Partially modified in the Board of studies on 26 August,2016

NAS-103   **MATHEMATICS –I**   L T P
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                                                          No. of Lecture Hrs.

Unit -I : Differential Calculus-I   8
Review of calculus: Basic definitions & Limit, continuity, differentiability and its obvious interpretations in engineering. Leibnitz theorem, Partial differentiation, Euler's theorem for homogeneous functions, Total derivatives, Limit, continuity, differentiability in more than one variables, Applications of derivatives to approximate errors, Change of variables, Curve tracing (Cartesian, Polar and Parametric Curves).

Unit – II : Differential Calculus-II   7
Taylor's and Maclaurin's series expansions for two variables, Expansion of functions of several variables, Extrema of functions of several variables, Lagrange method of multipliers with applications, Jacobians.

Unit – III: Multiple Integrals   7
Double and triple integrals, Change of order of Integration, Change of variables, Application of integration to arc lengths, area, volume and surface areas for Cartesian, Polar and Parametric Curves, Beta and Gamma functions, Dirichlet's integral with applications.

Unit – IV : Vector Calculus   7
Vector Point function, level surfaces, Directional derivatives, Gradient, Divergence and Curl of a vector and their physical interpretations, Vector identities, Line, surface integrals, Statement and applications of Green's, Stoke's and Gauss divergence theorems (without proof).

Unit – V: Linear Algebra   7
Elementary row and column transformations, Rank of matrix, Linear dependence, Consistency of linear system of equations and their solution, Characteristic equation, Cayley-Hamition's theorem, Eigen values and Eigen vectors, Application of matrices to engineering problems, Vector spaces, Subspaces, Linear transformations, Rank –Nullity theorem (with applications without proof).

Suggested Readings:
1. G. Prasad, A text book on Differential Calculus, Pothishala Pvt. Ltd. Allahabad 1979.
2. G. Prasad, A text book on Integral Calculus, Pothishala Pvt. Ltd. Allahabad 1991
3. B. V. Ramana, Higher Engineering Mathematics, Tata Mc Graw-Hill Publishing Company Ltd. New Delhi 2008.
4. R. K. Jain & S. R. K. Iyenger, Advanced Engineering Mathematics, Narosa Publication House 2002.

Reference Books:
1. M. R. Spiegel, S. Lipschutz and D. Spellman, Schaum's Outlines Vector Analysis, Tata Mc Graw-Hill Edition, New Delhi 2010
2. C. Ray Wylie & Louis C. Barrett, Advanced Engineering Mathematics, Tata Mc Graw-Hill Publishing Company Ltd. 2003
3. Thomas and Finney, Calculus, Addison Wesley.
5. E. Kreysig, Advanced Engineering Mathematics, John Wiley & Sons 2005.
6. C. Prasad, Advanced Mathematics for Engineers, Prasad Mudralaya 1996

Partially modified in the Board of studies on 26 August,2016

NAS-203   **MATHEMATICS –II**

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3   1   0
No. of Lecture Hrs.

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Unit -I: Ordinary Differential Equations   8

Degree and order of Differential equation; Review of First order Differential Equations; Solution of nth order Linear differential equations with constant coefficients; Simultaneous linear differential equations; Solution of second order linear differential equations - Method of variation of parameters, Particular solution and Complimentary functions, Applications in solving Engineering problems (without derivation).

Unit - II: Series Solution and Special Functions   7

Series solution (Power and Frobenius series) of second order linear ODEs- Legendre's equation   and *their applications for solving integrals,* Bessel's function of first kind and its Properties, *their applications for solving integrals.*

Unit - III: Laplace Transforms   8

Existence theorem for Laplace transform; *Laplace transform of derivatives and integrals,Unit step function, Dirac delta function, exponential function, periodic functions covering Sin and Cosine integral functions;* Convolution theorem, Applications for solving simple linear and simultaneous ordinary differential equations; Initial and Final value theorems; Inverse Laplace transforms.

Unit – IV: Fourier Series and Partial Differential Equations   8

Periodic functions, Fourier series of period 2π , Euler's formulae, Functions having arbitrary periods, Change of interval, Even and odd functions, Half range sine and cosine series, Solutions of first order PDE's by Lagrange's method, Solutions of second order Linear PDE's with constant coefficients.

Unit – V: Applications of Partial Differential Equations   8

Classifications of second order Linear PDE's: Parabolic, Elliptic and Hyperbolic with illustrative examples, Method of separation of variables for solving Wave and heat equations up to two dimensions, Laplace equation in two-dimensions.

