Code No.	Subject Name	Credits
	MATHEMATICS DIVISION	
MA201	Engineering Mathematics I	3:1:0
MA202	Engineering Mathematics II	3:1:0
MA203	Mathematics III	3:1:0
MA204	Mathematics IV	3:1:0
MA205	Probability and Random Processes	3:1:0
MA206	Numerical Methods	3:1:0
MA207	Resource Management Techniques	3:1:0
MA208	Discrete Mathematics	3:1:0
MA209	Vector Spaces, Probability Theory and Random Process	3:0:0
MA210	Special Mathematics	3:0:0
MA211	Mathematics III	3:1:0
MA301	Applied Mathematics	3:1:0
MA302	Applied Mathematics	3:1:0

MA 201 ENGINEERING MATHEMATICS I

Credit: 3 : 1 : 0
Marks: 40 + 60

Unit I : Algebra
Binomial, exponential and logarithmic series (without proof of theorems), problems on summation, approximations and coefficients.

Unit II : Trigonometry
Expansions of sin n θ and cos n θ in powers of sin θ and cos θ. Expansions of tan n θ in powers of tan θ – Expansions of sin n θ and cos n θ in powers of θ. Expansions of $\sin^n \theta$ and $\cos^n \theta$ in terms of sines and cosines of multiple of θ. Hyperbolic functions – inverse hyperbolic functions. Separating real and imaginary parts of complex functions.

Unit III : Matrices
Rank of a matrix – linear independence and dependence of vectors – consistency and inconsistency of a system of m linear equations in n unknowns – eigen values and eigen vectors – properties – Cayley Hamilton theorem and problems.

Unit IV : Theory of Equations
Relations between coefficients and roots. Irrational and imaginary roots occur in pairs – symmetric functions of the roots – transformation of equations – Reciprocal equations and formation of equation whose roots are given.

Unit V : Analytical Geometry of Three Dimensions
Direction cosines and ratios – angle between two lines – the equation of plane-equations to a straight line and shortest distance between two skew lines – coplanar lines.

Text Book

1. Kandasamy P., Thilagavathy K. and Gunavathy K., “Engineering Mathematics Vol.I” S. Chand Chand & Co. New Delhi.

Reference Books

1. Grewal, B.S. “Higher Engineering Mathematics” Khanna Publishers, 1997.
2. Venkataraman, M.K. “Engineering Mathematics Vol.I and II” National Publishing Co., Chennai 1993.

MA202 ENGINEERING MATHEMATICS II

Credit: 3 : 1 : 0
Marks: 40 + 60

Unit I : differential Calculus

Curvature in Cartesian coordinates and polar coordinates – circle of curvature – evolutes and envelopes – maxima and minima of functions of two variables (proof of theorems not included)

Unit II : Integral Calculus

Double integrals – change of order of integration – triple integrals (problems involving Jacobians are not included).

Unit III : Vector Calculus

Scalar and Vector functions – differentiation – gradient, divergence and curl – directional derivatives identities (without proof) – Irrotational and solenoidal fields – vector integration line, surface and volume integrals Green’s theorem, Gauss Divergence theorem and Stoke’s theorem (without proof). Simple applications involving rectangles and cuboids.

Unit IV : Differential Equation

First order linear differential equations – second and higher order linear differential equations with constant coefficients with RHS of the form e^{ax}, x^n, sin ax, cos ax,e^{ax}f(x), x f(x)where f(x) is sin ax or cos bx – differential equations with variable coefficients (Euler’s form) – Simultaneous equations – method of variation of parameters.

Unit V : Beta and Gamma Integrals

Beta and Gamma integrals – Relation between them – properties – evaluation of definite integrals in terms of beta and gamma functions simple application.

Text Book

1. Kandasamy P., Thilagavathy K. and Gunavathy K., “Engineering Mathematics Vol.I” S. Chand Chand & Co. New Delhi 1997.

Reference Books

1. Grewal, B.S. “Higher Engineering Mathematics” Khanna Publishers, 1997.

2. Venkataraman, M.K. “Engineering Mathematics Vol.I and II” National Publishing Co., Chennai 1993.

MA 203 –MATHEMATICS III

Credit: 3 : 1 : 0
Marks: 40 + 60

Unit : I

Laplace Transforms Definition – transform of standard functions – properties – transform of derivatives and integrals. Transforms of the type e^{at} f(t), tf(t) and f(t)/t – Inverse Laplace transrform – Convolution theorem. Transform of periodic functions: unit step function and unit impulse function – application to ordinary differential equation with constant coefficients.

Unit : II

Complex variables: Analytic functions – Necessary and sufficient conditions for f(z) to be analytic C-R equation in polar co-ordinates – Harmonic functions – orthogonal system – construction of an analytic functions given real or imaginary parts – Conformal Transformation – Standard transformation like w = z + c, w = e^z ,w = 1/z, w = sin z, w = cos z, w = sin h z, w = cos h z and w = z + 1/ z and Bilinear transformation.

Unit : III

Complex Integration: Cauchy’s integral theorem, Cauchy’s integral formula – Taylor’s and Laurent’s Series (without proof) – Singularities – Residues – Calculus of Residues – Evaluation of definite integrals.

Unit : IV

Statistics: Frequency distribution and measures of central tendency – Measures of dispersion Moments, skewness and Kurtosis – Linear correlation – rank correlation and regression lines – Theoretical Distributions – Binomial – Poisson – Normal.

Unit : V

Tests of Hypothesis: Level of significance – Type I and type II errors – critical value Test statistic – Large sample tests – mean – difference of means proportion, difference of proportion – Small sample tests – t test, F – test and Chi-square test.

Text Book

1. Kandasamy P. “Engineering Mathematics Vol III” By Etal., S. Chand & Co. New Delhi.

Reference Books

1. Venkataraman, M.K. “Engineering Mathematics” National Publishing Co., 1995.
2. Erwin Kereyszic, “Advanced Engineering Mathematics” Willey Eastern., Co, 1988.
3. Grewal, B.S. “Higher Engineering Mathematics” Khanna Publishers, 1988.
4. Irwin Miller and John E. Freund “Probability and Statistics”, PHI, 1977

MA204 MATHEMATICS IV

Credit: 3:1:0
Marks: 40 + 60

Unit I : Fourier Series
Euler's formula – Dirichlet's conditions convergence statement only – change of interval odd and even functions. Half range series – Rms value, Parseval's formula – complex form of Fourier series – harmonic analysis.

Unit II : Partial Differential Equations
Formation of equations by elimination of arbitrary constants and arbitrary functions – solution of equations – general, particular and complete integrals – Lagrange's linear equation – standard type of first order equations – second order and higher order equations with constant coefficients, homogeneous and nonhomogeneous equations.

Unit III : One-Dimensional Wave Equations and Heat Equation
Derivation of one dimensional wave equation – transverse vibration of finite elastic string with fixed ends – boundary and initial value problems – Fourier series solution. Derivation of one dimensional heat equation – steady and unsteady states, boundary and initial value problems – Fourier series solution.

Unit IV : Two Dimentional Heat Equation
Two – dimensional heat equations – steady state heat flow in two dimensions – Laplace Equations in Cartesian and polar (co ordinates) Fourier series solution.

Unit V : Fourier Transforms
The infinite Fourier transform – sine and cosine transforms – properties – inversion theorem – Finite Fourier Transform – sine and cosine transforms – convolution theorem – Parseval's identity – transform of derivatives.

Text Books

1. Kandasamy, P., "Engineering Mathematics", S. Chand & Co., New Delhi, Volume – III, 1996.
2. Venkataraman, M.K., "Higher Engineering Mathematics", National Publishing Co., 1992.

Reference Books

1. Erwin Kreyzic, "Advanced Engineering Mathematics", Wiley & Co, 1994.
2. Speigal, "Advanced Engineering Mathematics", Schaum's Series, 1995.

MA205 PROBABILITY AND RANDOM PROCESS

Credit: 3 :1 :0
Marks: 40 + 60

Unit : I
Axioms of probability – Probability spaces – Joint and conditional probabilities – Independent events.

Unit : II
Densities and distributions – Example, Properties of distribution and density functions – Joint distributions and densities – Conditional probability distribution and density functions – Independent random variables.

Unit : III
Function of random variables and random vectors – Statistical averages – Characteristic functions – Inequalities of Chebyshev and Schwart – Convergence concepts and the central limit theorem (Proof not expected).

Unit : IV
Random Access definitions – Basic concepts and examples – Stationarity and ergodicity – Second order processes – Weekly stationary process – Covariance functions and their properties – Special representation – Wiener Khinchine theorem.

Unit : V
Linear operations – Gaussian process – Poisson process – Low-pass and Band-pass process noise representations.

Text Books

1. Papoulis: " Probability, Random Variables and Stochastic Processes (2/e), Mc Graw Hill, 1991.
2. Veerarajan, "Probability statistics and Random Process" Tata Mc Graw Hill, 2002.

Reference Books

1. Davenport: "Probability and Random process for Scientists and Engineers", Mc Graw Hill.
2. E. Wong, "Introduction to Random Process", Spiringerverlag.
3. H. Stark and J.W. Woods: "Probability, Random process and estimation theory for Engineers", Prentice Hall

MA206 NUMERICAL METHODS

Credit 3: 1: 0
Marks: 40 + 60

Unit : I
Emperical laws and curve fitting – the linear law – Laws reducible to the linear law – Method of group averages – Principle of Least squares – Fitting a straight line – Fitting a parabola –

Fitting an exponential curve – Fitting a curve of the form $y = ax^b$ – Calculation of the sum of the squares of the residuals – Method of moments.

Unit : II
Solution of numerical algebraic and transcendental equations. The Bisection method – Iteration method - Regula Falsi Method – Newton – Raphson method – Gauss elimination method - Method of triangularisation – Crout's method – Gauss-Jacobi method – Gauss-Seidel method.

Unit : III
Finite differences: First and higher order differences – Forward differences and backward differences – Properties of operator – Differences of a polynomial –Factorial polynomials – Operator E – Relation between δ and E and D - Summation of series – Interpolation – Gregory-Newton forward Interpolation formula – Equidistant terms with one or more missing values – Gauss forward interpolation formula – Gauss backward interpolation formula.

Unit : IV
Interpolation with unequal intervals – Divided differences – Newton's divided difference formula – Lagrange's interpolation formula – Numerical differentiation and Integration – Newton's forward and backward differences to compute derivatives – The trapezoidal rule – Simpson's one third rule – Simpson's 3/8 rule – Difference Equations – Linear difference equations - Linear homogeneous difference equations with constant coefficients – Non-homogeneous difference equations with constant coefficients.

Unit : V
Numerical solutions of ordinary differential equations – Power series approximations – Solution by Taylor series – Euler method – Runge – Kutta method (4^{th} Order) – Numerical solutions of partial differential equations – Laplace's equations and its solution by Liebmann's process – Solution of Poisson's equation – Solutions of parabolic and hyperbolic equations.

Text Book
1. P. Kandasamy, " Numerical Methods", S. Chand & Co. New Delhi.

Reference Book
1. Venkataraman " Numerical Methods", National Publishing Company.

MA207 RESOURCE MANAGEMENT TECHNIQUES

Credit: 3 : 1 : 0
Marks: 40 + 60

Unit : I
Linear programming-formation of the problem – graphical method – primal dual problems – dual simplex method – two phase method – assignment models – transportation models – vogels approximation method – MODI method – unbalance in transportation – degeneracy in transportation model.

Unit: II

Resource scheduling – sequencing in jobs through two machines and three machines, Network analysis: PERT and CPM – network diagram – probability of achieving completion date – crash time – cost analysis.

Unit : III

Inventory models – deterministic models – production models – economic ordering quantity – buffers stock – shortage and quantity discount – probabilistic inventory model – EOQ and safety stock calculation.

Unit : IV

Queueing Theory (to be illustrated with engineering applications and no derivation) Poisson arrivals and exponential service time's – characteristics of Queueing models – single channel and multi channel models. Simulation – Monte Carlo technique – random number generation. Testing of random numbers – application in problems of queueing theory and inventory.

Unit : V

Replacement models – replacement of items that deteriorate with time – equipment's that fails completely and their analysis – individual and group replacement policy.

Game Theory: Two person zero sum games: Pure strategies and saddle points – mixed strategies. 2 x M and M x 2 games – method of dominance – numerical and graphical solution – matrix methods.

Text Books

1. Hamdy Taha., : "Operation research" Maxwell Macmillan.
2. Muruce sasient., : "Operations research methods and problems" , Wiley International ed., 1980.

Reference Books

1. Kantiswarup, etal., "Operation research", third Edition, 1980, Chand and Sons.
2. Gupta, and Hira, D.S.,: "Operations Research", 1986, S. Chand and Sons, New Delhi.
3. Dharani Venkatakrishnan., "Operation Research", 1988, Keerthi Publishing House (P) Ltd., Coimabtore.

MA208 DISCRETE MATHEMATICS

Credit: 3:1:0
Marks: 40 + 60

Unit I : Fundamentals

Sets & subsets operations on sets – sequences – Division on in the integers – Matrices & Mathematical Structures – Logic – Propositions & Operations – Conditional statements – Methods of proofs – Mathematical Induction – Revision.

Unit II : Counting
Permutations – Combinations – The pigeonhole principle – Elements of probability – Recurrence Relations – Relations & Digraphs – Product sets & Partitions – Relations & Digraphs – Paths in relations – Properties of relations – Equivalence relations – Computer Representation of relations & digraphs – Manipulation of relations – Transitive closure & Warshalls algorithm.

Unit III : Functions
Functions for computer science – Permutations functions – Growth of functions – Graph Theory – Graphs – Eular Paths & Circuits – Hamiltonian paths & Circuits – Coloring graphs – Revision.

Unit IV : Order Relations Structures
Partially ordered sets – External elements of partially ordered sets – Lattices, finite Boolean Algebra – Function on Boolean Algebra – Boolean functions as Boolean Polynomials. Trees – Labelled Trees – Tree searching – Undirected trees – Minimal Spanning Trees – Revision.

Unit V : Languages & Finite State Machine
Language – Representations of Special Language & Grammars – Finite State Machines – Semi groups – Machines & Languages – Machines & Regular languages – Simplification of machines – Revision.

Text Book
1. Bernard Kolman, Robert C. Busby, Sharon Ross, Discrete Mathematical Structures, Third Edition, Prentice–Hall of India, 1996.

Reference Book
1. Kenneth H. Rosen, Discrete Mathematics & Its Applications, Fourth edition, McGraw Hill, 1999.

MA209 VECTOR SPACES, PROBABILITY THEORY AND RANDOM PROCESS

Credit: 3:0:0
Marks: 40 + 60

Unit I : Vector Space Theory
Axioms of a Vector space – Examples Subspaces and linear space – Concept of linear independence – Basis of a vector space – Dimension of a Vector space and Dimension Theorem.

Unit II : Inner Product
Inner product space – norm – Schwary Inequality – Triangle Inequality - Orthogonal expansion – Parcval's relation – Gram Schmidt procedure – Hilbert space – examples

Unit III : Axioms Of Probability
Probability space – Joint and conditional Probability – Independent events Random variables – Density and distributions – Examples – Joint distribution and densities – Conditional Probability distributions with density – Independent events.

Unit IV : Random Process
Functions of random variables – Statistical averages – Characteristics functions – Random process – definition – Basic concepts – Examples – Stationary & ergodicity – Second order process – Covariance functions – Examples.

Unit V : Gaussian Process And Noise
Transmission of a random process through a linear filter – Power Spectral density – Guassian process – noise – Revision.

Text Books

1. Peebles Payton Z. Jr. "Probability, Random variable and Random Signal Principles" Mc Graw-Hill 1993 (3/e)
2. Papoulis, Anthanasios " Probability, Random Variable and Random and Stochastic Process Mc Graw-Hill, 1994(3/e)
3. Hoffmann Kenneth and Kunze, Ray, "Linear Algebra" 2/e, PHI, 1994

Reference Book

1. Simon Haykins, "Communication System" (3/e) John Willey and sons, 1994.
2. Noble, Ben and Daniel, James W "Applied Linear Algebra" (3/e) PHI 1998.
3. Mortensen, Richard E. "Random Signals and Systems" (3/e) John Willey and Sons, 1987.
4. Gabel Robert A and Robert, Richard A "Signal and Linear Systems", (3/e) John Willey and Sons, 1987

MA210 SPECIAL MATHEMATICS

Credit: 3:0:0
Marks: 40 + 60

Unit I : Trigonometry
Expansions of sin nθ and cos nθ in powers of cos θ and sin θ. Expansions of tan nθ in powers of tan θ. Expansions of $\sin^n \theta$ and $\cos^n \theta$ in terms of sines and cosines of multiple of θ. Expansions of sin θ and cos θ in power of θ. Hyperbolic functions – inverse hyperbolic functions. Separating real and imaginary parts of complex functions.

Unit II : Matrices
Rank of a matrix – linear independence and dependence of vectors – consistency and inconsistency of a system of m linear equations in n unknowns – eigen values and eigen vectors – properties – Cayley Hamilton theorem and problems.

Unit III : Differential Calculus

Carvature in Cartesian coordinates and polar coordinates – circle of curvature – radius of curvature.

Unit IV : Differential Equations

First order linear differential equations – second order linear differential equations with constant coefficients with RHS of the form e^{ax}, x^n, sin ax, cos ax,e^{ax}f(x) where f(x) is sin bx or cos bx

Unit V : Vector Calculus

Scalar and vector functions – differentiation – gradient, divergence and curl – directional derivative – identities (without proof) – irrotational and solenoidal fields.

Text Book

1. Kandasamy P., Thilagavathy K. and Gunavathy K., "Engineering Mathematics Vol.I" S. Chand Chand & Co. New Delhi, 1996.

Reference Books

1. Venkataraman, M.K. "Engineering Mathematics Vol.I and II" National Publishing Co., Chennai 1993.

MA 211 MATHEMATICS - III

Credit: 3: 1: 0
Marks: 40 + 60

UNIT I: *Laplace Transforms*

Definition – transforms of standard functions – properties – transform of derivatives & integrals transforms of the type t[f(t)] & [f(t)]/t- Inverse transform – Convolution theorem – transform of periodic functions – unit step functions unit - impulse function – application to ordinary differential equation with constant coefficients.

UNIT II : *Fourier Series*

Euler's formula - Dirichlet's conditions convergence statement only – change of interval odd and even functions. Half range series – RMS value, Parceval's formula – complex form of Fourier series – harmonic analysis.

UNIT III: *Partial Differential Equation*

Formation of equations by elimination of arbitrary constants and arbitrary functions, solution of equations general, particular and complete integrals, Lagrange's linear equation, standard type of first order equations, second order and higher order equations with constant coefficients, homogeneous and nonhomogeneous equations.

UNIT IV: *One-dimensional Wave Equation and Heat Equation*

Derivation of one-dimensional wave equation, transverse vibration of finite elastic string with fixed ends, boundary and initial value problems, Fourier series solution. Derivation of one dimensional heat equation, steady and unsteady states, boundary and initial value problems, Fourier series solution.

UNIT V: ***Statistics - Test of Hypothesis***

Level of significance. Type I & II errors critical value, test statistic, large sample test – mean, differences of mean, proportion, difference of proportion, standard deviation. Small sample tests based on., t, F, Chisquare distributions.

Text Books:

1. Kandasamy P. 'Engineering Mathematics' Vol: II – S. Chand & Co. New Delhi.
2. Kandasamy P. 'Engineering Mathematics' Vol: III – S. Chand & Co. New Delhi, 1996.
3. Venkataraman M.K. 'Higher Engineering Mathematics' National Publishing Co. 1992.

Reference Books:

1. Erwin Kreyzig, "Advanced Engineering Mathematics" Wiley & Co. 1994.
2. Grewal B.S. "Higher Engineering Mathematics" Khanna Publishers, 1997.
3. Speigal, "Advanced Engineering Mathematics", Schaum's Series, 1995.

MA301 APPLIED MATHEMATICS

Credit: 3:1:0
Marks: 40 + 60

Unit : I

Calculus of Variations: Maximum and Minimum of functions of several independent variables – Lagrangian method of multipliers. Variational problems of fixed boundaries only simplest Variational problems – Euler equation – Branchsto Chrone problem – Variational problems involving several unknown functions – Functionals involving first and second order derivations – Functional involving two or more independent variables – Isoperimetric problems.

Unit : II

Linear integral equations: Different types of integral equations – Fredholm and Volterra integral equations – Relation between differential and integral equations – Green's function – Fredholm equation with separable kernal – Interactive method of solving equation of second kind – Properties of symmetric kernels.

Unit : III

Vector Space: Definition and examples of linear space – Linear dependence and independence – Basis and Dimension – Subspace – Inner Product space – Orthogonalisation process.

Unit : IV

Functions and Relations: Injective and Surjective, bijective functions – Compositions, indentity, inverse functions – properties of relations.

Unit : V

Graph Theory: Introduction – Basic terminology – Representations of graphs – connected Graphs – Matrix representation of graphs (excluding graphs), Applications – Critical path method – Shortest path problems – trees – definition – Binary tree.

Z – Transforms: Definition – Z – Transform of standard functions : Applications to signals and linear time invariant system.

Text Books

1. Venkataraman M.K. "Higher Mathematics for Engg. And Science", National Publishing Company, 1986.
2. Narsingh Dev, "Graph Theory with Applications to Engineering and Computer Science", Prentice Hall of India (P) Ltd.1984.
3. Hoffmann and Kunze, "Linear Algebra" 2/C, PHI 1994

References Books

1. Tremblay, J.P. and Manohar R. "Discrete Mathematical Structures with Applications to Computer Science", McGraw Hill, 1987
2. John G. Proakis, "Digital Signal Processing", Prentice Hall of India (P) Ltd., 1995

MA 302 APPLIED MATHEMATICS

Credit: 3: 1: 0
Marks: 40 + 60

UNIT: I -*Nonlinear ordinary differential equations*
Introduction – Equations with separable variables – Equations reduced to linear form – Bernoulli's equation – Riccati's equation – Special forms of Riccati's equation – Nonlinear pendulum – Duffing's equation.

UNIT: II – *Matrix Theory*
Special vectors and matrices – Matrix inversion lemma – Least square normal equations – The Cholesky decomposition – Toeplitz matrices and their solutions – Levinson Durbin algorithm – Singular value decomposition.

UNIT: III – *Random processes*
Some important distributions, Functions of random variable, Moment generating function – statistics of random process – Power spectrum – Input-output relations for random processes in linear systems. The Gaussian random process.

UNIT: IV – *Numerical Techniques*
Single step methods – multistep methods – Stability analysis Boundary value problems – Difference methods – Convergence of difference schemes – Shooting methods.

UNIT: V – *Graph Theory*
Rudiments of graph theory – Trees – minimum weight spanning tree – Kruskal's algorithm Djikstra's shortest path algorithm.

<u>Text Books</u>

1. Froberg. C.E, 'Numerical Mathematics', Benjamin/Cummings publishing Co. Inc, 1985.
2. Stephenson, G, Radmore, P.M. Advanced Mathematical Methods for Engineering and Science Students, Cambridge University Press 1999.
3. M.K. Jain, S.R.K. Iyengar, R.K.Jain Numerical Methods for Scientific and Engineering Computation, Wiley Eastern Ltd. 1987.
4. Bondy J.A. and Murthy, U.S.R. Graph Theory with Applications, McMillan, 1977.
5. Medhi J. Stochastic Processes, Wiley Eastern Ltd. 1994.

<u>Reference Books</u>

1. Marple, S.L. Digital Spectral Analysis, Prentice Hall (N.J) 1987.
2. Stark, H, Tuteur, F.B., Anderson J.B., Modern Electrical Communications, Prentice Hall, 1988.
3. Bhat. U.N. Elements of Applied Stochastic Processes, John Wiley & Sons, II Edition, New York, 1984.

ADDITIONAL SUBJECTS

Code	Subject	Credits
MA212	Discrete Mathematics	4:0:0
MA303	Applied Mathematics	3:1:0
MA304	Applied Mathematics	3:1:0
MA305	Applied Mathematics	4:0:0

MA212 DISCRETE MATHEMATICS

Credits: 4:0:0 **Marks(40+60)**

UNIT I

Fundamentals: set and subsets – operation on sets – sequences – division in the integers – matrices – mathematical structures.

Logic: propositions and logical operation – conditional statements – methods of proof – mathematical induction.

Counting: permutation – combinations – Pigeonhole principle – elements of probability – recurrence relations.

UNIT II

Relations and digraph: products sets and partitions – relations and digraphs – paths in relations and digraphs – properties of relations – equivalence of relations – computer representation of relations and digraphs – operations on relations – transitive closure and Wars hall's algorithm.

Functions: functions – functions for computer science – growth of functions – permutation functions.

UNIT III

Order relations and structures: partially ordered sets – external elements of partially ordered sets – lattices – finite Boolean algebras – functions on Boolean algebra – circuit design.

Trees: trees – labeled trees – tree searching – undirected trees – minimal spanning trees.

UNIT IV

Topics in graphs theory: graphs –euler paths and circuits –Hamiltonian Paths and circuits – transport networks – matching problems – coloring graphs.

Semi-groups and groups: binary operations revisited – semi-groups – products and quotients of groups – other mathematical structures.

UNIT V

Languages and finite state machines : languages – representations of special grammars and languages – finite state machines – monoids ,machines and languages – machines and regular languages – simplification of machines.

Groups and coding: coding of binary information and error detection – decoding and error correction.

Text Book:

1. Bernard Kolman, Robert C. Busby ,Sharon Cutler Ross, "Discrete Mathematical Structures", 5th Edition, Pearson Education, 2004

MA303 APPLIED MATHEMATICS

Credit: 3:1:0 **Marks: 40 + 60**

UNIT: I – Vector Spaces
Definition and examples of linear space – Linear dependence and independence – Basis and Dimension – Subspace – Inner product space – Orthogonalization process.

UNIT: II – Matrix Theory
Special vectors and matrices – Matrix inversion lemma – Least square normal equations – The Cholesky decomposition – Toeplitz matrices and their solutions – Levinson Durbin algorithm – Singular value decomposition.

UNIT: III – Calculus of Variations
Maximum and minimum of functions of several independent variables – Variational problems of fixed boundaries (only simplest variational problems) – Euler equation – Brachistochrone problem – Variational problems involving several unknown functions Functionals involving two or more independent variables – Isoperimetric problems – Variational problems with moving boundaries.

UNIT: IV – Nonlinear Ordinary Differential Equations
Non linear ordinary differential equations – Introduction – Equations with separable variables – Equations reduced to linear form – Bernonli's equation – Riccati's equation – Special forms of Riccati's equation – Nonlinear pendulum.

UNIT: V – Graph Theory
Rudiments Graph Theory – Trees – Minimum weight spanning tree – Kruskal's algorithm – Digikstra's shortest path algorithm.

Test Books

1. Hoffmann and Kunze, "Linear Algebra" PHI, New Delhi, 2002
2. Venkataraman M.K, "Higher Mathematics for Engineering and Science", National Publishing Company, Chennai, 1999

Reference Books

1. Raisinghania, "Advanced Differential Equations", S. Chand & Company Ltd, New Delhi, 2003.
2. Bondy J.A. and Murthy V.S.R., "Graph Theory with Applications", McMillan, New Delhi, 1997.

3. Karunya Lecture Notes, “Matrix Theory”, 2004

MA 304 APPLIED MATHEMATICS

Credit: 3:1:0 **Marks: 40 + 60**

UNIT I : Probability

Conditional Probability – Baye’s Theorem – Probability Distributions – Mathematical Expectations – Discrete Uniform Distribution – Binomial Distribution – Poisson Distribution – Normal Distribution – Gamma Distribution – Exponential distribution – Moments and Moment generating functions of the above distributions.

UNIT II : Statistics

Tchebyshev’s inequality – Estimation – Maximum likelihood estimation – Correlation – Partial correlation – Multiple correlation – Regression – Multiple regression.

UNIT III : Vector Space

Definition and examples of linear space – Linear dependence and independence – Basis and Dimension – Subspace – Inner product space – Orthogonalisation process.

UNIT IV : Graph Theory

Introduction – Basic terminology – Representation of graphs – Connected graphs – Matrix representation of graphs (excluding directed graphs), Applications – Critical path method – Shortest path problems – Trees – definition – Binary tree.

UNIT V : Optimization Techniques

Linear Programming – Graphical methods – Simplex method – Two phase simplex method – Principle of optimality.

Text Books:

1. S.C. Gupta, V.K. Kapoor, “*Fundamentals of Mathematical Statistics*”, Sultan Chand & Sons, 2002.
2. Narsngh Dev, “*Graph Theory with Applications to Engineering and Computer Science*”, Prentice Hall of India (p) Ltd. 1988.
3. Haffmann and Kunze “*Linear Algebra*”, PHI, 1994.

Reference Book:

1. Hamdy A. Taha, “*Operation Research*”, Maxwell Macmillan.
2. Walpole Myers, Myers, Ye, “*Probability & Statistics for Engineers and Scientists*” Pearson Edication, first Indian reprint, 2002.
3. S.C. Gupta V.K. Kapoor, “*Fundamentals of Applied Statistics*”, Sultan Chand & Sons, 2002.

MA305 APPLIED MATHEMATICS

Credits: 4:0:0 **Marks: (40 + 60)**

Unit I: Basic Concepts in Algebra

Number Theory: Prime numbers, Extended Euclidean Algorithm, Modular Arithmetic, Modular Inverses, Chinese Remainder Theorem.

Groups, Rings, Fields; Finite Fields; Galois Fields; Modular Polynomial Arithmetic in GF(P) GF(2^n)

Relations, Functions.

Basic Complexity Theory, NP-Completeness.

Unit II: Graph Theory

Terminology – Representations of graphs – connected graphs – Matrix representation of graphs.

Applications – Critical path Method – Trees – Binary trees.

Unit III: Automata Theory

Language – Representations of Special languages and Grammars – Finite State Machines – Machines & Languages - Machines & Regular languages – Simplification of machines

Unit IV: Random Processes

Basic Concepts and Examples - Continuity Concepts. Classes of Stochastic Process – Gaussian Process - Stationarity and Ergodicity - Correlation - Covariance and their properties - Linear operations

Unit V: Queuing theory

Introduction to Queuing theory - First in First out - Queue discipline with capacity problems based on M/M/1: $\propto$/FIFO and M/M/ C: $\propto$/FIFO – Multiple Queues.

Reference Books:

1. Bernard Kolman, Robert C. Busby, Sharon Cutler Ross, *Discrete Mathematical Structures*, Fifth Edition, Pearson Education, 2004.
2. T. Veerarajan, *Theory of Probability and Random Processes*, Tata McGraw Hill Publishing Company.
3. Narsingh Deo, *Graph Theory with Application to Engineering and Computer Science*, Prentice-Hall of India Private Ltd.
4. I.N. Herstain, *Topics in Algebra*, John Wiley & Sons, New York, 1975.
5. Dharani Venkatakrishnan, *Operations Research*, Keerthi Publishing House (P) Ltd., 1988.

MA213 MATHEMATICS - I

Credit : 3:1:0 **Marks: 40 + 60**

Unit I : Theory of Equations

Relations between coefficients and roots. Irrational and imaginary roots occur in pairs – symmetric functions of the roots – transformation of equations – Reciprocal equations and formation of equation whose roots are given.

Unit II : Matrices

Characteristic equation – Eigen values and eigenvectors of a real matrix – Properties of eigen values – Cayley Hamilton theorem – Orthogonal reduction of a symmetric matrix to diagonal form – Orthogonal matrices – Reduction of quadratic form to canonical form by orthogonal transformation.

Unit III : Three Dimensional Analytical Geometry

Direction cosines and ratios – Angle between two lines – Equation of a plane – Equation of a straight line – Co-planer lines – Shortest distance between skew lines – Sphere – Tangent plane – Plane section of a sphere – orthogonal spheres.

Unit IV : Geometrical Applications of Differential Calculus

Curvature – Cartesian and polar co-ordinates – Circle of curvature – involutes and Evolutes – Properties of envelopes – Evolutes as envelope of normals.

Unit V : Functions of Several Variables

Functions of two variables – Partial derivatives – Total differential – Differentiation of implicit functions – Taylor's expansion – Maxima and Minima – Constrained Maxima and Minima by Lagrange's – Multiplier method – Jacobians

Text Book:

1. Kandasamy, Thilagavathi .K and Gunavathi K., Engineering Mathematics volume I (6th revised Edition), S.Santhan & Co., New Delhi, 2003

Reference Books:

1. Kreyszig, E., "Advanced Engineering Mathematics" (8th Edition), John Wiley and Sons (Asia) Pte Ltd., Singapore, 2000
2. Grewal, B.S., "Higher Engineering Mathematics" (6th Edition) Khanna Publisher, New Delhi, 2001

MA214 MATHEMATICS - II

Credit : 3:1:0 **Marks: 40 + 60**

Unit I : Multiple Integrals

Evaluation of Multiple Integrals , Change of order of Integration, Application of Multiple Integrals to find area enclosed by plane curves and volume of solids.

Unit II : Beta and Gamma Integrals

Definition, relation connecting Beta and Gamma integrals, properties, evaluation of definite integrals in terms of Beta and Gamma functions.

Unit III : Ordinary differential Equation

Simultaneous first order linear equations with constant coefficients – Linear equations of second order with constant and variable coefficients – Homogeneous equation of Euler type – Equations reducible to homogeneous form – Method of reduction of order – Method of variation of parameters.

Unit IV : Vector Calculus

Curvilinear coordinates – Gradient, Divergence, Curl – Line, surface & volume integrals – Statements of Green's, Gauss divergence and stokes' theorems (without proof) – verification and applications.

Unit V : Laplace Transforms

Transforms of simple functions – Basic operational properties – Transforms of derivatives and integrals – Initial and final value theorems – Inverse transforms – Convolution theorem – Periodic function – Applications of Laplace transforms of solving linear ordinary differential equations upto second order with constant coefficients and simultaneous equations of first order with constant coefficients.

Text Book

1. Kandasamy, Thilagavathi .K and Gunavathi K., Engineering Mathematics volume II (6^{th} revised Edition), S.Santhan & Co., New Delhi, 2003

Books for Reference

1. Kreyszig, E., "Advanced Engineering Mathematics" (8^{th} Edition), John Wiley and Sons (Asia) Pte Ltd., Singapore, 2000
2. Grewal, B.S., "Higher Engineering Mathematics" (6^{th} Edition) Khanna Publisher, New Delhi, 2001

MA215 MATHEMATICS - III

Credit : 3:1:0 **Marks: 40 + 60**

Unit I : Analytic Functions

Cauchy Riemann equations – Properties of analytic functions – Determination of harmonic conjugate – Milne – Thomson's method – Conformal mappings w = z + a, az, 1/z, z^2 and bilinear transformation.

Unit II : Complex Integration

Cauchy's theorem – Statement and application of Cauchy's integral formulae – Taylor's and Laurent's expansions – Singularities – Classification – Residues – Cauchy's residue theorem – Contour integration – Circular and semi Circular contours (excluding poles on real axis)

Unit III : Statistics

Frequency distribution and measures of central tendency – Measures of dispersion Moments, skewness and Kurtosis – Linear correlation – rank correlation and regression lines – Theoretical Distributions – Binomial – Poisson – Normal.

Unit IV : Testing of hypothesis
Moments – Coefficient of correlation – Lines of regression – Tests based on Normal and t distributions, for means and difference of means – χ^2 test for goodness of fit.

Unit V : Z - Transforms
Z-transforms of standard functions, inverse Z-transform (Partial fraction expansions), properties of Z-transform, Solution of difference equations.

Text Book

1. Kandasamy, Thilagavathi .K and Gunavathi K., Engineering Mathematics volume II and III (6th revised Edition), S.Santhan & Co., New Delhi, 2003

Books for Reference

1. Kreyszig, E., "Advanced Engineering Mathematics" (8th Edition), John Wiley and Sons (Asia) Pte Ltd., Singapore, 2000
2. Grewal, B.S., "Higher Engineering Mathematics" (6th Edition) Khanna Publisher, New Delhi, 2001

MA216 MATHEMATICS
(For students who did not study Mathematics in Higher Secondary course)

Credit : 3:1:0 **Marks: 40 + 60**

Unit I : Trigonometry
Trigonometrical ratios and identities – Compound angles – Inverse trigonometrical functions – De Moivre's theorem.

Unit II : Differentiation Techniques
Derivatives of elementary function from first principle – Derivatives of inverse functions – Logarithmic differentiation – Differentiation of parametric functions – Second order derivatives.

Unit III : Integration Techniques
Integrals of functions – Methods of integration – Decomposition method – Method of substitution – Integration by parts.

Unit IV : Analytical Geometry
Locus – Straight lines – Family of straight lines – Circle – Definition of a conic – Parabola, Ellipse, Hyperbola – Standard form.

Unit V : Application of Differentiation
Rate of change – Tangent and normal – Angle between two curves – Partial derivatives.

Text Books:

1. Mathematics, Higher Secondary first year, Volume I & II.
2. Mathematics, Higher Secondary second year, Volume I & II

MA306 APPLIED MATHEMATICS

Credit : 4:0:0 **Marks: 40 + 60**

Unit – I : Basic Concepts in Algebra

Number theory: Prime numbers, Extended Euclidean Algorithm, modular Arithmetic, modular inverses, Chinese Remainder Theorem.
Groups, Rings, Fields; Finite fields; Galois Fields; Modular polynomial arithmetic in GF (p) GF (2^n) [Simple problems]

Unit – II : Graph Theory

Terminology – Representations of graphs – Connected graphs – Matrix representation of Graphs. Applications – Critical Path Method – Trees – Binary Trees.

Unit – III : Automata Theory

Language - Representation of Special languages and Grammars – Finite State Machines - machines & Regular languages – Simplification of machines.

Unit – IV : Random Processes

Basic concepts and Examples – Continuity Concepts. Classes of Stochastic – Gaussian Process – Stationary and Ergodicity – Correlation – Covariance and their properties – Linear operations.

Unit – V : Queuing Theory

Introduction to Queuing theory – First in First out – Queue discipline with infinite capacity problems based on M/M/1: μ/FIFO and M/M/1: μ/FIFO - Multiple Queues.

Books for Reference

1. Bernard Kolman, Robert C. Busby, Sharon Cutler Ross, Discrete Mathematical Structures, 5th Edition, Pearson Education, 2004.
2. T. Veerarajan, Theory of Probability and Random processes, Tata McGraw Hill Publishing Company.
3. Narsingh Deo, Graph Theory with Application to Engineering and Computer Sciences, Prentice-Hall of India Private Ltd., 2000.
4. Garmett Birkhoff & Thomas C. Bartee "Modern Applie Algebra", McGraw-Hill inc.,
5. Dharani Venkatakrishnan, Operations Research, Keerthi Publishing House (p) Ltd.

MA307 APPLIED MATHEMATICS

Credit 3:1:0 **Marks 40+60**

Unit – I : Calculus of Variations

Variation and its properties- Eluer's equation-functionals dependent on first and higher order derivatives- Functionals dependent on functions of several independent variables – some applications-direct methods- Ritz and Kantorovich methods.

Unit – II : Elliptic Equations

Laplace equation-properties of harmonic functions- Fourier transform methods for Laplace equation. Solution for Poisson equation by Fourier method.

Unit – III : Numerical Solutions or Partial Differential Equations

Solution of Laplaces and Poisson equation on a rectangular region by Liebmann's method- Diffusion equation by the explicit and Crank Nicholson - Implicit methods- Stability and Convergence criterion- solution of wave equation by explicit scheme.

Boundary Value Problems, Characteristic value problems & Initial value Problems.

Unit IV : Introduction to Numerical Methods Applied to Engineering Problems

Example, solving sets of equations, matrix notation - Determinants and inversion- Iterative methods- Relaxation methods- systems of non-linear equations.

Unit V : Numerical Integration

Newton-Cote's integration formulas- Simpson's rules. Gaussian quadrature, Adaptive integration- cubic spline functions- Beizer curves and B splines.

Text Book

1. Curtis . F. Gerald Patrick. O. Wheatley " Applied Numerical Analysis", Addison weiley1989.

Reference

1. Douglas J. Faries, Riched Burden, " Numerical Methods", Brooks / Cole Publishing company, 1988, 2nd Edition
2. Ward Cheney & david Kincaid" Numerical Mathematics and Computing", Brooks/Cole Publishing Company, 1999, 4th Edition
3. Riley K.F. M.P. Hosbon & Bence S.J. "Mathematical Methods for Physics and Engineering", Cambridge University Press, 1999.
4. Snedon. I.N. "Elements of Partial Differential Equations", McGraw Hill, 1986.
5. Piskunov N., "Differential and Integral Calculus", Vol. I & II, Mir Publication
6. Sankara Rao, K., "Introduction to Partial Differential Equations", Prentice hall of India, New Delhi, 1995.
7. Elsgolts. L., "Differential Equation and Calculus of Variations", Mir publishers, Moscow, 1966.

DEPARTMENT

OF

MATHEMATICS

ADDITIONAL SUBJECTS

Code	Subject	Credits
MA217	Probability and Bio-statistics	4:0:0
MA218	Mathematics For Food Engineers	4:0:0
MA219	Mathematics I	4:0:0
MA220	Mathematics II	4:0:0
MA221	Mathematics III	4:0:0
MA222	Mathematics IV	4:0:0
MA223	Numerical Methods	4:0:0
MA224	Resource Management Techniques	4:0:0
MA225	Mathematics	4:0:0
MA226	Probability And Random Process	4:0:0
MA227	Discrete Mathematics	4:0:0
MA308	Discrete Mathematics (MA212)*	4:0:0
MA309	Applied Mathematics	4:0:0
MA310	Applied Mathematics	4:0:0
MA311	Applied Mathematics	4:0:0
MA312	Applied Mathematics for Chemists	4:0:0

* new code only

MA217 PROBABILITY AND BIOSTATISTICS

CREDITS 4:0:0 **MARKS 40 + 60**

UNIT I Probability and random variables
Probability concepts, random variables, moment, moment generating function, binomial, Poisson, functions of random variable, chebychev is inequality.

