. Study of charts and mathematicians
11. Solid surfaces and others models
12. Making geometrical models
13. Unbalanced transportation problems
14. Game theory mixed strategy games
15. Travelling salesman problem
16. Job scheduling problems
17. Graph theory

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M-308 Mathematical Practicals 2

1. Basic Arithmetic operations and expressions
2. Finding greatest common divisor and last common multiple of integers, determination of perfect numbers, prime numbers etc.
3. Solution of polynomial equations and transcendental equations.
4. Solution of simultaneous linear equations
5. Basic operations on matrices; trace, transpose, determinant, rank of matrix.
6. Upper triangularization, row echelon form and inverse of a matrix.
7. Eigenvalues and eigenvectors of matrix.
8. Basic operations on n-tuple of real numbers; dot product, norm, linear independence.
9. Interpolation
10. Numerical integral and differentiation of a function.
11. Solving a differential equation.
12. Plotting curves (in Cartesian, polar and parametric equations)
13. Bar Chart, Pie Chart
14. Simplex method

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M-309 Mathematical Practicals III

Practicals in Set-1 will be done in using any of the softwares : (i) MathCad 2001(Student edition) (ii) MACSYMA Prolite (iii) MATLAB.

Set 1:

Basic arithmetic operations and expressions  
Finding greatest common divisor and least common multiple of integers, determination of-perfect numbers, prime numbers etc.  
Solution of polynomial equations and transcendental equations.  
Solution of simultaneous linear equations  
Basic operations on matrices; trace, transpose, determinant, rank of a matrix.  
Bar Chart and pie Chart.  
Solving a differential equations.

Set 2:

Recognition of the properties of functions from their graphs  
Construction with a ruler and compass only  
Verification of geometric results  
Unbalanced transportation problems  
Game theory mixed strategy games  
Travelling salesman problem  
Job scheduling problems