Suggested Readings:
1. M. R. Spiegel, Schaum's Outlines Laplace Transforms, Tata Mc Graw-Hill Edition, New Delhi 2005
2. B. V. Ramana, Higher Engineering Mathematics, Tata Mc Graw-Hill Publishing Company Ltd. 2008.
3. M. D. Rai Singhania, Ordinary and Partial Differential Equations, S. Chand Publications

Reference Books:
1. E. Kreysig, Advanced Engineering Mathematics, John Wiley & Sons 2005.
2. Tyn Myint-U, Lokenath Debnath, Linear Partial Differential Equations for Scientists and Engineers, Birkhauser (Open Access e-book)

EAS-301   **MATHEMATICS –III**

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3   1   0
No. of Lecture Hrs.
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Unit – I: Functions of Complex variable   **10**

Review on differentiability of functions of more than one variable, complex valued functions, Analytic functions-C-R equations, Anti derivative, Cauchy's integral formula, Gauss Mean value theorem, Cauchy's Inequality, Taylor's and Laurent's series, Singularities, Residue theorem, Evaluation of real integrals of the type $\int_{-\infty}^{\infty} f(\cos\theta, \sin\theta) \, d\theta$ and $\int_{-\infty}^{\infty} f(x) \, dx$.

Unit – II: Statistical Techniques - I   **7**

Moments, Moment generating functions, Skewness, Kurtosis, Curve fitting, Method of least squares, fitting of straight lines, Correlation, Linear and non–linear regression.

Unit – III: Statistical Techniques – II   **8**

Probability theory, Baye's rule, Binomial, Poisson and Normal distributions, Sampling theory (small and large samples), Tests of significations: Chi-square and t-test, Analysis of variance and some practical applications to Engineering, Medicine, Agriculture.

Unit – IV: Numerical Techniques – I   **8**

Zeroes of transcendental and polynomial equations-Bisection, Regula-falsi and Newton-Raphson methods with rate of convergence.
Interpolation: Polynomial interpolation-Lagrange, Newton, Newton's forward and backward differences.

Unit – V: Numerical Techniques –II   **8**

Solution of system of linear equations: Gauss-Seidel and Crout's method; Numerical differentiation and Numerical integration- Trapezoidal, Simpson's one third and three-eight rules, Composite rules; Solution of first order IVP-Euler method, Modified Euler method, Taylor series method, Runge-Kutta methods.

Suggested Readings:

1. Jain, Iyenger & Jain, Numerical Methods for Scientific and Engineering Computation, New Age International, New Delhi 2003.
2. S. Ponnusamy, Foundations of Complex Variables, Narosa Publishing House
3. Murray Spiegel, John Schiller, R. Alu Srinivasan, Probability and Statistics (Schaum's Outline Series), Mc Graw-Hill Edition (Open Access e-book)
4. M. R. Spiegel, Schaum's Outline Series: Theory and Problems of COMPLEX VARIABLES, Tata Mc Graw-Hill Edition, (Open Access e-book)
5. E. Kreysig, Advanced Engineering Mathematics, John Wiley & Sons 2005 (Open Access e-book)

Reference Books:

1. Conte, S. D.; De Boor, Carl Elementary Numerical Analysis - An Algorithmic Approach, Second Edition, **Tata** Mc graw-hill
2. Chandrika Prasad, Advanced Mathematics for Engineers, Prasad Mudralaya, Allahabad 1996.
3. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers 2005.

Partially modified in the Board of studies on 26 August,2016

ECS-303 **DISCRETE MATHEMATICAL STRUCTURES**

L T P
3 1 0
No. of Lecture Hrs.

Unit –I: **10**
Set Theory: Introduction, Combination of sets, Multisets, Ordered pairs. Proofs of some general identities on sets.
Relations: Definition, Operations on relations, Properties of relations, Composite Relations, Equality of relations, Recursive definition of relation, Order of relations.
Functions: Definition, Classification of functions, Operations on functions, Recursively defined functions. Growth of Functions.
Natural Numbers: Introduction, Mathematical Induction, Variants of Induction, Induction with Nonzero Base cases. Proof Methods, Proof by counter – example, Proof by contradiction.

Unit –II: **8**
Algebraic Structures: Definition, Groups, Subgroups and order, Cyclic Groups,Cosets, Lagrange's theorem, Normal Subgroups, Permutation and Symmetric groups, Group Homo morphisms, Definition and elementary properties of Rings and Fields, Integers Modulo n.

Unit –III: **8**
Partial order sets: Definition, Combination of partial order sets, Hasse diagram.
Lattices: Definition, Properties of lattices – Bounded, Complemented, Modular and Complete lattice.
Boolean Algebra: Introduction, Axioms and Theorems of Boolean algebra, Algebraic manipulation of Boolean expressions. Simplification of Boolean Functions, Karnaugh maps, Logic gates, Digital circuits and Boolean algebra.

Unit –IV: **7**
Propositional Logic: Proposition, well formed formula, Truth tables, Tautology, Satisfiability, Contradiction, Algebra of proposition, Theory of Inference
Predicate Logic: First order predicate, well formed formula of predicate, quantifiers, Inference theory of predicate logic.

Unit –V: **9**
Trees: Definition, Binary tree, Binary tree traversal, Binary search tree.
Graphs: Definition and terminology, Representation of graphs, Multigraphs, Bipartite graphs, Planar graphs,
Recurrence Relation & Generating function: Recursive definition of functions, Recursive algorithms, Method of solving recurrences.
Combinatorics: Introduction, Counting Techniques, Pigeonhole Principle, Pólya's Counting Theory.