UNIT II Two-dimensional random variables
Marginal and conditional distributions, covariance, correlation and regression, transformation of random variables, central limit theorem.

UNIT III Random process
Classification, stationary and markov processes, poisson process, pure birth process, birth and death process, markov chains, markovian queueing models.

UNIT IV Reliability engineering
Concepts of reliability, hazard function, series and parallel systems, reliability and availability of markovian systems, maintainability, preventive maintenance.

UNIT V Design of experiments and quality control
Aim of the design of experiments – completely randomized design- analysis of variance for one factor of classification – randomized block design- analysis of variance for two factors of

classification- Latin square design – analysis of design for three factors of classification-comparison of RBD and LSD.

References:

1. Mille I.R. And Freund J.E., "Probability And Statistics For Engineers", Prentice-Hall, 1995.
2. Kapur J.N. And Saxena H.C., "Mathematical Statistics", S Chand And Company Ltd., New Delhi, 1997.
3. Balagurusamy E., "Reliability Engineering", Tata McGraw Hill Publishers, New Delhi, 1984.
4. Bhat U.N., " Elements Of Applied Stochastic Processes ", Wiley Series In Probability And Mathematical Statistics, New York, 1983.

MA218 MATHEMATICS FOR FOOD ENGINEERS

CREDITS 4:0:0 **MARKS 40+60**

Unit I Statistics

Mean- Median- Mode—Range-Quartile Deviation- Moments- Correlation, Regression – Definition and problems.- Binomial –Poisson -Normal distributions.

Unit II Curve fitting and correlation

Method of least square - least square estimation
Determining the least square estimators
Correlations coefficients – correlations coefficients in terms of regression c oefficients

UNIT III Regression

Statistical model for Straight-line regression – confidence limits for regression coefficients – multiple regression – Normal equation for multiple regression.

Unit IV Testing of Hypothesis

Population- sample- one tail and two tailed tests- Large samples-proportion and mean – Small Samples – t, F, χ^2 Distributions.

UNIT V Design of experiments and quality control

Aim of the design of experiments – completely randomized design- analysis of variance for one factor of classification – randomized block design- analysis of variance for two factors of classification- Latin square design – analysis of design for three factors of classification-comparison of RBD and LSD.

Text Book:

1. Kandasamy, Thilagavathi .K and Gunavathi K.,Engineering Mathematics vol III(6^{th} revised Edition), S.Santhan & Co., New Delhi, 2003
2. T.Veerarjan, Theory of Probability and Random Process, Tata McGraw Hill Publishing Company

MA219 MATHEMATICS - I

Credit : 4:0:0 **Marks: 40 + 60**

Unit I : Theory of Equations

Relations between coefficients and roots. Irrational and imaginary roots occur in pairs – symmetric functions of the roots – transformation of equations – Reciprocal equations and formation of equation whose roots are given.

Unit II : Matrices

Characteristic equation – Eigen values and eigenvectors of a real matrix – Properties of eigen values – Cayley Hamilton theorem – Orthogonal reduction of a symmetric matrix to diagonal form – Orthogonal matrices – Reduction of quadratic form to canonical form by orthogonal transformation.

Unit III : Three Dimensional Analytical Geometry

Direction cosines and ratios – Angle between two lines – Equation of a plane – Equation of a straight line – Co-planer lines – Shortest distance between skew lines – Sphere – Tangent plane – Plane section of a sphere – orthogonal spheres.

Unit IV : Geometrical Applications of Differential Calculus

Curvature – Cartesian and polar co-ordinates – Circle of curvature – involutes and Evolutes – Properties of envelopes – Evolutes as envelope of normals.

Unit V : Functions of Several Variables

Functions of two variables – Partial derivatives – Total differential – Differentiation of implicit functions – Taylor's expansion – Maxima and Minima – Constrained Maxima and Minima by Lagrange's – Multiplier method – Jacobians

Text Book:

1. Kandasamy, Thilagavathi .K and Gunavathi K., Engineering Mathematics volume I (6^{th} revised Edition), S.Santhan & Co., New Delhi, 2003

Reference Books:

1. Kreyszig, E., "Advanced Engineering Mathematics" (8^{th} Edition), John Wiley and Sons (Asia) Pte Ltd., Singapore, 2000
2. Grewal, B.S., "Higher Engineering Mathematics" (6^{th} Edition) Khanna Publisher, New Delhi, 2001

MA220 MATHEMATICS - II

Credit : 4:0:0 **Marks: 40 + 60**

Unit I : Multiple Integrals

Evaluation of Multiple Integrals , Change of order of Integration, Application of Multiple Integrals to find area enclosed by plane curves and volume of solids.

Unit II : Beta and Gamma Integrals
Definition, relation connecting Beta and Gamma integrals, properties, evaluation of definite integrals in terms of Beta and Gamma functions.

Unit III : Ordinary differential Equation
Simultaneous first order linear equations with constant coefficients – Linear equations of second order with constant and variable coefficients – Homogeneous equation of Euler type – Equations reducible to homogeneous form – Method of reduction of order – Method of variation of parameters.

Unit IV : Vector Calculus
Curvilinear coordinates – Gradient, Divergence, Curl – Line, surface & volume integrals – Statements of Green's, Gauss divergence and stokes' theorems (without proof) – verification and applications.

Unit V : Laplace Transforms
Transforms of simple functions – Basic operational properties – Transforms of derivatives and integrals – Initial and final value theorems – Inverse transforms – Convolution theorem – Periodic function – Applications of Laplace transforms of solving linear ordinary differential equations upto second order with constant coefficients and simultaneous equations of first order with constant coefficients.

Text Book

1. Kandasamy, Thilagavathi .K and Gunavathi K., Engineering Mathematics volume II (6^{th} revised Edition), S.Santhan & Co., New Delhi, 2003

Books for Reference

1. Kreyszig, E., "Advanced Engineering Mathematics" (8^{th} Edition), John Wiley and Sons (Asia) Pte Ltd., Singapore, 2000
2. Grewal, B.S., "Higher Engineering Mathematics" (6^{th} Edition) Khanna Publisher, New Delhi, 2001

MA221 MATHEMATICS - III

Credit : 4:0:0 **Marks: 40 + 60**

Unit I : Analytic Functions
Cauchy Riemann equations – Properties of analytic functions – Determination of harmonic conjugate – Milne – Thomson's method – Conformal mappings $w = z + a, az, 1/z, z^2$ and bilinear transformation.

Unit II : Complex Integration
Cauchy's theorem – Statement and application of Cauchy's integral formulae – Taylor's and Laurent's expansions – Singularities – Classification – Residues – Cauchy's residue theorem – Contour integration – Circular and semi Circular contours (excluding poles on real axis)

Unit III : Statistics
Frequency distribution and measures of central tendency – Measures of dispersion Moments, skewness and Kurtosis – Linear correlation – rank correlation and regression lines – Theoretical Distributions – Binomial – Poisson – Normal.

Unit IV : Testing of hypothesis
Moments – Coefficient of correlation – Lines of regression – Tests based on Normal and t distributions, for means and difference of means – χ^2 test for goodness of fit and F - distribution.

Unit V : Z - Transforms
Z-transforms of standard functions, inverse Z-transform (Partial fraction expansions), properties of Z-transform, Solution of difference equations.

Text Book

1. Kandasamy, Thilagavathi .K and Gunavathi K., Engineering Mathematics volume II and III (6th revised Edition), S.Santhan & Co., New Delhi, 2003

Books for Reference

1. Kreyszig, E., "Advanced Engineering Mathematics" (8th Edition), John Wiley and Sons (Asia) Pte Ltd., Singapore, 2000
2. Grewal, B.S., "Higher Engineering Mathematics" (6th Edition) Khanna Publisher, New Delhi, 2001

MA222 MATHEMATICS IV

Credit: 4:0:0 **Marks: 40 + 60**

Unit I : Fourier Series
Euler's formula – Dirichlet's conditions convergence statement only – change of interval odd and even functions. Half range series – Rms value, Parseval's identity – complex form of Fourier series – harmonic analysis.

Unit II : Partial Differential Equations
Formation of equations by elimination of arbitrary constants and arbitrary functions – solution of equations – general, particular and complete integrals – Lagrange's linear equation – standard type of first order equations – second order and higher order equations with constant coefficients, homogeneous and nonhomogeneous equations.

Unit III : One-Dimensional Wave Equations and Heat Equation
Derivation of one dimensional wave equation – transverse vibration of finite elastic string with fixed ends – boundary and initial value problems – Fourier series solution. Derivation of one dimensional heat equation – steady and unsteady states, boundary and initial value problems – Fourier series solution.

Unit IV : Two Dimentional Heat Equation

Two – dimensional heat equations – steady state heat flow in two dimensions – Laplace Equations in Cartesian and polar (co ordinates) Fourier series solution.

Unit V : Fourier Transforms

The infinite Fourier transform – sine and cosine transforms – properties – inversion theorem – Finite Fourier Transform – sine and cosine transforms – convolution theorem – Parseval's identity – transform of derivatives.

Text Books

1. Kandasamy, P., "Engineering Mathematics", S. Chand & Co., New Delhi, Volume – III, 1996.
2. Venkataraman, M.K., "Higher Engineering Mathematics", National Publishing Co., 1992.

Reference Books

1. Erwin Kreyzic, "Advanced Engineering Mathematics", Wiley & Co, 1994.
2. Speigal, "Advanced Engineering Mathematics", Schaum's Series, 1995.

MA223 NUMERICAL METHODS

Credit 4:0:0 **Marks: 40 + 60**

Unit : I

Emperical laws and curve fitting – the linear law – Laws reducible to the linear law – Method of group averages – Principle of Least squares – Fitting a straight line – Fitting a parabola – Fitting an exponential curve – Fitting a curve of the form $y = ax^b$ – Calculation of the sum of the squares of the residuals – Method of moments.

Unit : II

Solution of numerical algebraic and transcendental equations. The Bisection method – Iteration method - Regula Falsi Method – Newton – Raphson method – Gauss elimination method - Method of triangularisation – Crout's method – Gauss-Jacobi method – Gauss-Seidel method.

Unit : III

Finite differences: First and higher order differences – Forward differences and backward differences – Properties of operator – Differences of a polynomial –Factorial polynomials – Operator E – Relation between δ and E and D - Summation of series – Interpolation – Gregory-Newton forward Interpolation formula – Equidistant terms with one or more missing values – Gauss forward interpolation formula – Gauss backward interpolation formula.

Unit : IV

Interpolation with unequal intervals – Divided differences – Newton's divided difference formula – Lagrange's interpolation formula – Numerical differentiation and Integration – Newton's forward and backward differences to compute derivatives – The trapezoidal rule – Simpson's one third rule – Simpson's 3/8 rule – Difference Equations – Linear difference equations - Linear homogeneous difference equations with constant coefficients – Non-homogeneous difference equations with constant coefficients.

Unit : V

Numerical solutions of ordinary differential equations – Power series approximations – Solution by Taylor series – Euler method – Runge – Kutta method (4^{th} Order) – Numerical solutions of partial differential equations – Laplace's equations and its solution by Liebmann's process – Solution of Poisson's equation – Solutions of parabolic and hyperbolic equations.

Text Book

1. P. Kandasamy, " Numerical Methods", S. Chand & Co. New Delhi.

Reference Book

1. Venkataraman " Numerical Methods", National Publishing Company.

MA224 RESOURCE MANAGEMENT TECHNIQUES

Credit: 4:0:0 **Marks: 40 + 60**

Unit : I

Linear programming-formation of the problem – graphical method – primal dual problems – dual simplex method – two phase method – assignment models – transportation models – vogels approximation method – MODI method – unbalance in transportation – degeneracy in transportation model.

Unit: II

Resource scheduling – sequencing in jobs through two machines and three machines, Network analysis: PERT and CPM – network diagram – probability of achieving completion date – crash time – cost analysis.

Unit : III

Inventory models – deterministic models – production models – economic ordering quantity – buffers stock – shortage and quantity discount – probabilistic inventory model – EOQ and safety stock calculation.

Unit : IV

Queueing Theory (to be illustrated with engineering applications and no derivation) Poisson arrivals and exponential service time's – characteristics of Queueing models – single channel and multi channel models. Simulation – Monte Carlo technique – random number generation. Testing of random numbers – application in problems of queueing theory and inventory.

Unit : V

Replacement models – replacement of items that deteriorate with time – equipment's that fails completely and their analysis – individual and group replacement policy.

Game Theory: Two person zero sum games: Pure strategies and saddle points – mixed strategies. 2 x M and M x 2 games – method of dominance – numerical and graphical solution – matrix methods.

Text Books

1. Hamdy Taha., : "Operation research" Maxwell Macmillan.
2. Muruce sasient., : "Operations research methods and problems" , Wiley International ed., 1980.

Reference Books

1. Kantiswarup, etal., "Operation research", third Edition, 1980, Chand and Sons.
2. Gupta, and Hira, D.S.,: "Operations Research", 1986, S. Chand and Sons, New Delhi.
3. Dharani Venkatakrishnan., "Operation Research", 1988, Keerthi Publishing House (P) Ltd., Coimabtore.

MA225 MATHEMATICS

(For students who did not study Mathematics in Higher Secondary course)

Credit : 4:0:0 **Marks: 40 + 60**

Unit I : Trigonometry

Trigonometrical ratios and identities – Compound angles – Inverse trigonometrical functions – De Moivre's theorem.

Unit II : Differentiation Techniques

Derivatives of elementary function from first principle – Derivatives of inverse functions – Logarithmic differentiation – Differentiation of parametric functions – Second order derivatives.

Unit III : Integration Techniques

Integrals of functions – Methods of integration – Decomposition method – Method of substitution – Integration by parts.

Unit IV : Analytical Geometry

Locus – Straight lines – Family of straight lines – Circle – Definition of a conic – Parabola, Ellipse, Hyperbola – Standard form.

Unit V : Application of Differentiation

Rate of change – Tangent and normal – Angle between two curves – Partial derivatives.

Text Books:

1. Mathematics, Higher Secondary first year, Volume I & II.
2. Mathematics, Higher Secondary second year, Volume I & II

MA226 PROBABILITY AND RANDOM PROCESS

Credit: 4:0:0 **Marks: 40 + 60**

Unit : I
Axioms of probability – Probability spaces – Joint and conditional probabilities – Independent events.

Unit : II
Densities and distributions – Example, Properties of distribution and density functions – Joint distributions and densities – Conditional probability distribution and density functions – Independent random variables.

Unit : III
Function of random variables and random vectors – Statistical averages – Characteristic functions – Inequalities of Chebyshev and Schwart – Convergence concepts and the central limit theorem (Proof not expected).

Unit : IV
Random Access definitions – Basic concepts and examples – Stationarity and ergodicity – Second order processes – Weekly stationary process – Covariance functions and their properties – Special representation – Wiener Khinchine theorem.

Unit : V
Linear operations – Gaussian process – Poisson process – Low-pass and Band-pass process noise representations.

Text Books

1. Papoulis: " Probability, Random Variables and Stochastic Processes (2/e), Mc Graw Hill, 1991.
2. Veerarajan, "Probability statistics and Random Process" Tata Mc Graw Hill, 2002.

Reference Books

1. Davenport: "Probability and Random process for Scientists and Engineers", Mc Graw Hill.
2. E. Wong, "Introduction to Random Process", Spiringerverlag.
3. H. Stark and J.W. Woods: "Probability, Random process and estimation theory for Engineers", Prentice Hall

MA227 DISCRETE MATHEMATICS

Credits: 4:0:0 **Marks(40+60)**

UNIT I
Fundamentals: set and subsets – operation on sets – sequences – division in the integers – matrices – mathematical structures.

Logic: propositions and logical operation – conditional statements – methods of proof – mathematical induction.
Counting: permutation – combinations – Pigeonhole principle – elements of probability – recurrence relations.

UNIT II
Relations and digraph: products sets and partitions – relations and digraphs – paths in relations and digraphs – properties of relations – equivalence of relations – computer representation of relations and digraphs – operations on relations – transitive closure and Wars hall's algorithm.
Functions: functions – functions for computer science – growth of functions – permutation functions.

UNIT III
Order relations and structures: partially ordered sets – external elements of partially ordered sets – lattices – finite Boolean algebras – functions on Boolean algebra – circuit design.
Trees: trees – labeled trees – tree searching – undirected trees – minimal spanning trees.

UNIT IV
Topics in graphs theory: graphs –euler paths and circuits –Hamiltonian Paths and circuits – transport networks – matching problems – coloring graphs.
Semi-groups and groups: binary operations revisited – semi-groups – products and quotients of groups – other mathematical structures.

UNIT V
Languages and finite state machines : languages – representations of special grammars and languages – finite state machines – monoids ,machines and languages – machines and regular languages – simplification of machines.
Groups and coding: coding of binary information and error detection – decoding and error correction.

Text Book:

1. Bernard Kolman, Robert C. Busby ,Sharon Cutler Ross, "Discrete Mathematical Structures", 5th Edition, Pearson Education, 2004

MA309 APPLIED MATHEMATICS

Credit: 4 :0:0 **Marks: 40 + 60**

Unit:-I Calculus of Variations:
Variation & its properties-Euler's equation-Functionals dependant on its first, higher order derivatives& of several independent variables-some applications –Ritz method& Kantorvich methods.

Unit:-II: Numerical Solution of Partial Differential Equation
Solution of Laplace & Poisson equation on a rectangular region by Liebmann's Method-Differential equation by the explicit & Crank Nickolson-Impilicit methods- Solution of wave equation by explicit scheme.

Unit:-III: Initial, Eigen & Boundary Value Problems
Initial values problems- Taylor & Maclaurin series, Picards, Euler, Improved Euler and Modified Euler, Runge- Kutta methods, Milne's & Adams predictor corrector methods.Eigen value problems: Power & inverse power methods, Jacobi's & given, methods.Boundary value problems: Raleigh- Ritz, Collocation, Galerkin methods.

Unit:-IV: Solution of Numerical & Transcendental Equation
Linear equations-Horner's method, Bolzano's bisection, Iteration, False position, Newton-Rap son, Muller, Chebyshev, Graeffe's root, Barstow's, Birge-vieta methods
Gauss-Elimination, Gauss-Jordan, Triangular, Crout's, Gauss-Seidel, Gauss-Jacobi, Relaxation methods-System of non-linear equations- Newton-Raphson method.

Unit:-V: Numerical Integration
Newton-Cote's Quadrature formula, Trapezoidal, Simpson, Weddle's rule (Single & Double Integrals) Romberg's method, Gaussian- Quadrature Formulas-Natural cubic spline functions, Beizer curves

Text books:

1. T.Veerarajan, T.Ramachandran, Numerical Methods, Tata McGraw Hill
2. P.Kandasamy et al., Numerical Methods S. Chand & Co Ltd
3. Naveen Kumar, An elementary Course on Variational problems in Calculus, Narosa publishing house.
4. Curtis F-Gerald, Applied Numerical Analysis (5th edition), Addison Wesley publishing company
5. Ward Cheney, David Kincaid, Numerical Mathematics & Computing (3rd edition), Brooks/Cole publishing Company Ltd.

MA310 APPLIED MATHEMATICS

Credit: 4:0:0 **Marks: 40 + 60**

UNIT: I Basic Concepts In Algebra
Number theory: Prime numbers - Extended Euclidean algorithm – modular arithmetic – modular inverse – Chinese Reminder Theorem – Linear Congruence - Groups, Rings - Relations and Functions - Basic Complexity Theory

UNIT: II Graph Theory
Terminology - Representation of graphs – Connected graphs – Matrix representation of graphs, Incidence Matrix, Circuit Matrix Adjacency Matrix
Applications – Critical path method –Trees – Binary tree.

UNIT: III Automata Theory
Language – Representation of special language and grammar – finite state machines – machines & Languages – machines and regular languages – Simplification of machines

UNIT: IV Random process
Basic concept and examples in Random process – continuity concepts – classes of stochastic – Gaussian process- stationarity and ergodicity – correlation –covariance and their properties.

UNIT: V Queuing theory
Introduction to queuing theory -first in first out queue discipline with infinite capacity problems based on M/M/I : ∞/FIFO and M/M/C : ∞ /FIFO (derivations not included).

Text books:

1. Bernard Kolman, Robert C Busby, Sharon Cutler Ross, Discrete Mathematical Structures,5^{th} Edition, Pearson Education.2004.
2. T.Veerarjan, Theory of Probability and Random Process, Tata McGraw Hill Publishing Company.
3. Narsingh Deo, Graph theory will application to Engineering and computer sciences, Prentice-Hall of India Pvt.Ltd., 2000.
4. Kenneth.H.Rosen, Discrete Mathematics and its applications, 5 th edition. Tata McGraw hill ed 2004
5. S.Kalavathy, Operations Research, Vikas Publishing House (p) Ltd.

MA311 APPLIED MATHEMATICS

Credit: 4 :0:0 **Marks: 40 + 60**

UNIT: I Probability
Probabilty- Conditional Probability – Baye’s Theorem – standard Probability Distributions (Discrete and continuous) – Binomial Distribution – Poisson Distribution – Normal Distribution – Gamma Distribution – Exponential distribution – defintion,Moment generating functions and characterstic functions of the above distributions.

UNIT: II Statistics
Tchebyshev’s inequality – Maximum likelihood estimation – Correlation – Partial correlation – Multiple correlations – Regression – Multiple regression.

UNIT: III Vector Space
Definition and examples of vector space – Linear dependence and independence – Basis and Dimension – Subspace – Inner product space – Orthogonalisation process.

UNIT: IV Graph Theory
Introduction – Basic terminology – Representation of graphs – Connected graphs – Matrix representation of graphs (excluding directed graphs), Applications – Critical path method – Shortest path problems – Trees – definition – Binary tree.

UNIT: V Optimization Techniques
Linear Programming – Graphical methods – Simplex method (Artificial variables not included)- transportation and Assignment problems.

Text Books:

1. S.C. Gupta, V.K. Kapoor, "*Fundamentals of Mathematical Statistics*", Sultan Chand & Sons, 2002.
2. Narsngh Dev, "*Graph Theory with Applications to Engineering and Computer Science*", Prentice Hall of India (p) Ltd. 1988.
3. Haffmann and Kunze "*Linear Algebra*", PHI, 1994.

Reference Book:

1. Hamdy A. Taha, "*Operation Research*", Maxwell Macmillan.
2. Walpole Myers, Myers, Ye, "*Probability & Statistics for Engineers and Scientists*" Pearson Education, first Indian reprint, 2002.
3. S.C. Gupta V.K. Kapoor, "*Fundamentals of Applied Statistics*", Sultan Chand & Sons, 2002.
4. T.Veerarjan, Theory of Probability and Random Process, Tata McGraw Hill Publishing Company

MA312 APPLIED MATHEMATICS FOR CHEMISTS

Credits 4:0:0 **Marks: 40 + 60**

Unit I : Fundamental Statistics
Central tendencies: Mean, Median, Mode-Measure of dispersion-Range, Quartiles, Distributions: Binomial, Poisson, and Normal distributions.

Unit II : Correlation And Regression
Linear correlation - rank Correlation- Multiple & partial Correlation. Linear Regression, Multiple regressions.

Unit III : Testing Of Hypothesis
Large Samples- Proportions, population mean –two sample Means.Small Samples- t F, Chi-square distributions.

Unit IV : Differential & Integral Calculus.
Differentiation- Trigonometry, polynomial, exponential, logarithmic, Implicit, hyperbolic & inverse circular functions. Integration- Trigonometric, exponential, logarithmic, Rational functions. Double, Triple Integrals.

Unit V: Differential Equations.
Linear differential equation of the type Second order, Euler- homogeneous linear differential, Simultaneous differential equations

Text books:

1. T. K. Manickavasagam Pillai, Differential Calculus, S. Viswanathan (Printers & Publishers) Pvt. Ltd.
2. Kandasamy, K.Thilagavathy, K.Gunavathy, Engineering Mathematics (Vol-III & I), S.Chand & Company Ltd
3. S.C. Gupta V.K. Kapoor, "*Fundamentals of Applied Statistics*", Sultan Chand & Sons, 2002

DEPARTMENT
OF
MATHEMATICS

ADDITIONAL SUBJECTS

Sub. Code	Subject	Credits
MA228	Mathematics	3:1:0
MA229	Basic Mathematics	3:1:0
MA230	Foundation to Mathematics	3:0:0
MA231	Mathematics - I	3:1:0
MA232	Mathematics - II	3:1:0
MA233	Mathematics - III	3:1:0
MA234	Mathematics - IV	3:1:0
MA235	Probability and Biostatistics	3:1:0
MA236	Mathematics for Food Engineers	3:1:0
MA237	Numerical Methods	3:1:0
MA238	Resource Management Techniques	3:1:0
MA239	Probability and Random Process	3:1:0
MA240	Discrete Mathematics	3:1:0
MA241	Discrete Mathematics for Bioinformaticians	3:1:0
MA242	Probability and Biostatistics	3:1:0
MA243	Mathematics for Food Engineers	3:1:0
MA313	Applied Mathematics	3:1:0
MA314	Applied Mathematics	3:1:0
MA315	Applied Mathematics	3:1:0
MA316	Applied Mathematics	3:1:0
MA317	Mathematics for Bioinformaticians	3:1:0
MA318	Biostatistics	3:1:0
MA319	Engineering Mathematics	3:1:0
MA320	Probability and Statistics	3:1:0
MA321	Probability and Biostatistics for Food Engineers	3:1:0

MA228 MATHEMATICS
(For students who did not study Mathematics in Higher Secondary course)

Credit: 3:1:0 **Marks: 40+60**

Unit I: Trigonometry
Trigonometrical ratios and identities – Compound angles – Inverse trigonometrical functions – De Moivre’s theorem.

Unit II: Differentiation Techniques
Derivatives of elementary function from first principle – Derivatives of inverse functions – Logarithmic differentiation – Differentiation of parametric functions – Second order derivatives.

Unit III: Integration Techniques
Integrals of functions – Methods of integration – Decomposition method – Method of substitution – Integration by parts.

Unit IV: Analytical Geometry
Locus – Straight lines – Family of straight lines – Circle – Definition of a conic – Parabola, Ellipse, Hyperbola – Standard form.

Unit V: Application of Differentiation
Rate of change – Tangent and normal – Angle between two curves – Partial derivatives.

Text Books:
1. Mathematics, Higher Secondary first year, Volume I & II.
2. Mathematics, Higher Secondary second year, Volume I & II

MA229 BASIC MATHEMATICS

Credits 3:1:0 **Marks 40+60**

Unit I: Matrices
Definition - various types of Matrices – Addition and Multiplication – Properties – Adjoint of equations a square matrix and its properties – Inverse of a matrix – Elementary Transformation – Rank of matrix – consistency of a system of linear equations.

Unit II: Differentiation Techniques
Logarithmic differentiation – Differentiation of parametric functions – Second order derivatives. Derivatives of elementary function from first principle – Derivatives of inverse functions

Unit III: Integration Techniques
Integrals of functions – Methods of integration – Decomposition method – Method of substitution – Integration by parts.

Unit IV: Application of Differentiation
Rate of change – Tangent and normal – Angle between two curves – Partial derivatives.

Unit V: Statistics
Frequency Distribution – graphical representation – Arithmetic mean - Median – Mode – Geometric Mean – Harmonic mean – Standard Deviation – correlation and Regression

Text Book:
1. Higher Engineering Mathematics by H.K.Dass, S.Chand Company Ltd, Ram Nagar, New Delhi, 110 055

MA230 FOUNDATION TO MATHEMATICS

Credit:3:0:0 **Marks : 40+60**

Unit I: Trigonometry

Expansions of sin nθ and cos nθ in powers of cos θ and sin θ. Expansions of tan nθ in powers of tan θ. Expansions of sinn θ and cosn θ in terms of sines and cosines of multiple of θ. Expansions of sin θ and cos θ in power of θ. Hyperbolic functions – inverse hyperbolic functions. Separating real and imaginary parts of complex functions.

Unit II: Matrices

Rank of a matrix – linear independence and dependence of vectors – consistency and inconsistency of a system of m linear equations in n unknowns – Eigen values and Eigen vectors – properties – Cayley Hamilton theorem and problems.

Unit III: Differential Calculus

Curvature in Cartesian coordinates and polar coordinates – circle of curvature – radius of curvature.

Unit IV : Differential Equations

Second order linear differential equations with constant coefficients with RHS of the form e^{ax}, x^n, sin ax, cos ax, e^{ax} f(x) where f(x) is sin bx or cos bx

Unit V: Vector Calculus

Scalar and vector functions – differentiation – gradient, divergence and curl – directional derivative – identities (without proof) – irrotational and solenoidal fields.

Text Books:

1. Kandasamy P., Thilagavathy K. and Gunavathy K., "Engineering Mathematics Vol.I" S. Chand & Co. New Delhi, 1996.

Reference Books

1. Venkataraman, M.K. "Engineering Mathematics Vol.I and II" National Publishing Co., Chennai 1993.

MA231 MATHEMATICS - I

Credit:3:1:0 **Marks: 40+60**

Unit I: Theory of Equations

Relations between coefficients and roots. Irrational and imaginary roots occur in pairs – symmetric functions of the roots – transformation of equations – Reciprocal equations and formation of equation whose roots are given.

Unit II: Matrices

Characteristic equation – Eigen values and eigenvectors of a real matrix – Properties of Eigen values – Cayley Hamilton theorem – Orthogonal reduction of a symmetric matrix to diagonal form – Orthogonal matrices – Reduction of quadratic form to canonical form by orthogonal transformation

Unit III: Three Dimensional Analytical Geometry
Direction cosines and ratios – Angle between two lines – Equation of a plane – Equation of a straight line – Co-planar lines – Shortest distance between skew lines

Unit IV: Geometrical Applications of Differential Calculus
Curvature – Cartesian and polar co-ordinates – Circle of curvature – involutes and Evolutes – Properties of envelopes – Evolutes as envelope of normals.

Unit V: Functions of Several Variables
Functions of two variables – Partial derivatives – Total differential – Differentiation of implicit functions – Taylor's expansion – Maxima and Minima – Constrained Maxima and Minima by Lagrange's – Multiplier method – Jacobians

Text Book:
1. Kandasamy, Thilagavathi .K and Gunavathi K., Engineering Mathematics volume I (6^{th} revised Edition), S.Santhan & Co., New Delhi, 2003

Reference Books:
1. Kreyszig, E., "Advanced Engineering Mathematics" (8^{th} Edition), John Wiley and Sons (Asia) Pvt Ltd., Singapore, 2000
2. Grewal, B.S., "Higher Engineering Mathematics" (6^{th} Edition) Khanna Publisher, New Delhi, 2001

MA232 MATHEMATICS - II

Credit:3:1:0 **Marks : 40+60**

Unit I : Multiple Integrals
Evaluation of Multiple Integrals, Change the order of Integration, Application of Multiple Integrals to find area enclosed by plane curves and volume of solids.

Unit II: Beta and Gamma Integrals
Definition, relation connecting Beta and Gamma integrals, properties, evaluation of definite integrals in terms of Beta and Gamma functions.

Unit III: Ordinary differential Equation
Simultaneous linear equations with constant coefficients – Linear equations of higher order with constant coefficients – Homogeneous equation of Euler type – Method of variation of parameters.

Unit IV: Vector Calculus
Gradient, Divergence, Curl – Line, surface & volume integrals – Statements of Green's, Gauss divergence and stokes' theorems (without proof) – verification and applications.

Unit V: Laplace Transforms
Transforms of simple functions – Basic operational properties – Transforms of derivatives and integrals – Initial and final value theorems – Inverse transforms – Convolution theorem – Periodic function – Applications of Laplace transforms of solving linear ordinary differential

equations upto second order with constant coefficients and simultaneous equations of first order with constant coefficients.

Text Book:

1. Kandasamy, Thilagavathi .K and Gunavathi K., Engineering Mathematics volume II (6^{th} revised Edition), S.Santhan & Co., New Delhi, 2003

Reference Books:

1. Kreyszig, E., "Advanced Engineering Mathematics" (8^{th} Edition), John Wiley and Sons (Asia) Pvt Ltd., Singapore, 2000
2. Grewal, B.S., "Higher Engineering Mathematics" (6^{th} Edition) Khanna Publisher, New Delhi, 2001

MA233 MATHEMATICS - III

Credit: 3:1:0 **Marks : 40+60**

Unit I : Analytic Functions

Cauchy Riemann equations – Properties of analytic functions – Determination of harmonic conjugate – Milne – Thomson's method – Conformal mappings $w = z + a$, az, $1/z$, z^2 , and bilinear transformation.

Unit II: Complex Integration

Cauchy's theorem – Statement and application of Cauchy's integral formulae – Taylor's and Laurent's expansions – Singularities – Classification – Residues – Cauchy's residue theorem – Contour integration – Circular and semi Circular contours (excluding poles on real axis)

Unit III: Statistics

Moments, skewness and Kurtosis – Linear correlation-coefficient of correlation – rank correlation and regression lines – Theoretical Distributions – Binomial – Poisson – Normal.

Unit IV: Testing of hypothesis

Tests based on large samples - Small samples: t mean and difference of means – χ^2 test for goodness of fit and attributes and F - distribution.

Unit V: Z – Transforms

Z-transforms of standard functions, inverse Z-transform (Partial fraction expansions), properties of Z-transform, Solution of difference equations.

Text Book:

1. Kandasamy, Thilagavathi .K and Gunavathi K., Engineering Mathematics volume II and III (6^{th} revised Edition), S.Santhan & Co., New Delhi, 2003

Reference books:

1. Kreyszig, E., "Advanced Engineering Mathematics" (8^{th} Edition), John Wiley and Sons (Asia) Pvt Ltd., Singapore, 2000
2. Grewal, B.S., "Higher Engineering Mathematics" (6^{th} Edition) Khanna Publisher, New Delhi, 2001

MA234 MATHEMATICS IV

Credit: 3:1:0 **Marks : 40+60**

Unit I: Fourier series

Euler's formula – Dirichlet's conditions convergence statement only – change of interval odd and even functions. Half range series – RMS value, Parseval's identity – complex form of Fourier series – harmonic analysis.

Unit II: Partial Differential Equations

Formation of equations by elimination of arbitrary constants and arbitrary functions – solution of equations – general, particular and complete integrals – Lagrange's linear equation – standard type of first order equations – second order and higher order equations with constant coefficients, homogeneous and nonhomogeneous equations.

Unit III: One-Dimensional Wave Equations and Heat Equation

Derivation of one dimensional wave equation – transverse vibration of finite elastic string with fixed ends – boundary and initial value problems – Fourier series solution. Derivation of one dimensional heat equation – steady and unsteady states, boundary and initial value problems – Fourier series solution.

Unit IV: Two Dimensional Heat Equation

Two – dimensional heat equations – steady state heat flow in two dimensions – Laplace Equations in Cartesian and polar (co ordinates) Fourier series solution.

Unit V: Fourier transforms

The infinite Fourier transform – sine and cosine transforms – properties – inversion theorem – Finite Fourier Transform – sine and cosine transforms – convolution theorem – Parseval's identity – transform of derivatives.

Text Books:

1. Kandasamy, P., "Engineering Mathematics", S. Chand & Co., New Delhi, Volume – III, 1996.
2. Venkataraman, M.K., "Higher Engineering Mathematics", National Publishing Co., 1992.

Reference Books:

1. Erwin Kreyzic, "Advanced Engineering Mathematics", Wiley & Co, 1994.
2. Speigal, "Advanced Engineering Mathematics", Schaum's Series, 1995.

MA235 PROBABILITY AND BIOSTATISTICS

Credit: 3:1:0 **Marks: 40+60**

Unit I: Probability and random variables

Probability concepts, random variables, moments, moment generating function, binomial, Poisson, Tchebychev's inequality.

Unit II: Two-dimensional random variables
Marginal and conditional distributions, covariance, correlation and regression, transformation of random variables, central limit theorem.

Unit III: Random process
Classification, stationary and markov processes, Poisson process markov chains, markovian queuing model (M/M/1:∞./FIFO)

Unit IV: Reliability engineering
Concepts of reliability, hazard function, series and parallel systems, reliability and availability of markovian systems, maintainability, preventive maintenance.

Unit V: Design of experiments
Aim of the design of experiments – completely randomized design- analysis of variance for one factor of classification – randomized block design- analysis of variance for two factors of classification- Latin square design – analysis of design for three factors of classification- comparison of RBD and LSD.

References:

1. Mille I.R. And Freund J.E., "Probability and Statistics For Engineers", Prentice-Hall, 1995.
2. Kapur J.N. And Saxena H.C., "Mathematical Statistics", S Chand And Company Ltd., New Delhi, 1997.
3. Balagurusamy E., "Reliability Engineering", Tata McGraw Hill Publishers, New Delhi, 1984.
4. Bhat U.N., "Elements of Applied Stochastic Processes ", Wiley Series in Probability and Mathematical Statistics, New York, 1983.

MA236 MATHEMATICS FOR FOOD ENGINEERS

Credit: 3:1:0 **Marks: 40+60**

Unit I: Curve fitting and correlation
Method of least square - Correlations coefficients – correlations coefficients in terms of regression coefficients, Rank correlation.

Unit II: Testing of Hypothesis
Population- sample- one tail and two tailed tests- Large samples-proportion and mean – Small Samples – t, F,ψ^2 Distributions

Unit III: Design of experiments
Aim of the design of experiments – completely randomized design- analysis of variance for one factor of classification – randomized block design- analysis of variance for two factors of classification- Latin square design – analysis of design for three factors of classification- comparison of RBD and LSD.

Unit IV: SQC

Introduction – Types of variation – types of control charts – X chart, R. Chart, Sigma Chart, C- Chart, Advantages and Limitations of SQC – Acceptance sampling – Single acceptance sampling plan, double sampling plan, multiple sampling plan, construction of a OC curve – AQL and LTPD, six σ concepts.

Unit V: Reliability engineering

Concepts of reliability, hazard function, series and parallel systems, reliability and availability of markovian systems, maintainability, preventive maintenance.

Text Books:

1. Statistical Methods by S.P. Gupta, Sultan Chand and sons., New Delhi.
2. Method of Statistical Analysis by P.S.Grewal, Sterling publishers pvt.Ltd., New Delhi
3. Balagurusamy E., "Reliability Engineering", Tata McGraw Hill Publishers, New Delhi, 1984

MA237 NUMERICAL METHODS

Credit: 3:1:0 **Marks : 40+60**

Unit I:

Empirical laws and curve fitting – the linear law – Laws reducible to the linear law – Method of group averages – Principle of Least squares – Fitting a straight line – Fitting a parabola – Fitting an exponential curve – Fitting a curve of the form $y = ax^b$ – Calculation of the sum of the squares of the residuals – Method of moments.

Unit II:

Solution of numerical, algebraic and transcendental equations. The Bisection method – Newton – Raphson method – System of linear equations: Gauss elimination method – Crout's method – Gauss-Seidel method.

Unit III:

Finite differences: First and higher order differences – Forward differences and backward differences – Properties of operator – Differences of a polynomial –Factorial polynomials – Operator E – Relation between δ and E and D - Summation of series – Interpolation – Gregory-Newton forward Interpolation formula – Equidistant terms with one or more missing values – Gauss forward interpolation formula – Gauss backward interpolation formula.

Unit IV:

Interpolation with unequal intervals – Divided differences – Newton's divided difference formula – Lagrange's interpolation formula – Numerical differentiation and Integration – Newton's forward and backward differences to compute derivatives – The trapezoidal rule – Simpson's one third rule – Simpson's 3/8 rule – Difference Equations – Linear difference equations - Linear homogeneous difference equations with constant coefficients – Non-homogeneous difference equations with constant coefficients.

Unit V:
Numerical solutions of ordinary differential equations – Power series approximations – Solution by Taylor series– Runge – Kutta method (4^{th} Order)- Milne's Predictor Corrector method – Numerical solutions of partial differential equations – Laplace's equations and its solution by Liebmann's process – Solution of Poisson's equation – Solutions of parabolic and hyperbolic equations.

Text Book:

1. P. Kandasamy, "Numerical Methods", S. Chand & Co. New Delhi.

Reference Book:

1. Venkataraman "Numerical Methods", National Publishing Company.

MA238 RESOURCE MANAGEMENT TECHNIQUES

Credit: 3:1:0 **Marks: 40+60**

Unit I:
Linear programming-formation of the problem – graphical method – Simplex method –– two phase method- primal dual relationship – assignment models – transportation models – vogels approximation method – MODI method –unbalanced transportation – degeneracy in transportation model.

Unit II:
Resource scheduling – sequencing of n jobs through two machines and three machines – Johnson's algorithm, Network analysis: PERT and CPM – network diagram – probability of achieving completion date – crash time – cost analysis.

Unit III:
Inventory models – deterministic models – production models – economic ordering quantity – buffers stock – shortage and quantity discount.

Unit IV:
Queuing Theory (to be illustrated with engineering applications and no derivation) Poisson arrivals and exponential service time's – characteristics of Queuing models – single channel and multi channel models. Simulation – Monte Carlo technique – random number generation. Testing of random numbers – application in problems of queuing theory and inventory.

Unit V:
Replacement models – replacement of items that deteriorate with time – equipment's that fails completely and their analysis – individual and group replacement policy. Game Theory: Two person zero sum games: Pure strategies and saddle points – mixed strategies. 2 x M and M x 2 games – method of dominance – numerical and graphical solution – matrix methods.

Text Books:

1. Hamdy Taha.,: "Operation research" Maxwell Macmillan.

2. Muruce sasient.,: “Operations research methods and problems”, Wiley International ed., 1980.

Reference Books:

1. Kantiswarup, et al., “Operation research”, third Edition, 1980, Chand and Sons.
2. Gupta, and Hira, D.S.,: “Operations Research”, 1986, S. Chand and Sons, New Delhi.
3. Dharani Venkatakrishnan., “Operation Research”, 1988, Keerthi Publishing House (P) Ltd., Coimbatore.

MA239 PROBABILITY AND RANDOM PROCESS

Credit: 3:1:0 **Marks: 40+60**

Unit I:
Axioms of probability – Probability spaces – Joint and conditional probabilities – Independent events.

Unit II:
Densities and distributions – Example, Properties of distribution and density functions – Joint distributions and densities – Conditional probability distribution and density functions – Independent random variables.

Unit III:
Function of random variables and random vectors – Statistical averages – Characteristic functions – Inequalities of Tchebyshev and Cauchy Schwartz – Convergence concepts and the central limit theorem (Proof not expected).

Unit IV:
Random process definitions – Basic concepts and examples – Stationarity and ergodicity – Second order processes – Weekly stationary process – Covariance functions and their properties – Wiener Khinchine theorem.

Unit V:
Linear operations – Gaussian process – Poisson process – Low-pass and Band-pass process noise representations.

Text Books:

1. Papoulis: “Probability, Random Variables and Stochastic Processes (2/e), Mc GrawHill, 1991.
2. Veerarajan, “Probability statistics and Random Process” Tata Mc Graw Hill, 2002.

Reference Books:

1. Davenport: “Probability and Random process for Scientists and Engineers”, Mc GrawHill.
2. E.Wong,“Introduction to Random Process”, Spiringerverlag.
3. H. Stark and J.W. Woods: “Probability, Random process and estimation theory for Engineers”, Prentice Hall

MA240 DISCRETE MATHEMATICS

Credit: 3:1:0 **Marks: 40+60**

Unit I:

Fundamentals: set and subsets – operation on sets – sequences – division in the integers – matrices – mathematical structures. Logic: propositions and logical operation – conditional statements – methods of proof – mathematical induction.

Counting: permutation – combinations – Pigeonhole principle – elements of probability – recurrence relations**.**

Unit II:

Relations and digraph: products sets and partitions – relations and digraphs – paths in relations and digraphs – properties of relations – equivalence of relations – computer representation of relations and digraphs – operations on relations – transitive closure and Warshall's algorithm. Functions: functions – functions for computer science – growth of functions – permutation functions.

Unit III:

Order relations and structures: partially ordered sets – external elements of partially ordered sets – lattices – finite Boolean algebras – functions on Boolean algebra – circuit design.Trees: trees – labeled trees – tree searching – undirected trees – minimal spanning trees.

Unit IV:

Topics in graphs theory: graphs –Euler paths and circuits –Hamiltonian Paths and circuits – transport networks – matching problems – coloring graphs. Semi-groups and groups: binary operations revisited – semi-groups- other mathematical structures.

Unit V:

Languages and finite state machines : languages – representations of special grammars and languages – finite state machines – monoids ,machines and languages – machines and regular languages – simplification of machines.

Groups and coding: coding of binary information and error detection .

Text Book:

1. Bernard Kolman, Robert C. Busby, Sharon Cutler Ross, "Discrete Mathematical Structures", 5th Edition, Pearson Education, 2004

MA241 DISCRETE MATHEMATICS FOR BIOINFORMATICIANS

Credits: 3:1:0 **Marks: (40 + 60)**

Unit I

Foundations: Sets and Operations on sets – Relations and functions.

Combinatories: Basics of counting – Combinations and permutations – Counting combinatorial identities – Binomial and multinomial theorems.

Unit II

Mathematical Logic: Propositions and Logical operators – Construction of Truth tables – Methods of proof – Equivalence and implication – Induction and recursion – Lattices and Boolean algebra.

Unit III

Graph Theory: Basic concepts – directed graphs – TSP – Basic graph algorithms - (Kruskals and Prim's)

Unit IV

Numerical Errors – Roots of transcendental equations – bisection method – Newton – raphson method (methods only). Simultaneous equation – Gauss elimination, Gauss seidal method – Interpolation formula – Newton – Gregory formula (forward and backward difference) – Principles of Least Squares – Fitting a straight line.

Unit V : Numerical integration and differentiation:

Numerical integration - Trapezoidal rule – Simpson's one third rule (with derivation) – Numerical differentiation – Taylor series method (1^{st} order only) – Euler's method – Runge Kutta method (2^{nd} and 4^{th} order only).

Text book:

1. N.Ch.S.N Iyengar, V.Chandrasekharan, K.A.Venkatesh and P.S. Arunachalam, "Discrete mathematics", Vikas Publishing (2003)
2. V. Rajaraman, Computer Oriented Numerical Methods, PHI, New Delhi.

References:

1. Lipschutz, Discrete mathematics , Schaum's Series (2002)
2. Bernard Kolman, Robert C Busby and Sharon Ross, "Discrete mathematical structures", PHI (1997)

MA242 PROBABILITY AND BIOSTATISTICS

Credit: 3:1:0 **Marks: 40+60**

Unit I: Probability and random variables

Probability concepts, random variables, moments, moment generating function, binomial, Poisson, Tchebychev's inequality.

Unit II: Two-dimensional random variables

Marginal and conditional distributions, covariance, correlation and regression, transformation of random variables.

Unit III: Random process

Classification, stationary and markov processes, Poisson process markov chains, markovian queuing model (M/M/1:∞./FIFO)

Unit IV: Reliability engineering

Concepts of reliability, hazard function, series and parallel systems, reliability and availability of markovian systems, maintainability, preventive maintenance (proof and derivations not needed).

Unit V: Design of experiments

Aim of the design of experiments – completely randomized design- analysis of variance for one factor of classification – randomized block design- analysis of variance for two factors of classification- Latin square design – analysis of design for three factors of classification-comparison of RBD and LSD.

Text Books

1. Mille I.R. And Freund J.E., "Probability and Statistics For Engineers", Prentice-Hall, 1995.
2. Kapur J.N. And Saxena H.C., "Mathematical Statistics", S Chand And Company Ltd., New Delhi, 1997.

References

1. Balagurusamy E., "Reliability Engineering", Tata McGraw Hill Publishers, New Delhi, 1984.
2. Bhat U.N., "Elements of Applied Stochastic Processes ", Wiley Series in Probability and Mathematical Statistics, New York, 1983.

MA243 MATHEMATICS FOR FOOD ENGINEERS

Credit: 3:1:0 **Marks: 40+60**

Unit I: Curve fitting and correlation

Method of least square - Correlations coefficients – correlations coefficients in terms of regression coefficients, Rank correlation**.**

Unit II: Testing of Hypothesis

Population- sample- one tail and two tailed tests- Large samples-proportion and mean – Small Samples – t, F,χ^2 Distributions

Unit III: Design of experiments

Aim of the design of experiments – completely randomized design- analysis of variance for one factor of classification – randomized block design- analysis of variance for two factors of classification- Latin square design – analysis of design for three factors of classification-comparison of RBD and LSD.

Unit IV: SQC

Introduction – Types of variation – types of control charts – X chart, R. Chart, Sigma Chart, C- Chart, Advantages and Limitations of SQC – Acceptance sampling – Single acceptance sampling plan, double sampling plan, multiple sampling plan, construction of a OC curve – AQL and LTPD, six σ concepts.

Unit V: Reliability engineering

Concepts of reliability, hazard function, series and parallel systems, reliability and availability of markovian systems, maintainability, preventive maintenance. (proof and derivations not needed)

Text Books:

1. Statistical Methods by S.P. Gupta, Sultan Chand and sons., New Delhi.
2. Method of Statistical Analysis by P.S.Grewal, Sterling publishers pvt.Ltd., New Delhi
3. Balagurusamy E., "Reliability Engineering", Tata McGraw Hill Publishers, New Delhi, 1984

MA313 APPLIED MATHEMATICS

Credit: 3:1:0 **Marks : 40+60**

Unit I:

Calculus of Variations: Maximum and Minimum of functions of several independent variables – Lagrangian method of multipliers. Variational problems of fixed boundaries only simplest Variational problems – Euler equation – Brachisto Chrone problem – Variational problems involving several unknown functions – Functionals involving first and second order derivations – Functional involving two or more independent variables – Isoperimetric problems.

Unit II:

Linear integral equations: Different types of integral equations – Fredholm and Volterra integral equations – Relation between differential and integral equations – Green's function – Fredholm equation with separable kernal – Interactive method of solving equation of second kind – Properties of symmetric kernels.

Unit III:

Vector Space: Definition and examples of linear space – Linear dependence and independence – Basis and Dimension – Subspace – Inner Product space – Orthogonalisation process.

Unit IV:

Functions and Relations: Injective and Surjective, bijective functions – Compositions, identity, inverse functions – properties of relations.

Unit V:

Graph Theory: Introduction – Basic terminology – Representations of graphs – connected Graphs – Matrix representation of graphs (excluding graphs), Applications – Critical path method – Shortest path problems – trees – definition – Binary tree.
Z – Transforms: Definition – Z – Transform of standard functions: Applications to signals and linear time invariant system.

Text Books

1. Venkataraman M.K. "Higher Mathematics for Engg. And Science", National Publishing Company, 1986.

2. Narsingh Dev, "Graph Theory with Applications to Engineering and Computer Science", Prentice Hall of India (P) Ltd.1984.
3. Hoffmann and Kunze, "Linear Algebra" 2/C, PHI 1994

Reference Books

1. Tremblay, J.P. and Manohar R. "Discrete Mathematical Structures with Applications to Computer Science", McGraw Hill, 1987
2. John G. Proakis, "Digital Signal Processing", Prentice Hall of India (P) Ltd., 1995

MA314 APPLIED MATHEMATICS

Credit: 3:1:0 **Marks: 40+60**

Unit I: Calculus of Variations:

Variation & its properties-Euler's equation-Functionals dependant on its first, higher order derivatives& of several independent variables-some applications –
Ritz method& Kantorvich methods

Unit II: Numerical Solution of Partial Differential Equation

Solution of Laplace & Poisson equation on a rectangular region by Liebmann's Method-Differential equation by the explicit & Crank Nickolson-Impilicit methods-Solution of wave equation by explicit scheme.

Unit III: Initial, Eigen & Boundary Value Problems

Initial values problems- Taylor & Maclaurin series, Picards, Euler, Improved Euler and Modified Euler, Runge- Kutta methods, Milne's & Adams predictor corrector methods.Eigen value problems: Power & inverse power methods, Jacobi's & given, methods.Boundary value problems: Raleigh- Ritz, Collocation, Galerkin methods.

Unit IV: Solution of Numerical & Transcendental Equation

Linear equations-Horner's method, Bolzano's bisection, Iteration, False position, Newton-Raphson, Muller, Chebyshev, Graeffe's root, Barstow's, Birge-vieta methods Gauss-Elimination, Gauss-Jordan, Triangular, Crout's, Gauss-Seidel, Gauss-Jacobi, Relaxation methods- System of non-linear equations- Newton-Raphson method

Unit:-V: Numerical Integration

Newton-Cote's Quadrature formula, Trapezoidal, Simpson, Weddle's rule (Single & Double Integrals) Romberg's method, Gaussian- Quadrature Formulas-Natural cubic spline functions, Beizer curves

Text books:

1. T.Veerarajan, T.Ramachandran, Numerical Methods, Tata McGraw Hill
2. P.Kandasamy et al., Numerical Methods S. Chand & Co Ltd
3. Naveen Kumar, An elementary Course on Variational problems in Calculus, Narosa publishing house.
4. Curtis F-Gerald, Applied Numerical Analysis (5^{th} edition), Addison Wesley publishing company
5. Ward Cheney, David Kincaid, Numerical Mathematics & Computing (3^{rd} edition), Brooks/Cole publishing Company Ltd.

MA315 APPLIED MATHEMATICS

Credit: 3:1:0 **Marks: 40+60**

Unit I: Basic Concepts In Algebra
Number theory: Prime numbers - Extended Euclidean algorithm – modular arithmetic – modular inverse – Chinese Reminder Theorem – Linear Congruence - Groups, Rings - Relations and Functions - Basic Complexity Theory

Unit II: Graph Theory
Terminology - Representation of graphs – Connected graphs – Matrix representation of graphs, Incidence Matrix, Circuit Matrix Adjacency Matrix Applications – Critical path method –Trees – Binary tree.

Unit III: Automata Theory
Language – Representation of special language and grammar – finite state machines – machines & Languages – machines and regular languages – Simplification of machines

Unit IV: Random process
Basic concept and examples in Random process – continuity concepts – classes of stochastic – Gaussian process- stationarity and ergodicity – correlation –covariance and their properties.

Unit: V Queuing theory
Introduction to queuing theory -first in first out queue discipline with infinite capacity problems based on M/M/I : ∞/FIFO and M/M/C : ∞ /FIFO (derivations not included).

Text books:

1. Bernard Kolman, Robert C Busby, Sharon Cutler Ross, Discrete Mathematical Structures,5th Edition, Pearson Education.2004.
2. T.Veerarjan, Theory of Probability and Random Process, Tata McGraw Hill Publishing Company.
3. Narsingh Deo, Graph theory will application to Engineering and computer sciences, Prentice-Hall of India Pvt.Ltd., 2000.
4. Kenneth.H.Rosen, Discrete Mathematics and its applications, 5 th edition. Tata McGraw hill ed 2004
5. S.Kalavathy, Operations Research, Vikas Publishing House (p) Ltd.

MA316 APPLIED MATHEMATICS

Credit: 3:1:0 **Marks : 40+60**

Unit I: Probability
Probability- Conditional Probability – Baye's Theorem – standard Probability Distributions (Discrete and continuous) – Binomial Distribution – Poisson Distribution – Normal Distribution – Gamma Distribution – Exponential distribution – defintion, Moment generating functions and characterstic functions of the above distributions.

Unit II: Statistics
Tchebyshev's inequality – Maximum likelihood estimation – Correlation – Partial correlation – Multiple correlations – Regression – Multiple regression.

Unit III: Vector Space
Definition and examples of vector space – Linear dependence and independence – Basis and Dimension – Subspace – Inner product space – Orthogonalisation process.

Unit IV: Graph Theory
Introduction – Basic terminology – Representation of graphs – Connected graphs – Matrix representation of graphs (excluding directed graphs), Applications – Critical path method – Shortest path problems – Trees – definition – Binary tree.

Unit V: Optimization Techniques
Linear Programming – Graphical methods – Simplex method (Artificial variables not included) - transportation.

Text Books:
1. S.C. Gupta, V.K. Kapoor, "Fundamentals of Mathematical Statistics", Sultan Chand & Sons, 2002.
2. Narsingh Dev, "Graph Theory with Applications to Engineering and Computer Science", Prentice Hall of India (p) Ltd. 1988.
3. Haffmann and Kunze "Linear Algebra", PHI, 1994.

Reference Books:
1. Hamdy A. Taha, "Operation Research", Maxwell Macmillan.
2. Walpole Myers, Myers, Ye, "Probability & Statistics for Engineers and Scientists" Pearson Education, first Indian reprint, 2002.
3. S.C. Gupta V.K. Kapoor, "Fundamentals of Applied Statistics", Sultan Chand & Sons, 2002.
4. T. Veerarajan, Theory of Probability and Random Process, Tata McGraw Hill Publishing Company

MA317 MATHEMATICS FOR BIOINFORMATICIANS

Credit: 3:1:0 **Marks : 40+60**

Unit I: Matrices
Sets- Relations-Functions-Matrix-Linear Dependence and Independence-Reduction of real Matrix to diagonal form. Orthogonal matrices – reduction of quadratic form to a canonical form by orthogonal transformation.

Unit II: Differential and Integral Calculus
Differentiation of standard functions – basic rules of differentiation – successive differentiation – meaning of the derivative – tangent and normal – curvature. Methods of integration – simple problems – Second order differential equations (ordinary)

Unit III: Multiple integrals
Double integration in cartesian and polar co-ordinates-change the order of integration triple integration-Gamma and Beta functions-properties and applications

Unit IV: Vector Calculus
Gradient-divergence-Curl-Directional Derivative-identities (without proof)-irrotational and solenoidal line and surface integrals-Green's-Gauss and stokes theorem-Verification and applications.

Unit V: Combinatorial Theory
Introductory concepts – counting – one to one correspondence – parity. Binomial coefficients – permutations, combinations, identities, applications, sampling with replacement (theorems – statements only), simple problems.

Reference Books:

1. Higher Engineering Mathematics, B.S.Grewal, Khanna Publishers, 1998.
2. Advanced Engineering Mathematics, Erwin Kreyszig, Wiley Eastern Ltd., 1991.
3. Churchill .V, Complex variables and applications, Tata Mc. Graw Hill Book Co., 1994.
4. Cohen, Basic techniques of Combinatorial Theory, North-Eastern University, John-Wiley, New York.

MA318 BIOSTATISTICS

Credit: 3:1:0 **Marks: 40+60**

Unit I: Probability & Random Variables
Probability concepts, Random variables, Moments, Moment Generating function, Binomial, Poisson, Geometric, Negative Binomial, Exponential, Gamma, Weibull distribution, Functions of Random variable, Chebychev inequality.

Unit II: Two-dimensional Random variables
Marginal and Conditional distributions, Covariance, Correlation and regression. Functions of random variable, Central Limit theorem (No Proof) - problems

Unit III: Random Process
Classification, Stationary and Markov Processes, Poisson Process, Pure birth Process, Birth and death Process, Markov Chains Markovian queueing models.

Unit IV: Reliability Engineering
Concepts of reliability, Hazard function, Series and parallel systems, Reliability and Availability of Markovian systems, Maintainability, Preventive Maintenance.

Unit V: Design of Experiments & Quality Control
Completely randomized design, Randomized block design, Latin square design, Process control charts of measurements and attributes, Tolerance limits.

Reference Books:

1. Mille, I.R., and Freund, J.E., Probability and statistics for Engineers, Prentice-Hall, 1995
2. Kapur, J.N and Saxena, H.C., Mathematical Statistics, S. Chand & Company Lt., New Delhi, 1997.
3. Balagurusamy, E, Reliability Engineering, Tata – McGraw Hill Publishers, New Delhi, 1984.
4. Bhat, U.N., Elements of Applied Stochastic processes, Wiley Series in Probability and Mathematical Statistics, New York, 1983.

MA319 ENGINEERING MATHEMATICS

Credit: 3:1:0 **Marks: 40+60**

Unit 1: Algebra

Algebra – Binomial, Exponential and Logarithmic series – Straight lines, Conics -Parabola, Ellipse, Hyperbola tangent and normals and its applications.

Unit II: Differential and Integral Calculus:

Differentiation – methods of differentiation – integration – methods of integration – Maxima and Minima. Second order differential equations – Linear differential equations with constant coefficients - Euler's type. Applications to biological sciences.

Unit III: Probability and its distributions

Probability – addition and multiplication theorem – Binomial, Poisson – normal distributions

Unit IV: Reliability Engineering

Concepts of reliability, Hazard function, Series and parallel systems, Reliability and Availability of Markovian systems, Maintainability, Preventive Maintenance.

Unit V Sampling distributions

Tests based on large samples, t , F and chi-square test. Goodness of fit ANOVA – applications for biological sciences (one way, two way and three way classifications)

References:

1. Manikavasakam T.K., Algebra
2. Manikavasakam T.K., Calculus – Both Differential and Integral
3. Kapur and Gupta., Mathematical Statistics.

MA320 PROBABILITY AND STATISTICS

Credit 3:1:0 **Marks 40+60**

Unit I: Probability:

Axioms of probability – Probability spaces – Joint and conditional probabilities – Independent events.

Unit II:
Densities and distributions – Example, Properties of distribution and density functions – Joint distributions and densities – Conditional probability distribution and density functions – Independent random variables.

Unit III: Fundamental Statistics
Central tendencies: Mean, Median, Mode-Measure of dispersion-Range, Quartiles, Distributions: Binomial, Poisson, and Normal distributions.

Unit IV: Correlation and Regression
Linear correlation - rank Correlation- Multiple & partial Correlation. Linear Regression, Multiple regressions.

Unit V: Testing of Hypothesis
Large Samples- Proportions, population mean –two sample Means.- Small Samples- t, F, Chi-square distributions

Text books:

1. Kandasamy, K.Thilagavathy, K.Gunavathy, Engineering Mathematics (Vol-III &I), S.Chand & Company Ltd
2. S.C. Gupta V.K. Kapoor, “Fundamentals of Applied Statistics”, Sultan Chand & Sons, 2002.
3. Veerarajan, “Probability statistics and Random Process” Tata Mc Graw Hill, 2002.

MA321 PROBABILITY AND BIOSTATISTICS FOR FOOD ENGINEERS

Credits 4:0:0 **Marks (40+60)**

Unit I : Statistics
Measures of central tendency – Measures of Dispersion — Binomial –Poisson -Normal distributions.

Unit II : Correlation
Correlations and regression, - Correlations coefficients – correlations coefficients in terms of regression coefficients, Rank correlation and repeated ranks.

Unit III : Testing of Hypothesis
Population- sample- one tail and two tailed tests- Large samples-proportion and mean – Small Samples – t, F, ψ^2 Distributions.

UNIT IV Design of experiments and quality control
Aim of the design of experiments – completely randomized design- analysis of variance for one factor of classification – randomized block design- analysis of variance for two factors of classification- Latin square design – analysis of design for three factors of classification- comparison of RBD and LSD.

Unit V: SQC

Introduction – Types of variation – types of control charts – X chart, R. Chart, Sigma Chart, C- Chart, Advantages and Limitations of SQC – Acceptance sampling – Single acceptance sampling plan, double sampling plan, multiple sampling plan, construction of a OC curve – AQL and LTPD.

Text Books:

1. Statistical Methods by S.P. Gupta, Sultan Chand and sons., New Delhi.
2. Method of Statistical Analysis by P.S.Grewal, Sterling publishers pvt.Ltd., New Delhi
3. T.Veerarajan, Theory of Probability and Random Process, Tata McGraw Hill Publishing Company

ADDITIONAL SUBJECTS

Code	Subject	Credits
MA244	Algebra, Differential Calculus and Analytical Geometry	3:1:0
MA245	Multiple Integrals, Differential Equations and Laplace Transforms	3:1:0
MA246	Complex Analysis, Statistics and Z-Transforms	3:1:0
MA247	Fourier Series, Transforms and Partial Differential Equations	3:1:0
MA248	Probability, Random Processes and Design of Experiments	3:1:0
MA249	Discrete Mathematics	3:1:0
MA250	Operations Research Techniques	3:1:0
MA251	Statistical Data Analysis and Reliability Engineering	3:1:0
MA252	Probability and Bio Statistics	3:1:0
MA253	Mathematical Foundation	3:0:0
MA322	Applied Mathematics	4:0:0
MA323	Applicable Mathematics	3:1:0
MA324	Mathematical and Statistical Methods	3:1:0
MA325	Graph Theory and Optimization Techniques	4:0:0
MA326	Linear Algebra	4:0:0
MA327	Real Analysis – I	4:0:0
MA328	Ordinary Differential Equations	4:0:0
MA329	Mechanics	4:0:0
MA330	Algebra	4:0:0
MA331	Real Analysis – II	4:0:0
MA332	Partial Differential Equations	4:0:0
MA333	Tensor Analysis and Special Theory of Relativity	4:0:0
MA334	Complex Analysis – I	4:0:0
MA335	Probability Theory	4:0:0
MA336	Functional Analysis	4:0:0
MA337	Topology	4:0:0
MA338	Complex Analysis – II	4:0:0
MA339	Differential Geometry	4:0:0
MA340	Mathematical Statistics	4:0:0
MA341	Fluid Dynamics	4:0:0
MA342	Fuzzy Sets and Their Applications	4:0:0
MA343	Number Theory and Cryptography	4:0:0
MA344	Formal Languages and Automata Theory	4:0:0
MA345	Programming in C++ and Numerical Methods	4:0:0
MA346	Discrete Mathematics	4:0:0
MA347	Graph Theory	4:0:0

MA348	Java Programming	4:0:0
MA349	Data Structures and Algorithms	4:0:0
MA350	Operations Research	4:0:0
MA351	Financial Mathematics	4:0:0
MA352	Stochastic Processes	4:0:0
MA353	Relational Database Management Systems	4:0:0
MA354	Statistical Mathematics	4:0:0
MA355	Research Methodology	4:0:0
MA356	Mathematical Methods	4:0:0
MA357	Graphs and Networks	4:0:0
MA358	Fuzzy Mathematics	4:0:0
MA359	Difference Equations	4:0:0
MA360	Optimization Techniques	4:0:0
MA361	Statistical Methods	3:1:0
MA362	Graphs, Random Processes and Queues	4:0:0

MA244 ALGEBRA, DIFFERENTIAL CALCULUS AND ANALYTICAL GEOMETRY

Credit: 3:1:0

Unit I: Theory of Equations
Relations between coefficients and roots. Irrational and imaginary roots s – symmetric functions of the roots – transformation of equations – Reciprocal equations and formation of equation whose roots are given.

Unit II: Matrices
Characteristic equation – Eigen values and eigenvectors of a real matrix – Properties of Eigen values – Cayley Hamilton theorem – Orthogonal reduction of a symmetric matrix to diagonal form – Orthogonal matrices – Reduction of quadratic form to canonical form by orthogonal transformation

Unit III: Three Dimensional Analytical Geometry
Direction cosines and ratios – Angle between two lines – Equation of a plane – Equation of a straight line – Co-planar lines – Shortest distance between skew lines

Unit IV: Geometrical Applications of Differential Calculus
Curvature – Cartesian and polar co-ordinates – Circle of curvature – involutes and Evolutes – Properties of envelopes – Evolutes as envelope of normals.

Unit V: Functions of Several Variables
Functions of two variables – Partial derivatives – Total differential – Differentiation of implicit functions – Taylor's expansion – Maxima and Minima – Constrained Maxima and Minima by Lagrange's – Multiplier method – Jacobians

Text Book:

1. Kandasamy.P, Thilagavathi .K and Gunavathi K., Engineering Mathematics, Volume I (6^{th} revised Edition), S Chand. & Co., New Delhi, 2003

Reference Books:

1. Kreyszig, E., "Advanced Engineering Mathematics" (8^{th} Edition), John Wiley and Sons (Asia) Pvt Ltd., Singapore, 2000
2. Grewal, B.S., "Higher Engineering Mathematics" (6^{th} Edition) Khanna Publisher, New Delhi, 2001

MA245 MULTIPLE INTEGRALS, DIFFERENTIAL EQUATIONS AND LAPLACE TRANSFORMS

Credit: 3:1:0

Unit I: Multiple Integrals

Evaluation of Multiple Integrals, Change of order of Integration, Application of Multiple Integrals to find area enclosed by plane curves and volume of solids.

Unit II: Beta and Gamma Integrals

Definition, relation connecting Beta and Gamma integrals, properties, evaluation of definite integrals in terms of Beta and Gamma functions.

Unit III: Ordinary differential Equation

Simultaneous linear equations with constant coefficients – Linear equations of higher order with constant coefficients – Homogeneous equation of Euler type – Method of variation of parameters.

Unit IV: Vector Calculus

Gradient, Divergence, Curl – Line, surface & volume integrals – Statements of Green's, Gauss divergence and stokes' theorems (without proof) – verification and applications.

Unit V: Laplace Transforms

Transforms of simple functions – Basic operational properties – Transforms of derivatives and integrals – Initial and final value theorems – Inverse transforms – Convolution theorem – Periodic function – Applications of Laplace transforms of solving linear ordinary differential equations upto second order with constant coefficients and simultaneous equations of first order with constant coefficients.

Text Book:

1. Kandasamy.P, Thilagavathi .K and Gunavathi K., Engineering Mathematics volume II (6^{th} revised Edition), S. **Chand** & Co., New Delhi, 2003

Reference Books:

1. Kreyszig, E., "Advanced Engineering Mathematics" (8^{th} Edition), John Wiley and Sons (Asia) Pvt Ltd., Singapore, 2000
2. Grewal, B.S., "Higher Engineering Mathematics" (6^{th} Edition) Khanna Publisher, New Delhi, 2001

MA 246 COMPLEX ANALYSIS, STATISTICS AND Z-TRANSFORMS

Credit: 3:1:0

Unit I : Analytic Functions
Cauchy Riemann equations – Properties of analytic functions – Determination of harmonic conjugate – Milne – Thomson's method – Conformal mappings w = z + a, az, 1/z, z^2 , and bilinear transformation.

Unit II: Complex Integration
Cauchy's theorem – Statement and application of Cauchy's integral formulae – Taylor's and Laurent's expansions – Singularities – Classification – Residues – Cauchy's residue theorem – Contour integration – Circular and semi Circular contours (excluding poles on real axis)

Unit III: Statistics
Moments, skewness and kurtosis (based on moments only) – Linear correlation-coefficient of correlation – rank correlation and regression lines – Theoretical Distributions – Binomial – Poisson – Normal.

Unit IV: Testing of hypothesis

Tests based on large samples - Small samples: t mean and difference of means – χ^2 test for goodness of fit and attributes and F - distribution.

Unit V: Z – Transforms
Z-transforms of standard functions, inverse Z-transform (Partial fraction expansions and residues), properties of Z-transform, Solution of difference equations.

Text Book:

1. Kandasamy.P, Thilagavathi .K and Gunavathi K., Engineering Mathematics volume II and III (6th revised Edition), S. Chand & Co., New Delhi, 2003

Reference books:

1. Kreyszig, E., "Advanced Engineering Mathematics" (8th Edition), John Wiley and Sons (Asia) Pvt Ltd., Singapore, 2000
2. Grewal, B.S., "Higher Engineering Mathematics" (6th Edition) Khanna Publisher, New Delhi, 2001

MA247 FOURIER SERIES , TRANSFORMS AND PARTIAL DIFFERENTIAL EQUATIONS

Credit: 3:1:0

Unit I: Fourier series
Euler's formula – Dirichlet's conditions convergence statement only – change of interval odd and even functions. Half range series – RMS value, Parseval's formula – complex form of Fourier series – harmonic analysis.

Unit II: Partial Differential Equations
Formation of equations by elimination of arbitrary constants and arbitrary functions – solution of equations – general, particular and complete integrals – Lagrange's linear equation – standard type of first order equations – second order and higher order equations with constant coefficients, homogeneous and nonhomogeneous equations.

Unit III: One-Dimensional Wave Equations and Heat Equation
One dimensional wave equation – transverse vibration of finite elastic string with fixed ends – boundary and initial value problems – Fourier series solution. One dimensional heat equation – steady and unsteady states, boundary and initial value problems – Fourier series solution. (Proofs and derivations not needed)

Unit IV: Two Dimensional Heat Equation
Two dimensional heat equations – steady state heat flow in two dimensions – Laplace Equations in Cartesian and polar co ordinates Fourier series solution. (Proofs and derivations not needed)

Unit V: Fourier transforms
The infinite Fourier transform – sine and cosine transforms – properties (Proof not needed) – inversion theorem – Finite Fourier Transform – sine and cosine transforms – convolution theorem – Parseval's identity – transform of derivatives. (Proofs and derivations not needed)

Text Books:

1. Kandasamy, P., "Engineering Mathematics", S. Chand & Co., New Delhi, Volume – III, 1996.
2. Venkataraman, M.K., "Higher Engineering Mathematics", National Publishing Co., 1992.

Reference Books:

1. Erwin Kreyzig, "Advanced Engineering Mathematics", Wiley & Co, 1994.
2. Speigal, "Advanced Engineering Mathematics", Schaum's Series, 1995.

MA248 PROBABILITY, RANDOM PROCESSES AND DESIGN OF EXPERIMENTS

Credit: 3:1:0

Unit I: Probability and random variables
Probability concepts, random variables, moments, moment generating function, binomial, Poisson, Tchebychev's inequality.

Unit II: Two-dimensional random variables
Marginal and conditional distributions, covariance, correlation and regression, transformation of random variables.

Unit III: Random process
Classification, stationary and Markov processes, Poisson process Markov chains, Markovian queuing model (M/M/1:∞./FIFO)

Unit IV: Reliability engineering
Concepts of reliability, hazard function, series and parallel systems, reliability and availability of markovian systems, maintainability, preventive maintenance (proof and derivations not needed).

Unit V: Design of experiments
Aim of the design of experiments – completely randomized design- analysis of variance for one factor of classification – randomized block design- analysis of variance for two factors of classification- Latin square design – analysis of design for three factors of classification- comparison of RBD and LSD.

Text Books

1. Mille I.R. And Freund J.E., "Probability and Statistics For Engineers", Prentice-Hall, 1995.
2. Kapur J.N. And Saxena H.C., "Mathematical Statistics", S Chand And Company Ltd., New Delhi, 1997.

References

1. Balagurusamy E., "Reliability Engineering", Tata McGraw Hill Publishers, New Delhi, 1984.
2. Bhat U.N., “Elements of Applied Stochastic Processes ", Wiley Series in Probability and Mathematical Statistics, New York, 1983.

MA249 DISCRETE MATHEMATICS

Credit: 3:1:0

Unit I
Fundamentals: set and subsets – operation on sets – sequences – division in the integers – matrices – mathematical structures.
Logic: propositions and logical operation – conditional statements – methods of proof – mathematical induction.

Unit II
Relations and digraph: products sets and partitions – relations and digraphs – paths in relations and digraphs – properties of relations – equivalence of relations – computer representation of relations and digraphs – operations on relations – transitive closure and Wars hall’s algorithm.
Functions: functions – functions for computer science – growth of functions – permutation functions.

Unit III
Order relations and structures: partially ordered sets – external elements of partially ordered sets – lattices – finite Boolean algebras – functions on Boolean algebra.
Trees: trees – labeled trees – tree searching – undirected trees – minimal spanning trees.

Unit IV

Topics in graphs theory: graphs –euler paths and circuits –Hamiltonian Paths and circuits – transport networks – matching problems – coloring graphs.

Semi-groups and groups: binary operations revisited – semi-groups – products and quotients of groups.

Unit V

Languages and finite state machines : languages – representations of special grammars and languages – finite state machines – monoids ,machines and languages – machines and regular languages – simplification of machines.

Groups and coding: coding of binary information and error detection – decoding and error correction.

Text Book:

Bernard Kolman, Robert C. Busby ,Sharon Cutler Ross, "Discrete Mathematical Structures", 5th Edition, Pearson Education, 2004

MA250 OPERATIONS RESEARCH TECHNIQUES

Credit: 3:1:0

Unit I : Linear Programming

The Linear Programming Problem - Introduction, formulation of Linear Programming problem, Graphical solution to L.P.P, Simplex Method, Artificial variable techniques, two phase Method, Variants of the Simplex Method.

Unit II : Duality and Transportation

Duality In Linear Programming - Concept of duality, Fundamental properties of Duality, Duality & simplex method, Dual simplex method. THE TRANSPORTATION PROBLEM: Introduction, Transportation Model, finding initial basic feasible solutions, moving towards optimality, Degeneracy.

Unit III: Assignment and Inventory Control

Assignment Problem - Introduction, Solution of an Assignment problem, Multiple Solution, Hungarian Algorithm, Maximization in Assignment Model, Impossible Assignment.

Inventory Models: Purchasing model: No Shortages, Manufacturing Model: No Shortages, EOQ: System of Ordering. (Derivations and proofs not needed)

Unit IV: Sequencing and Queueing

Sequencing - Job sequencing, n jobs through two machines, two jobs through m machines, n jobs through m machines. QUEUING THEORY: Introduction, Definition of terms in Queuing model, problem-involving M/M/1: ∞/FIFO queue (Derivations and proofs not needed)

Unit V: Replacement and Simulation

Replacement Model - Replacement of items with gradual deterioration, items deteriorating with time value of money, items that fail completely and suddenly. Simulation Models: Elements of Simulation Model- Monte Carlo Technique.

Text Book
Kanti Swarup, Manmohan, P.K. Guptha, “Operations Research”, Sultan Chand & Sons, 1991.

References

1. S.Dharani Ventakrishnan, “Operations Research, Principles and Problems”, Keerthi Publishing House Private Ltd., 1992.
2. Venkatesan, “Operation Research”, JS Publications, 1998

MA251 STATISTICAL DATA ANALYSIS AND RELIABILITY ENGINEERING

Credit: 3:1:0

Unit I: Curve fitting and correlation
Method of least square - Correlation coefficients – correlation coefficients in terms of regression coefficients, Rank correlation**.**

Unit II: Testing of Hypothesis
Population- sample- one tail and two tailed tests- Large samples-proportion and mean – Small Samples – t, F, Chi-square Distributions

Unit III: Design of experiments
Aim of the design of experiments – completely randomized design- analysis of variance for one factor of classification – randomized block design- analysis of variance for two factors of classification- Latin square design – analysis of design for three factors of classification- comparison of RBD and LSD.

Unit IV: SQC
Introduction – Types of variation – types of control charts – X chart, R. Chart, Sigma Chart, C- Chart, Advantages and Limitations of SQC – Acceptance sampling – Single acceptance sampling plan, double sampling plan, multiple sampling plan, construction of a OC curve – AQL and LTPD, six σ concepts.

Unit V: Reliability engineering
Concepts of reliability, hazard function, series and parallel systems, reliability and availability of markovian systems, maintainability, preventive maintenance. (Proof and derivations not needed)

Text Books:

1. Statistical Methods by S.P. Gupta, Sultan Chand and sons, New Delhi.
2. Method of Statistical Analysis by P.S.Grewal, Sterling publishers pvt.Ltd., New Delhi
3. Balagurusamy E., "Reliability Engineering", Tata McGraw Hill Publishers, New Delhi, 1984

MA252 PROBABILITY AND BIO STATISTICS

Credit: 3:1:0

Unit: I

Collection of data – Graphical representation of Data – Histogram – Frequency Polygon – Frequency Curves – Relative Cumulative Frequency Curves – Measures of Central Tendency – Relation between AM, Mean, Median – Relation between AM & GM.

Unit: II

Measures of Dispersion – Range – Quartile Deviation – Quartile Range – Mean Deviation – Standard Deviation – Variance – Percentiles – Simple Problems.

Unit: III

Scatter Diagram – Correlation Coefficient (Karl Pearson) – Coefficient of Correlation for a Bivariate Data - Rank Correlation – Regression – Regression Lines.

Unit: IV

Tests of Significance – Student t - Test – Difference of Means – Test for Correlation and Regression Coefficients – Chi Square Test for Goodness of Fit – Analysis of Variance – Simple Problems based on One Way Classification

Unit: V

Probability – Addition Law – Multiplication Law – Conditional Probability – Baye's Theorem. Distributions : Binomial, Poisson, Normal – Z - score, P - Value and E - Value – Introduction to Markov Models – Neural Networks

Text Books:

1. S.C. Gupta, V.K. Kapoor, Fundamentals of Mathematical Statistics, Sultan Chand & Sons. XI edition, New Delhi, 2002.
2. D.W. Jordan and P. Smith, Mathematical Techniques, 3rd Edn, Oxford University Press, New Delhi, 2002.
3. L. Forthofer, Introduction to Biostatistics, Academic Press, 1995.
4. Robert R. Sokal and F.J. Rohlf, Introduction to Biostatistics (Biology-Statistics Series), W.H. Freeman & Company, New York, 1987.
5. E. Batschelet, Introduction to Mathematics for Life Scientists, 2nd Edn., Springer International Student Edn., Narosa Publishing House, New Delhi, 1991.
6. R. Durbin, S.R. Eddy, A. Krogh and G. Mitchison, Biological Sequence Analysis, Cambridge University Press, Cambridge, UK, 1998.
7. Steve Selvin, Bio Statistics – How it works?, Pearson Education, 2004.
8. P.S.S. Sundar Rao and J. Richard, An Introduction to Biostatistics – A manual for students in health sciences, Prentice hall of India Pvt. Ltd., 2004.

MA253 MATHEMATICAL FOUNDATION

Credit:3:0:0

Unit I: Trigonometry

Expansions of sin $n\theta$ and cos $n\theta$ in powers of cos θ and sin θ. Expansions of tan $n\theta$ in powers of tan θ. Expansions of $\sin^n \theta$ and $\cos^n \theta$ in terms of sines and cosines of multiple of θ. Expansions of sin θ and cos θ in power of θ. Hyperbolic functions – inverse hyperbolic functions. Separating real and imaginary parts of complex functions.

Unit II: Matrices
Rank of a matrix – linear independence and dependence of vectors – consistency and inconsistency of a system of m linear equations in n unknowns – Eigen values and Eigen vectors – properties – Cayley Hamilton theorem and problems.

Unit III: Differential Calculus
Curvature in Cartesian coordinates and polar coordinates – circle of curvature – radius of curvature.

Unit IV : Differential Equations
Second order linear differential equations with constant coefficients with RHS of the form e^{ax}, x^n, sin ax, cos ax, e^{ax} f(x) where f(x) is sin bx or cos bx

Unit V: Vector Calculus
Scalar and vector functions – differentiation – gradient, divergence and curl – directional derivative – identities (without proof) – irrotational and solenoidal fields.

Text Books:

1. Kandasamy P., Thilagavathy K. and Gunavathy K., "Engineering Mathematics Vol.I" S. Chand & Co. New Delhi, 1996.

Reference Books

1. Venkataraman, M.K. "Engineering Mathematics Vol.I and II" National Publishing Co., Chennai 1993.

MA322 APPLIED MATHEMATICS

Credit: 4:0:0

Unit I : Basic Concepts in Algebra
Number theory: Prime numbers, Extended Euclidean Algorithm, Modular Arithmetic, Modular Inverses, Chinese Remainder Theorem. Groups, Rings, Basic Definitions and Examples only
Relations & Functions. Basic Complexity Theory.

Unit II : Graph Theory
Terminology – Representations of graphs – Connected graphs – Matrix representation of graphs.
Applications – Critical Path Method – Trees – Binary Trees

Unit III : Automata Theory
Language – Representation of Special languages and Grammars – Finite State Machines – Machines & Languages – Machines & Regular languages – Simplification of machines.