Suggested Readings:
1. Kenneth H. Rosen, Discrete Mathematics and Its Applications, 6/e, Mc Graw-Hill 2006. (Open Access e-book)
2. J. P. Tremblay, R. Manohar, Discrete Mathematical Structures with Application to Computer Science, Tata McGraw-Hill Edition, New Delhi 1997. (Open Access e-book)
 Reference Books:
1. B. Kolman, R.C. Busby, and S.C. Ross, Discrete Mathematical Structures, 5/e, Prentice Hall 2004.
2. E.R. Scheinerman, Mathematics: A Discrete Introduction, Brooks/Cole 2000.
3. R.P. Grimaldi, Discrete and Combinatorial Mathematics, 5/e, Addison Wesley 2004.

EOE-038 / EOE-048:   DISCRETE MATHEMATICS (Open Elective)

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No. of Lecture Hrs.

UNIT-I   9
Set Theory: Definition of Sets, Venn Diagrams, complements, Cartesian products, power sets, counting principle, cardinality and countability (Countable and Uncountable sets), proofs of some general identities on sets, pigeonhole principle.
Relation: Definition, types of relation, composition of relations, domain and range of a relation, pictorial representation of relation, properties of relation, partial ordering relation.
Function: Definition and types of function, composition of functions, recursively defined functions.

UNIT-II   8
Propositional logic: Proposition logic, basic logic, logical connectives, truth tables, tautologies, contradiction , normal forms (conjunctive and disjunctive), modus ponens and modus tollens, validity, predicate logic, universal and existential quantification.
Notion of proof: Proof by implication, converse, inverse, contra positive, negation, and contradiction, direct proof, proof by using truth table, proof by counter example.

UNIT-III   8

Combinatories: Mathematical induction, recursive mathematical definitions, basics of counting, permutations, combinations, inclusion-exclusion, recurrence relations (n^{th} order recurrence relations with constant coefficients, Homogeneous recurrence relations, Inhomogeneous recurrence relation), generating function (closed form expression, properties of G.F., solution of recurrence relation using G.F, solution of combinatorial problem using G.F.)

Unit-IV   7
Algebraic Structure: Binary composition and its properties definition of algebraic structure; Semi group, Monoid Groups, Abelian Group, properties of groups, Permutation Groups, Sub Group, Cyclic Group, Rings and Fields with definition and standard results

UNIT-V   8
Graphs: Graph terminology, types of graph connected graphs, components of graph, Euler graph, Hamiltonian path and circuits, Graph coloring, Chromatic number.
Tree: Definition, types of tree (rooted, binary), properties of trees, binary search tree, tree traversing (pre order, in order, post order).

Suggested Readings:

1. Kenneth H. Rosen, Discrete Mathematics and Its Applications, 6/e, Mc Graw-Hill 2006. (Open Access e-book)
2. J. P. Tremblay, R. Manohar, Discrete Mathematical Structures with Application to Computer Science, Tata McGraw-Hill Edition, New Delhi 1997. (Open Access e-book)

Reference Books
1. B. Kolman, R.C. Busby, and S.C. Ross, Discrete Mathematical Structures, 5/e, Prentice Hall 2004.
2. E.R. Scheinerman, Mathematics: A Discrete Introduction, Brooks/Cole 2000.
3. R.P. Grimaldi, Discrete and Combinatorial Mathematics, 5/e, Addison Wesley 2004.

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EOE-073:   **OPERATIONS RESEARACH (Open Elective)**   **L   T   P**

                     3   1   0

No. of Lecture Hrs.

UNIT-I   **12**

Linear Programming: Definition and scope of Operations Research, OR models, Two variable Linear Programming models and their Graphical solutions, Simplex method, Dual Simplex method, special cases of Linear Programming, duality, Sensitivity (Post optimal) analysis.

UNIT-II   **8**

Transportation and Assignment Problems: Types of transportation problems, mathematical models, LCEM and Vogel's approximation methods for initial BFS of transportation problems, u-v method for optimal solution of TP, Balanced and unbalanced assignment problems and models, Hungarian method for assignment problems.

UNIT-III   **4**

Sequencing: Solution of Sequencing problem, processing n jobs through 3 machines, processing n jobs through 2 machines.

UNIT-IV   **8**

Network Techniques and Project Management: Shortest path model, minimum spanning Tree Problem, Max-Flow problem and Min-cost problem, Phases of project management, guidelines for network construction, CPM and PERT.

UNIT-V   **10**

Theory of Games and Queuing models: Rectangular games, Minimax (Maximin) criterion and optimal Strategy, graphical solution of rectangular (2 x n or m x 2) games, games with mixed strategies, Dominance principle to reduce the Size of game, reduction to linear programming model, Elements of Queuing model, generalized Poisson queuing model, M|M|1 and M|M|s models.

Suggested Readings:
1. Hamdy H. Taha, Operations Research: An Introduction, Pearson Education 2003.
2. S. D. Sharma, Operations Research, Kedar Nath Ram Nath & Co. Meerut 2008.

Reference Books:

1. Wayne L Winston, Operations Research, Thomson Learning 2003.
2. Kantiswaroop, Gupta P K and Manmohan, Operations Research