Unit IV : Random Processes
Basic concepts and Examples – Continuity Concepts. Classes of Stochastic Process –

Gaussian Process – Stationary and Ergodicity – Correlation – Covariance and their properties.

Unit V : Queuing Theory
Introduction to Queuing theory – First in First out – Queue discipline with infinite capacity problems based on M/M/1: µ/FIFO and M/M/C: µ/FIFO (Derivations not needed).

Reference Books:

1. Bernard Kolman, Robert C. Busby, Sharon Cutler Ross, *Discrete Mathematical Structures*, Fifth Edition, Pearson Education, 2004.
2. T. Veerarajan, *Theory of Probability and Random Processes*, Tata McGraw Hill Publishing Company.
3. Narsingh Deo, *Graph Theory with Application to Engineering and Computer Sciences*, Prentice-Hall of India Private Ltd., 2000.
4. Garnett Birkhoff & Thomas C. Bartee "*Modern Applied Algebra*", McGraw-Hill Inc., Dharani . Venkatakrishnan, *Operations Research*, Keerthi Publishing House (P) Ltd

MA323 APPLICABLE MATHEMATICS

Credit: 3:1:0

Unit I: Probability
Probability- Conditional Probability – Baye's Theorem – standard Probability Distributions (Discrete and continuous) – Binomial Distribution – Poisson Distribution – Normal Distribution – Gamma Distribution – Exponential distribution – definition, Moment generating functions and characterstic functions of the above distributions.

Unit II: Statistics
Tchebyshev's inequality – Maximum likelihood estimation – Correlation – Partial correlation – Multiple correlations – Regression – Multiple regression.

Unit III: Vector Space
Definition and examples of vector space – Linear dependence and independence – Basis and Dimension – Subspace – Inner product space – Orthogonalisation process.

Unit IV: Graph Theory
Introduction – Basic terminology – Representation of graphs – Connected graphs – Matrix representation of graphs (excluding directed graphs), Applications – Critical path method – Shortest path problems – Trees – definition – Binary tree.

Unit V: Optimization Techniques
Linear Programming – Graphical methods – Simplex method (Artificial variables not included) - transportation.

Text Books:

1. S.C. Gupta, V.K. Kapoor, "Fundamentals of Mathematical Statistics", Sultan Chand & Sons, 2002.

2. Narsingh Dev, “Graph Theory with Applications to Engineering and Computer Science”, Prentice Hall of India (p) Ltd. 1988.
3. Haffmann and Kunze “Linear Algebra”, PHI, 1994.
4. T. Veerarajan, Theory of Probability and Random Process, Tata McGraw Hill Publishing Company

Reference Books:

1. Hamdy A. Taha, “Operation Research”, Maxwell Macmillan.
2. Walpole Myers, Myers, Ye, “Probability & Statistics for Engineers and Scientists” Pearson Education, first Indian reprint, 2002.
3. S.C. Gupta V.K. Kapoor, “Fundamentals of Applied Statistics”, Sultan Chand & Sons, 2002.

MA324 MATHEAMTICAL AND STATISTICAL METHODS

Credit: 3:1:0

Unit 1: Algebra
Binomial, Exponential and Logarithmic series

Unit II: Differential and Integral Calculus:
Differentiation (Simple Problems) – Integration (Simple Problems)– Maxima and Minima. Second order differential equations with constant coefficients.

Unit III: Probability and its distributions Probability – addition and multiplication theorem – Binomial, Poisson – normal distributions

Unit IV: Reliability Engineering
Concepts of reliability, Hazard function, Series and parallel systems, Reliability and Availability of Markovian systems, Maintainability, Preventive Maintenance (Proof and derivations not needed).

Unit V Sampling distributions
Tests based on large samples, t, F and chi-square test for Goodness of fit - ANOVA – applications for biological sciences (one way, two way classifications)

Text Books:

1. Manikavasakam Pillai T.K., Algebra
2. Manikavasakam Pillai T.K., Calculus – Both Differential and Integral
3. Kapur and Gupta., Mathematical Statistics.

MA325 GRAPH THEORY AND OPTIMIZATION TECHNIQUES

Credit: 4:0:0

Unit I : BASICS OF GRAPH THEORY

Graphs – Data structures for graphs – Subgraphs – Operations on Graphs Connectivity – Networks and the maximum flow – Minimum cut theorem - Trees – Spanning trees – Rooted trees – Matrix representation of graphs.

Unit II Classes Of Graphs
Eulerian graphs and Hamiltonian graphs – Standard theorems – Planar graphs – Euler's formula - Five colour theorem – Coloring of graphs – Chromatic number (vertex and edge) properties and examples – Directed graphs.

Unit III Graph Algorithm
Computer Representation of graphs – Basic graph algorithms – Minimal spanning tree algorithm – Kruskal and Prim's algorithm - Shortest path algorithms – Dijsktra's algorithm – DFS and BFS algorithms.

Unit IV Optimization Techniques
Linear Programming – Graphical methods – Simplex method (Artificial variables not included)- transportation and Assignment problems.

Unit V Statistics
Tchebyshev's inequality – Maximum likelihood estimation – Correlation – Partial correlation – Multiple correlations – Regression – Multiple regression.

Text Books:

1. S.C. Gupta, V.K. Kapoor, "Fundamentals of Mathematical Statistics", Sultan
2. Chand & Sons, 2002.
3. Narsngh Dev, "Graph Theory with Applications to Engineering and Computer Science", Prentice Hall of India (p) Ltd. 1988.
4. Haffmann and Kunze "Linear Algebra", PHI, 1994.
5. Rao S.S., Engineering Optimization: Theory and Practice, New Age International Pvt. Ltd., 3rd Edition1998

Reference Book:

1. Hamdy A. Taha, "Operation Research", Maxwell Macmillan.
2. Walpole Myers, Myers, Ye, "Probability & Statistics for Engineers and Scientists" Pearson Education, first Indian reprint, 2002.
3. S.C. Gupta V.K. Kapoor, "Fundamentals of Applied Statistics", Sultan Chand & Sons, 2002.
4. T.Veerarjan, Theory of Probability and Random Process, Tata McGraw Hill Publishing Company
5. Narsingh Deo, Graph Theory with Applications to Engineering and Computer Science, PHI

MA326 LINEAR ALGEBRA

Credits 4:0:0

Unit I:
Vector Spaces: Vector Spaces – Subspaces – Bases and dimension – Coordinates – Summary of Row – Equivalance – Computations concerning subspaces.

Chapter 2: Sections 2.1 to 2.6

Unit II:
Linear Transformations: Linear Transformations – The Algebra of Linear Transformations – Isomorphism – Representation of Transformation by Matrices – Linear Functionals.
Chapter **3 :** Section 3.1 to 3.5

Unit III:
Elementary Canonical Forms: Introduction – Characteristic Values – Annihilating Polynomials – Invariant Subspaces – Simultaneous Triangulation; Simultaneous Diagonalization
Chapter 6: Sections 6.1 to 6.5

Unit IV:
The Rational and Jordan Forms: Cyclic Subspaces and Annihilators – Cyclic Decompositions and the Rational Form – The Jordan Form – Computations of Invariant Factors.
Chapter 7 : Sections 7.1 to 7.4

Unit V:
Inner Product Spaces: Inner Products – Inner Product Spaces – Linear Functionals and Adjoints – Unitary Operators – Normal Operators
Chapter 8 : Sections 8.1 to 8.5

Content and Treatment as in :
Kenneth Hoffman and Ray Kunze. Linear Algebra (II Edition), Prentice-Hall of India Pvt. Ltd. , New Delhi, 2000.

Books for Supplementary Reading and Reference:

1. Halmos. P. Finite Dimensional Vector Spaces, D. Van Nostrand Co., Princeton, 1958.
2. I.N. Herstein, Topics in Algebra, II Edition. Wiley Eastern Limited, New Delhi, 2000.
3. M. Artin, Algebra, Prentice Hall of India, 1991.
4. P.B. Bhattacharya, S.K. Jain, and S.R. Nagpaul , Basic Abstract Algebra (II Edition) Cambridge University Press, 1997 (Indian Edition)

MA327 REAL ANALYSIS –I

Credits 4:0:0

Unit - I
Functions of bounded variation - Introduction - Properties of monotonic functions - Functions of bounded variation - Total variation - Additive property of total variation - Total variation on [a, x] as a function of x - Functions of bounded variation expressed as the difference of two increasing functions - Continuous functions of bounded variation.
Chapter – 6 : Sections 6.1 to 6.8

Infinite Series: Absolute and conditional convergence - Dirichlet's test and Abel's test - Rearrangement of series - Riemann's theorem on conditionally convergent series.

Chapter 8 : Sections 8.8, 8.15, 8.17, 8.18

Unit - II

The Riemann - Stieltjes Integral - Introduction - Notation - The definition of the Riemann - Stieltjes integral - Linear Properties - Integration by parts- Change of variable in a Riemann - Stieltjes integral - Reduction to a Riemann Integral – Euler's summation formula - Monotonically increasing integrators, Upper and lower integrals - Additive and linearity properties of upper and lower integrals - Riemann's condition - Comparison theorems.
Chapter - 7: Sections 7.1 to 7.14

Unit-III

The Riemann-Stieltjes Integral - Integrators of bounded variation-Sufficient conditions for the existence of Riemann-Stieltjes integrals-Necessary conditions for the existence of Riemann-Stieltjes integrals- Mean value theorems for Riemann - Stieltjes integrals - The integrals as a function of the interval - Second fundamental theorem of integral calculus- Change of variable in a Riemann integral-Second Mean Value Theorem for Riemann integral-Riemann-Stieltjes integrals depending on a parameter-Differentiation under the integral sign-Lebesgue criteriaon for the existence of Riemann integrals.
Chapter - 7: 7.18 to 7.26

Unit IV:

Infinite Series and infinite Products - Double sequences - Double series - Rearrangement theorem for double series - A sufficient condition for equality of iterated series - Multiplication of series - Cesaro summability - Infinite products.
Chapter - 8 Sec, 8.20, 8.21 to 8.26

Power series - Multiplication of power series - The Taylor's series generated by a function - Bernstein's theorem - Abel's limit theorem - Tauber's theorem
Chapter 9: Sections 9.14, 9.15, 9.19, 9.20, 9.22, 9.23

Unit V:

Sequences of Functions - Pointwise convergence of sequences of functions - Examples of sequences of real - valued functions - Definition of uniform convergence - Uniform convergence and continuity - The Cauchy condition for uniform convergence - Uniform convergence of infinite series of functions - Uniform convergence and Riemann - Stieltjes integration - Uniform convergence and differentiation - Sufficient condition for uniform convergence of a series - Mean convergence.
Chapter -9 Sec 9.1 to 9.6, 9.8, 9.10, 9.11, 9.13

Contents and Treatment as in:

Tom M.Apostol : Mathematical Analysis, 2nd Edition, Addison-Wesley Publishing Company Inc. New York, 1974.

Books for Supplementary Reading and Reference:

1. Bartle, R.G. *Real Analysis*, John Wiley and Sons Inc., 1976.
2. Rudin,W. *Principles of Mathematical Analysis*, 3rd Edition. McGraw Hill Company, New York, 1976.

3. Malik,S.C. and Savita Arora. *Mathematical Anslysis*, Wiley Eastern Limited.New Delhi, 1991.
4. Sanjay Arora and Bansi Lal, *Introduction to Real Analysis*, Satya Prakashan, New Delhi, 1991.
5. Gelbaum, B.R. and J. Olmsted, Counter Examples in Analysis, Holden day, San Francisco, 1964.

MA328 ORDINARY DIFFERENTIAL EQUATIONS

Credits 4:0:0

Unit I: Linear equations with constant coefficients

Second order homogeneous equations-Initial value problems-Linear dependence and independence-Wronskian and a formula for Wronskian-Non-homogeneous equation of order two.

Chapter 2: Sections 1 to 6

Unit II: Linear equations with constant coefficients

Homogeneous and non-homogeneous equation of order n –Initial value problems-Annihilator method to solve non-homogeneous equation- Algebra of constant coefficient operators.

Chapter 2 : Sections 7 to 12.

Unit III: Linear equation with variable coefficients

Initial value problems -Existence and uniqueness theorems – Solutions to solve a non-homogeneous equation – Wronskian and linear dependence – reduction of the order of a homogeneous equation – homogeneous equation with analytic coefficients-The Legendre equation.

Chapter : 3 Sections 1 to 8 (Omit section 9)

Unit IV: Linear equation with regular singular points

Euler equation – Second order equations with regular singular points –Exceptional cases – Bessel Function.

Chapter 4 : Sections 1 to 4 and 6 to 8 (Omit sections 5 and 9)

UnitV: Existence and uniqueness of solutions to first order equations

Eequation with variable separated – Exact equation – method of successive approximations – the Lipschitz condition – convergence of the successive approximations and the existence theorem.

Chapter 5 : Sections 1 to 6 (Omit Sections 7 to 9)

Content and Treatment as in :

E.A.Coddington, A Introduction to Ordinary Differential Equations (3rd Printing) Prentice-Hall of India Ltd.,New Delhi, 1987.

Books for Supplementary Reading and Reference:

1. Williams E. Boyce and Richard C. DI Prima, *Elementary differential equations and*

boundary value problems,John Wiley and sons, New York, 1967.
2. George F Simmons, *Differential equations with applications and historical notes,* Tata McGraw Hill, New Delhi, 1974.
3. N.N. Lebedev, *Special functions and their applications*, Prentice Hall of India, New Delhi, 1965.
4. W.T. Reid. *Ordinary Differential Equations*, John Wiley and Sons, New York, 1971
5. P.Hartman, *Ordinary Differential Equations,* John Wiley and Sons, New York, 1964.
6. M.D.Raisinghania, *Advanced Differential Equations*, S.Chand & Company Ltd. New Delhi 2001
7. B.Rai, D.P.Choudary and H.I. Freedman, *A Course in Ordinary Differential Equations,* Narosa Publishing House, New Delhi, 2002.

MA329 MECHANICS

Credits 4:0:0

Unit - I: Mechanical Systems

The Mechanical system- Generalised coordinates – Constraints - Virtual work - Energy and Momentum

Chapter 1: Sections 1.1 to 1.5

Unit-II: Lagrange's Equations

Derivation of Lagrange’s equations- Examples- Integrals of motion.

Chapter 2 : Sections 2.1 to 2.3 (Omit Section 2.4)

Unit - III: Hamilton's Equations

Hamilton's Principle - Hamilton's Equation - Other variational principle.

Chapter 4 : Sections 4.1 to 4.3 (Omit section 4.4)

Unit – IV: Hamilton-Jacobi Theory

Hamilton Principle function – Hamilton-Jacobi Equation - Separability

Chapter 5 : Sections 5.1 to 5.3

Unit-V: Canonical Transformation

Differential forms and generating functions – Special Transformations– Lagrange and Poisson brackets.

Chapter 6 : Sections 6.1, 6.2 and 6.3 (omit sections 6.4, 6.5 and 6.6)

Contents and Treatment as in:

D. Greenwood, Classical Dynamics, Prentice Hall of India, New Delhi, 1985.

Books for Supplementary Reading and Reference:

1. H. Goldstein, *Classical Mechanics,* (2nd Edition) Narosa Publishing House, New Delhi.
2. N.C.Rane and P.S.C.Joag, *Classical Mechanics*, Tata McGraw Hill, 1991.
3. J.L.Synge and B.A.Griffth, *Principles of Mechanics* (3rd Edition) McGraw Hill Book Co., New York, 1970.

MA330 ALGEBRA

Credits 4:0:0

Unit - I:
Another Counting Principle – Class Equations for Finite Groups and its Applications – Sylow's Theorems (for Theorem 2.12.1, First Proof only)

Chapter 2 Sections 2.11 and 2.12 (Omit Lemma 2.12.5)

Unit – II: Solvable Groups – Direct Products – Finite Abelian Groups - Modules
Chapter 5: Sections 5.7 (Lemma 5.7.1, Lemma 5.7.2, Theorem 5.7.1)
Chapter 2: Sections 2.13 and 2.14 (Theorem 2.14.1 only)
Chapter 4: Section 4.5

Unit - III: Extension Fields – Roots of Polynomial – More about roots

Chapter 5 : Section 5.1, 5.3, 5.5

Unit - IV: Elements of Galois Theory.

Chapter 5: Sections 5.6

Unit - V: Finite Fields – Wedderburn's theorem on finite division rings.

Chapter 7 : Sections 7.1 and 7.2 (Theorem 7.2.1 only)

Content and treatment as in :

I.N. Herstein. Topics in Algebra (II Edition) Wiley Eastern Limited, New Delhi, 1975.

Books for Supplementary Reading and Reference:

1. M.Artin, Algebra, Prentice Hall of India, 1991.
2. P.B.Bhattacharya, S.K.Jain, and S.R.Nagpaul, Basic Abstract Algebra (II Edition) Cambridge University Press, 1997. (Indian Edition)
3. I.S.Luther and I.B.S.Passi, Algebra, Vol. I –Groups(1996); Vol. II Rings, Narosa Publishing House , New Delhi, 1999
4. D.S.Malik, J.N. Mordeson and M.K.Sen, Fundamental of Abstract Algebra, McGraw Hill (International Edition), New York. 1997.
5. N.Jacobson, Basic Algebra, Vol. I & II W.H.Freeman (1980); also published by Hindustan Publishing Company, New Delhi.

MA331 REAL ANALYSIS – II

Credits 4:0:0

Unit –I:

Measure on the Real line - Lebesgue Outer Measure - Measurable sets - Regularity - Measurable Functions - Borel and Lebesgue Measurability
Chapter - 2 Sec 2.1 to 2.5 (de Barra)

Unit - II:

Integration of Functions of a Real variable - Integration of Non- negative functions - The General Integral - Riemann and Lebesgue Integrals
Chapter - 3 Sec 3.1,3.2 and 3.4 (de Barra)

Unit – III:

Fourier Series and Fourier Integrals - Introduction - Orthogonal system of functions - The theorem on best approximation - The Fourier series of a function relative to an orthonormal system - Properties of Fourier Coefficients - The Riesz-Fischer Thorem - The convergence and representation problems in for trigonometric series - The Riemann - Lebesgue Lemma - The Dirichlet Integrals - An integral representation for the partial sums of Fourier series - Riemann's localization theorem - Sufficient conditions for convergence of a Fourier series at a particular point - Cesaro summability of Fourier series- Consequences of Fejes's theorem - The Weierstrass approximation theorem
Chapter 11 : Sections 11.1 to 11.15 (Apostol)

Unit – IV:

Multivariable Differential Calculus - Introduction - The Directional derivative - Directional derivative and continuity - The total derivative - The total derivative expressed in terms of partial derivatives - The matrix of linear function - The Jacobian matrix - The chain rule - Matrix form of chain rule - The mean - value theorem for differentiable functions - A sufficient condition for differentiability - A sufficient condition for equality of mixed partial derivatives - Taylor's theorem for functions of
R^n to R^1
Chapter 12 : Section 12.1 to 12.14 (Apostol)

Unit – V:

Implicit Functions and Extremum Problems : Functions with non-zero Jacobian determinants – The inverse function theorem-The Implicit function theorem-Extrema of real valued functions of severable variables-Extremum problems with side conditions.
Chapter 13 : Sections 13.1 to 13.7 (Apostol)

Content and Treatment as in :

1. G. de Barra, Measure Theory and Integration, Wiley Eastern Ltd., New Delhi, 1981. (for Units I and II)
2. Tom M.Apostol : Mathematical Analysis, 2^{nd} Edition, Addison-Wesley Publishing Company Inc. New York, 1974. (for Units III, IV and V)

Books for Supplementary Reading and Reference:

1. Burkill,J.C. *The Lebesgue Integral*, Cambridge University Press, 1951.

2. Munroe,M.E. *Measure and Integration*. Addison-Wesley, Mass.1971.
3. Roydon,H.L.*Real Analysis*, Macmillan Publishing Company, New York,1988.
4. Rudin, W. *Principles of Mathematical Analysis*, McGraw Hill Company, New York,1979.
5. Malik,S.C. and Savita Arora. *Mathematical Analysis,* Wiley Eastern Limited. New Delhi, 1991.
6. Sanjay Arora and Bansi Lal, *Introduction to Real Analysis*, Satya Prakashan, New
7. Delhi, 1991

MA332 PARTIAL DIFFERENTIAL EQUATIONS

Credits 4:0:0

Unit-I : Partial Differential Equations of First Order: Formation and solution of PDE- Integral surfaces – Cauchy Problem order eqn- Orthogonal surfaces – First order non-linear – Characteristics – Csmpatible system – Charpit method. **Fundamentals:** Classification and canonical forms of PDE.
Chapter 0: 0.4 to 0.11 (omit .1,0.2.0.3 and 0.11.1) and Chapter 1: 1.1 to 1.5

Unit-II : Elliptic Differential Equations: Derivation of Laplace and Poisson equation – BVP – Separation of Variables – Dirichlet's Problem and Newmann Problem for a rectangle – Interior and Exterior Dirichlets's problems for a circle – Interior Newmann problem for a circle – Solution of Laplace equation in Cylindrical and spherical coordinates – Examples.
Chapter 2: 2.1, 2 2 ,2.5 to 2.13 (omit 2.3 and 2.4)

Unit-III : Parabolic Differential Equations: Formation and solution of Diffusion equation – Dirac-Delta function – Separation of variables method – Solution of Diffusion Equation in Cylindrical and spherical coordinates Examples.
Chapter 3: 3.1 to 3.7 and 3.9 (omit 3.8)

Unit-IV :**Hyperbolic Differential equations**: Formation and solution of one-dimensional wave equation – canocical reduction – IVP- d'Alembert's solution – Vibrating string – Forced Vibration – IVP and BVP for two-dimensional wave equation – Periodic solution of one-dimensional wave equation in cylindrical and spherical coordinate systems – vibration of circular membrane – Uniqueness of the solution for the wave equation – Duhamel's Principle – Examples
Chapter 4: 4.1 to 4.12 (omit 4.13)

Unit-V: Green's Function: Green's function for laplace Equation – methods of Images – Eigen function Method – Green's function for the wave and Diffusion equations. **Laplace Transform method:** Solution of Diffusion and Wave equation by Laplace Transform. **Fourier Transform Method:** Finite Fourier sine and cosine franforms – solutions of Diffusion, Wave and Lpalce equations by Fourier Transform Method.
Chapter 5: 5.1 to 5.6 Chapter 6: 6.13, 6.13.1 and 6.13.2 only (omit 6.14) Chapter 7: 7.10 to 7.13(omit 7.14)

Contents and treatment as in :

S, Sankar Rao, *Introduction to Partial Differential Equations*, 2nd Edition, Prentice Hall of India, New Delhi. 2005

References :

1. R.C.McOwen, *Partial Differential Equations*, 2nd Edn. Pearson Eduction, New Delhi, 2005.
2. I.N.Sneddon, *Elements of Partial Differential Equations,* McGraw Hill, New Delhi, 1983.
3. R. Dennemeyer, *Introduction to Partial Differential Equations and Boundary Value Problems,* McGraw Hill, New York, 1968.
4. M.D.Raisinghania, *Advanced Differential Equations,* S.Chand &
5. Company Ltd., New Delhi, 2001.

MA333 TENSOR ANALYSIS AND SPECIAL THEORY OF RELATIVITY

Credits 4:0:0

Unit I :

Tensor Algebra: Systems of Different orders – Summation Convention – Kronecker Symbols – Transformation of coordinates in S_n – Invariants – Covariant and Contravariant vectors – Tensors of Second Order – Mixed Tensors – Zero Tensor – Tensor Field – Algebra of Tensors – Equality of Tensors – Symmetric and Skew-symmetric tensors – Outer multiplication, Contraction and Inner Multiplication – Quotient Law of Tensors – Reciprocal Tensor of Tensor – Relative Tensor – Cross Product of Vectors.
Chapter I : I.1 – I.3, I.7 and I.8 and Chapter II : II.1 –II.19

Unit II :

Tensor Calculus: Riemannian Space – Christoffel Symbols and their properties
Chapter III: III.1 and III.2

Unit III :

Tensor Calculua(contd): Covariant Differentiation of Tensors – Riemann-Christoffel Curvature Tensor – Intrinsic Differentiation.
Chapter III: III.3 – III.5

Unit-IV :

Special Theory of Relativity: Galilean Transformation – Maxwell's equations – The ether Theory – The Principle of Relativity

Relativistic Kinamatics : Lorentz Transformation equations – Events and simultaneity – Example – Einstein Train – Time dilation – Longitudinal Contraction – Invariant Interval – Proper time and Proper distance – World line – Example – twin paradox – addition of velocities – Relativistic Doppler effect.
Chapter 7 : Sections 7.1 and 7.2

Unit-V

Relativistic Dynamics : Momentum – Energy – Momentum-energy four vector – Force – Conservation of Energy – Mass and energy – Example – inelastic collision – Principle of equivalence – Lagrangian and Hamiltonian formulations.
Accelarated Systems : Rocket with constant accelaration – example – Rocket with constant thrust
Chapter 7 : Sections 7.3 and 7.4

Contents and Treatment as in :
For Units I,II and III
U.C. De, Absos Ali Shaikh and Joydeep Sengupta, *Tensor Calculus*, Narosa Publishing House, New Delhi, 2004.
and
For Units IV and V
D. Greenwood, *Classical Dynamics*, Prentice Hall of India, New Delhi, 1985.

Books for Supplementary Reading and Reference:
1. P.G.Bergman, *An Introduction to Theory of Relativity,* New York, 1942.
2. M.C.Chaki, *A Text Book of Tensor Calculus*, Calcutta Publishers, 2000.
3. A.S.Eddington. *The Mathematical Theory of Relativity,* Cambridge University Press, 1930.
4. B. Spain, *Tensor Calculus*, Radha Publishing House, Kolkatta(3rd Edn), 1995.
5. I.S.Sokolnikoff, *Tensor Analysis*, John Wiley and Sons, Inc. 1964.
6. J.L.Synge and A.Schild, *Tensor Calculus,* Toronto, 1949.
7. C.E.Weatherburn, *Riemannian Geometry and the Tensor Calculus*, Cambridge, 1938.

MA334 COMPLEX ANALYSIS - I

Credits 4:0:0

Unit I : Cauchy's Integral Formula
The Index of a point with respect to a closed curve – The Integral formula – Higher derivatives. Local Properties of analytical Functions: Removable Singularities-Taylors's Theorem – Zeros and poles – The local Mapping – The Maximum Principle.
Chapter 4 : Section 2 : 2.1 to 2.3
Chapter 4 : Section 3 : 3.1 to 3.4

Unit II: The genral form of Cauchy's Theorem
Chains and cycles- Simple Continuity - Homology - The General statement of Cauchy's Theorem - Proof of Cauchy's theorem - Locally exact differentials- Multilply connected regions - Residue theorem - The argument principle.
Chapter 4 : Section 4 : 4.1 to 4.7
Chapter 4 : Section 5: 5.1 and 5.2

Unit III: Evaluation of Definite Integrals and Harmonic Functions
Evaluation of definite integrals - Definition of Harmonic function and basic properties - Mean value property - Poisson formula.
Chapter 4 : Section 5 : 5.3
Chapter 4 : Sections 6 : 6.1 to 6.3
Unit IV: Harmonic Functions and Power Series Expansions

Schwarz theorem - The reflection principle - Weierstrass theorem – Taylor's Series – Laurent series .
Chapter 4 : Sections 6.4 and 6.5
Chapter 5 : Sections 1.1 to 1.3

Unit V: Partial Fractions and Entire Functions
Partial fractions - Infinite products – Canonical products – Gamma Function- Jensen's formula – Hadamard's Theorem
Chapter 5 : Sections 2.1 to 2.4
Chapter 5 : Sections 3.1 and 3.2

Contents and Treatment as in:
Lars V. Ahlfors, Complex Analysis, (3rd edition) McGraw Hill Co., New York, 1979

Books for Supplementary Reading and Reference:
1. H.A. Presfly, *Introduction to complex Analysis*, Clarendon Press, oxford, 1990.
2. J.B. Corway, *Functions of one complex variables* Springer - Verlag, International student Edition, Naroser Publishing Co.
3. E. Hille, *Analytic function Thorey* (2 vols.), Gonm & Co, 1959.
4. M.Heins, *Complex function Theory*, Academic Press, New York,1968.

MA335 PROBABILITY THEORY

Credits 4:0:0

Unit I : Random Events and Random Variables
Random events – Probability axioms – Combinatorial formulae – conditional probability – Bayes Theorem – Independent events – Random Variables – Distribution Function – Joint Distribution – Marginal Distribution – Conditional Distribution – Independent random variables – Functions of random variables.
Chapter 1: Sections 1.1 to 1.7
Chapter 2 : Sections 2.1 to 2.9

Unit II : Parameters of the Distribution
Expectation- Moments – The Chebyshev Inequality – Absolute moments – Order parameters – Moments of random vectors – Regression of the first and second types.
Chapter 3 : Sections 3.1 to 3.8

Unit III : Characteristic functions
Properties of characteristic functions – Characteristic functions and moments – semi0invariants – characteristic function of the sum of the independent random variables – Determination of distribution function by the Characteristic function – Characteristic function of multidimensional random vectors – Probability generating functions.
Chapter 4: Sections 4.1 to 4.7

Unit IV: Some Probability distributions
One point , two point , Binomial – Polya – Hypergeometric – Poisson (discrete) distributions – Uniform – normal gamma – Beta – Cauchy and Laplace (continuous) distributions.

Chapter 5 : Section 5.1 to 5.10 (Omit Section 5.11)

Unit V : Limit Theorems
Stochastic convergence – Bernaulli law of large numbers – Convergence of sequence of distribution functions – Levy-Cramer Theorems – DeMoivre-Laplace Theorem – Poisson, Chebyshev, Khintchine Weak law of large numbers – Lindberg Theorem – Lapunov Theroem – Borel-Cantelli Lemma - Kolmogorov Inequality and Kolmogorov Strong Law of large numbers.
Chapter 6: Sections 6.1 to 6.4, 6.6 to 6.9, 6.11 and 6.12. (Omit Sections 6.5, 6.10, 6.13 to 6.15)

Contents and treatment as in:

M. Fisz, Probability Theory and Mathematical Statistics, John Wiley and Sons, New York, 1963.

Books for Supplementary Reading and Reference:

1. R.B. Ash, *Real Analysis and Probability*, Academic Press, New York, 1972
2. K.L.Chung, *A course in Probability*, Academic Press, New York, 1974.
3. Y.S.Chow and H.Teicher, *Probability Theory*, Springer Verlag. Berlin, 1988 (2nd Edition)
4. R.Durrett, *Probability: Theory and Examples*, (2nd Edition) Duxbury Press, New York, 1996.
5. V.K.Rohatgi *An Introduction to Probability Theory and Mathematical Statistics*, Wiley Eastern Ltd., New Delhi, 1988(3rd Print).
6. S.I.Resnick, *A Probability Path*, Birhauser, Berlin,1999.
7. B.R.Bhat , *Modern Probability Theory* (3rd Edition), New Age International (P)Ltd, New Delhi, 1999
8. J.P. Romano and A.F. Siegel, *Counter Examples in Probability and Statistics,* Wadsworth and Brooks / Cole Advanced Books and Software, California, 1968.

MA336 FUNCTIONAL ANALYSIS

Credits 4:0:0

Unit I: Banach Spaces
Definition – Some examples – Continuous Linear Transformations – The Hahn-Banach Theorem – The natural embedding of N in N**
Chapter 9 : Sections 46 to 49

Unit II: Banach spaces and Hilbert spaces
Open mapping theorem – conjugate of an operator – Definition and some simple properties – Orthogonal complements – Orthonormal sets
Chapter 9: Sections 50 and 51
Chapter 10: Sections 52, 53 and 54.

Unit III: Hilbert Space

Conjugate space H* - Adjoint of an operator – Self-adjoint operator – Normal and Unitary Operators – Projections
Chapter 10: Sections 55, 56,57,58 and 59.

Unit IV: Preliminaries on Banach Algebras
Definition and some examples – Regular and single elements – Topological divisors of zero – spectrum – the formula for the spectral radius – the radical and semi-simplicity.
Chapter 12 : Sections 64 to 69.

Unit V : Structure of commutative Banach Algebras
Gelfand mapping – Applications of the formula $r(x) = \lim 7\ x^n\ 7^{1/n}$ - Involutions in Banach Algebras – Gelfand-Neumark Theorem.
Chapter 13: Sections 70 to 73.

Contents and treatment as in :

G.F.Simmons , Introduction to topology and Modern Analysis, McGraw Hill International Book Company, New York, 1963.

Books for Supplementary Reading and Reference:

1. W. Rudin Functional Analysis, Tata McGraw-Hill Publishing Company, New Delhi , 1973.
2. G. Bachman & L.Narici, Functional Analysis Academic Press, New York ,1966.
3. H.C. Goffman and G.Fedrick, First course in Functional Analysis, Prentice Hall of India, New Delhi, 1987
4. E. Kreyszig Introductory Functional Analysis with Applications, John wiley & Sons, New York.,1978.

MA337 TOPOLOGY

Credits 4:0:0

Unit 1: Topological spaces
Topological spaces – Basis for a topology – The order topology – The product topology on X × Y – The subspace topology – Closed sets and limit points.
Chapter 2 : Sections 12 to 17

Unit II: Continuous functions
Continuous functions – the product topology – The metric topology.
Chapter 2 : Sections 18 to 21 (Omit Section 22)

Unit III: Connectedness
Connected spaces- connected subspaces of the Real line – Components and local connectedness.

Chapter 3 : Sections 23 to 25.

Unit IV: Compactness
Compact spaces – compact subspaces of the Real line – Limit Point Compactness – Local Compactness.
Chapter 3 : Sections 26 to 29.

Unit V: Countability and Separation Axiom
The Countability Axioms – The separation Axioms – Normal spaces – The Urysohn Lemma – The Urysohn metrization Theorem – The Tietz extension theorem.
Chapter 4 : Sections 30 to 35.

Contents and Treatment as in :
James R. Munkres, Topology (2^{nd} Edition) Pearson Education Pve. Ltd., Delhi-2002 (Third Indian Reprint)

Books for Supplementary Reading and Reference:
1. J. Dugundji , *Topology* , Prentice Hall of India, New Delhi, 1975.
2. George F.Sinmons, *Introduction to Topology and Modern Analysis*, McGraw Hill Book Co., 1963
3. J.L. Kelly, *General Topology*, Van Nostrand, Reinhold Co., New York
4. L.Steen and J.Subhash, Counter Examples in Topology, Holt, Rinehart and Winston, New York, 1970.
5. S.Willard, *General Topology*, Addison - Wesley, Mass., 1970

MA338 COMPLEX ANALYSIS- II

Credits 4:0:0

Unit I: Riemann Zeta Function and Normal Families
Product development – Extension of ζ(s) to the whole plane – The zeros of zeta function – Equicontinuity – Normality and compactness – Arzela's theorem – Families of analytic functions – The Classcial Definition
Chapter 5 : Sections 4.1 to 4.4
Chapter 5 : Sections 5.1 to 5.5

Unit II :
Riemann mapping Theorem : Statement and Proof – Boundary Behaviour – Use of the Reflection Principle.
Conformal mappings of polygons : Behaviour at an angle – Schwarz-Christoffel formula – Mapping on a rectangle.
Harmonic Functions : Functions with mean value property – Harnack's principle.
Chapter 6 : Sections 1.1 to 1.3 (Omit Section1.4)
Chapter 6 : Sections 2.1 to 2.3 (Omit section 2.4)
Chapter 6 : Section 3.1 and 3.2

Unit III : Elliptic functions
Simply periodic functions – Doubly periodic functions
Chapter 7 : Sections 1.1 to 1.3 and Sections 2.1 to 2.4

Unit IV : Weierstrass Theory

The Weierstrass $\wp$-function – The functions $\zeta(s)$ and $\sigma(s)$ – The differential equation – The modular equation $\lambda(\tau)$ – The Conformal mapping by $\lambda(\tau)$.
Chapter 7 : Sections 3.1 to 3.5

Unit V : Analytic Continuation

The Weiertrass Theory – Germs and Sheaves – Sections and Riemann surfaces – Analytic continuation along Arcs – Homotopic curves – The Monodromy Theorem – Branch points.
Chapter 8 : Sections 1.1 to 1.7

Contents and Treatment as in :

Lars F. Ahlfors, Complex Analysis, (3rd Edition) McGraw Hill Book Company, New York, 1979.

Books for Supplementary Reading and Reference:

1. H.A. Presfly, Introduction to complex Analysis, Clarendon Press, oxford, 1990.
2. J.B. Corway, Functions of one complex variables, Springer - Verlag, International student Edition, Naroser Publishing Co.
3. E. Hille, Analytic function Thorey (2 vols.), Gonm & Co, 1959.
4. M.Heins, Complex function Theory, Academic Press, New York,1968.

MA339 DIFFERENTIAL GEOMETRY

Credits 4:0:0

Unit I - Space curves:

Definition of a space curve – Arc length – tangent – normal and binormal – curvature and torsion – contact between curves and surfaces- tangent surface- involutes and evolutes- Intrinsic equations – Fundamental Existence Theorem for space curves- Helies.
Chapter I : Sections 1 to 9.

Unit II – Intrinsic properties of a surface

Definition of a surface – curves on a surface – Surface of revolution – Helicoids – Metric- Direction coefficients – families of curves- Isometric correspondence- Intrinsic properties.
Chapter II: Sections 1 to 9.

Unit III – Geodesics

Geodesics – Canonical geodesic equations – Normal property of geodesics- Existence Theorems – Geodesic parallels – Geodesics curvature- Gauss- Bonnet Theorem – Gaussian curvature- surface of constant curvature.
Chapter II: Sections 10 to 18.

Unit IV – Non Intrinsic properties of a surface

The second fundamental form- Principle curvature – Lines of curvature – Developable - Developable associated with space curves and with curves on surface - Minimal surfaces – Ruled surfaces.
Chapter III: Sections 1 to 8.

Unit V – Differential Geometry of Surfaces
Compact surfaces whose points are umblics- Hilbert’s lemma – Compact surface of constant curvature – Complete surface and their characterization – Hilbert’s Theorem – Conjugate points on geodesics.
Chapter IV : Sections 1 to 8 (Omit 9 to 15).

Contents and Treatment as in :
T.J.Willmore, An Introduction to Differential Geometry, Oxford University Press,(17th Impression) New Delhi 2002. (Indian Print)

Books for Supplementary Reading and Reference:

1. Struik, D.T. Lectures on Classical Differential Geometry, Addison – Wesley, Mass. 1950.
2. Kobayashi. S. and Nomizu. K. Foundations of Differential Geometry, Interscience Publishers, 1963.
3. Wilhelm Klingenberg: A course in Differential Geometry, Graduate Texts in Mathematics, Springer-Verlag 1978.
4. J.A. Thorpe, Elementary topics in Differential Geometry, Under - graduate Texts in Mathematics, Springer - Verlag 1979.

MA340 MATHEMATICAL STATISTICS

Credits: 4:0:0

Unit I : Sample Moments and their Functions
Notion of a sample and a statistic – Distribution functions of X , S^2 and (X , S^2) - χ^2 distribution – Student t-distribution – Fisher’s Z-distribution – Snedecor’s F- distribution – Distribution of sample mean from non-normal populations
Chapter 9 : Sections 9.1 to 9.8

Unit II : Significance Test
Concept of a statistical test – Parametric tests for small samples and large samples - χ^2 test – Kolmogorov Theorem 10.11.1 – Smirnov Theorem 10.11.2 – Tests of Kolmogorov and Smirnov type – The Wald-Wolfovitz and Wilcoxon-Mann-Whitney tests – Independence Tests by contingency tables.
Chapter 10 : Sections 10.11
Chapter 11 : 12.1 to 12.7.

Unit III : Estimation
Preliminary notion – Consistency estimation – Unbiased estimates – Sufficiency – Efficiency – Asymptotically most efficient estimates – methods of finding estimates – confidence Interval.

Chapter 13 : Sections 13.1 to 13.8 (Omit Section 13.9)

Unit IV : Analysis of Variance
One way classification and two-way classification. ***Hypotheses Testing***
Poser functions – OC function- Most Powerful test – Uniformly most powerful test – unbiased test.
Chapter 15 : Sections 15.1 and 15.2 (Omit Section 15.3)
Chapter 16 : Sections 16.1 to 16.5 (Omit Section 16.6 and 16.7)

Unit V : Sequential Analysis
SPRT – Auxiliary Theorem – Wald's fundamental identity – OC function and SPRT – E(n) and Determination of A and B – Testing a hypothesis concerning p on 0-1 distribution and m in Normal distribution.
Chapter 17 : Sections 17.1 to 17.9 (Omit Section 17.10)

Contents and Treatment as in :
M. Fisz , Probability Theory and Mathematical Statistics, John Wiley and sons, New Your, 1963.

Books for Supplementary Reading and Reference:

1. E.J.Dudewicz and S.N.Mishra , *Modern Mathematical Statistics*, John Wiley and Sons, New York, 1988.
2. V.K.Rohatgi *An Introduction to Probability Theory and Mathematical Statistics,* Wiley Eastern Ltd., New Delhi, 1988(3rd Print)
3. G.G.Roussas, *A First Course in Mathematical Statistics,* Addison Wesley Publishing Company, 1973
4. B.L.Vander Waerden, *Mathematical Statistics,* G.Allen & Unwin Ltd., London, 1968.

MA341 FLUID DYNAMICS

Credits 4:0:0

Unit I : Kinematics of Fluids in motion.
Real fluids and Ideal fluids- Velocity of a fluid at a point, Stream lines , path lines , steady and unsteady flows- Velocity potential - The vorticity vector- Local and particle rates of changes - Equations of continuity - Worked examples - Acceleration of a fluid - Conditions at a rigid boundary.
Chapter 2. Sec 2.1 to 2.10.

Unit II: Equations of motion of a fluid
Pressure at a point in a fluid at rest.- Pressure at a point in a moving fluid - Conditions at a boundary of two invircid immiscible fluids- Euler's equation of motion - Discussion of the case of steady motion under conservative body forces.
Chapter 3. Sec 3.1 to 3.7

Unit III : Some three dimensional flows.
Introduction- Sources, ranks and doublets - Images in a rigid infinite plane - Axis symmetric flows - stokes stream function

Chapter 4 Sec 4.1, 4.2, 4.3, 4.5.

Unite IV : Some two dimensional flows
Meaning of two dimensional flow - Use of Cylindrical polar coordinate - The stream function - The complex potential for two dimensional , irrotational in compressible flow - Complex velocity potentials for standard two dimensional flows - Some worked examples - Two dimensional Image systems - The Milne Thompsan circle Theorem.
Chapter 5. Sec 5.1 to 5.8

Unit V : Viscous flows
Stress components in a real fluid. - Relations between Cartesian components of stress- Translational motion of fluid elements - The rate of strain quadric and principle stresses - Some further properties of the rate of strain quadric - Stress analysis in fluid motion - Relation between stress and rate of strain- The coefficient of viscosity and Laminar flow - The Navier – Stokes equations of motion of a Viscous fluid
Chapter 8. Sec 8.1 to 8.9

Contents and Treatment as in :
F. Chorlton, Text Book of Fluid Dynamics ,CBS Publications. Delhi ,1985.

Books for Supplementary Reading and Reference :
1. Milne Thomson, *Theoretical Hydrodynamics* Macmillan ,1949.
2. Rutherford, *Fluid Dynamics*
3. Bansal , *Viscons Flow*, IBA Publishing Company.

Group- A (Electives for Semester –I)

MA342 FUZY SETS AND THEIR APPLICATIONS

Credits 4:0:0

Unit I
Fundamental Notions: Chapter I: Sec. 1 to 8

Unit II
Fuzzy Graphs: Chapter II: Sec. 10 to 18

Unit III
Fuzzy Relations: Chapter II: Sec. 19 to 29

Unit IV
Fuzzy Logic: Chapter III: Sec.31 to 40 (omit Sec. 37, 38, 41)

Unit V
The Laws of Fuzzy Composition: Chapter IV: Sec.43 to 49

Contents and Treatment as in:
A.Kaufman, Introduction to the theory of Fuzzy subsets, Vol.I, Academic Press, New York, 1975.

Books for Supplementary Reading and Reference:
H.J.Zimmermann, *Fuzzy Set Theory and its Applications*, Allied Publishers, Chennai, 1996
George J.Klir and Bo Yuan, *Fuzzy sets and Fuzzy Logic-Theory and Applications*, Prentice Hall India, New Delhi, 2001.

MA343 NUMBER THEORY AND CRYPTOGRAPHY

Credits 4:0:0

Unit I
Elementary Number Theory – Time Estimates for doing arithmetic – divisibility and Euclidean algorithm – Congruences – Application to factoring.

Unit II
Introduction to Classical Crypto systems – Some simple crypto systems – Enciphering matrices DES

Unit III
Finite Fields and quadratic Residues - Reciprocity

Unit IV
Public Key Cryptography

Unit V
Primality , Factoring and Elliptic Curves

Contents and Treatment as in:

Neal Koblitz, A Course in Number Theory and Cryptography, Springer-Verlag, New York,1987

Books for Supplementary Reading and Reference :
1. Niven and Zuckermann, *An Introduction to Theory of Numbers* (Edn. 3), Wiley Eastern Ltd., New Delhi,1976
2. David M.Burton, *Elementary Number Theory*, Wm C.Brown Publishers, Dubuque, Iowa,1989
3. K.Ireland and M.Rosen, *A Classical Introduction to Modern Number Theory*, Springer Verlag, 1972

MA344 FORMAL LANGUAGES AND AUTOMATA THEORY
Credits 4:0:0

Unit I : Finite automata, regular expressions and regular grammars

Finite state systems – Basic definitions – Nondeterministic finite automata – Finite automata with ε moves – Regular expressions – Regular grammars.
Chapter 2. Sections 2.1 to2.5
Chapter 9 Section 9.1

Unit II : Properties of regular sets.
The Pumping lemma for regular sets – Closure properties of regular sets – Decision algorithms for regular sets – The Myhill-Nerode Theorem and minimization of finite automata.
Chapter 3 : Sections 3.1 to 3.4

Unit III : Context-free grammars
Motivation and introduction – Context-free grammars – Derivation trees- Simplification of context-free grammars – Chomsky normal form – Greibach normal form.

Chapter 4 : Section 4.1 to 4.6

Unit IV : Pushdown automata
Informal description- Definitions-Pushdown automata and context-free languages – Normal forms for deterministic pushdown automat.
Chapter 5 : Sections 5.1 to 5.3

Unit V : Properties of context-free languages
The pumping lemma for CFL's – Closure properties for CFL's – Decision algorithms for CFL's.
Chapter 6 : Sections 6.1 to 6.3

Contents and Treatment as in :

John E.Hopcraft and Jeffrey D.Ullman, Introduction to Automata Theory, Languages and Computation, Narosa Publishing House, New Delhi, 1987.

Book for Supplementary Reading and Reference :

1. A. Salomaa, *Formal Languages*, Academic Press, New York, 1973.
2. John C. Martin, *Introduction to Languages and theory of Computations*
3. (2nd Edition) Tata-McGraw Hill Company Ltd., New Delhi, 1997.

MA345 PROGRAMMING IN C++ AND NUMERICAL METHODS
(Theory 50 marks + Computer Laboratory 50 marks)

Credits 4:0:0

Unit I
Tokens, Expressions and Control Structures – Functions in C++
Chapters: 3 and 4 (Balagurusamy)

Unit II

Classes and Objects – Constructors and Destructors – Operator Overloading and Type conversions
Chapters : 5, 6 and 7(Balagurusamy)

Unit III
Inheritance – Pointers – Virtual Functions and Polymorphism
Chapters 8 and 9(Balagurusamy)

Unit IV
The solution of Nonlinear Equations f(x)=0
Chapter2: Sec. 2.1 to 2.7(John H.Mathews)
Interpolation and Polynomial Approximation
Chapter 4: 4.1 to 4.4 (omit Sec. 4.5 & 4.6)(John H.Mathews)

Unit V
Curve Fitting
Chapter 5: Sec. 5.1 to 5.3 (omit Sec. 5.4)(John H.Mathews)

Solution of Differential Equations
Chapter 9: Sec. 9.1 to 9.6 (omit 9.7 to 9.9) (John H.Mathews)

Contents and Treatment as in :
John H.Mathews, Numerical Methods for Mathematics, Science and Engineering (2nd Edn.), Prentice Hall, New Delhi, 2000

Books for Supplementary Reading and Reference:

Computer Laboratory Practice Exercises : (50 marks)

Section I : Computer Language Exercises for Programming in C++ :
1 a) Define a class to represent a bank account. Include the following members : Name, Acc-no, Acc-Type, Balance. Member functions: To assign initial values, Deposit an amt, withdraw an amt after checking the balance . Write a main program to test the program for handling 10 customers.

1 b) Write a class to represent a vector (a series of float values). Include member functions to perform the following tasks: To create the vector, To modify the value of a given element, To multiply by a scalar value, To display the vector in the form (10, 20, 30,…). Write a program to test your class.

2 a) Create two classes **DM** and **DB** which store the value of distances**. DM** stores distances in meters and centimeters and **DB** in feet and inches. Write a program that can read values for the class objects and add one object **DM** with another object **DB**. Use a friend function to carry out the addition operation. The object that stores the results may be a **DM** object or **DB** object, depending on the units in which the results are required. The display should be in the format of feet and inches or meters and centimeters depending on the object on display.

2 b) Create a class **FLOAT** that contains one float data member. Overload all the four arithmetic operators so that they operate on the objects of **FLOAT**.

3 a) Define a class **string**. Use overloaded == operator to compare two strings.

3 b) Write a class called employee that contains a name and an employee number. Include a member function to get data from the user for insertion into object, and another function to display the data. Write a main() program to create an array of employee information and accept information from the user and finally print the information.

4 a) Write a function called zersmaller() that is passed two arguments to reference and then sets the smaller of the two numbers to 0. Write a main() program to exercise this function.

4 b) Write a program which shows the days from the start of year to date specified. Hold the number of days for each month in an array. Allow the user to enter the month and the day of the year. Then the program should display the total days till the day.

5 a) Write a function called reversit() that reverse a string (an array of char). Use the for loop that swaps the first and last characters, then the second and next-to-last characters and so on. The string should be passed to reversit() as argument. Write a program to exercise reversit(). The program should get a string from the user, call reversit(), and print out the result. Use an input method that allows embedded blanks.

5 b) Write a program to use a common friend function to exchange the private values of two classes.

6 a) Write a program to read a set of integer numbers from the keyboard as long as the operator does not want to exit and find the maximum number entered. Use a constructor to count the number of integers entered. This counter should be initialized to 0. Use a constructor to initialize it.

6 b) Write a program to include all possible binary operator overloading using friend function.

7 a) Write a program to read an array of integer numbers and sort it in descending order. Use readdata, putdata, and arraymax as member functions in a class.

7 b) Write a program to read two values of time and to find the greater of the two overload the '<' operator for comparison.

8 a) Write a program that has a class PUB with two derived classes BOOK and TAPE. Each of the 3 classes should have getdata() and putdata() functions to accept and display data respectively.

8 b) Write a program to read two character strings and use the overloaded '+' operator to append the second string to the first.

9 a) Write a program to accept employee information such as name, number and salary of 3 employees and display the record of the employee chosen by the user using pointers.

9 b) Write a function that takes two Distance values as arguments and returns the larger one. Include a main() program that accept two Distance values from the user, compare them and displays the larger.

10 a) Implement the concept of overloading Binary operator using friend function.

10 b) Write a program to implement the concept of object as function argument and returning objects.

11 a) Write a program for maintaining Employee Information System using Hierarchical Inheritance and stream.

11 b) Write a program to reverse a given string. "The world of computers is exciting" using pointers.

12. Develop a program Railway Reservation System using Hybrid Inheritance and Virtual Function.

13 a) i) Write a program for swapping 2 numbers using reference arguments.
ii) Write a program using inline function.

13 b) Using overloaded constructor in a class write a program to add two complex numbers.

14 a) Write a program to read the starting time of an event and the duration, the time at which the event will end. Define time as a class & start, duration, finish as objects belonging to class time. Define a function which will take as argument values of time add them and return the result.

14 b) Create a class MAT of size(m,n). Define all possible matrix operations for MAT type objects.

15 a) Write a program that determines whether a given number is a prime number or not and then prints the result using polymorphism.

15 b) Write a program to solve the general quadratic equation $ax^2 + bx + c = 0$ using the polymorphic technique.

Sections II Numerical Methods Exercises for Programming in C++:

1. Non-Linear Equations
    - 1.1 Bisection Method
    - 1.2 Regula-falsi Method
    - 1.3 Newton-Raphson Method
    - 1.4 Secant Method
    - 1.5 Fixed Point Iteration

2. Interpolation
    2.1 Lagrange's Interpolation Formula
    2.2 Newton Interpolation Formula

3. Curve Fitting
    3.1 Least-Square line
    3.2 Least-Square polynomial
    3.3 Non linear curve fitting

4. Numerical Solution to Differential Equations
    4.1 Euler's Method
    4.2 Taylor's Method of order 4
    4.3 Runge-Kutta Method of order 4
    4.4 Milne-Simpson Method

Group- B (Electives for Semester –III)

MA346 DISCRETE MATHEMATICS

Credits 4:0:0

Unit I - Lattices

Properties of Lattices: Lattice definitions – Modular and distributive lattice; Boolean algebras: Basic properties – Boolean polynomials, Ideals; Minimal forms of Boolean polynomials.
Chapter 1: § 1 A and B § 2A and B. § 3.

Unit II - Applications of Lattices

Switching Circuits: Basic Definitions - Applications
Chapter 2: § 1 A and B

Unit III - Finite Fields

Chapter 3: § 2

Unit IV : Polynomials

Irreducible Polynomials over Finite fields – Factorization of Polynomials
Chapter 3: § 3 and §4.

Unit V – Coding Theory

Linear Codes and Cyclic Codes
Chapter 4 § 1 and 2

Contents and Treatment as in:

Rudolf Lidl and Gunter Pilz, Applied Abstract Algebra, Spinger-Verlag, New York, 1984.

Books for Supplementary Reading and Reference :

1. A.Gill, *Applied Algebra for Computer Science*, Prentice Hall Inc., New Jersey.

2. J.L.Gersting, *Mathematical Structures for Computer Science*(3rd Edn.), Computer Science Press, New York.
3. S.Wiitala, *Discrete Mathematics- A Unified Approach,* McGraw Hill Book Co.

MA347 GRAPH THEORY

Credits 4:0:0

Unit I

Graphs, subgraphs and Trees : Graphs and simple graphs – Graph Isomorphism – The Incidence and Adjacency Matrices – Subgraphs – Vertex Degrees – Paths and Connection – Cycles – Trees – Cut Edges ana Bonds – Cut Vertices.
Chapter 1 (Section 1.1 – 1.7)
Chapter 2 (Section 2.1 – 2.3)

Unit II

Connectivity, Euler tours and Hamilton Cycles : Connectivity – Blocks – Euler tours – Hamilton Cycles.
Chapter 3 (Section 3.1 – 3.2)
Chapter 4 (Section 4.1 – 4.2)

Unit III

Matchings, Edge Colourings : Matchings – Matchings and Coverings in Bipartite Graphs – Edge Chromatic Number – Vizing's Theorem.
Chapter 5 (Section 5.1 – 5.2)
Chapter 6 (Section 6.1 – 6.2)

Unit IV

Independent sets and Cliques, Vertex Colourings : Independent sets – Ramsey's Theorem – Chromatic Number – Brooks' Theorem – Chromatic Polynomials.
Chapter 7 (Section 7.1 – 7.2)
Chapter 8 (Section 8.1 – 8.2, 8.4)

Unit V

Planar graphs : Plane and planar Graphs – Dual graphs – Euler's Formula – The Five-Colour Theorem and the Four-Colour Conjecture.

Chapter 9 (Section 9.1 – 9.3, 9.6)
Chapter (Section)
Contents and Treatment as in :
J.A.Bondy and U.S.R. Murthy , Graph Theory and Applications , Macmillan, London, 1976.

Books for Supplementary Reading and Reference:

1. J.Clark and D.A.Holton , A First look at Graph Theory, Allied Publishers, New Delhi , 1995.
2. R. Gould. Graph Theory, Benjamin/Cummings, Menlo Park, 1989.

3. A.Gibbons, Algorithmic Graph Theory, Cambridge University Press, Cambridge, 1989.
4. R.J.Wilson and J.J.Watkins, Graphs : An Introductory Approach, John Wiley and Sons, New York, 1989.
5. S.A.Choudum, A First Course in Graph Theory, MacMillan India Ltd. 1987.

MA348 JAVA PROGRAMMING
(Theory 50 Marks + Computer laboratory 50 Marks)

Credits 4:0:0

Unit I :
Java Tokens – Java statements – Constants – Variables – Data types
Chapters 3 and 4

Unit II :
Operators – Expressions – Decision making and Branching.
Chapters 5,6 and 7

Unit III :
Classes – Objects – Methods – Arrays – Strings – Vectors – Multiple Inheritance
Chapters 8, 9 and 10

Unit IV
Multithreaded Programming – Managing errors and Exceptions
Chapters 12 and 13

Unit V
Applet Programming
Chapter 14

Contents and Treatment as in :
E. Balagurusamy, Programming with Java – A primer , Tata McGraw Hill Publishing Company Limited, New Delhi, 1998.

Books for Supplementary Reading and Reference :

1. Mitchell Waite and Robert Lafore, Data Structures and Algorithms in Java, Techmedia (Indian Edition), New Delhi, 1999
2. Adam Drozdek, Data Structures and Algorithms in Java, (Brown/Cole), Vikas Publishing House, New Delhi, 2001.

Computer Laboratory Exercises

Section 1. CLASSES, OBJECTS, INHERITANCE,INTERFACE

1. Write a program that randomly fills a 3 by 4 array the prints the largest and smallest values in the array.

2. Design a class to represent a bank Account.Include the following members:

Data Members:	Methods:
(1) Name of the Depositor	(1)To Assign initial values.
(2)Account Number	(2)To deposit an amount.
(3)Type of account	(3)To withdraw an amount after checking the balance.
(4)Balance	(4)To display the name and balance.

Write a Java program for handling 10 customers.

3. Java lacks a complex datatype. Write a complex class that represents a single Complex number and includes methods for all the usual operations, ie: addition, subtraction, multiplication, division.

4. Create a class called Publication. Create class Tape and class Book from Publication. Describe properties for subclasses. Create an array of publication references to hold combination of books and tapes.

5. Assume that the test results of a batch of students are stored in 3 different classes.ClassStudent stores the Roll number.Class test stores the marks obtained in two subjects and Class Result contains the total marks. The Class Result can inherit the details of marks and Roll Number of students. The Weightage is stored in a seperate interface Sports. Implement the above multiple inheritance problem by using interface.

Section 2 : EXCEPTION HANDLING, MULTITHREADING AND PACKAGES

6. Write a Java program to handle different types of exceptions using try, catch and finally statements

7. Write a Java program to implement the behavior of threads.
   (a) To create and run threads.
   (b) To suspend and stop threads.
   (c) To move a thread from one state to another.
   (d) By assigning a priority for each thread.

8. Create two Threads subclasses, one witha sun() that starts up, captures the handle of the second Thread object and then calls wait(). The other class run() should call notifyall() for the first Thread after some number of seconds have passed, so that the first thread after some seconds have passed, so the first thread after some number of seconds have passed, so that the first thread can print out a message.

9. Create a thread to copy the contents of one file to another file. Write a program to implement this thread. Create multiple threads within the program to do multiple file copies.

10. Create three classes Protection, Derived and SamePackage all in same package. Class Protection is a base class for the class Derived and SamePackage is a seperate class. Class Protection has three variables each of type private,protected and public. Write a program that shows the legal protection modes of all the different variables.

Section 3: APPLET PROGRAMMING

11. Write an applet to draw the following shapes : a) Cone b)Cylinder c)Cube d) Square inside a circle e) Circle inside a square.

12. Design applet to display bar chart for the following table which shows the annual turnover of XYZ company during the period 1997 to 2000.

year	:	1997	1998	1999	2000
Turnover (in Crore)	:	110	150	100	180

13. Creating a Java applet which finds palindromes in sentences. Your applet will have two input controls; One input will be a text field for entering sentences, the other input will be a text field or scroll bar for selecting the minimum length a palindrome to be shown. Your applet will output the first 10 palindromes it finds in the sentence.

14. Write a program which displays a text message coming down the screen by moving left to right and modify the above program instead of text moving from left to right it moves top to bottom.

15. Create a thread in an applet that draws an image and makes it move along the screen.

Section 4 : AWT FORMS DESIGN USING FRAMES

16. Create a frame with two text fields and three buttons (Cut, Copy & Paste). Data entered in the first text field should response, according to the buttons clicked.

17. Create a frame that contains 3 text fields and four buttons for basic arithmetic operations. You have to enter two numbers in first two text fields. On clicking the respective button that answer should be displayed in the last text filed.

18. Create a frame with check box group containing Rectangle, Circle, Triangle, Square. If the particular value is true then the corresponding shape should be displayed.

19. Using AWT create a frame which contains four text field name,age,sex and qualification lay out using the flow layouted manager. Run the program and give the values of all text fields in the command line. Initially all the values of text field should be blank. On clicking the click button all the text fields should contain the command line inputs.

20. A car company called Maruthi is selling four models of cars. They are shown below

CODE	CAR MODEL	PRICE
800	Maruthi 800	Rs 2.14 Lakhs
1000	Maruthi 1000	Rs 3.72 Lakhs
Esteem	Maruthi Esteem	Rs 3.69 Lakhs

Zen	Maruthi Zen	Rs 3.91 Lakhs

Design a frame with 4 buttons called 800, 1000, Esteem, Zen. When we click a button the details of a particular model must appeared in an exclusive background color,text color and font.

MA 349 DATA STRUCTURES AND ALGORITHMS
(Theory 50 Marks + Computer Laboratory 50 Marks)

Credits 4:0:0

Unit I : Algorithms and Elementary Data Structures
Algorithms – Structured programs – Analysis of algorithms - Stacks and Queues – Trees – Heaps and Heapsort – Sets and disjoint set union – Graphs – Hashing.
Cahpter 1 : Sections 1.1 to 1.4
Chapter 2 : sections 2.1 to 2.6.

Unit II : The Divide and Conquer Method
The general method – Binary search – Finding the maximum and minimum – Mergesort – Quicksort – Selection sort – Strassen's matrix multiplication.
Chapter 3 : Sections 3.1 to 3.7

Unit III : The Greedy Method
The General method – Optimal storage on tapes – Knapsack problem – Job scheduling with deadlines – Optimal merge pattern – Minimum spanning trees – Single source shortest paths.
Chapter 4 : Sections 4.1 to 4.7

Unit IV : Backtracking
The general methods – The 8-queens problem – sum of subsets – Graph colouring – Hamiltonian Cycles – Knapsack problem.
Chapter 7 : Sections 7.1 to 7.6

Unit V : Branch-and-Bound and NP-Hard and NP-Complete problems
Branch and Bound Method – 0/1 knapsack problem – Traveling salesperson – Efficiency Considerations- Basic concepts of NP-Hard problems – Cook's theorem- NP-Hard graph problems – NP-Hard Scheduling Problems.
Chapter 8 : Sections 8.1 to 8.4
Chapter 11 : Sections 11.1 to 11.4 (omit 11.5 and 11.6)

Computer Laboratory Exercises
(Data structure exercises for Programming in C++)
(Laboratory Examination : 50 marks)

1. Arrays
   1.1 Operations on Arrays
   1.2 Linear Search
   1.3 Binary Search
2. Sorting
   2.1 Bubble Sort
   2.2 Selection Sort

2.3 Insertion Sort
2.4 Shell Sort
2.5 Quick Sort
2.6 Heap Sort

3. Stacks and Queues
   3.1 Operations on Stack
   3.2 Operations on Queue
   3.3 Operations on Priority Queue
   3.4 Operations on Circular Queue

4. Linked Lists
   4.1 Singly Linked List
   4.2 Doubly Linked List
   4.3 Double-ended List
5. Recursion
   5.1 Towers of Honoi
   5.2 Merge Sort
6. Binary Tree Traversal
7. Conversion of Polish Expression and Evaluation

Group- C (Electives for Semester –IV)

MA350 OPERATIONS RESEARCH

Credits 4:0:0

Unit – I : Decision Theory

Decision Environments - Decision making under certainty - Decision making under risk - Decision making under uncertainty.

Markovian Decision Process

Scope of the Markovian Decision Problem - Gardner example - Finite stage Dynamic Programming model - Infinite stage model - Linear Programming solution.
Chapter 14 : Sections 14.1 to 14.4
Chapter 19 : Sections 19.1 to 19.4

Unit II : Deterministic and Probabilistic Dynamic Programming

Recursive nature of computations in DP – Selected DP Applications – Problem of Dimensionality – A Game of chance - Investment Problem – Maximization of the event of Achieving a Goal.
Chapter 10 : Sections 10.1 to 10.5
Chapter 15 : Sections 15.1 to 15.4

Unit – III : Network Analysis

Network Definitions - Minimal spanning tree algorithm - Shortest route Problem - Maximum flow Model - Minimum cost capacitated flow problem - Linear Programming formulation - Network Simplex method – CPM and PERT.
Chapter 6, Sections 6.1 to 6.7

Unit – IV : Inventory Theory
Basic Elements of an Inventory model - Deterministic models of the following types: Single item static model with and without price breaks - Multiple item static model with storage limitation. Probabilistic Models: Continuous Review model - Single period models.
Chapter 11. Sections 11.1 to 11.3
Chapter 16. Sections 16.1 to 16.3

Unit – V : Queueing Theory
Basic elements of a queueing model - Role of Poisson and Exponential distributions - Pure Birth and Death models – Specialised Poisson Queues – M/G/1 queue - Pollaczek - Khintchine formula.
Chapter 17. Sections 17.2 to 17.7; Omit 17.6.4

Contents and Treatment as in :

Hamdy A. Taha , Operations Research (sixth edition), Prentice - Hall of India Private Limited, New Delhi.

Books for Supplementary Reading and Reference:

1. F.S. Hiller and J.Lieberman -,*Introduction to Operations Research* (7th Edition), Tata McGraw Hill Publishing Company, New Delhui, 2001.
2. Beightler. C, D.Phillips, B. Wilde ,*Foundations of Optimization* (2nd Edition),Prentice Hall Pvt Ltd., New York, 1979
3. Bazaraa, M.S; J.J.Jarvis, H.D.Sharall ,*Linear Programming and Network flow,* John Wiley and sons, New York 1990.
4. Gross, D and C.M.Harris, Fundamentals of Queueing Theory, (3rd Edition), Wiley and Sons, New York, 1998.

MA351 FINANCIAL MATHEMATICS

Credits 4:0:0

Unit I : Single Period Models
Definitions from Finance – Pricing a forward – One-step Binary Model – a ternary Model – Characterization of no arbitrage – Risk-Neutral Probability Measure

Unit II : Binomial Trees and Discrete parameter martingales
Multi-period Binary model – American Options – Discrete parameter martingales and Markov processes – Martingale Theorems – Binomial Representation Theorem – Overture to Continuous models

Unit III : Brownian Motion
Definition of the process – Levy's Construction of Brownian Motion – The Reflection Principle and Scaling – Martingales in Continuous time.

Unit IV : Stochastic Calculus
Stock Prices are not differentiable – Stochastic Integration – Ito's formula – Integration by parts and Stochastic Fubini Theorem – Girsanov Theorem – Brownian Martingale

Representation Theorem – Geometric Brownian Motion – The Feynman - Kac Representation

Unit V : Block-Scholes Model
Basic Block-Scholes Model – Block-Scholes price and hedge for European Options – Foreign Exchange – Dividends – Bonds – Market price of risk.

Contents and Treatment as in :
Alison Etheridge, A Course in Financial Calculus, Cambridge University Press, Cambridge, 2002.

Books for supplementary reading and Reference :

1. Martin Boxter and Andrew Rennie, *Financial Calculus : An Introduction to Derivatives Pricing,* Cambridge University Press, Cambridge, 1996.
2. Damien Lamberton and Bernard Lapeyre , (Translated by Nicolas Rabeau and Farancois Mantion), *Introduction to Stochastic Calculus Applied to Finance*, Chapman and Hall, 1996
3. Marek Musiela and Marek Rutkowski, *Martingale Methods in Financial Modeling,* Springer Verlag, New York, 1988.
4. Robert J.Elliott and P.Ekkehard Kopp, *Mathematics of Financial Markets,* Springer Verlag, New York, 2001 (3^{rd} Printing)

MA352 STOCHASTIC PROCESSES

Credits 4:0:0

Unit I : Markov Chains
Classification of General Stochastic Processes – Markov Chain – Examples – Transition Probability Matrix – Classifications of States – Recurrence – Examples of recurrent Markov Chains.
Chapter 1: Section 3 only
Chapter 2: Sections 1 to 6 (Omit section 7)

Unit II: Limit Theorems of Markov Chains
Discrete renewal equation and its proof – Absorption probabilities – criteria for recurrence – Queuing models – Random walk.
Chapter 3: Sections 1 to 7

Unit III: Continuous Time Markov Chains
Poisson Process – Pure Birth Process – Birth and Death Process – Birth and Death process with absorbing states – Finite State Continuous time Markov Chains.
Chapter 1: Section 2 (Poisson Process)
Chapter 4: Sections 1, 2 and 4 to 7 (Omit sections 3 and 8)

Unit IV: Renewal Processes
Definition and related concepts – Some special Renewal processes – Renewal equation and Elementary Renewal Theorem and its applications.
Chapter 5: Sections 1 to 6.

Unit V: Brownian Motion
Definition – Joint probabilities for Brownian Motion – Continuity of paths and the maximum variables – Variations and extensions – Computing some functionals of Brownian Motion by Martingale methods.
Chapter 1 : Section 2 (Brownian Motion)
Chapter 6 : Sections 1 to 5 and 7A only (Omit Sections 6, and 7B,C)

Contents and Treatments as in :
S.Karlin and H.M.Taylor. A First Course in Stochastic Processes (2nd edition), Academic Press, New York, 1975.

Books for supplementary reading:

1. Cinler E., *Introduction to Stochastic Processes,* Prentice Hall Inc., New Jersey, 1975
2. Cox D.R. & H.D.Miller, *Theory of Stochastic Processes* (3rd Edn.), Chapman and Hall, London, 1983
3. Kannan D., *An Introduction to Stochastic Processes*, North Holland, New York 1979
4. Ross S.M., *Stochastic Processes*, John Wiley and Sons, New York, 1983
5. H.W.Taylor and S.Karlin, *An Introduction to Stochastic Modeling* (3rd Edition), Academic Press, New York, 1998

MA353 RELATIONAL DATABASE MANAGEMENT SYSTEMS
(Theory 50 marks + Computer Laboratory 50 marks)

Credits 4:0:0

Unit I : Data, Information and Information Processing – Secondary storage devices – Files, File Organization and File structure – Indexing and Hashing – Introduction to DBMS – Software development Life-cycle – Database Development Life cycle – Introduction to RDBMS
Chapters 1 to 7

Unit II: Database Architecture and Data Modeling – Entity-Relationship (E-R) Modeling – Enhanced Entity-Relationship Model – Data Normalization.
Chapters 8 to 11

Unit III : Relational Algebra and Relational Calculus – Tables – SQL – Tables – Views – and Indexes – Nulls – Queries and subqueries – Aggregate functions.
Chapters 12 to 18

Unit IV: Insert, update and delete operations – cursors – Joins and Unions – programming with SQL – Query-by-example – QUEL-Triggers – Query processing and Optimization.
Chapters 19 to 26

Unit V: Database security – Data integrity – Transaction management and concurrency control – Backup and Recovery.
Chapters 27 to 30

Contents and Treatment as in :
A. Leon and M. Leon. Database Management Systems, Leon Vikas, Chennai, 2002.

Computer Laboratory Exercises (MS Access)
(Laboratory Examination: 50 marks)

1. Student Information System
2. Hospital Management system
3. Airlines Booking system
4. Personal Information system
5. Personnel Information system
6. Library Information System
7. Inventory Management system
8. Pay Bill Preparation
9. Electricity Billing System (for a region)
10. Students mark sheet processing

MA354 STATISTICAL MATHEMATICS

Credits: 4:0:0

Unit I. Fundamental statistics
Central tendencies: Mean, Median and Mode - Measures of dispersion: Range, Quartiles,Standard Deviation - Distributions: Binomial, Poisson, and Normal .

Unit II. Correlation and Regression
Linear correlation- Coefficient of correlation-Coeffient of rank Correlation- Multiple & partial Correlation. Linear regression and Multiple regressions.

Unit III. Testing of hypothesis
Large Samples- Proportions, population mean –two sample Means.
Small Samples- Student's t – test, F – test and Chi-square test for Goodness of fit.

Unit IV. Differential & Integral calculus
Differentiation- Trigonometry, polynomial, exponential, logarithmic, Implicit, hyperbolic & inverse circular functions. Integration- Trigonometric, exponential, logarithmic and Rational functions. Double and Triple Integrals.

Unit V. Differential equations
Linear differential equation of the type Second order, Euler- homogeneous linear differential and Simultaneous differential equations.

Reference Books:

1. Differential Calculus by T.K. Manickavasagam Pillai S.Vishvanathan Printers&Publishers Pvt. Ltd.
2. Engineering Mathematics (Volume-III & I) by P. Kandasamy, K. Thilagavathy and K. Gunavathy, S. Chand & Company Ltd.
3. Statistics by Sharma & Goyel

M. Phil. (MATHEMATICS)

MA355 RESEARCH METHODOLOGY

Credits 4:0:0

Unit I: Bounded Linear Operators:
Uniformly continuous semigroups of bounded linear operators – Strongly continuous semigroups of bounded linear operators – The Hille-Yosida theorem – The Lumer Phillips theorem.

Unit II: Infinitesimal Generators and Semigroups:
The characterization of the infinesimal generators of Co semigroups – Groups of bounded operators – The inversion of the Laplace transform – Two exponential formulas.

Unit III: Spectral Theory:
Weak equal strong – Spectral mapping theorem – Semigroups of compact operator – Differentiability – Analytic semigroups.

Unit IV: Fundamental Group:
Homotopy of Paths – Fundamental Group – Covering Spaces – Fundamental Groups of the Circle and S^n.

Unit V: Separation Theorems in the Plane:
Jordan Separation Theorem – Invariance of Domain – Jordan Curve Theorem.

Treatment as in:
A. PAZY, Semigroups of Linear Operators and Applications to Partial Differential Equations, Springer-Verlag, New York, 1983.

Unit I: Chapter 1 Sections 1.1 – 1.4
Unit II: Chapter 1 Sections 1.5 – 1.8
Unit III: Chapter 2 Sections 2.1 – 2.5
J.R. Munkres, Topology, 2nd Edition, Pearson Education (Singapore) Pvt. Ltd., 2000.
Unit IV: Chapter 9 Sections 51.54, 57 and 59
Unit V: Chapter 10 Sections 61-63.

Reference Books:

1. A.V. Balakrishnan, Applied Functional Analysis, Springer-Verlag, New York, 1976.
2. J.A. Goldstein, Semigroups of Linear Operators and Applications, Oxford University Press, New York, 1985.
3. J. Dugundji, Topology, Allyn and Bacon, Boston, 1966.
4. W.S. Massey, Algebraic Topology-An Introduction, Springer-Verlag, New York, 1976.

MA356 MATHEMATICAL METHODS

Credits 4:0:0

Unit I: Elementary Fixed Point Theorems:
Fixed point spaces – Forming new fixed point spaces from old – Topological transversality – Factorization technique – Banach contraction principle – Elementary domain invariance – Continuation method for cotractive maps – Nonlinear alternative for contractive maps – Extensions of the Banach theorem – Miscellaneous results and examples.

Unit II: Fixed Points for Compact Maps in Normed Linear Spaces:
Compact and completely continuous operators – Schauder projection and approximation theorem – Extension of the Brouwer and Borsuk theorems – Topological transversability. Existence of essential maps – Equation $x = F(x)$. The Leray-Schauder principle – Equation $x = \lambda F(x)$. Birkhoff-Kellogg theorem – Compact fields – Equation $y = x – F(x)$. Invariance of domain – Miscellaneous results and examples.
Treatment as in:
A. Granas and J. Dugundji, Fixed Point Theory, Springer, 2003.

Unit I: Chapter 0: Sections 1-4 and Chapter 1: Sections 1-6.
Unit II: Chapter 6: Sections 1-9.
Unit III: Perturbation Methods:

Parameter Perturbations – An algebraic equation – The Van der pol oscillator – Coordinate perturbations – Bessel equation of zeroth order – A simple example – Order symbols and Guage functions – Asymptotic series – Asymptotic expansions – Uniqueness of Asymptotic expansions – Convergent versus asymptotic series – Nonuniform expansions – Elementary operations on asymptotic expansions – Straight forward expansions and sources of Nonuniformity – Infinite domains – The Duffing equation – A model for weak nonlinear instability – A small parameter multiplying the highest derivative – A second order example – Relaxation oscillations – Type change of a partial differential equation – A simple example – The presence of singularities – Shift in singularity – The earth-moon spaceship problem – The role of coordinate systems – The method of strained parameters – The Lindstedt-Poincare Method – transition curves for the Mathieu equation – Lighthill's Technique – A first order differential equation.

Treatment as in: A.H Nayfeh, Perturbation Methods, John Wiley & Sons, New York, 1973.

Chapter 1Sections 1.1-1.7

Chapter 2 Sections 2.1.1, 2.1.2, 2.2.1, 2.2.3, 2.3.1, 2.4.1, 2.4.2 & 2.5.

Chapter 3 Sections 3.1.1, 3.1.2, 3.2.1.

Unit IV: Finite Element Methods:

Finite elements – Line segment – Triangular element – Linear Lagrange polynomial – Numerical Integration over finite element – Finite element methods – Ritz finite element method – Least square finite element method – Galerkin finite element method – Convergence analysis – Boundary value problems in ordinary differential equations – Assembly of element equations – Mixed Boundary Conditions – Galerkin method.

Treatment as in:

M.K. Jain, Numerical Solution of Differential Equations, New Age International Pvt. Ltd., New Delhi, 2002.

Chapter 8 (Relevant sections only from sections 8.4, 8.5 and 8.6.

Unit V: Finite Volume Method:

Finite volume method for Diffusion Problems: Finite volume for one dimensional steady state diffusion – Worked examples – Finite volume method for two dimensional diffusion problems – Finite volume method for three dimensional diffusion problems – Summary of discretised equations for diffusion problems.

Finite volume method for Convection-Diffusion Problems: Steady one dimensional convection and diffusion – The central differencing schemes.

Treatment as in:

H.K. Versteeg and W. Malalasekera, An Introduction to Computational Fluid Dynamics, Longman Scientific & Technical, England, 1995.

Chapter 4

Chapter 5 Sections 5.1-5.4.

Reference Book:

S.V Patankar, Numerical Heat Transfer and Fluid Flow, Hemisphere Publishing Corporation, New York, 1980.

MA357 GRAPHS AND NETWORKS

Credits 4:0:0

Unit I: Connectivity and Networks:
K-connected Graphs: 2-Connected graphs – Connectivity of digraphs – K-Connected and K-edge connected graphs – Applications of Monger's theorem. Network Flow Problems: Maximum network flow – Integral flows – Supplies and Demands.

Unit II: Perfect Graphs:
The perfect graph theorem – Chordal graphs revisited – other classes of perfect graphs – Imperfect graphs – the strong perfect graph conjecture.

Unit III: Matroids:
Hereditary systems and examples – Properties of matroids – the span function and duality – minors and planar graphs – matroid intersection and matroid union.

Unit IV: Random Graphs*:*
Existence and Expectation – Properties of Almost All Graphs – Threshold Functions – Evolution and properties of Random Graphs – Connectivity, Cliques and Coloring – martingales.

Treatment as in: Douglas B. West, Introduction to Graph Theory, Prentice Hall of India, 1999.

Unit I: Chapter 4 – Sections: 4.2 and 4.3(Pages 144-172)
Unit II: Chapter 8 – Section: 8.1 (Pages 288-320)
Unit III: Chapter 8 – Section 8.2(Pages 320-347)
Unit IV: Chapter 8 – Section 8.5(Pages 405-429)

Unit V: Decompositions and Labelings*:*
Factorizations and Decompositions of Graphs – Labelings of graphs.

Treatment as in: G. Chartrand and L. Leshiak, Graphs and Digraphs, Chapman and Hall/CRC, 1996.

Chapter 9: Sections 9.2 and 9.3

MA358 FUZZY MATHEMATICS

Credits 4:0:0

Unit I: Basic Notions and Concepts of Fuzzy Sets:
Set Membership and Fuzzy Sets-Types of Membership Functions-Characteristics of a Fuzzy Set-Generalization of Fuzzy Sets-Fuzzy Set Operations.

Unit II: Characterization of Fuzzy Sets:
Entropy Measures of Fuzziness-Energy Measures of Fuzziness-Specificity of a Fuzzy Set—Decoding Mechanisms for Pointwise Data-Distance between Fuzzy Sets.

Unit III: Fuzzy Relations:

Relations and Fuzzy Relations-Operations on Fuzzy Relations-Binary Fuzzy Relations-Some Classes of Fuzzy Relations-Fuzzy Relational Equations-Generalizations of Fuzzy Relational Equations.

Unit IV: Fuzzy Numbers:
Definition-Interval Analysis and Fuzzy Numbers-Computing with Fuzzy Numbers-Triangular Fuzzy Numbers and Basic Operations-Fuzzy Numbers and Approximate Operations. *Fuzzy Logic*: Introduction-Propositional Calculus-Predicate Logic-Many Valued Logic-Fuzzy Logic-Computing with Fuzzy logic.

Unit V: Fuzzy Computational Models:
Rule-Based Computations-Syntax of Fuzzy Rules-Computing with fuzzy Rules- Rule Consistency and Completeness-Neural Networks-Logic Based Neurons-Fuzzy Neural Network-Fuzzy Cellular Automata.

***Reference Books*:**
1. Witold Pedrycz and Fernando Gomide, An Introduction to Fuzzy Sets-Analysis and Design,
Prentice-Hall of India Pvt. Ltd, 2005.
2. Zimmermann, H.J.,Fuzzy Set Theory and its Applications, Dordrecht, Kluwer,1985

MA359 DIFFERENCE EQUATIONS

Credits 4:0:0

Unit I: Dynamics of First Order Difference Equations:
Introduction – Linear First Order Difference equations – Equilibrium points – Criteria for Asymptotic of equilibrium points – Period points and cycles – The Logistic equation and Bifurcation

Unit II: Linear Difference Equations of Higher order:
Difference calculus – General theory of linear difference equations – Linear homogeneous equations with constant coefficient – Linear nonhomogeneous equations – Limiting behaviour of variation of constants(parameters) – Nonlinear equations transformable to linear equation

Unit III: Systems of Difference Equations:
Autonomous(time-Invariant) systems – The Basic Theory – The Jordan Form: Autonomous(Time-Invariant) – linear periodic systems – Applications

Unit IV: Asymptotic Behaviour of Difference Equations:
Tools of approximation – Pioneer's theorem – Second order difference equations – Asymptotically diagonal systems – High order Difference equations – Nonlinear difference equations

Unit V: Oscillation Theory:
Three term difference equations – Nonlinear difference equation – Self-adjoint second order equations

Treatment as in: Sabe N. Elaydi, An Introduction to Difference Equations, 1st Edition, Springer-Verlag, New York Berlin, 1996.

MA360 OPTIMIZATION TECHNIQUES

Credits 4:0:0

Unit I: Dynamic programming:
Elements of the DP Model: The Capital Budgeting – More on the Definition of the state – Examples of DP models and computations – Problem of Dimensionality in Dynamic Programming – Solution of Linear programs by Dynamic Programming.
Chapter 10

Unit II: Decision Theory and Games:
Decisions under Risk – Decision under Uncertainty – Game Theory.
Chapter 12

Unit III: Inventory Models:
The ABC Inventory system – A Generalized Inventory Models – Deterministic Models – Just-in-Time (JIT) manufacturing system.
Chapter 14

Unit IV: Queuing Models:
Role of Poisson and Exponential Distribution – Processes Birth and Death – Queues with Combined Arrival and Departures – Non-Poisson Queues – Queues with Priorities for Service – Tandem or Series Queues.
Chapter 15

Unit V: Nonlinear Programming:
Unconstrained Extremal Problems – Constrained Extremal problems – Constrained Extremal problems – Nonlinear Programming Algorithm – Unconstrained Nonlinear Algorithms – Constrained Nonlinear Algorithms.
Chapter 19
Chapter 20

Treatment as in:
Operations Research – An Introduction (Fifth Edition-1996) H. A. Taha, Prentice Hall of India (P) Limited, New Delhi, 1996.

Reference Books:

1. Operations Research: Principals and Practice, DON'T PHILLIPS, Ravin dran, J. Solberg, John Wiley & Sons, 1976.
2. Engineering Optimization: Singiresu S. Rao, 3rd Edition, New Age International (P) Ltd., New Delhi, 1996.

MA361 STATISTICAL METHODS

Credits 4:0:0

Unit I: Statistics
Measures of central tendency – Measures of Dispersion — Binomial –Poisson -Normal distributions.

Unit II: Correlation
Correlations and regression, - Correlations coefficients – correlations coefficients in terms of regression coefficients, Rank correlation and repeated ranks.

Unit III: Testing of Hypothesis
Population- sample- one tail and two tailed tests- Large samples-proportion and mean – Small Samples – t, F, Chi-square Distributions.

Unit IV Design of experiments and quality control
Aim of the design of experiments – completely randomized design- analysis of variance for one factor of classification – randomized block design- analysis of variance for two factors of classification- Latin square design – analysis of design for three factors of classification- comparison of RBD and LSD.

Unit V: SQC
Introduction – Types of variation – types of control charts – X chart, R. Chart, Sigma Chart, C- Chart, Advantages and Limitations of SQC – Acceptance sampling – Single acceptance sampling plan, double sampling plan, multiple sampling plan, construction of a OC curve – AQL and LTPD.

Text Books:

1. Statistical Methods by S.P. Gupta, Sultan Chand and sons, New Delhi.
2. Method of Statistical Analysis by P.S.Grewal, Sterling publishers pvt.Ltd., New Delhi
3. T.Veerarajan, Theory of Probability and Random Process, Tata McGraw Hill
4. Publishing Company

MA362 GRAPHS, RANDOM PROCESSES AND QUEUES

Credit: 4:0:0

Unit - I
Topics in Graph Theory: Graphs – Euler paths and Circuits – Hamiltonian paths and circuits – Transport Networks – Matching Problems - Coloring graphs.

Unit – II
Trees: Trees – Labeled Trees – Tree Searching – Undirected Trees – Minimal Spanning Trees.

Unit – III
Probability Theory: Axiomatic definition of Probability – Conditional Probability – Independent events – Theorem of Total probability – Baye's Theorem – Discrete Random Variable – Probability function – Continuous Random variable – Probability Density function – Cumulative Distribution Function(Cdf) – Properties of Cdf – Special Discrete Distribution – Mean and Variance , MGF of Binomial and Poisson distribution –[

Unit – IV
Random Processes: Classification – Methods of Description – Special classes – Average Values – Stationary – Example of SSS – Analytical representations – Weiner Process function – Auto correlation – Properties of R(τ) – cross Correlation – Properties – Ergodicity – Mean Ergodic theorem – Correlation Ergodic process – Power spectral density and its properties.

Unit – V
Queueing Theory: Symbolic representation of Queueing model – Model 1: M/M/1: ∞/FIFO – Model I M/M/C : ∞/FIFO – Model III : M/M/1 : N/FIFO – Formulae and problems of above models.

Text Books:

1. Bernard Kolman, Robert C. Busby and Sharon Ross, Discrete Mathematical Structures, 5th Edition, Pearson Education, 2004, ISBN: 81-297-0465-X
2. T. Veerarajan, Probability , Statistics and Random processes, 2nd Edition, Tata McGraw Hill, 2006. ISBN: 0-07-060170 – 4.
3. Kanti Swarup, Man Mohan, P.K. Gupta, "Operations Research", Sultan Chand & Sons, 1991.

Reference Books:

1. Narsingh Deo, Graph Theory with Application to Engineering and Computer Sciences, Prentice-Hall of India Private Ltd., 2000
2. Hamdy A. Taha, "Operation Research", Maxwell Macmillan.
3. Kandasamy P. , Thilagavathy, Gunavathy, "Probability, Random Process and Queueing Theory, S. Chand & Co. New Delhi, 2007

ADDITIONAL SUBJECTS

Code	Subject Name	Credits
09MA201	Mathematical Transforms	3:1:0
09MA202	Discrete Mathematics for Bioinformaticians	3:1:0
09MA203	Applied Statistics & Operations Research	3:1:0
09MA204	Computer Literacy with Numerical Analysis	3:1:0
09MA205	Discrete Mathematics	3:1:0
09MA301	Discrete Mathematics	4:0:0
09MA302	Statistics and Numerical Methods	4:0:0
09MA303	Resource Management Techniques	4:0:0
09MA304	Operations Research Techniques	4:0:0
09MA305	Applied Mathematics	4:0:0
09MA306	Probability and Statistics for Water Resources Management	4:0:0
09MA307	Graphs, Optimization and Statistics	4:0:0
09MA308	Graphs, Random Processes and Queuing Theory	4:0:0
09MA309	Computational Mathematics	4:0:0
09MA310	Advanced Applied Mathematics	4:0:0
09MA311	Graph Theory and Optimization Techniques	4:0:0
09MA312	Special Course in Engineering Mathematics	4:0:0
09MA313	Abstract Control Theory	4:0:0
09MA314	Theory of Near-Rings	4:0:0

09MA201 MATHEMATICAL TRANSFORMS

Credit: 3:1:0

Objective: *To provide the student with the concept and an understanding of basic concepts in Differential Equation, Laplace Transforms, Fourier Series, Fourier Transforms and Z Transforms for Analysis and Modeling in Media Technology.*

Unit I : Differential Equations
First order linear differential equations – second and higher order linear differential equations with constant coefficients with RHS of the form e^{ax}, x^n, sin ax, cos ax,e^{ax}f(x), f(x)where f(x) is sin ax or cos bx – differential equations with variable coefficients (Euler's form) – Simultaneous equations – method of variation of parameters.

Unit : II : Laplace Transforms
Laplace Transforms Definition – transform of standard functions – properties – transform of derivatives and integrals. Transforms of the type e^{at} f(t), tf(t) and f(t)/t – Inverse Laplace transform – Convolution theorem. Transform of periodic functions: unit step function and unit impulse function – application to ordinary differential equation with constant coefficients.

Unit III : Fourier Series
Euler's formula – Dirichlet's conditions convergence statement only – change of interval odd and even functions. Half range series – Rms value, Parseval's formula – complex form of Fourier series – harmonic analysis.

Unit IV : Fourier Transforms
The infinite Fourier transform – sine and cosine transforms – properties – inversion theorem – Finite Fourier Transform – sine and cosine transforms – convolution theorem – Parseval's identity – transform of derivatives.

Unit V: Z - Transforms
Z-transforms of standard functions, inverse Z-transform (Using partial fraction expansions), properties of Z-transform, Solution of difference equations

Text Books:

1. Kandasamy, Thilagavathi .K and Gunavathi K., Engineering Mathematics (8^{th} revised Edition), S. Chand & Co., New Delhi, 2008
2. Veerarajan T, Engineering Mathematics (for Semester III), Tata McGraw Hill Pub. Com. Ltd. 2007

Reference Books:

1. Kreyszig, E., "Advanced Engineering Mathematics" (8th Edition), John Wiley and Sons (Asia) Pte Ltd., Singapore, 2000
2. Grewal, B.S., "Higher Engineering Mathematics" (6th Edition) Khanna Publisher, New Delhi, 2001

09MA202 DISCRETE MATHEMATICS FOR BIOINFORMATICIANS

Credit: 3:1:0

Objective: To provide the student with the concept and an understanding of Sets, Order Relations and Structures, Numerical Methods for Analysis and Modeling in Bio Informatics.

Unit I: FUNDAMENTALS
Sets and subsets - Operations on sets, Logic: Prepositions - Conditional statements - Methods of Proof - Mathematical Induction

Unit : II : COUNTING
Permutations – Combinations - Pigeonhole Principle - Elements of Probability - Recurrence Relation Functions: Permutation Function

Unit: III ORDER RELATIONS AND STRUCTURES
Partially Ordered Sets - Extremal elements of partially ordered sets – Lattices - Finite Boolean Algebra - Functions on Boolean Algebra

Topics in Graph Theory:
Graphs - Euler Paths and circuits - Hamiltonian Paths and Circuits - Transport Networks and Traveling salesman problem

Unit: IV NUMERICAL METHODS
Numerical Errors – Roots of Transcendental Equations – Bisection method – Newton-Raphson method. Simultaneous Equation – Gauss elimination, Gauss-seidal method – Interpolation formula – Newton-Gregory formula [Forward and backward difference] – Principle of least squares – Fitting a straight line.

Unit: V NUMERICAL INTEGRATION AND DIFFERENTIATION.
Numerical Integration – Trapezoidal rule – Simpson's one third rule (with derivation). Numerical differentiation – Taylor's series method (I order only) – Euler's Method – Runge Kutta method. [2^{nd} and 4^{th} order only]

Text Books:

1. Bernard Kolman, Robert C. Busby and Sharon Ross "Discrete Mathematical Structures" PH 1(2005), 5^{th} Edition.
2. P. Kandasamy., K. Thilagavathy., K. Gunavathy, "Numerical Methods", S. Chand & Co, New Delhi. (2007)

Reference Books:

1. Lipschultz, Discrete Mathematics, Schaum's Series (2002)
2. J.P. Tremblay, R. Manohar, Discrete Mathematical Structures with Applications to Computer Science, McGraw Hill, 1987.

09MA203 APPLIED STATISTICS AND OPERATIONS RESEARCH

Credit: 3:1:0

Objective: To provide the student with the concept and an understanding of Testing of Hypothesis, Analysis of Variance, Operations Research Techniques for Analysis and Modeling in Food Technology.

Unit – I Testing of Hypothesis

Population- sample- one tailed and two tailed tests- Large samples-proportion and mean – Small Samples – t, F,χ^2 Distributions

Unit – II Analysis of Variance
Aim of the design of experiments – completely randomized design- analysis of variance for one factor of classification – randomized block design- analysis of variance for two factors of classification- Latin square design – analysis of design for three factors of classification- comparison of RBD and LSD

Unit – III Linear Programming Problem
The Linear Programming Problem - Introduction, formulation of Linear Programming problem, Limitations of L.P, Graphical solution to L.P.P, Simplex Method, Artificial variable techniques, two phase Method, Variants of the Simplex Method.

Unit – IV Transportation & Assignment
THE TRANSPORTATION PROBLEM: Introduction, Transportation Model, transportation problem as an L.P model, finding initial basic feasible solutions, moving towards optimality, Degeneracy. Assignment Problem - Introduction, Mathematical formulation of the problem, Solution of an Assignment problem, Multiple Solution, Hungarian Algorithm, Maximization in Assignment Model.

Unit –V Networking
Network analysis– PERT & CPM- network diagram- crash time- cost analysis.

Text Books:

1. T. Veerarajan, Probability, Statistics & Random Processes, Tata McGraw Hill, II Edn., 2006
2. Kanti Swarup, Manmohan , P.K. Gupta "Operations Research" – Sultan Chand & Sons., 14th Edn. 2008.

Reference Books:

1. Winston, - Operations Research, Applications and Algorithms – CENGAGE Learning, 2004/ 4th Edn.
2. Hamdy, A. Taha, Operations Research (Sixth Edition) Prentice – Hall of India Private Limited, New Delhi, 2001.
3. Gupta,S.C and Kapoor, V.K., Fundamentals of Mathematical Statistics, Sultan Chand and Sons, New Delhi, 2001.

09MA204 COMPUTER LITERACY WITH NUMERICAL ANALYSIS

Credit: 3:1:0

***Objective**: To provide the student with the concept and an understanding of basic concepts in Computers and Control Structures and Numerical Methods for Analysis and Modeling in Technology.*

Unit I:
Introduction: Computers- Classification of Computers- System Software- Software Lifecycle – Algorithms – Flowcharts – Pseudo code – Structured programming – Compilers – Operating Systems – Running C programs. Variables and Expressions: Introduction – Character set – Identifiers and keywords – Variables – Characters and Character strings. Basic Input-Output: Introduction – Single character Input-Output – String Input and Output – Types of characters in format strings – Scanf width specifier – Input fields for scanf.

Unit II:
Control Structures: Introduction – If statement – Multiway decision – Compound statements – Loops – Break switch continue and Goto statements. Functions: Introductions – Function main – Functions

accepting more than one parameter – User defined and Library functions – Functions parameters – Return. Arrays: Introduction – How arrays are useful – Multidimensional arrays

Unit III:
The Solution of Numerical Algebraic and Transcendental Equations-Bisection method– Successive approximation method – False position method – Newton Raphson method – Gauss Elimination method - Eigen values and Eigen vectors–Power Method.

Unit IV:

Numerical differentiation – Newton's forward difference formula. Integration-Trapezoidal rule-Simpsons $1/3^{rd}$ rule-Newton's three eighth. Solution of differential equations-Predictor-corrector method-Runge-Kutta method.

Unit V:

Implementation of the following numerical methods in C programming

1. Newton-Raphson method to find smallest positive root.
2. Gauss-Seidel iteration method
3. Derivate at initial point by Newton's forward formula
4. Numerical integration using Trapezoidal rule & Simpson rule
5. Numerical differentiation using Runge-Kutta method

Text Books

1. K R Venugopal S R Prasad, *Mastering in C.* Tata McGraw Hill Publishing Company Limited, 2nd reprint 2007
2. P. Thangaraj, *Computer – Oriented Numerical methods,* Prentice Hall of India (p) Ltd, 2008

Reference Books:

1. T. Veerarajan, T. Ramachandran, Numerical Methods with Programs in C, Tata McGraw Hill (Second Edn.), 2008.
2. P.Kandasamy, K. Thilagavathy, K. Gunavathy, Numerical Methods – S.Chand & Co. Ltd. 2009.

09MA205 DISCRETE MATHEMATICS

Credit: 3:1:0

Objective: To provide the student with the concept and the understanding of basic concepts in logic, relations and digraphs, lattice and Boolean algebra, graph theory and automata theory for analysis and modeling for computer science and engineering.

Unit I
Fundamentals: set and subsets – operation on sets – sequences – division in the integers – matrices – mathematical structures.
Logic: propositions and logical operation – conditional statements – methods of proof – mathematical induction – Recurrence relation.

Unit II

Relations and digraph: products sets and partitions – relations and digraphs – paths in relations and digraphs – properties of relations – equivalence of relations – computer representation of relations and digraphs – operations on relations – transitive closure and Wars hall's algorithm.
Functions: functions – functions for computer science – growth of functions – permutation functions.

Unit III
Order relations and structures: partially ordered sets – external elements of partially ordered sets – lattices – finite Boolean algebras – functions on Boolean algebra.
Trees: trees – labeled trees – tree searching – undirected trees – minimal spanning trees.

Unit IV
Topics in graphs theory: graphs –euler paths and circuits –Hamiltonian Paths and circuits – transport networks – matching problems – coloring graphs.
Semi-groups and groups: binary operations revisited – semi-groups.

Unit V
Languages and finite state machines : languages – representations of special grammars and languages – finite state machines – monoids ,machines and languages – machines and regular languages – simplification of machines.
Groups and coding: coding of binary information and error detection – decoding and error correction.

Text Book:
1. Bernard Kolman, Robert C. Busby, Sharon Cutler Ross, "Discrete Mathematical Structures", 5th Edition, Pearson Education, 2004.

Reference Books:

1. Kenneth Roshan, Discrete Mathematics and its Applications, Tata McGraw Hill Ltd, Fifth Edition, 2003.
2. T. Veerarajan, Discrete Mathematics, Tata McGraw Hill Ltd. 2008

09MA301 DISCRETE MATHEMATICS

Credit: 4:0:0

Objective: To provide the student with the concept and an understanding of basic concepts in Differential Equation, Laplace Transforms, Fourier Series, Fourier Transforms and Z Transforms for Analysis and Modeling in Media Technology.

Unit I:
Logic - Propositional Equivalences - Predicates and Quantifiers-Nested Quantifiers - Methods of Proof – Sets - Set operations - Functions (Chapter 1).
Boolean Functions - Representing Boolean Functions – Logic Gates – Minimization of Circuits (Chapter 10).

Unit II:
Proof Strategy – Sequences and Summations – Mathematical Induction – Recursive Definitions and Structural Induction – Recursive Algorithms – Program Correctness (Chapter 3).

Relations and their Properties – *n*-ary Relations and their applications – Representing Relations – Closure of Relations – Equivalence Relations – Partial Orderings (Chapter 7).

Unit III:
Introduction to Graphs – Graph Terminology – Representing Graphs and Graph Isomorphism – Connectivity – Euler and Hamiltonian Paths – Shortest Path Problems – Planar Graphs – Coloring Graphs (Chapter 8).

Unit IV:
Introduction to Trees – Applications of Trees – Tree Traversal – Spanning Trees – Minimum Spanning Trees (Chapter 9).

Unit V:
Languages and Grammars – Finite-State Machines with Output – Finite-State Machines with No Output – Language Recognition – Turing Machines (Chapter 11).

Text Book:
1. Kenneth H. Rosen, *Discrete Mathematics and its Applications,* Fifth Edition, Tata McGraw-Hill Edition, 2003, ISBN: 0-07-053047-5.

Reference Books:
1. Edgan G.Goodaire, Michael M. Parmeter, *Discrete Mathematics with Graph Theory*, Third Edition, 2003, ISBN: 81-203-2121-9.
2. Lipschultz, Discrete Mathematics, Schaum's Series (2002)

09 MA302 STATISTICS AND NUMERICAL METHODS

Credit: 4:0:0

Objective: To provide the student with the concept and an understanding of basic concepts in Statistics, Probability and Numerical Methods for Analysis and Modeling in Computer Applications.

Unit I:
Introduction–Statistics-Definition–Functions–Applications–Limitations.Classifications–Discrete Frequency distributions, Continous Frequency distribution–Graphs of frequency Distribution–Histogram, Frequency Polygon. Measures of central Value–Mean, Median, Mode–Merits and Demerits– Measures of Dispersion– Range,Mean deviation, Standard deviation. (Chapters–Volume I: 1,5,6,7,8)

Unit II:
Correlation Analysis – Scatter Diagram – Karl Pearsons Coefficient of correlation – Rank Correlation – Regression Analysis–Regression Lines–Regression Equations. (Chapters– Volume I: 10 & 11)

Unit III:
Probability and Expected value–Theorems of Probability–conditional probability-Bayes Theorem–Mathematical Expectation. Theoretical Distributions:- Binomial distribution, Poisson distribution and Normal distribution. (Chapters-Volume II: 1 & 2)

Unit IV:
The Solution of Numerical Algebraic and Transcendental Equations-Bisection method– Successive approximation method –False position method–Newton Raphson method– Simultaneous Linear Algebraic Equations-Gauss Elimination method-Jacobi method –Pivotal condensation-Gauss seidal-Gauss Jordan –Eigen values and Eigen vectors–Power Method. (Chapters–3 & 4)

Unit V:
Numerical differentiation-Newtons forward and backward difference formula. Integration-Trapezodral rule-Simpsons 1/3rd rule-Newtons three eighth. Solution of differential equations-Tailyors series-Eulers Method, Predictor-corrector method-Runge-Kutta method. (Chapters–9 & 11)

Text Books
1. S.P.Gupta, *Statistical Methods*, 33rd edition, Sultan Chand & Co., 2004. ISBN: 81-8054-214-9.
2. M.K.Venkataraman, *Numerical Methods in Science and Engineering*, 5th edition,The National Publishing Company, 1999.

Reference Books:
1. P. Kandasamy, K. Thilagavathy, K. Gunavathy., Numerical Methods – S. Chand & Co. Ltd. Reprint 2009.
2. T. Veerarajan, T. Ramachandran – Numerical Methods with Programs in C – Second Edn. 2006, Tata McGraw Hill Publishing Company Ltd.

09MA303 RESOURCE MANAGEMENT TECHNIQUES

Credit: 4:0:0

Objective: To provide the student with the concept and an understanding of basic concepts in Operations Research Techniques for Analysis and Modeling in Computer Applications.

Unit I:
The Linear Programming Problem - Introduction, formulation of Linear Programming problem, Limitations of L.P, Graphical solution to L.P.P, Simplex Method, Artificial variable techniques, two phase Method, Variants of the Simplex Method.

Unit II:
Duality In Linear Programming - Concept of duality, Fundamental properties of Duality, Duality & simplex method, Dual simplex method. THE TRANSPORTATION PROBLEM: Introduction, Transportation Model, transportation problem as an L.P model, finding initial basic feasible solutions, moving towards optimality, Degeneracy.

Unit III:
Assignment Problem - Introduction, Mathematical formulation of the problem, Solution of an Assignment problem, Multiple Solution, Hungarian Algorithm, Maximization in Assignment Model, Impossible Assignment. Inventory Models: Purchasing model: No Shortages, Manufacturing Model: No Shortages, EOQ: System of Ordering.

Unit IV:
Sequencing - Job sequencing, n jobs through two machines, two jobs through m machines, n jobs through m machines. QUEUING THEORY: Introduction, Definition of terms in Queuing model, problem-involving M\M\1: α \FIFO queue, M\M\M : FCFS\μ\μ, M\M\1 : FCFS\N\μ, M\M\S : FCFS\μ\μ

Unit V:
Replacement Of Model - Replacement of items with gradual deterioration, items deteriorating with time value of money, items that fail completely and suddenly, staff replacement problems. Simulation Models: Elements of Simulation Model- Monte carlo Technique- Applications.

Text Book:

1. Kanti Swarup, Manmohan, P.K. Gupta, "Operations Research", Sultan Chand & Sons, 2008

Reference Book:

1. Sharma J.K., "Operations Research", III Edn. 2007.
2. Winston, - Operations Research, Applications and Algorithms – Cengage Learning, 2004/ 4th Edn.
3. Hamdy, A. TAha, Operations Research (Sixth Edition) Prentice – Hall of India Private Limited, New Delhi. 2001

09MA304 OPERATIONS RESEARCH TECHNIQUES

Credit: 4:0:0

Objective: To provide the student with the concept and an understanding of basic concepts in Operations Research Techniques for Analysis and Modeling in Food Technology.

Unit I Linear Programming Problem
The Linear Programming Problem - Introduction, formulation of Linear Programming problem, Graphical solution to L.P.P, Simplex Method, Artificial variable techniques, two phase Method, Variants of the Simplex Method.

Unit II Duality & Transportation
Duality In Linear Programming - Concept of duality, Fundamental properties of Duality, Duality & simplex method, Dual simplex method. THE TRANSPORTATION PROBLEM: Introduction, Transportation Model, finding initial basic feasible solutions, moving towards optimality, Degeneracy.

Unit III Assignment & Sequencing
Assignment Problem - Introduction, Solution of an Assignment problem, Multiple Solution, Hungarian Algorithm, Maximization in Assignment Model, Impossible Assignment. Sequencing - Job sequencing, n jobs through two machines, two jobs through m machines, n jobs through m machines.

Unit IV Queuing Models
Introduction- definition of terms in queuing model, problem involving M/M/I/FIFO queue, M/M/M: FCFS/M/M/I : FCFS/N M/M/S: FCFS

Unit V Network Model & Simulation
Network analysis– PERT & CPM- network diagram-probability of achieving completion date- crash time- cost analysis. Simulation models. Elements of simulation model-Montecarlo technique – applications.

Text Book:

1. Kanti Swarup, Manmohan , P.K. Gupta "Operationals Research" – Sultan Chand & Sons., 14th Edn. 2008.

Reference Books:

1. Winston, - Operations Research, Applications and Algorithms – Cengage Learning, 2004/ 4th Edn.
2. Hamdy, A. TAha, Operations Research (Sixth Edition) Prentice – Hall of India Private Limited, New Delhi.
3. Natarajan A.m. Balasubramani P., Tamilarasi A., Operations Research, Pearson Education, I Edn. 2003.
4. Srinivasan G., Operations Research, I Edn. 2007. PHI

09MA305 APPLIED MATHEMATICS

Credit : 4:0:0

Objective: To provide the student with the concept and an understanding of basic concepts in algebra, graph theory, automata theory, random process and queuing theory for analysis and modeling in software technology

Unit – I : Basic Concepts in Algebra

Divisibility, G.C.D, prime numbers, fundamental theorem of arithmetic, Congruence, Fermat's theorem, Euler function, primality testing, solution of congruence, Chinese remainder theorem.
Groups and subgroups, homomorphism, cosets and normal subgroups, rings, finite fields(simple problems).

Unit – II : Graph Theory
Terminology – Representations of graphs – Connected graphs – Matrix representation of Graphs. Applications – Critical Path Method – Trees – Binary Trees.

Unit – III : Automata Theory
Language - Representation of Special languages and Grammars – Finite State Machines - machines & Regular languages – Simplification of machines.

Unit – IV : Random Processes
Basic concepts and Examples – Continuity Concepts. Classes of Stochastic – Gaussian Process – Stationary and Ergodicity – Correlation – Covariance and their properties – Linear operations.

Unit – V : Queuing Theory
Introduction to Queuing theory – First in First out – Queue discipline with infinite capacity problems based on M/M/1: $\propto$/FIFO and M/M/k: $\propto$/FIFO - Multiple Queues.

Text Book:

1. Bernard Kolman, Robert C. Busby, Sharon Cutler Ross, *Discrete Mathematical Structures*, Fifth Edition, Pearson Education, 2004.
2. Richard H. Williams, Probability, Statistics and Random Process for Engineers, CENGAGE Learning, 2009.

Reference Books:

1. Narsingh Deo, *Graph Theory with Application to Engineering and Computer Science*, Prentice-Hall of India Private Ltd. 2004.
2. I.N. Herstain, *Topics in Algebra*, John Wiley & Sons, New York, 1975.
3. Kanti Swarup, Manmohan , P.K. Gupta "Operations Research" – Sultan Chand & Sons., 14th Edn. 2008.

09MA306 PROBABILITY AND STATISTICS FOR WATER RESOURCES MANAGEMENT

Credits : 4:0:0

Objectives:

To provide the student with the concept and an understanding of statistical probability and random processes, needed for analysis and modeling in hydrology and water resources management.

UNIT: 1. Empirical Statistics
Measures of central tendency, dispersion, skewness and kurtosis – Correlation and regression.

UNIT: 2. Probability and Distribution
Axioms of probability – Bayes' Theorem – Random variables – Binomial, Poisson, Exponential and Normal distributions – Expectation and variance.

UNIT: 3. Sampling Distributions and Estimation
Sampling distributions – Estimation of parameters – Method of moments – Principle of least squares – Method of maximum likelihood.

UNIT: 4. Testing of Hypothesis
Tests based on Normal, t, Chi-square and F distributions for mean and variance – Analysis of variance – One way and two way classifications.

UNIT: 5. Random Processes

Classification – Stationary random process – Markov process – Markov chain – Time series – Characteristics – Moving Average.

Text Books

1. Johnson, R.J., Miller and Freunds, Probability and Statistical Methods for Engineers. 6th Edition, Prentice – Hall of India, Private Ltd., New Delhi, 2002.
2. Gupta,S.C and Kapoor, V.K., Fundamentals of Mathematical Statistics, Sultan Chand and Sons, New Delhi, 2001.

Reference Books:

1. Jay L. Devore, Probability and Statistics for Engineers and the Sciences. Thomson and Duxbury, Singapore, 2002.
2. Murry R. Spiegel and Larry J. Stephens, Schaum's Outlines Statistics, 3rd Edition, Tata McGraw Hill, 1999.
3. Ven Te Chow, Handbook of Applied Hydrology,McGraw Hill, 1964.
4. Medhi, J., Stochastic Processes. New Age International (P) Ltd., New Delhi, 2000.
5. Richard H., Williams, Probability, Statistics and Random Process for Engineers. CENGAGE Learning, 2009.

09MA 307 GRAPH THEORY AND OPTIMIZATION TECHNIQUES

Credit: 4:0:0

Objective: To provide the student with the concept and the understanding of basic concepts in Graphs, Graph Algorithm, Optimization Techniques and Statistics for analysis and modeling for software technology.

Unit I : BASICS OF GRAPH THEORY
Graphs – Data structures for graphs – Subgraphs – Operations on Graphs Connectivity – Networks and the maximum flow – Minimum cut theorem - Trees – Spanning trees – Rooted trees – Matrix representation of graphs.

Unit II Classes Of Graphs
Eulerian graphs and Hamiltonian graphs – Standard theorems – Planar graphs – Euler's formula - Five colour theorem – Coloring of graphs – Chromatic number (vertex and edge) properties and examples – Directed graphs.

Unit III Graph Algorithm
Computer Representation of graphs – Basic graph algorithms – Minimal spanning tree algorithm – Kruskal and Prim's algorithm - Shortest path algorithms – Dijsktra's algorithm – DFS and BFS algorithms.

Unit IV Optimization Techniques
Linear Programming – Graphical methods – Simplex method (Artificial variables not included)- transportation and Assignment problems.

Unit V Statistics
Tchebyshev's inequality – Maximum likelihood estimation – Correlation – Partial correlation – Multiple correlations – Regression – Multiple regression.

Text Books:

1. Narsingh Deo, "Graph Theory with Applications to Engineering and Computer Science", Prentice Hall of India (p) Ltd. 1988.
2. S.C. Gupta, V.K. Kapoor, "Fundamentals of Mathematical Statistics", Sultan Chand & Sons, 2002.

Reference Book:

1. Hamdy A. Taha, "Operation Research", Maxwell Macmillan.
2. Walpole Myers, Myers, Ye, "Probability & Statistics for Engineers and Scientists" Pearson Education, first Indian reprint, 2002.
3. T.Veerarjan, Theory of Probability and Random Process, Tata McGraw Hill Publishing Company
4. Haffmann and Kunze "Linear Algebra", PHI, 1994.
5. Rao S.S., Engineering Optimization: Theory and Practice, New Age International Pvt. Ltd., 3rd Edition1998

09MA308 GRAPHS, RANDOM PROCESSES AND QUEUING THEORY

Credit: 4:0:0

Objective: To provide the student with the concept and the understanding of basic concepts in Graph Theory, Probability Theory, Random Process and Queuing theory for analysis and modeling for software technology.

Unit - I
Topics in Graph Theory: Graphs – Euler paths and Circuits – Hamiltonian paths and circuits – Transport Networks – Matching Problems - Coloring graphs.

Unit – II
Trees: Trees – Labeled Trees – Tree Searching – Undirected Trees – Minimal Spanning Trees.

Unit – III
Probability Theory: Axiomatic definition of Probability – Conditional Probability – Independent events – Theorem of Total probabilizty – Baye's Theorem – Discrete 1 D Random Variable – Probability function – Continuous 1 – D Random variable – Probability Density function – Cumulative Distribution Function(Cdf) – Properties of Cdf – Special Discrete Distribution (Pdf and pmf only)– Mean and Variance , MGF of Binomial and Poisson distribution –[

Unit – IV
Random Processes: Classification – Methods of Description – Special classes – Average Values – Stationary – Example of SSS – Analytical representations – Weiner Process function – Auto correlation – Properties of R(τ) – cross Correlation – Properties – Ergodicity – Mean Ergodic theorem – Correlation Ergodic process – Power spectral density and its properties.

Unit – V
Queueing Theory: Symbolic representation of Queueing model – Model 1: M/M/1: ∞ /FIFO – Model I M/M/C : ∞ /FIFO – Model III : M/M/1 : N/FIFO – Formulae and problems of above models.

Text Books:

1. Bernard Kolman, Robert C. Busby and Sharon Ross, Discrete Mathematical Structures, 5th Edition, Pearson Education, 2004, ISBN: 81-297-0465-X
2. T. Veerarajan, Probability , Statistics and Random processes, 2nd Edition, Tata McGraw Hill, 2006. ISBN: 0-07-060170 – 4.

Reference Books:

1. Narsingh Deo, Graph Theory with Application to Engineering and Computer Sciences, Prentice-Hall of India Private Ltd., 2000
2. Hamdy A. Taha, "Operation Research", Maxwell Macmillan.
3. Kandasamy P. , Thilagavathy, Gunavathy, "Probability, Random Process and Queueing Theory, S. Chand & Co. New Delhi, 2007
4. Kanti Swarup, Man Mohan, P.K. Gupta, "Operations Research", Sultan Chand & Sons, 1991.

09MA309 COMPUTATIONAL MATHEMATICS

Credits: 4:0:0
Objective: To provide the student with the concept and the understanding of basic concepts in Variations, Partial Differential Equations and Numerical Methods for analysis and modeling for higher engineering.

Unit: 1
Introduction – Variation – Properties of variation – Euler's equation – Functional dependant on its first derivatives – Functional dependant on its higher derivatives – Problems – Kantorvich method
Unit: 2
Classification of partial differential equation of second order – Solution of Laplace equation by Liebmann method – Solution of Poisson equation by Liebmann method – Differential Equation by explicit – Bender

Schmidt method – Differential equation by implicit – Crank Nicholson method – Solution of wave equation by explicit method

Unit: 3

Introduction initial value problems – Picard's method – Euler method – Improved Euler method and modified Euler method – Adam's predictor corrector method – Eigen value problems – power & inverse power method – Jacobi & given methods – Boundary value problems – Raleigh-Ritz, collocation, Galerkin methods

Unit: 4

Homer's method Muller, Chebyshew, Graffe's root, Birge Vita methods – Gauss elimination, Gauss-Jordan, Gauss-Jacobi, Relaxation methods – System of non linear equation – Newton Raphson methods

Unit: 5

Newton- cotes quadrature formula – Weddle's rule (Single & Double integral) – Romberg's method – Gaussian quadrature, Natural cubic spline functions formula – Beizer curves.

Text Books:

1. P. Kandasamy, et al Numerical Methods, S. Chand & Co. Ltd. 2005.
2. T. Veerarajan, T. Ramachandran, Numerical Methods, Tata McGraw Hill, 2003.

Reference Books:

1. Naveenkumar, An Elementary course on Variational problems in calculus, Narosa Publishing House, 2003.
2. Curtis F-Gerald, Applied Numerical Analysis (5th edition, Addition Wesley Publishing Company, 2001.

09MA310 ADVANCED APPLIED MATHEMATICS

Credits: 4:0:0

Objective: To provide the student with the concept and the understanding of basic concepts in algebra, Graph Theory, Automata theory, Random Process and Queuing theory for analysis and modeling for software technology.

Unit 1 Basic Concepts in Algebra

Divisibility, GCD, Prime Numbers, Fundamental theorem of Arithmetic, Congruence, Fermats Theorem, Euler function, Solution of Congruence, Chinese Reminder theorem.

Groups and Subgroups: Basic Definitions and simple theorems. Homomorphisms, cosets and normal subgroups, rings, finite fields (Definitions and Examples only).

Unit 2: Graph Theory

Terminology-Representations of Graphs- Connected graphs-Matrix representation of graphs. Applications- Critical path method- trees- binary trees.

Unit 3: Automata Theory:

Language-Representation of special languages and grammars – finite state machine – regular languages – simplifications of machines.

Unit 4:Random Processes:
Basic Concepts and examples-continuity concepts. Classes of stochastic- Gaussian process- stationary and ergodicity- correlation- covariance and properties-linear operations.

Unit 5: Queueing Theory
Introduction to Queuing theory- first in first out- Queue discipline with infinite capacity problems based on M/M/I:infinity/FIFO and M/M/k:infinity/FIFO – multiple Queues.

Text Books:

1. Bernard Kolman, Robert C Busby, Sharon Cutler Ross, Discrete Mathematical Structures, 5th edition, Pearson education, 2004.
2. T.Veerarajan, Probability, Statistics, Random Processes, Tata McGraw-Hill, 2nd Edition, 2003.

Reference Books

1. Kenneth Roshan, Discrete Mathematics and its Applications, Tata McGraw Hill Ltd, Fifth Edition, 2003.
2. I.N. Herstain, Topics in Algebra, John Willey and sons, Newyork,2007.
3. Narsingh Deo, Graph Theory with applications to engineering and computer science, Prentice Hall of India, 2004.
4. Richard H Williams, Proability, Statisitics and Random Process for engineers, CENGAGE Learning, 2009.
5. Kanti Swarup, Manmohan, P.K Gupta, Operations Research, Sultan chand and sons, 14th Edition, 2008.

09MA311 GRAPH THEORY AND OPTIMIZATION TECHNIQUES

Credit: 4:0:0

Objective: To provide the student with the concept and the understanding of basic concepts in Graphs, Graph Algorithm, Decision Making Problems and Probability for analysis and modeling for higher engineering.

UNIT I
Introduction to graphs – Definitions on Graphs – Subgraphs – Paths and Cycles – Matrix representation of Graphs – Fusion.
Trees – Definitions and simple properties – Spanning Trees – Prim's and Kruskal's Algorithms for finding minimal spanning trees

UNIT II
Shortest path problems – Dijkstra's Algorithm – Breadth First Search and Depth First Search Algorithm
Euler tours – Hamilton graphs - Directed Graphs and Indegree and outdegree (Definitions and examples)

UNIT III
Planar graphs – Definitions – Euler's Formula – Coloring of graphs, vertex and edge chromatic number (Definitions and examples only)
Networks – Flows and cuts – Maximum flow minimum cut theorem – Ford Fulkerson algorithm to find the maximum flow – Problems

UNIT IV

Linear Programming – Introduction – Graphical Methods – Simplex method (Artificial Variable Techniques not included) – Transportation Model – Solution of Transportation Model – Moving towards optimality – Maximization in Transportation problems – Assignment Problems – Hungarian Algorithm – problems

UNIT V

Basic Concepts of Probability – Random variables – Expectation - Tchebychev's inequality- Correlation – Partial correlation – Multiple correlations – Regression – Multiple regressions

Text Books:

1. John Clark and Derek Allan Holton, "A First Look At Graph Theory", Allied Publishers Ltd., 1995.
2. S.C. Gupta and V.K.Kapoor, "Fundamentals of Mathematical Statistics", Sultan chand and sons, 2002.

Reference Book:

1. Hamdy A.Taha, "Operations Research", Prentice Hall of India, Fifth Edition, 1995.
2. Narsingh Deo, Graph Theory with application

09MA312 SPECIAL COURSE IN ENGINEERING MATHEMATICS

Credit : 4:0:0

Objective: To provide the student with the concept and the understanding of basic concepts in Algebra, Calculus, Laplace Transformations, Vector Calculus and Analytical Geometry for analysis and modeling for higher engineering.

Unit:1 Algebra

Binomial , Exponential and Logarithmic Series with simple Applications. Determinants- Matrices – Eigen Values – Eigen vectors.

Unit : II Calculus:

Differential Calculus: Rate of Change- Maxima and Minima

Integral Calculus: Finding Area and Volume

Unit III Laplace Transformation:

Basic Definition – Inverse Laplace Transform- Solving differential Equations.

Unit IV Vector Calculus

Gradient – Divergent – Curl – Basic Definition of Tensors.

Unit V: Analytical Geometry(2D)

Straight lines – Circles – Parabola – Ellipse – Hyper bola – Simple Properties.

Text Books:

1. T.K. Manickavachagam Pillai , Algebra and Calculus; Vishwanathan Publishers, Chennai.
2. T.K. Manickavachagam Pillai , Analytical Geometry and Vector Calculus, Vishwanathan Publishers, Chennai.

Reference Books:

1. Thilagavathi and Kandasamy, Allied Mathematics; S. Chand & Co. Chennai
2. T.Veerarajan, Engineering Mathematics, Tata McGraw Hill Ltd. 2008.

09MA313 ABSTRACT CONTROL THEORY

Credit : 4:0:0

Objective: To provide the student with the concept and the understanding of basic concepts in Semi-groups of Linear Operators, Applications to Partial Differential Equations and Infinite Dimensional Linear System Theory for higher mathematics.

Unit I: Bounded Linear Operators
Uniformly continuous semigroups of bounded linear operators – Strongly continuous semigroups of bounded linear operators – The Hille-Yosida theorem – Semigroups of Compact operators – Differentiability. (Sections 1.1- 1.3, 2.3- 2.4 A. Pazy)

Unit II: Abstract Cauchy Problem
The Homogeneous Initial value problem – The inhomogeneous initial value problem – Regularity of mild solutions for Analytical semigroups.
(Sections 4.1, 4.2 and 4.3; A Pazy)

Unit III: Evolution Equations
Evolution systems – Stable families of Generators – An Evolution system in the Hyperbolic case – Regular solutions in the Hyperbolic case – The inhomogeneous equation in hyperbolic case. (Sections 5.1 to 5.5; A Pazy)

Unit IV: Nonlinear Evolution Equations
Lipschitz perturbation of linear evolution equations – Semilinear equations with compact semigroups – Semilinear equations with Analytical semigroups. (Sections 6.1 to 6.3; A Pazy)

Unit V: Basic concepts in Control Theory
Controllability, Observability and Exponential stability.

Text Books:

(1) **Semigroups of Linear Operators and Applications to Partial Differential Equations by A. Pazy,** Springer-Verlag, New York, 1983.
(2) **Introduction to infinite dimensional linear systems theory, R.F. Curtain and H. Zwart,** Spinger-Verlag, New York, 1995.

Reference Books:

1. James Munkres, Topology, Second Edition, Prentice Hall, 2000.
2. K. Balachandran and J.P. Dauer, Elements of Control Theory, Narosa Publishing, 1999.

09MA314 THEORY OF NEAR-RINGS

Credits: 4:0:0

Objective: To provide the student with the concept and the understanding of basic concepts in Near Rings, Theory and Applications for higher mathematics.

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Unit I: **The elements of theory of near-rings:** Fundamentals delimitations and properties – N-groups – Homomorphism and Ideal – Annihilators – Generated Objects.

Constructions: Product, direct sums and sub-direct products – Near –rings of quotients – Free near – rings and N-groups.

Unit II: Embedding: Embedding in M(г) – More beds – Some axiomatic considerations – Miscellaneous results – Related structures.

Unit III: Ideal Theory: Sums and Direct sums – Distributive sums – Chain Conditions – Decomposition Theorems

Unit IV: Prime ideals: Product of subsets – Prime Ideals – Semi prime Ideals – Nil and Nilpotent

Unit V: Distributively generated near-ring: Elementary – Some axiomatic – constructions of distributively generated near-rings

More classes of near –ring: IFP near – rings – p-near-rings – Boolean near-rings

Text Book:

1. Gunder Pilz, Near – rings: The Theory and its Applications, North Holland Publishing Company, Amsterdam, 1977. Chapters: 1, 2, 6 (a), 6(b), 6(c) and 9(a).

Reference Book:

1. Neal Henry McCoy: The Theory of Rings, Bronx, N.Y.Chelsea Pub. Co. – 1973.
2. I.N. Herstain, Topics in Algebra, John Willey and Sons, New York, 2007.

MATHEMATICS

ADDITIONAL SUBJECTS

Code	Subject Name	Credits
10MA201	Partial Differential Equations and Transforms	4:0:0
10MA202	Biostatistics	4:0:0
10MA203	Discrete Mathematics and Numerical Methods	4:0:0

10MA201 PARTIAL DIFFERENTIAL EQUATIONS AND TRANSFORMS

Credits: 4:0:0

Course Objective:
To provide the student with the concept and the understanding of basics in Partial Differential Equations and Transforms.

Course Outcome:
Knowledge in the Technique, methodology of solving Partial Differential Equations. A basic understanding in the Transforms which are useful in solving engineering problems.

Unit: I Partial Differential Equations – First Order
Formation of equations by elimination of arbitrary constants and arbitrary functions – solutions of equations – general, particular and complete integrals – Lagrange's linear equations – standard type of first order equations.

Unit: II Partial Differential Equations – Higher Order
Second order and higher order equations with constant coefficients, homogeneous and non homogeneous equations.

Unit: III Fourier Series
Euler's formula – Dirichlet's conditions (convergence statement only) – change of interval odd and even functions. Half range series – RMS value, Parseval's formula.

Unit: IV Fourier Transforms
The infinite Fourier transform – sine and cosine transforms, properties (Proof not needed) – inversion theorem – convolution theorem – Parseval's identity – transform of derivatives – (Proof and derivations not needed).

Unit: V Z-Transforms
Z-transforms of standard functions, inverse Z-transforms (partial function expansions and residues). Properties of z-transform, Solution of difference equations.

Text Books:

1. Kandasamy, P., "Engineering Mathematics". S. Chand & Co., New Delhi, Vol. III, 2006
2. Venkataraman, M.K. "Higher Engineering Mathematics", National Publishing Co., 2001.

Reference Books:

1. Erwin Kreyzig, "Advanced Engineering Mathematics", Wiley & Co., 8^{th} Edn. 2008.
2. Speigal, "Advanced Engineering Mathematics", Schaum's Series, John Wiley & Co., 2006.

10MA202 BIOSTATISTICS

Credits: 4:0:0

Course Objective:
To develop the skills of the students in the area of Probability & Statistics.
To understand the various design of experiments.

Course Outcome:
Knowledge in the Technique, Methodology and Application in Statistics. A basic knowledge in collection, presentation and tabulation of data.

Unit: I Statistics
Frequency distribution and measures of central tendency – measures of dispersion, moments, skewness and kurtosis – Linear correlation – rank correlation and regression lines.

Unit: II Testing of Hypothesis
Level of significance – type I, type II errors – critical value test – statistics – large sample tests – mean – difference of means proportion, difference of proportion – small sample test – t test – F test – Chi – square test.

Unit: III Probability
Axioms of probability – probability spaces-joint and conditional probabilities – Independent events – total probability theorem – Baye's theorem – Theoretical distributions – Binomial – Poisson – Normal.

Unit: IV Random Variables
Densities and distribution – example, Properties of distribution and density functions – joint distribution and densities – conditional probability distribution and density function – Independent random variables.

Unit: V Design of experiments
Aim of the design of experiments – completely randomized design – analysis of variance for one factor of classification – randomized block design – analysis of variance for two factors of classification – Latin square design – analysis of design.

Text Books:

1. Kapur J.N. and Saxena H.C. "Mathematical Statistics", S. Chand & Co. Ltd., New Delhi. 2003.
2. Singaravelu, Rama R, Sivasubramanian; "Probability & Statistics", Meenakshi Agency, Chennai, 2007.

Reference Books:

1. Balagurusamy E., "Reliability Engineering", Tata McGraw Hill Publishers, New Delhi, 2003
2. Veerarajan, "Probability & Random Process" Tata McGraw Hill Ltd. New Delhi. 2007.
3. Mille I.R. and Freund J.E. "Probability and Statistics for Engineers", Prentice Hall, 2004, II edn.

10MA203 DISCRETE MATHEMATICS AND NUMERICAL METHODS

Credits: 4:0:0
Objective:

To develop the skills of the student in the area of Discrete Mathematics.
To know about Numerical Methods.

Outcomes:

- Knowledge in the Technology, Methodology and Applications of Discrete Mathematics for Bioinformaticians.
- A basic understanding in the application of Numerical Differentiation and Integration.

Unit I

Foundations: Sets and Operations on sets – Relations and functions. Combinatorics: Basics of counting – Combinations and Permutations – Counting combinatorial identities – Binomial and multinomial theorems. (Proofs not needed)

Unit II

Mathematical Logic: Propositions and Logical operators – Construction of Truth tables – Methods of proof – Equivalence and implication – Induction and recursion – Lattices and Boolean algebra. Graph Theory: Basic concepts – directed graphs – TSP – Basic graph algorithms (Kruskals and Prim's) (Proofs not needed)

Unit-III

Principles of Least Squares-Fitting a Straight line- Numerical Errors-solutions of transcendental equations – bisection method – Newton-Raphson Method.

Unit IV

Simultaneous equations – Gauss elimination, Gauss-Seidal method – Interpolation formula – Newton – Gregory formula (forward and backward differences).

Unit V

Numerical differentiation – Taylor series method (1st order only) - Numerical integration - Trapezoidal rule – Simpson's one third rule (without derivation) –– Euler's method – Runge Kutta method (2nd and 4th order only).

Text Books

1. Bernard Kolman, Robert C Busby and Sharon Ross, Discrete Mathematical Structures, PHI, NewDelhi, 2006.
2. P. Kandasamy, K. Thilagavathy, K. Gunavathy, Numerical Methods, S. Chand & Co. New Delhi, 7^{th} Edition, 2007.

Reference Books

1. Lipschutz, Discrete Mathematics , Schaum's Series, John Wiley, 2002.
2. M.K Venkatraman, Numerical Methods, National Publishing Co., 2001.

Department of Mathematics

REVISED AND NEW SUBJECTS

Sub. Code	Subject Name	Credit
10MA301	Mathematical and Statistical Methods	4:0:0
10MA302	Commutative Algebra	4:0:0
10MA303	Bio-Statistics	4:0:0
10MA304	Graphs and Probability	4:0:0

10MA301 MATHEMATICAL AND STATISTICAL METHODS

Credit: 4:0:0

Objectives:

- To develop skills of the students in the area of probability and statistics.
- To know more about descriptive and inferential statistics.
- To know about the various reliability methods.
- To understand the various application design experiments.

Outcome:

- Knowledge in the technique, methodology and Application of statistics.
- A basic understanding in collection, presentation and drawing conclusion about biological data.

Unit I: Algebra, Calculus and Differential Equations

Algebra : Binomial Theorem (Statement only)- Summation of series – coefficient of x^n (using binomial theorem).

Calculus : Differentiation – Product and Quotient Rule (simple problems) –Maxima and Minima.

Integration: Bernoulli's Method.

Differential Equations: Second order differential equations with constant coefficients.

Unit II: Probability and Distributions

Probability – Axiomatic definition of probability – Independent events – Addition Theorem – Binomial, Poisson Distributions – Moment Generating Function of Binomial ,Poisson Distributions – Normal Distribution – Definition – Characteristics of the Normal probability curve – simple problems.

Unit III: Reliability Engineering

Concepts of reliability – Hazard function – Series and parallel systems – Reliability of Markovian systems – maintainability – preventive maintenance – availability – point availability of a component – interval availability - system availability (proofs and derivations not included).

Unit IV: Testing of Hypothesis

Population – sample – one tailed and two tailed tests - Tests based on large samples – proportion and mean – Small samples – t, F, chi square distributions.

Unit V: Design of Experiments

Aim of design of experiments – completely randomized design – analysis of variance for one factor of classification – Randomized block design – analysis of variance for two factors of classification – Latin square design – analysis of design for three factor of classification – comparison of RBD and LSD.

Text Books:

1. S.P. Gupta, Statistical Methods, Sultan Chand and Sons, New Delhi, 37th Edn. 2009.
2. T. Veerarajan, Probability, Statistics and Random Processes, Second Edition, Tata McGraw Hill publishing company, 2003
3. Kandasamy, Thilagavathi and Gunavathy, Engineering Mathematics, Volume I, S.Chand & Co., 2001.

Reference Books:

1. Manickavasagam Pillai , Algebra , Volume I & II , S. Viswanathan publishers, 2002.
2. S.C. Gupta and V.K. Kapoor ,Fundamentals of Mathematical Statistics, Sultan Chand & Co., 2007.

10MA302 COMMUTATIVE ALGEBRA

Credits: 4:0:0

Objectives:

Commutative Algebra is one of the fundamental and basic for all the disciplines in Mathematics. This programme aims at providing basic tools and exposure to the students who intend to pursue research in Commutative Algebra at the international level.

Outcome:

Knowledge in the Technology, Methodology and applications of Commutative Algebra.

Unit I: Rings, Ideals and Modules

Rings and ring homomorphism – Ideals, Quotient rings – Zero-divisor, nilpotent elements – prime ideals and maximal ideals – Nil Radical and Jacobian Radical – Operations on Ideals – Extensions and contraction - Modules and module homomorphism - Sub modules and quotient modules - Operations on sub modules - Finitely generated modules - Exact sequences.

Unit II: Module Fractions

Local properties - Extended and contracted Ideals in Rings of fractions - Primary Decomposition.

Unit III: Integral Dependence and Valuations

Integral dependence - The going-up theorem - Integrally closed integral domains - The going-down theorem - Valuation rings - Chain conditions.

Unit IV: Noetherian Rings and Artin Rings
Primary decomposition in Noetherian Rings – Artin Rings.

Unit V: Discrete Valuation Rings and Dedekind domains
Discrete valuation Rings - Dedekind domains - Fractional Ideals.

Text Book:

1. Atiyah and Macdonald, Introduction to Commutative Algebra, Addison – Wesley Publishing Company, 1969. (Chapters 1 to 9).

Reference Books:

1. Neal Henry McCoy, The theory of Rings, Chelsea Publishing Company, 1973.
2. I.N. Herstein, Topics in Algebra, John Wiley and Sons. New York. 2007.

10MA303 BIOSTATISTICS

Credit : 4:0:0

Objectives:

- To develop skills of the students in the area of probability and statistics.
- To know more about descriptive and inferential statistics.
- To know about the various reliability methods.
- To understand the various application design experiments.

Outcome:

- Knowledge in the technique, methodology and Application of statistics.
- A basic understanding in collection, presentation and drawing conclusion about biological data.

Unit I
Basic concepts: Two views of probability; Properties; calculating the probability of an event; Baye's theorem, screening tests, sensitivity, specificity, predictive value.
Probability distributions: Binomial, Poisson and Normal distributions.
(Proofs/ derivations not included)

Unit II
Sampling distributions: distribution of the sample mean; difference between two sample means; sample proportion; difference between two sample proportions.
Estimation: confidence interval for a population mean; the t distribution; confidence interval for the difference between two population means; confidence interval for a population proportion; confidence interval for the difference between two population proportions; determination of sample size for estimating means; determination of sample size for estimating proportions; confidence interval for the variance of a normally distributed

population; confidence interval for the ratio of the variances of two normally distributed populations.

Unit III

Testing of Hypothesis: a single population mean; the difference between two population means; paired comparisons; a single population proportion; the difference between two population proportions; a single population variance; the ratio of two population variances; the type II error and the power of a test; determining sample size to control type II errors.

Unit IV

Analysis of variance: the completely randomized design; the randomized block design; the repeated measures design; the factorial experiment.

Unit V

Simple linear regression & correlation: the regression model; the sample regression equation; evaluating the regression equation; using the regression equation; the correlation model; the correlation coefficient; precautions.

Textbook

1. W. W. Daniel Biostatistics: A Foundation for Analysis in the Health Sciences, 7/e, John Wiley & Sons, 2000.

Reference Book:

1. S.P.Gupta, Statistical Method , Sultan Chand and Sons, New Delhi.
2. T.Veerarajan, Theory of Probability and Random Process, Tata McGraw Hill Publishing Co. Second Edition, 2003.

10MA304 GRAPHS AND PROBABILITY

Credit 4:0:0

Objectives:

- To develop skills of the students in the area of Graphs.
- To know more about Probability and Sampling Distribution.

Outcome:

- Knowledge in the technology, methodology and applications of Graphs.
- A basic understanding in Probability and Sampling Distributions.

Unit I Basics of graph theory

Graphs – Data structures for graphs – Subgraphs – Operations on Graphs Connectivity – Networks and the maximum flow – Minimum cut theorem - Trees – Spanning trees – Rooted trees – Matrix representation of graphs (Definitions and simple problems)

Unit II Classes of Graphs

Eulerian graphs and Hamiltonian graphs – Standard theorems – Planar graphs – Euler's formula – Coloring of graphs – Chromatic number - properties and examples – Directed graphs.

Unit III Graph Algorithm

Computer Representation of graphs – Basic graph algorithms – Minimal spanning tree algorithm – Kruskal and Prim's algorithms - Shortest path algorithms – Dijsktra's algorithm – DFS and BFS algorithms.

Unit IV Probability

Addition Law – Multiplication law – Conditional Probability – Baye's Theorem.
Distributions: Binomial, Poisson and Normal distributions.

Unit V Sampling Distributions

Tests based on large samples, t, F and chi-square test for Goodness of fit- ANOVA-applications for biological sciences(one way, two way classifications)

Text Books:

1. Narsingh Deo, Graph Theory with Applications to Engineering and Computer Science, Prentice Hall of India, 2007.
2. S.C. Gupta, V.K. Kapoor, Fundamentals of Mathematical Statistics, Sultan Chand & Sons, New Delhi 2008.

Reference Books:

1. A. Bondy, and U Moorthy, Graph Theory and Applications, McMillan, London,1976.
2. J. Clark, and D.A Holton, A First Look at graph Theory, Allied Publishers, New Delhi, 1995.
3. M. Fisz, Probability theory and Mathematical statistics, John Wiley, 1997.

ADDITIONAL SUBJECTS

Code	Subjects	Credits
11MA201	Algebra, Differential Calculus And Analytical Geometry	3:1:0
11MA202	Multiple Integrals, Differential Equations And Laplace Transforms	3:1:0
11MA203	Algebra, Analytical Geometry and Calculus I	4:0:0
11MA204	Matrices, Differential Equations and Calculus II	4:0:0
11MA205	Numerical Methods For Bio Technologists	4:0:0
11MA206	Mathematical Foundation	3:0:0
11MA207	Discrete Mathematics and Numerical Methods For Bio informaticists	4:0:0
11MA208	Complex Analysis, Statistics and Z-Transforms	4:0:0
11MA209	Fourier Series, Transforms and Partial Differential Equations	4:0:0
11MA210	Probability and Bio-Statistics	4:0:0
11MA211	Discrete Mathematics	4:0:0
11MA212	Numerical Methods	4:0:0
11MA213	Probability, Random Process and Numerical Methods	4:0:0
11MA214	Probability and Random Process	4:0:0
11MA301	Applied Mathematics	4:0:0
11MA302	Operations Research Techniques	4:0:0
11MA303	Statistics and Mathematics	4:0:0
11MA304	Probability and Bio-Statistics for Food Sciences	4:0:0
11MA305	Applied Mathematics for Circuit Branches	3:1:0
11MA306	Graphs, Random Processes and Queues	4:0:0
11MA307	Graph Theory and Optimization Techniques	4:0:0
11MA308	Linear Algebra	4:0:0
11MA309	Real Analysis I	4:0:0
11MA310	Ordinary Differential Equations	4:0:0
11MA311	Mechanics	4:0:0
11MA312	Algebra	4:0:0
11MA313	Real Analysis II	4:0:0
11MA314	Partial Differential Equations	4:0:0
11MA315	Tensor Analysis and Special Theory of Relativity	4:0:0
11MA316	Complex Analysis I	4:0:0
11MA317	Probability Theory	4:0:0
11MA318	Functional Analysis	4:0:0
11MA319	Topology	4:0:0
11MA320	Complex Analysis II	4:0:0
11MA321	Differential Geometry	4:0:0
11MA322	Mathematical Statistics	4:0:0
11MA323	Fluid Dynamics	4:0:0
11MA324	Fuzzy Sets and Their Applications	4:0:0
11MA325	Number Theory and Cryptography	4:0:0
11MA326	Formal Languages and Automata Theory	4:0:0
11MA327	Programming in C++and Numerical Methods	4:0:0
11MA328	Discrete Mathematics	4:0:0
11MA329	Graph Theory	4:0:0

11MA330	Java Programming	4:0:0
11MA331	Operations Research	4:0:0
11MA332	Financial Mathematics	4:0:0
11MA333	Stochastic Processes	4:0:0
11MA334	Relational Database Management Systems	4:0:0
11MA335	Statistical Mathematics	4:0:0
11MA336	Research Methodology	4:0:0
11MA337	Mathematical Methods	4:0:0
11MA338	Graphs and Networks	4:0:0
11MA339	Fuzzy Mathematics	4:0:0
11MA340	Difference Equations	4:0:0
11MA341	Optimization Techniques	
11MA342	Relational Database Management Systems	0:0:2
11MA343	Java Programming	0:0:2
11MA344	Programming in C++and Numerical Methods	0:0:2

11MA201 ALGEBRA, DIFFERENTIAL CALCULUS AND ANALYTICAL GEOMETRY

Credits: 3:1:0

Course Objective

To provide the student with the concept and an understanding of Theory of Equations , Matrices, Analytical Geometry, Differential Calculus and Functions of several variables for Analysis and Modeling in Technology.

Course outcome

Students will be able to relate their subject knowledge with their engineering subjects during their course of study.

Unit I: Theory of Equations

Relations between coefficients and roots. Irrational and imaginary roots – symmetric functions of the roots – transformation of equations – Reciprocal equations and formation of equation whose roots are given.

Unit II: Matrices

Characteristic equation – Eigen values and eigen vectors of a real matrix – Properties of Eigen values – Cayley Hamilton theorem – Orthogonal reduction of a symmetric matrix to diagonal form – Orthogonal matrices – Reduction of quadratic form to canonical form by orthogonal transformation

Unit III: Three Dimensional Analytical Geometry

Direction cosines and ratios – Angle between two lines – Equation of a plane – Equation of a straight line – Co-planar lines – Shortest distance between skew lines

Unit IV: Geometrical Applications of Differential Calculus

Curvature – Cartesian and polar co-ordinates – Circle of curvature – involutes and Evolutes – Properties of envelopes – Evolutes as envelope of normals.

Unit V: Functions of Several Variables

Functions of two variables – Partial derivatives – Total differential – Differentiation of implicit functions – Taylor's expansion – Maxima and Minima – Constrained Maxima and Minima by Lagrange's – Multiplier method – Jacobians

Text Book:

1. T.Veerarajan, Engineering Mathematics, (4th Edition)Tata McGraw Hill, New Delhi, 2009.

Reference Books:

1. . Kandasamy.P, Thilagavathi .K and Gunavathi K., Engineering Mathematics volume I & II (6th revised Edition), S. Chand & Co., New Delhi, 2003
2. Grewal, B.S., "Higher Engineering Mathematics" (6th Edition) Khanna Publisher, New Delhi, 2001

11MA202 MULTIPLE INTEGRALS, DIFFERENTIAL EQUATIONS AND LAPLACE TRANSFORMS

Credit: 3:1:0

Course Objective:

To provide the student with the concept and an understanding of Multiple Integrals , Beta and Gamma Integrals , Ordinary differential Equation , Vector Calculus and Laplace Transforms for Analysis and Modeling in Technology.

Course outcome:

Students will be able to relate their subject knowledge with their engineering subjects during their course of study.

Unit I: Multiple Integrals

Evaluation of Multiple Integrals, Change of order of Integration, Application of Multiple Integrals to find area enclosed by plane curves and volume of solids.

Unit II: Beta and Gamma Integrals

Definition, relation connecting Beta and Gamma integrals, properties, evaluation of definite integrals in terms of Beta and Gamma functions.

Unit III: Ordinary differential Equation

Simultaneous linear equations with constant coefficients – Linear equations of higher order with constant coefficients – Homogeneous equation of Euler type – Method of variation of parameters.

Unit IV: Vector Calculus

Gradient, Divergence, Curl – Line, surface & volume integrals – Statements of Green's, Gauss divergence and stokes' theorems (without proof) – verification and applications.

Unit V: Laplace Transforms

Transforms of simple functions – Basic operational properties – Transforms of derivatives and integrals – Inverse transforms – Convolution theorem – Periodic function – Applications of Laplace transforms of solving linear ordinary differential equations up to second order with constant coefficients.

Text Book:

1. T.Veerarajan, Engineering Mathematics, (4th Edition)Tata McGraw Hill, New Delhi, 2009.

Reference Books:

1. Kreyszig, E., "Advanced Engineering Mathematics" (8th Edition), John Wiley and Sons (Asia) Pvt Ltd., Singapore, 2000
2. . Kandasamy.P, Thilagavathi .K and Gunavathi K., Engineering Mathematics volume I & II (6th revised Edition), S. Chand & Co., New Delhi, 2003

11MA203 ALGEBRA, ANALYTICAL GEOMETRY AND CALCULUS I
(Bio-Technology/ Bio-Informatics/ Food Processing) Semester 1:

Credits: 4:0:0

Course objective

To provide the student with the concept and an understanding of trigonometry, differentiation & integration techniques, analytical geometry and theory of equations.

Course outcome

Students will be able to relate their subject knowledge with their engineering subjects during their course of study.

Unit I: Trigonometry

Trigonometrical ratios and identities – Compound angles – Inverse trigonometrical functions – De Moivre's theorem.

Unit II: Differentiation Techniques

Derivatives of elementary function from first principle – Derivatives of inverse functions – Logarithmic differentiation – Differentiation of parametric functions – Second order derivatives.

Unit III: Integration Techniques

Integrals of functions – Methods of integration – Decomposition method – Method of substitution – Integration by parts.

Unit IV: Analytical Geometry

Locus – Straight lines – Family of straight lines – Circle – Definition of a conic – Parabola, Ellipse, Hyperbola – Standard form.

Unit V: Theory of Equations

Relations between coefficients and roots. Irrational and imaginary roots – symmetric functions of the roots – transformation of equations – Reciprocal equations and formation of equation whose roots are given.

Text Book:

1. A.Hepzibah Christinal, Porselvi, R.Selvamani, Foundation Mathematics, Tata McGraw Hill, NewDelhi, 2011.

Reference Book:

1. Kandasamy.P, Thilagavathi .K and Gunavathi K., Engineering Mathematics, Volume I (4 th revised Edition), S Chand & Co., New Delhi, 2001.

11MA204 MATRICES, DIFFERENTIAL EQUATIONS AND CALCULUS II

(Bio-Technology/ Bio-Informatics/ Food Processing) Semester 2:

Credits: 4:0:0

Course objective
To provide the student with the concept and an understanding of matrices, ordinary differential equations, multiple integrals, vector calculus and functions of several variables.

Course outcome
Students will be able to relate their subject knowledge with their engineering subjects during their course of study.

Unit I: Matrices
Characteristic equation – Eigen values and Eigenvectors of a real matrix – Properties of Eigen values – Cayley Hamilton theorem (without proof) – Orthogonal reduction of a symmetric matrix to diagonal form .

Unit II: Ordinary differential Equation
Linear equations of higher order with constant coefficients – Homogeneous equation of Euler type – Method of variation of parameters.

Unit III: Multiple Integrals
Evaluation of Multiple Integrals, Application of Multiple Integrals to find area enclosed by plane curves and volume of solids.

Unit IV: Vector Calculus
Scalar and vector functions – differentiation – gradient, divergence and curl – directional derivative – irrotational and solenoidal fields.

Unit V: Functions of Several Variables
Functions of two variables – Partial derivatives – Total differential – Differentiation of implicit functions – Taylor's expansion – Maxima and Minima– Jacobians

Text Book:
1. T.Veerarajan, Engineering Mathematics, (4^{th} Edition)Tata McGraw Hill, New Delhi, 2009.

Reference Books:
1. Kreyszig, E., "Advanced Engineering Mathematics" (8th Edition), John Wiley and Sons (Asia) Pvt Ltd., Singapore, 2000.
2. Kandasamy.P, Thilagavathi .K and Gunavathi K., Engineering Mathematics, Volume I, II (6th revised Edition), S Chand & Co., New Delhi, 2003.

11MA205 NUMERICAL METHODS FOR BIO-TECHNOLOGISTS

Credits 4:0:0
Course Objective:
To provide the knowledge to find the solution of algebraic and transcendental equations.

Course Outcome:

Students will be able to relate their subject knowledge with their biological experiments during their course of study.

UNIT I: Empirical Formulae and Curve Fitting
Curve fitting - method of group averages - Principle of least squares - fitting a straight line (y = ax + b), a parabola ($y = ax^2 + bx + c$), exponential curve ($y = ae^{bx}$), the curve ($y = ax^b$).

UNIT II: Solution of Algebraic Equations
Newton – Raphson method – Gauss elimination method, Gauss-Jordan method – Gauss-Jacobi – Gauss-Seidel method.

UNIT III: Interpolation
Newton forward Interpolation, Newton backward Interpolation - Gauss forward interpolation formula, Gauss backward interpolation formula– Lagrange's Interpolation formula.

UNIT IV: Numerical Differentiation and Integration
Numerical differentiation – Newton's forward difference formula, Newton's backward difference formula, Numerical Integration - Trapeziodal rule and Simpson's rule.

UNIT V: Ordinary Differential Equation
Taylor series- Euler's method - Fourth order Runge – kutta method to solve first and second order differential equations.

Text Book:
1. Venkataraman M.K., Numerical methods in Science and Engineering , National Publishing Company, Revised Edition, 2005.

Reference Books:
1. P.Kandasamy, Numerical Methods, S.Chand and Co, Reprint 2010.
2. T.Veerarajan, 'Numerical Methods with programs in C', Tata McGraw Hill, 3rd Reprint, 2009.

11MA206 MATHEMATICAL FOUNDATION

Credits: 3:0:0

Course Objective:
To provide basic concepts about trigonometry, matrices, differential and vector calculus.

Course Outcome:
Students will be able to relate their subject knowledge with their engineering subjects during their course of study.

Unit I: Trigonometry
Expansions of sin nθ and cos nθ in powers of cos θ and sin θ. Expansions of tan nθ in powers of tan θ. Expansions of sinn θ and cosn θ in terms of sines and cosines of multiple of θ. Expansions of sin θ and cos θ in power of θ. Hyperbolic functions – inverse hyperbolic functions. Separating real and imaginary parts of complex functions.

Unit II: Matrices
Rank of a matrix – linear independence and dependence of vectors – consistency and

inconsistency of a system of m linear equations in n unknowns – Eigen values and Eigen vectors – properties – Cayley Hamilton theorem and problems.

Unit III: Calculus
Curvature in Cartesian coordinates and polar coordinates – circle of curvature – radius of Curvature- Integration Techniques - Definition – Integration by Substitution- Integration by Parts.

Unit IV: Differential Equations
Second order linear differential equations with constant coefficients with RHS of the form e^{ax}, x^n, sin ax, cos ax, e^{ax} f(x) where f(x) is sin bx or cos bx.

Unit V: Vector Calculus
Scalar and vector functions – differentiation – gradient, divergence and curl – directional derivative – identities (without proof) – irrotational and solenoidal fields.

Text Book: .
1. T.Veerarajan, Engineering Mathematics, (4^{th} Edition)Tata McGraw Hill, New Delhi, 2009.

Reference Book:
1. Kandasamy P., Thilagavathy K. and Gunavathy K., "Engineering Mathematics Vol.I" S.Chand & Co. New Delhi, 2009.

11MA207 DISCRETE MATHEMATICS AND NUMERICAL METHODS FOR BIO-INFORMATICISTS

Credits 4:0:0
Course Objective:
To provide basic concepts about sets, graph theory and finding solutions of different types of equations using numerical methods.

Course Outcome:
Students will be able to relate their subject knowledge with their biological experiments during their course of study.
Unit I:
Foundations: Sets and Operations on sets – Relations and functions. Combinatories: Basics of counting – Combinations and permutations – Counting combinatorial identities.
Unit II:
Graph Thoery: Trees-Labeled Trees-Tree searching-Undirected trees-Minimal spanning trees (Theorems and derivations not included).
Unit III:
Graph Theory: Euler paths and circuits-Hamiltonian paths and circuits-Transport networks-Coloring graphs (Theorems and derivations not included).
Unit IV:
Solution of Numerical, Algebraic and transcendental equations – bisection method – Newton-Raphson method (methods only). Simultaneous equation – Gauss elimination, Gauss seidal method – Interpolation formula – Newton – Gregory formula (forward and backward difference) – Principles of Least Squares – Fitting a straight line.
Unit V:

Numerical integration - Trapezoidal rule – Simpson's one third rule (with derivation) – Numerical differentiation – Taylor series method (1st order only) – Euler's method – Runge Kutta method (2nd and 4th order only).

Text book:

1. N.Ch.S.N Iyengar, V.Chandrasekharan, K.A.Venkatesh and P.S. Arunachalam, "Discrete mathematics", Vikas Publishing (2003).
2. P.Kandasamy, Numerical Methods, S.Chand and Co, Reprint 2010.

References:

1. Venkataraman M.K. Numerical methods in Science and Engineering , National Publishing Company, Revised Edition, 2005.
2. Bernard Kolman, Robert C. Busby ,Sharon Cutler Ross, "Discrete Mathematical Structures",5th Edition, Pearson Education, 2004.

11MA208 COMPLEX ANALYSIS, STATISTICS AND Z-TRANSFORMS

Credits: 4:0:0

Course Objective:
To provide basic concepts about analytic functions, complex integration and certain methods in solving difference equations using Z-transform.

Course Outcome:
Students will be able to relate their subject knowledge with their engineering subjects during their course of study.

Unit I: Analytic Functions
Cauchy Riemann equations–Properties of analytic functions – Determination of harmonic conjugate – Milne – Thomson's method – Conformal mappings w = z + a, az, 1/z, z^2 and bilinear transformation.

Unit II: Complex Integration
Cauchy's theorem – Statement and application of Cauchy's integral formulae – Taylor's and Laurent's expansions – Singularities – Classification – Residues – Cauchy's residue theorem – Contour integration – Circular and semi Circular contours (excluding poles on real axis)

Unit III: Statistics
Moments, skewness and kurtosis (based on moments only) – Linear correlation-Coefficient of correlation – Rank correlation and regression lines – Theoretical Distributions – Binomial – Poisson – Normal.

Unit IV: Testing of hypothesis
Tests based on large samples - Small samples: t mean and difference of means – χ 2 test for goodness of fit and attributes and F - distribution.

Unit V: Z – Transforms
Z-transforms of standard functions, inverse Z-transform (Partial fraction expansions and residues), properties of Z-transform, Solution of difference equations.

Text Book:

1. Kandasamy.P, Thilagavathi .K and Gunavathi K., Engineering Mathematics volume II and III (6th revised Edition), S. Chand & Co., New Delhi, 2003.

Reference books:

1. Kreyszig, E., "Advanced Engineering Mathematics" (8th Edition), John Wiley and Sons (Asia) Pvt Ltd., Singapore, 2000.
2. Grewal, B.S., "Higher Engineering Mathematics" (6th Edition) Khanna Publisher, New Delhi, 2001.

11MA209 FOURIER SERIES, TRANSFORMS AND PARTIAL DIFFERENTIAL EQUATIONS

Credits: 4:0:0

Course Objective:

To provide basic concepts about Fourier series, applications of PDE and Fourier-transforms.

Course Outcome:

Students will be able to relate their subject knowledge with their engineering subjects during their course of study.

Unit I: Fourier series

Euler's formula – Dirichlet's conditions convergence statement only – Change of interval odd and even functions- Half range series – RMS value, Parseval's formula – Complex form of Fourier series – Harmonic analysis.

Unit II: Partial Differential Equations

Formation of equations by elimination of arbitrary constants and arbitrary functions – solution of equations – General, particular and complete integrals – Lagrange's linear equation – Standard type of first order equations – Second order and higher order equations with constant coefficients, homogeneous equations.

Unit III: One-Dimensional Wave Equations and Heat Equation

One dimensional wave equation – Transverse vibration of finite elastic string with fixed ends – Boundary and initial value problems – Fourier series solution-One dimensional heat equation – Steady and unsteady states, boundary and initial value problems – Fourier series solution. (Proofs and derivations not needed).

Unit IV: Two Dimensional Heat Equation

Two dimensional heat equations – Steady state heat flow in two dimensions – Laplace equations in Cartesian and polar co ordinates Fourier series solution. (Proofs and derivations not needed).

Unit V: Fourier transforms

The infinite Fourier transform – Sine and cosine transforms – Properties (Proof not needed) – Inversion theorem – Finite Fourier Transform – Sine and cosine transforms – Convolution theorem – Parseval's identity – Transform of derivatives. (Proofs and derivations not needed).

Text Book:

1. Kandasamy, P., "Engineering Mathematics", S. Chand & Co., New Delhi, Volume – III, 2010.

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Reference Books:

1. Erwin Kreyzig, "Advanced Engineering Mathematics", Wiley & Co, 2000.
2. Venkataraman, M.K., "Higher Engineering Mathematics", National Publishing Co.,2005.

11MA210 PROBABILITY AND BIO STATISTICS

Credits: 4:0:0

Course Objective:

To provide basic concepts about the statistics and probability.

Course Outcome:

Students will be able to relate their subject knowledge with their biological experiments during their course of study.

Unit: I

Collection of data – Graphical representation of Data – Histogram – Frequency Polygon – Frequency Curves – Relative Cumulative Frequency Curves – Measures of Central Tendency– Relation between AM, Mean, Median – Relation between AM & GM.

Unit: II

Measures of Dispersion – Range – Quartile Deviation – Quartile Range – Mean Deviation – Standard Deviation – Variance – Percentiles – Simple Problems.

Unit: III

Scatter Diagram – Correlation Coefficient (Karl Pearson) – Coefficient of Correlation for a Bivariate Data - Rank Correlation – Regression – Regression Lines.

Unit: IV

Tests of Significance – Student t - Test – Difference of Means – Test for Correlation and Regression Coefficients – Chi Square Test for Goodness of Fit – Analysis of Variance – Simple Problems based on One Way Classification.

Unit: V

Probability – Addition Law – Multiplication Law – Conditional Probability – Baye's Theorem. Distributions: Binomial, Poisson, Normal–Z - score, P - Value and E – Value.

Text Book:

1. S.C. Gupta, V.K. Kapoor, Fundamentals of Mathematical Statistics, Sultan Chand & Sons. XI edition, New Delhi, 2002.

Reference Books:

1. D.W. Jordan and P. Smith, Mathematical Techniques, 3rd Edn, Oxford University Press, New Delhi, 2002.
2. P.S.S. Sundar Rao and J. Richard, An Introduction to Biostatistics – A manual for students in health sciences, Prentice hall of India Pvt. Ltd., 2004.

11MA211 DISCRETE MATHEMATICS

Credits: 4:0:0

Objective: To provide the student with the concept and the understanding of basic concepts in logic relations and digraphs, lattice and Boolean algebra, graph theory and automata theory for analysis and modeling for computer science and engineering.

Course outcome: The students will be able to develop fundamental ideas of discrete mathematics,a foundation for the development of more advanced mathematical concepts. Also they will gain training for writing good computer programmes.

Unit I
Fundamentals: set and subsets – operation on sets – sequences – division in the integers – matrices – mathematical structures.
Logic: propositions and logical operation – conditional statements – methods of proof – Mathematical induction – Recurrence relation

Unit II
Relations and digraph: products sets and partitions – relations and digraphs – paths in relations and digraphs – properties of relations – equivalence of relations – computer representation of relations and digraphs – operations on relations – transitive closure and Warshall's algorithm.
Functions: functions – functions for computer science – growth of functions – permutation functions. (Theorems Statement only)

Unit III
Order relations and structures: partially ordered sets – external elements of partially ordered sets – lattices – finite Boolean algebras – functions on Boolean algebra.
Trees: trees – labeled trees – tree searching – undirected trees – minimal spanning trees. (Theorems statement only)

Unit IV
Topics in graphs theory: graphs –Euler paths and circuits –Hamiltonian Paths and circuits – transport networks – matching problems – coloring graphs.
Semi-groups and groups: binary operations revisited – semi-groups – groups – definitions with examples only (Theorems statement only)

Unit V
Languages and finite state machines : languages – representations of special grammars and languages – finite state machines – monoids ,machines and languages – machines and regular languages – simplification of machines.
Groups and coding: coding of binary information and error detection – decoding and error correction. (Theorems statement only)

Text Book:

1. Bernard Kolman, Robert C. Busby ,Sharon Cutler Ross, "Discrete Mathematical Structures", 5th Edition, Pearson Education, 2004.

11MA212 NUMERICAL METHODS

Credits 4:0:0

Objective: To provide the students with the concept of solving algebraic and transcendental equations, interpolation, initial and boundary value problems.

Course Outcome: The students will be able to solve different kinds of problems that occur in engineering numerically.

Unit : I
Emperical laws and curve fitting – the linear law – Laws reducible to the linear law – Method of group averages – Principle of Least squares – Fitting a straight line – Fitting a parabola – Fitting an exponential curve – Fitting a curve of the form y = axb – Calculation of the sum of the squares of the residuals – Method of moments.

Unit : II
Solution of numerical algebraic and transcendental equations. The Bisection method – Iteration method - Regula Falsi Method – Newton – Raphson method – Gauss elimination method - Method of triangularisation – Crout's method – Gauss-Jacobi method – Gauss-Seidel method.

Unit : III
Finite differences: First and higher order differences – Forward differences and backward differences – Properties of operator – Differences of a polynomial –Factorial polynomials – Operator E – Relation between δand E and D - Summation of series – Interpolation – Gregory-Newton forward Interpolation formula – Equidistant terms with one or more missing values – Gauss forward interpolation formula – Gauss backward interpolation formula.

Unit : IV
Interpolation with unequal intervals – Divided differences – Newton's divided difference formula – Lagrange's interpolation formula – Numerical differentiation and Integration – Newton's forward and backward differences to compute derivatives – The trapezoidal rule – Simpson's one third rule – Simpson's 3/8 rule – Difference Equations – Linear differenceequations - Linear homogeneous difference equations with constant coefficients – Nonhomogeneousdifference equations with constant coefficients.

Unit : V
Numerical solutions of ordinary differential equations – Power series approximations – Solution by Taylor series – Euler method – Runge – Kutta method (4th Order) – Numerical solutions of partial differential equations – Laplace's equations and its solution by Liebmann's process – Solution of Poisson's equation – Solutions of parabolic and hyperbolic equations.

Text Book

1. P. Kandasamy, " Numerical Methods", S. Chand & Co. New Delhi, Reprint 2010.

Reference Book
1. Venkataraman " Numerical Methods", National Publishing Company, Reprint 2005.

11MA213 PROBABILITY, RANDOM PROCESS AND NUMERICAL METHODS

Credits: 4:0:0

Objective: To develop the skills of the students in the area of Probability & Random Process. To provide the students with the concept of solving algebraic and transcendental equations, interpolation, numerical differentiation and integration.

Course outcome: The students will be able to gain knowledge in probability theory and will be able to make simpler the mathematical descriptions or modelling of random signals and also they can solve the engineering problems numerically.

Unit I

Axioms of probability – Probability spaces – Joint and conditional probabilities – Independent event – Theorem of Total probability – Baye's Theorem.

Unit II

Densities and distributions – Example, Properties of distribution and density functions – Joint distributions and densities – Conditional probability distribution and density functions – Independent random variables – characteristic function – Moment Generating function – Tchebycheff Inequality.

Unit III

Random process definitions – Basic concepts and examples –Weekly stationary process – Autocorrelation function – cross correlation function – Ergodicity – Power spectral density function.

Unit IV

Soltuion of Numerical, Algebraic and f transcendental equations **–** bisection method – Newton – raphson method (methods only). Simultaneous equation – Gauss elimination, Gauss seidal method – Interpolation formula – Newton – Gregory formula (forward and backward difference) – Principles of Least Squares – Fitting a straight line.

Unit V

Numerical integration - Trapezoidal rule – Simpson's one third rule (with derivation) – Numerical differentiation – Taylor series method (1st order only) – Euler's method – Runge Kutta method (2nd and 4th order only).

Text book

1. Veerarajan, "Probability statistics and Random Process" Tata Mc Graw Hill, 2009.
2. P. Kandasamy, " Numerical Methods", S. Chand & Co. New Delhi. Reprint 2010.

References:

1. Papoulis: "Probability, Random Variables and Stochastic Processes (2/e), Mc GrawHill, 1991.
2. Venkataraman " Numerical Methods", National Publishing Company, Reprint 2005.

11MA214 PROBABILITY AND RANDOM PROCESS

Credits: 4:0:0

Objective: To develop the skills of the students in the area of Probability & Random Process.

Course outcome: The students will be able to gain knowledge in probability theory and will be able to make simpler the mathematical descriptions or modelling of random signals.

Unit I:
Axioms of probability – Probability spaces – Joint and conditional probabilities – Independent events.

Unit II:
Densities and distributions – Example, Properties of distribution and density functions – Joint distributions and densities – Conditional probability distribution and density functions – Independent random variables.

Unit III:
Function of random variables and random vectors – Statistical averages – Characteristic functions – Inequalities of Tchebyshev and Cauchy Schwartz – Convergence concepts and the central limit theorem (Statement only).

Unit IV:
Random process definitions – Basic concepts and examples – Stationarity and ergodicity – Second order processes – Weekly stationary process – Covariance functions and their properties – Wiener Khinchine theorem.

Unit V:
Linear operations – Gaussian process – Poisson process – Low-pass and Band-pass process noise representations.

Text Book:
T. Veerarajan, "Probability statistics and Random Process" Tata Mc Graw Hill, Reprint 2005.

Reference Book:
H. Stark and J.W. Woods: "Probability, Random process and estimation theory for Engineers", Prentice Hall, 2002.

11MA301 APPLIED MATHEMATICS

Credits: 4:0:0

Course Objective: To provide the student with the concept and an understanding of basic concepts in algebra,graph theory, automata theory, random process and queuing theory for analysis and modeling in softwaretechnology

Course outcome:
Students will be able relate their subject knowledge with their engineering subjects during the course of study

Unit – I : Basic Concepts in Algebra
Divisibility, G.C.D, prime numbers, fundamental theorem of arithmetic, Congruence, Fermat's theorem, Euler function, primality testing, solution of congruence, Chinese remainder theorem. Groups and subgroups, homomorphism, cosets and normal subgroups (simple problems).

Unit – II : Graph Theory
Terminology – Representations of graphs – Connected graphs – Matrix representation of Graphs. Applications – Critical Path Method – Trees – Binary Trees.

Unit – III : Automata Theory
Language - Representation of Special languages and Grammars – Finite State Machines - machines & Regular languages – Simplification of machines.

Unit – IV : Random Processes: Classification – Methods of Description – Special classes – Average Values – Stationary – Example of SSS – Analytical representations – Weiner Process function – Auto correlation – Properties of R(τ) – cross Correlation – Properties – Ergodicity – Mean Ergodic theorem – Correlation Ergodic process – Power spectral density and its properties.

Unit – V Queueing Theory
Introduction- definition of terms in queuing model involving M/M/I: ∞/FIFO queue, M/M/C: ∞/FCFS, M/M/I : N/FCFS, M/M/C:N/ FCFS (Derivations are not included – simple problems to be asked)

Text book:
1. Bernard Kolman, Robert C. Busby, Sharon Cutler Ross, Discrete Mathematical Structures, Fifth Edition, Pearson Education, 2004.
2. T.Veerarajan, Probability, Statistics and Random Processes, Tata McGraw Hill, Revised edition 2002.
3. Kanti Swarup, Manmohan , P.K. Gupta "Operations Research" – Sultan Chand & Sons., 14th Edn. 2008.

Reference Books:
1. Narsingh Deo, Graph Theory with Application to Engineering and Computer Science, Prentice-Hall of India Private Ltd. 2004.
2. Richard H. Williams, Probability, Statistics and Random Process for Engineers, CENGAGE Learning, 2009.

11MA302 OPERATIONS RESEARCH TECHNIQUES

Credits: 4:0:0
Course Objective: To provide the student with the concept and an understanding of basic concepts in Operations Research Techniques for Analysis and Modeling in Food Technology.

Course outcome:
Students will be able relate their subject knowledge with their engineering subjects during the course of study

Unit I Linear Programming Problem
The Linear Programming Problem - Introduction, formulation of Linear Programming problem, Graphical solution to L.P.P, Simplex Method, Artificial variable techniques, two phase Method, Variants of the Simplex Method.

Unit II Duality & Transportation

Duality In Linear Programming - Concept of duality, Fundamental properties of Duality, Duality & simplex method. THE TRANSPORTATION PROBLEM: Introduction, Transportation Model, finding initial basic feasible solutions, moving towards optimality, Degeneracy.

Unit III Assignment & Sequencing
Assignment Problem - Introduction, Solution of an Assignment problem, Multiple Solution, Hungarian Algorithm, Maximization in Assignment Model, Impossible Assignment. Sequencing - Job sequencing, n jobs through two machines, n jobs through m machines., two jobs through m machines.

Unit IV Queuing Models
Introduction- definition of terms in queuing model involving M/M/I: ∞/FIFO queue, M/M/C: ∞/FCFS, M/M/I : N/FCFS, M/M/C:N/ FCFS (Derivations are not included – simple problems to be asked)

Unit V Network Model & Simulation
Network analysis– PERT & CPM- network diagram-probability of achieving completion date-Simulation models. Elements of simulation model-Montecarlo technique – applications.

Text Book:
1. Kanti Swarup, Manmohan , P.K. Gupta "Operationals Research" – Sultan Chand & Sons., 14th Edn. 2008.

Reference Books:
1. Winston, - Operations Research, Applications and Algorithms – Cengage Learning, 2004/ 4th Edn.
2. Hamdy, A. TAha, Operations Research (Sixth Edition) Prentice – Hall of India Private Limited, New Delhi.
3. Natarajan A.m. Balasubramani P., Tamilarasi A., Operations Research, Pearson Education, I Edn.2003.

11MA303 STATISTICS AND MATHEMATICS

Credits: 4:0:0
Course Objective: To provide the student with the concept and an understanding of basic concepts in Statistics, Testing of Hypothesis and Differential an Integral calculus for analysis

Course outcome:
Students will be able relate their subject knowledge with their engineering subjects during the course of study

Unit I. Fundamental statistics
Central tendencies: Mean, Median and Mode - Measures of dispersion: Range, uartiles,Standard Deviation - Distributions: Binomial, Poisson, and Normal .

Unit II. Correlation and Regression
Linear correlation- Coefficient of correlation-Coeffient of rank Correlation- Multiple & partial Correlation. Linear regression and Multiple regressions.

Unit III. Testing of hypothesis

Large Samples- Proportions, population mean –two sample Means. Small Samples- Student's t – test, F – test and Chi-square test for Goodness of fit.

Unit IV. Differential & Integral calculus

Differentiation- Trigonometry, polynomial, exponential, logarithmic, Implicit, hyperbolic & inverse circular functions. Integration- Trigonometric, exponential, logarithmic and Rational functions. Double and Triple Integrals.

Unit V. Differential equations

Linear differential equation of the type Second order, Euler- homogeneous linear differential and Simultaneous differential equations.

Text Books:

1. T.K. Manickavasagam Pillai, Differential Calculus S.Vishvanathan Printers&Publishers Pvt. Ltd, 2005.
2. Engineering Mathematics (Volume-III & I) by P. Kandasamy, K. Thilagavathy and K. Gunavathy, S. Chand & Company Ltd, 2009.

Reference Books:

1. T.Veerarajan, Engineering Mathematics, (4^{th} Edition)Tata McGraw Hill, New Delhi, 2009.
2. S.C. Gupta, V.K. Kapoor, Fundamentals of Mathematical Statistics, Sultan Chand & Sons. XI edition, New Delhi, 2002.

11MA304 PROBABILITY AND BIOSTATISTICS FOR FOOD SCIENCES

Credits 4:0:0

Course Objective: To provide the student with the concept and an understanding of basic concepts in Statistics, Testing of Hypothesis for analysis

Course outcome:

Students will be able relate their subject knowledge with their engineering subjects during the course of study

Unit I : Statistics

Measures of central tendency – Measures of Dispersion — Binomial –Poisson –Normal distributions.

Unit II : Correlation

Correlations and regression, - Correlations coefficients – correlations coefficients in terms of regression coefficients, Rank correlation and repeated ranks.

Unit III : Testing of Hypothesis

Population- sample- one tail and two tailed tests- Large samples-proportion and mean – Small Samples – t, F, χ^2 Distributions.

UNIT IV Design of experiments and quality control

Aim of the design of experiments – completely randomized design- analysis of variance for one factor of classification – randomized block design- analysis of variance for two factors of classification- Latin square design – analysis of design for three factors of classification comparison of RBD and LSD.

Unit V: SQC

Introduction – Types of variation – types of control charts – X chart, R. Chart, Sigma Chart, C-Chart, Advantages and Limitations of SQC – Acceptance sampling – Single acceptance sampling plan, double sampling plan, multiple sampling plan, construction of a OC curve – AQL and LTPD.

Text Book:

1. S.P. Gupta, Statistical Methods , Sultan Chand and sons., New Delhi, 2002.

Reference Book:

1. T.Veerarajan, Theory of Probability and Random Process, Tata McGraw Hill Publishing Company, 2002.
2. P.S.Grewal, Method of Statistical Analysis, Sterling Publisher Pvt.LTD, New Delhi, 2002.

11MA305 APPLIED MATHEMATICS FOR CIRCUIT BRANCHES

Credit: 3:1:0

Course Objective: To provide the student with the concept and an understanding of basic concepts for analysis

Course outcome:

Students will be able relate their subject knowledge with their engineering subjects during the course of study

Unit I:

Calculus of Variations: Maximum and Minimum of functions of several independent variables – Lagrangian method of multipliers. Variational problems of fixed boundaries only simplest Variational problems – Euler equation – Brachisto Chrone problem – Variational problems involving several unknown functions – Functionals involving first and second order derivations – Functional involving two or more independent variables – Isoperimetric problems.

Unit II:

Linear integral equations: Different types of integral equations – Fredholm and Volterra integral equations – Relation between differential and integral equations – Green's function – Fredholm equation with separable kernal – Interactive method of solving equation of second kind – Properties of symmetric kernels.

Unit III:

Vector Space: Definition and examples of linear space – Linear dependence and independence – Basis and Dimension – Subspace – Inner Product space – Orthogonalisation process.

Unit IV:

Functions and Relations: Injective and Surjective, bijective functions – Compositions, identity, inverse functions – properties of relations.

Unit V:

Graph Theory: Introduction – Basic terminology – Representations of graphs – connected Graphs – Matrix representation of graphs (excluding graphs), Applications – Critical path method – Shortest path problems – trees – definition – Binary tree.
Z – Transforms: Definition – Z – Transform of standard functions: Applications to signals and linear time invariant system.

Text Books
1. Venkataraman M.K. "Higher Mathematics for Engg. And Science", National Publishing Company, 2002.
2. Narsingh Dev, "Graph Theory with Applications to Engineering and Computer Science", Prentice Hall of India (P) Ltd.2000.
3. Hoff mann and Kunze, Linear Algebra, 2/c, Prentice Hall India Limited, 1994.

Reference Books
1. Tremblay, J.P. and Manohar R. "Discrete Mathematical Structures with Applications to Computer Science", McGraw Hill, 1987
2. John G. Proakis, "Digital Signal Processing", Prentice Hall of India (P) Ltd., 1995

11MA306 GRAPHS, RANDOM PROCESSES AND QUEUES

Credit: 4:0:0

Course Objective: To provide the student with the concept and an understanding of basic concepts in graphs, Trees, probability, Random Process and queueing theory for analysis

Course outcome:
Students will be able relate their subject knowledge with their engineering subjects during the course of study

Unit - I
Topics in Graph Theory: Graphs – Euler paths and Circuits – Hamiltonian paths and circuits – Transport Networks – Matching Problems - Coloring graphs.

Unit – II
Trees: Trees – Labeled Trees – Tree Searching – Undirected Trees – Minimal Spanning Trees.

Unit – III
Probability Theory: Axiomatic definition of Probability – Conditional Probability – Independent events – Theorem of Total probability – Baye's Theorem – Discrete Random Variable – Probability function – Continuous Random variable – Probability Density function – Cumulative Distribution Function(Cdf) – Properties of Cdf — Mean and Variance , MGF of Binomial and Poisson distribution.

Unit – IV
Random Processes: Classification – Methods of Description – Special classes – Average Values – Stationary – Example of SSS – Analytical representations – Weiner Process function – Auto correlation – Properties of $R(\tau)$ – cross Correlation – Properties – Ergodicity – Mean Ergodic theorem – Correlation Ergodic process – Power spectral density and its properties.

Unit – V

Introduction- definition of terms in queuing model involving M/M/I: ∞/FIFO queue, M/M/C: ∞/FCFS, M/M/I : N/FCFS, M/M/C:N/ FCFS (Derivations are not included – simple problems to be asked)

Text Books:

1. Bernard Kolman, Robert C. Busby and Sharon Ross, Discrete Mathematical Structures, 5th Edition, Pearson Education, 2004, ISBN: 81-297-0465-X
2. T. Veerarajan, Probability , Statistics and Random processes, 2nd Edition, Tata McGraw Hill, 2006. ISBN: 0-07-060170 – 4.
3. Kanti Swarup, Man Mohan, P.K. Gupta, "Operations Research", Sultan Chand & Sons, 2000.

Reference Books:

1. Narsingh Deo, Graph Theory with Application to Engineering and Computer Sciences, Prentice-Hall of India Private Ltd., 2000.
2. Hamdy A. Taha, "Operation Research", Maxwell Macmillan, Revised Edition, 2000.
3. Kandasamy P. , Thilagavathy, Gunavathy, "Probability, Random Process and Queueing Theory, S. Chand & Co. New Delhi, 2007

11MA307 GRAPH THEORY AND OPTIMIZATION TECHNIQUES

Credit: 4:0:0

Course Objective: To provide the student with the concept and an understanding of basic concepts in Graphs and optimization techiniques and statistics for analysis

Course outcome:
Students will be able relate their subject knowledge with their engineering subjects during the course of study

Unit I : BASICS OF GRAPH THEORY
Graphs – Data structures for graphs – Subgraphs – Operations on Graphs Connectivity – Networks and the maximum flow – Minimum cut theorem - Trees – Spanning trees – Rooted trees – Matrix representation of graphs.

Unit II Classes Of Graphs
Eulerian graphs and Hamiltonian graphs – Standard theorems – Planar graphs – Euler's formula - Five colour theorem – Coloring of graphs – Chromatic number (vertex and edge) properties and examples – Directed graphs.

Unit III Graph Algorithm
Computer Representation of graphs – Basic graph algorithms – Minimal spanning tree algorithm – Kruskal and Prim's algorithm - Shortest path algorithms – Dijsktra's algorithm – DFS and BFS algorithms.

Unit IV Optimization Techniques
Linear Programming – Graphical methods – Simplex method (Artificial variables not included)-transportation and Assignment problems.

Unit V Statistics

Tchebyshev's inequality – Maximum likelihood estimation – Correlation – Partial correlation – Multiple correlations – Regression – Multiple regression.

Text Books:

1. S.C. Gupta, V.K. Kapoor, "Fundamentals of Mathematical Statistics", Sultan Chand & Sons, 2002.
2. Narsingh Dev, "Graph Theory with Applications to Engineering and Computer Science", Prentice Hall of India (p) Ltd. 1988. Haffmann and Kunze "Linear Algebra", PHI, 1994.
3. Kanti Swarup, Man Mohan, P.K. Gupta, "Operations Research", Sultan Chand & Sons, 2000.

Reference Books:

1. Walpole Myers, Myers, Ye, "Probability & Statistics for Engineers and Scientists" Pearson Education, first Indian reprint, 2002.
2. S.C. Gupta V.K. Kapoor, "Fundamentals of Applied Statistics", Sultan Chand & Sons, 2002.
3. T.Veerarjan, Theory of Probability and Random Process, Tata McGraw Hill Publishing Company Science, PHI, 2005.

11MA308 LINEAR ALGEBRA

Credits 4:0:0

Course Objectives: To provide the student with the concept and the understanding in vector spaces, linear transformations and inner product spaces.

Outcome: Knowledge in the methodology and applications of linear transformations

Unit I:
Vector Spaces: Vector Spaces – Subspaces – Bases and dimension – Coordinates – Summary of Row – Equivalence – Computations concerning subspaces.

Unit II:
Linear Transformations: Linear Transformations – The Algebra of Linear Transformations – Isomorphism – Representation of Transformation by Matrices – Linear Functionals.

Unit III:
Elementary Canonical Forms: Introduction – Characteristic Values – Annihilating Polynomials – Invariant Subspaces – Simultaneous Triangulation; Simultaneous Diagonalization

Unit IV:
The Rational and Jordan Forms: Cyclic Subspaces and Annihilators – Cyclic Decompositions and the Rational Form – The Jordan Form – Computations of Invariant Factors.

Unit V:
Inner Product Spaces: Inner Products – Inner Product Spaces – Linear Functionals and Adjoints – Unitary Operators – Normal Operators

Text Book :

1. Kenneth Hoffman and Ray Kunze. Linear Algebra (II Edition), Prentice-Hall of India Pvt. Ltd. , New Delhi, 2000.
   Unit I: Chapter 2: Sections 2.1 to 2.6,
   Unit II : Chapter **3:** Section 3.1 to 3.5

Unit III: Chapter 6: Sections 6.1 to 6.5,
Unit IV: Chapter 7: Sections 7.1 to 7.4
Unit V: Chapter 8: Sections 8.1 to 8.5

Reference Books:

1. Halmos. P. Finite Dimensional Vector Spaces, D. Van Nostrand Co., Princeton, 1958.
2. I.N. Herstein, Topics in Algebra, II Edition. Wiley Eastern Limited, New Delhi, 2000.
3. M. Artin, Algebra, Prentice Hall of India, 1991.
4. P.B. Bhattacharya, S.K. Jain, and S.R. Nagpaul , Basic Abstract Algebra (II Edition) Cambridge University Press, 1997 (Indian Edition).

11MA309 REAL ANALYSIS –I

Credits 4:0:0

Course Objectives: To provide the student with the concept and the understanding in functions of bounded variation, Riemann-Stieiltjes integral and sequences of functions.
Outcome: Knowledge in sequences of functions.

Unit - I
Functions of bounded variation - Introduction - Properties of monotonic functions - Functions of bounded variation - Total variation - Additive property of total variation – Total variation on [a, x] as a function of x - Functions of bounded variation expressed as the difference of two increasing functions - Continuous functions of bounded variation.

Infinite Series: Absolute and conditional convergence - Dirichlet's test and Abel's test - Rearrangement of series - Riemann's theorem on conditionally convergent series.

Unit - II
The Riemann - Stieltjes Integral - Introduction - Notation - The definition of the Riemann - Stieltjes integral - Linear Properties - Integration by parts- Change of variable in a Riemann - Stieltjes integral - Reduction to a Riemann Integral – Euler’s summation formula - Monotonically increasing integrators, Upper and lower integrals - Additive and linearity properties of upper and lower integrals - Riemann's condition - Comparison theorems.

Unit-III
The Riemann-Stieltjes Integral - Integrators of bounded variation-Sufficient conditions for the existence of Riemann-Stieltjes integrals-Necessary conditions for the existence of Riemann-Stieltjes integrals- Mean value theorems for Riemann - Stieltjes integrals – The integrals as a function of the interval - Second fundamental theorem of integral calculus- Change of variable in a Riemann integral-Second Mean Value Theorem for Riemann integral-Riemann-Stieltjes integrals depending on a parameter-Differentiation under the integral sign-Lebesgue criteriaon for the existence of Riemann integrals.

Unit IV:
Infinite Series and infinite Products - Double sequences - Double series – Rearrangement theorem for double series - A sufficient condition for equality of iterated series - Multiplication of series - Cesaro summability - Infinite products.

Power series - Multiplication of power series - The Taylor's series generated by a function - Bernstein's theorem - Abel's limit theorem - Tauber's theorem

Unit V:

Sequences of Functions - Pointwise convergence of sequences of functions - Examples of sequences of real - valued functions - Definition of uniform convergence – Uniform convergence and continuity - The Cauchy condition for uniform convergence – Uniform convergence of infinite series of functions - Uniform convergence and Riemann – Stieltjes integration - Uniform convergence and differentiation - Sufficient condition for uniform convergence of a series - Mean convergence.

Text Book

1. Tom M.Apostol : Mathematical Analysis, 2nd Edition, Addison-Wesley Publishing Company Inc. New York, 1974.
Unit 1: Chapter 8: Sections 8.8, 8.15, 8.17, 8.18. and Chapter – 6: Sections 6.1 to 6.8 .
Unit 2: Chapter - 7: Sections 7.1 to 7.14.
Unit 3: Chapter - 7: 7.18 to 7.26.
Unit 4: Chapter - 8 Sec, 8.20, 8.21 to 8.26. and Chapter 9: Sections 9.14, 9.15, 9.19, 9.20, 9.22, 9.23.
Unit 5: Chapter -9 Sec 9.1 to 9.6, 9.8, 9.10, 9.11, 9.13.

Books for Supplementary Reading and Reference:

1. Bartle, R.G. Real Analysis, John Wiley and Sons Inc., 1976.
2. Rudin,W. Principles of Mathematical Analysis, 3rd Edition. McGraw Hill Company, New York, 1976.
3. Malik,S.C. and Savita Arora. Mathematical Anslysis, Wiley Eastern Limited.New Delhi, 1991.
4. Sanjay Arora and Bansi Lal, Introduction to Real Analysis, Satya Prakashan, New Delhi, 1991.

11MA310 ORDINARY DIFFERENTIAL EQUATIONS

Credits 4:0:0

Course Objectives: To provide the student with the concept and the understanding in linear equations with constant coefficients and variable coefficients.

Outcome: Knowledge in ordinary differential equations.

Unit I: Linear equations with constant coefficients

Second order homogeneous equations-Initial value problems-Linear dependence and independence-Wronskian and a formula for Wronskian-Non-homogeneous equation of order two.

Unit II: Linear equations with constant coefficients

Homogeneous and non-homogeneous equation of order n –Initial value problems- Annihilator method to solve non-homogeneous equation- Algebra of constant coefficient operators.

Unit III: Linear equation with variable coefficients

Initial value problems - Existence and uniqueness theorems – Solutions to solve a nonhomogeneous equation – Wronskian and linear dependence – reduction of the order of a homogeneous equation – homogeneous equation with analytic coefficients-The Legendre equation.

Unit IV: Linear equation with regular singular points
Euler equation – Second order equations with regular singular points –Exceptional cases – essel Function.

Unit V: Existence and uniqueness of solutions to first order equations
Equation with variable separated – Exact equation – method of successive approximations – the Lipschitz condition – convergence of the successive approximations and the existence theorem.

Text Book:

1. E.A.Coddington, A Introduction to Ordinary Differential Equations (3rd Printing), Prentice-Hall of India Ltd.,New Delhi, 1987.
Unit 1: Chapter 2: Sections 1 to 6
Unit 2: Chapter 2 : Sections 7 to 12.
Unit 3: Chapter : 3 Sections 1 to 8 (Omit section 9)
Unit 4: Chapter 4 : Sections 1 to 4 and 6 to 8 (Omit sections 5 and 9)
Unit 5: Chapter 5 : Sections 1 to 6 (Omit Sections 7 to 9)

Books for Supplementary Reading and Reference:

1. Williams E. Boyce and Richard C. DI Prima, Elementary differential equations and boundary value problems,John Wiley and sons, New York, 1967.
2. George F Simmons, Differential equations with applications and historical notes, Tata McGraw Hill, New Delhi, 1974.

11MA311 MECHANICS

Credits 4:0:0

Course Objectives: To provide the student with the concept and the understanding in Mechanical systems, Lagrange’s equations and Hamilton’s equations.
Outcome: Knowledge in Mechanical systems.

Unit - I: Mechanical Systems
The Mechanical system- Generalised coordinates – Constraints - Virtual work - Energy and Momentum.

Unit-II: Lagrange's Equations
Derivation of Lagrange’s equations- Examples- Integrals of motion.

Unit - III: Hamilton's Equations
Hamilton's Principle - Hamilton's Equation - Other variational principle.

Unit – IV: Hamilton-Jacobi Theory
Hamilton Principle function – Hamilton-Jacobi Equation – Separability.

Unit-V: Canonical Transformation
Differential forms and generating functions – Special Transformations– Lagrange and Poisson brackets.

Text Book:

1. D. Greenwood, Classical Dynamics, Prentice Hall of India, New Delhi, 1985.

Unit 1: Chapter 1: Sections 1.1 to 1.5
Unit 2: Chapter 2 : Sections 2.1 to 2.3 (Omit Section 2.4)
Unit 3: Chapter 4 : Sections 4.1 to 4.3 (Omit section 4.4)
Unit 4: Chapter 5 : Sections 5.1 to 5.3.
Unit 5: Chapter 6: Sections 6.1, 6.2 and 6.3 (omit sections 6.4, 6.5 and 6.6)

Books for Supplementary Reading and Reference:

1. H. Goldstein, Classical Mechanics, (2nd Edition) Narosa Publishing House, New Delhi, 1980
2. N.C.Rane and P.S.C.Joag, Classical Mechanics, Tata McGraw Hill, 1991.
3. J.L.Synge and B.A.Griffth, Principles of Mechanics (3rd Edition) McGraw Hill Book Co., New York, 1970.

11MA312 ALGEBRA

Credits 4:0:0

Course Objectives: To provide the student with the concept and the understanding in Algebra.
Outcome: Knowledge in Finite Abelian groups and elements of Galois Theory .

Unit - I:
Another Counting Principle – Class Equations for Finite Groups and its Applications – Sylow's Theorems (for Theorem 2.12.1, First Proof only)

Unit – II: Solvable Groups – Direct Products – Finite Abelian Groups – Modules.

Unit - III: Extension Fields – Roots of Polynomial – More about roots.

Unit - IV: Elements of Galois Theory.

Unit - V: Finite Fields – Wedderburn's theorem on finite division rings.

Content and treatment as in: I.N. Herstein. Topics in Algebra (II Edition), Wiley Eastern Limited, New Delhi, 1975.

Unit 1: Chapter 2 Sections 2.11 and 2.12 (Omit Lemma 2.12.5)
Unit 2: Chapter 5: Sections 5.7 (Lemma 5.7.1, Lemma 5.7.2, Theorem 5.7.1)
Chapter 2: Sections 2.13 and 2.14 (Theorem 2.14.1 only); Chapter 4: Section 4.5.
Unit 3: Chapter 5 : Section 5.1, 5.3, 5.5.
Unit 4: Chapter 5: Sections 5.6.
Unit 5: Chapter 7 : Sections 7.1 and 7.2 (Theorem 7.2.1 only)

Books for Supplementary Reading and Reference:

1. M.Artin, Algebra, Prentice Hall of India, 1991.
2. P.B.Bhattacharya, S.K.Jain, and S.R.Nagpaul, Basic Abstract Algebra (II Edition), Cambridge University Press, 1997. (Indian Edition)
3. D.S.Malik, J.N. Mordeson and M.K.Sen, Fundamental of Abstract Algebra, McGraw Hill (International Edition), New York. 1997.
4. N.Jacobson, Basic Algebra, Vol. I & II W.H.Freeman (1980); also published by Hindustan Publishing Company, New Delhi.

11MA313 REAL ANALYSIS – II

Credits 4:0:0

Course Objectives: To provide the student with the concept and the understanding in Measure on the Real line, Fourier series and Fourier integrals and Multivariable Differential Calculus.

Outcome: Knowledge in evaluating Fourier integrals and solving extremum problems.

Unit –I:
Measure on the Real line - Lebesgue Outer Measure - Measurable sets - Regularity - Measurable Functions - Borel and Lebesgue Measurability.

Unit - II:
Integration of Functions of a Real variable - Integration of Non- negative functions – The General Integral - Riemann and Lebesgue Integrals.

Unit – III:
Fourier Series and Fourier Integrals - Introduction - Orthogonal system of functions – The theorem on best approximation - The Fourier series of a function relative to an orthonormal system - Properties of Fourier Coefficients - The Riesz-Fischer Thorem - The convergence and representation problems in for trigonometric series - The Riemann - Lebesgue Lemma - The Dirichlet Integrals - An integral representation for the partial sums of Fourier series - Riemann's localization theorem - Sufficient conditions for convergence of a Fourier series at a particular point - Cesaro summability of Fourier series- Consequences of Fejes's theorem - The Weierstrass approximation theorem.

Unit – IV:
Multivariable Differential Calculus - Introduction - The Directional derivative - Directional derivative and continuity - The total derivative - The total derivative expressed in terms of partial derivatives - The matrix of linear function - The Jacobian matrix - The chain rule - Matrix form of chain rule - The mean - value theorem for differentiable functions – A sufficient condition for differentiability - A sufficient condition for equality of mixed partial derivatives - Taylor's theorem for functions of R^n to R^1

Unit – V:
Implicit Functions and Extremum Problems : Functions with non-zero Jacobian determinants – The inverse function theorem-The Implicit function theorem-Extrema of real valued functions of severable variables-Extremum problems with side conditions.

Content and Treatment as in :

1. G. de Barra, Measure Theory and Integration, Wiley Eastern Ltd., New Delhi, 1981. (for Units I and II)
2. Tom M.Apostol : Mathematical Analysis, 2nd Edition, Addison-Wesley Publishing Company Inc. New York, 1974. (for Units III, IV and V)

Unit 1:Chapter - 2 Sec 2.1 to 2.5 (de Barra)
Unit 2: Chapter - 3 Sec 3.1,3.2 and 3.4 (de Barra)
Unit 3: Chapter 13 : Sections 13.1 to 13.7 (Apostol)
Unit 4: Chapter 12 : Section 12.1 to 12.14 (Apostol)

Unit 5: Chapter 11 : Sections 11.1 to 11.15 (Apostol)

Books for Supplementary Reading and Reference:

1. Burkill,J.C. The Lebesgue Integral, Cambridge University Press, 1951.
2. Munroe,M.E. Measure and Integration. Addison-Wesley, Mass.1971.
3. Roydon,H.L.Real Analysis, Macmillan Publishing Company, New York,1988.
4. Rudin, W. Principles of Mathematical Analysis, McGraw Hill Company, New York, 1979.

11MA314 PARTIAL DIFFERENTIAL EQUATIONS

Credits 4:0:0

Course Objectives: To provide the student with the concept and the understanding in Partial Differential Equations, Laplace and Fourier Transform method.
Outcome: Knowledge in solving elliptic, parabolic and hyperbolic equations.

Unit-I : Partial Differential Equations of First Order: Formation and solution of PDEIntegral surfaces – Cauchy Problem order eqn- Orthogonal surfaces – First order non-linear – Characteristics – Csmpatible system – Charpit method. **Fundamentals:** Classification and canonical forms of PDE.

Unit-II : Elliptic Differential Equations: Derivation of Laplace and Poisson equation – BVP – Separation of Variables – Dirichlet's Problem and Newmann Problem for a rectangle – Interior and Exterior Dirichlets's problems for a circle – Interior Newmann problem for a circle – Solution of Laplace equation in Cylindrical and spherical coordinates – Examples.

Unit-III : Parabolic Differential Equations: Formation and solution of Diffusion equation – Dirac-Delta function – Separation of variables method – Solution of Diffusion Equation in Cylindrical and spherical coordinates Examples.

Unit-IV :**Hyperbolic Differential equations**: Formation and solution of one-dimensional wave equation – canocical reduction – IVP- d'Alembert's solution – Vibrating string – Forced Vibration – IVP and BVP for two-dimensional wave equation – Periodic solution of one-dimensional wave equation in cylindrical and spherical coordinate systems – vibration of circular membrane – Uniqueness of the solution for the wave equation – Duhamel's Principle – Examples.

Unit-V: Green's Function: Green's function for laplace Equation – methods of Images – Eigen function Method – Green's function for the wave and Diffusion equations.
Laplace Transform method: Solution of Diffusion and Wave equation by Laplace Transform.
Fourier Transform Method: Finite Fourier sine and cosine franforms – solutions of Diffusion, Wave and Laplace equations by Fourier Transform Method.

Contents and treatment as in :S, Sankar Rao, Introduction to Partial Differential Equations, 2nd Edition, Prentice Hall of India, New Delhi. 2005.
Unit 1: Chapter 0: 0.4 to 0.11 (omit .1,0.2.0.3 and 0.11.1) and Chapter 1: 1.1 to 1.5
Unit 2: Chapter 2: 2.1, 2 2 ,2.5 to 2.13 (omit 2.3 and 2.4)
Unit 3: Chapter 3: 3.1 to 3.7 and 3.9 (omit 3.8)
Unit 4: Chapter 4: 4.1 to 4.12 (omit 4.13)
Unit 5: Chapter 5: 5.1 to 5.6 Chapter 6: 6.13, 6.13.1 and 6.13.2 only (omit 6.14)
Chapter 7: 7.10 to 7.13(omit 7.14)

Reference Books

1. R.C.McOwen, Partial Differential Equations, 2nd Edn. Pearson Eduction, New Delhi, 2005.
2. I.N.Sneddon, Elements of Partial Differential Equations, McGraw Hill, New Delhi, 1983.
3. R. Dennemeyer, Introduction to Partial Differential Equations and Boundary Value Problems, McGraw Hill, New York, 1968.
4. M.D.Raisinghania, Advanced Differential Equations, S.Chand & Company Ltd., New Delhi, 2001.

11MA315 TENSOR ANALYSIS AND SPECIAL THEORY OF RELATIVITY

Credits 4:0:0

Course Objectives:
To provide the student with the concept and the understanding in Tensor algebra, Tensor calculus and Special theory of relativity.

Outcome:
Knowledge in relativistic dynamics.

Unit I :
Tensor Algebra: Systems of Different orders – Summation Convention – Kronecker Symbols – Transformation of coordinates in Sn – Invariants – Covariant and Contravariant vectors – Tensors of Second Order – Mixed Tensors – Zero Tensor – Tensor Field – Algebra of Tensors – Equality of Tensors – Symmetric and Skew-symmetric tensors – Outer multiplication, Contraction and Inner Multiplication – Quotient Law of Tensors – Reciprocal Tensor of Tensor – Relative Tensor – Cross Product of Vectors.

Unit II:
Tensor Calculus: Riemannian Space – Christoffel Symbols and their properties

Unit III :
Tensor Calculua(contd): Covariant Differentiation of Tensors – Riemann-Christoffel Curvature Tensor – Intrinsic Differentiation.

Unit-IV :
Special Theory of Relativity: Galilean Transformation – Maxwell's equations – The ether Theory – The Principle of Relativity

Relativistic Kinamatics : Lorentz Transformation equations – Events and simultaneity – Example – Einstein Train – Time dilation – Longitudinal Contraction – Invariant Interval – Proper time and Proper distance – World line – Example – twin paradox – addition of velocities – Relativistic Doppler effect.

Unit-V
Relativistic Dynamics : Momentum – Energy – Momentum-energy four vector – Force – Conservation of Energy – Mass and energy – Example – inelastic collision – Principle of equivalence – Lagrangian and Hamiltonian formulations.
Accelarated Systems : Rocket with constant accelaration – example – Rocket with constant thrust.

Contents and Treatment as in:
For Units I,II and III : U.C. De, Absos Ali Shaikh and Joydeep Sengupta, Tensor Calculus, arosa Publishing House, New Delhi, 2004.

For Units IV and V: D. Greenwood, Classical Dynamics, Prentice Hall of India, New Delhi, 1985.

Unit 1: Chapter I : I.1 – I.3, I.7 and I.8 and Chapter II : II.1 –II.19.
Unit 2: Chapter III: III.1 and III.2.
Unit 3: Chapter III: III.3 – III.5.
Unit 4: Chapter 7 : Sections 7.1 and 7.2.
Unit 5: Chapter 7 : Sections 7.3 and 7.4.

Books for Supplementary Reading and Reference:
1. P.G.Bergman, An Introduction to Theory of Relativity, New York, 1942.
2. M.C.Chaki, A Text Book of Tensor Calculus, Calcutta Publishers, 2000.
3. A.S.Eddington. The Mathematical Theory of Relativity, Cambridge University Press, 1930.
4. I.S.Sokolnikoff, Tensor Analysis, John Wiley and Sons, Inc. 1964.

11MA316 COMPLEX ANALYSIS – I

Credits 4:0:0
Course Objectives:
To provide the student with the concept and the understanding in Cauchy's theorem, partial fractions and entire functions.

Outcome:
Knowledge in evaluation of Definite Integrals and Harmonic Functions.

Unit I : Cauchy's Integral Formula
The Index of a point with respect to a closed curve – The Integral formula – Higher derivatives. Local Properties of analytical Functions: Removable Singularities-Taylors's Theorem – Zeros and poles – The local Mapping – The Maximum Principle.

Unit II: The genral form of Cauchy's Theorem
Chains and cycles- Simple Continuity - Homology - The General statement of Cauchy's Theorem - Proof of Cauchy's theorem - Locally exact differentials- Multilply connected regions - Residue theorem - The argument principle.

Unit III: Evaluation of Definite Integrals and Harmonic Functions
Evaluation of definite integrals - Definition of Harmonic function and basic properties - Mean value property - Poisson formula.

Unit IV: Harmonic Functions and Power Series Expansions
Schwarz theorem - The reflection principle - Weierstrass theorem – Taylor's Series – Laurent series .

Unit V: Partial Fractions and Entire Functions
Partial fractions - Infinite products – Canonical products – Gamma Function- Jensen's formula – Hadamard's Theorem.

Contents and Treatment as in: Lars V. Ahlfors, Complex Analysis, (3rd edition) McGraw Hill Co., New York, 1979.
Unit 1: Chapter 4 : Section 2 : 2.1 to 2.3 and Chapter 4 : Section 3 : 3.1 to 3.4.
Unit 2: Chapter 4 : Section 4 : 4.1 to 4.7 and Chapter 4 : Section 5: 5.1 and 5.2.
Unit 3: Chapter 4 : Section 5 : 5.3 and Chapter 4 : Sections 6 : 6.1 to 6.3.
Unit 4: Chapter 4 : Sections 6.4 and 6.5 and Chapter 5 : Sections 1.1 to 1.3.
Unit 5: Chapter 5 : Sections 2.1 to 2.4. and Chapter 5 : Sections 3.1 and 3.2.

Books for Supplementary Reading and Reference:

1. H.A. Presfly, Introduction to complex Analysis, Clarendon Press, oxford, 1990.
2. J.B. Corway, Functions of one complex variables Springer - Verlag, International student Edition, Naroser Publishing Co. 1973.
3. E. Hille, Analytic function Thorey (2 vols.), Gonm & Co, 1959.
4. M.Heins, Complex function Theory, Academic Press, New York,1968.

11MA317 PROBABILITY THEORY

Credits 4:0:0

Course Objectives:
To provide the student with the concept and the understanding in Random Events , Random Variables, characteristic functions and probability distributions.

Outcome:
Knowledge in the technique and applications of probability theory.

Unit I : Random Events and Random Variables
Random events – Probability axioms – Combinatorial formulae – conditional probability – Bayes Theorem – Independent events – Random Variables – Distribution Function – Joint Distribution – Marginal Distribution – Conditional Distribution – Independent random variables – Functions of random variables.

Unit II : Parameters of the Distribution
Expectation- Moments – The Chebyshev Inequality – Absolute moments – Order parameters – Moments of random vectors – Regression of the first and second types.

Unit III : Characteristic functions
Properties of characteristic functions – Characteristic functions and moments – semi invariants – characteristic function of the sum of the independent random variables – Determination of distribution function by the Characteristic function – Characteristic function of multidimensional random vectors – Probability generating functions.

Unit IV: Some Probability distributions
One point , two point , Binomial – Polya – Hypergeometric – Poisson (discrete) distributions – Uniform – normal gamma – Beta – Cauchy and Laplace (continuous) distributions.

Unit V : Limit Theorems
Stochastic convergence – Bernaulli law of large numbers – Convergence of sequence of distribution functions – Levy-Cramer Theorems – DeMoivre-Laplace Theorem – Poisson, Chebyshev, Khintchine Weak law of large numbers – Lindberg Theorem – Lapunov Theroem – Borel-Cantelli Lemma - Kolmogorov Inequality and Kolmogorov Strong Law of large numbers.

Contents and treatment as in:
M. Fisz, Probability Theory and Mathematical Statistics, John Wiley and Sons, New York, 1963.

Unit 1: Chapter 1: Sections 1.1 to 1.7 and Chapter 2 : Sections 2.1 to 2.9.
Unit 2: Chapter 3 : Sections 3.1 to 3.8.
Unit 3: Chapter 4: Sections 4.1 to 4.7.
Unit 4: Chapter 5 : Section 5.1 to 5.10 (Omit Section 5.11).
Unit 5: Chapter 6: Sections 6.1 to 6.4, 6.6 to 6.9, 6.11 and 6.12. (Omit Sections 6.5, 6.10, 6.13 to 6.15).

Books for Supplementary Reading and Reference:
1. K.L.Chung, A course in Probability, Academic Press, New York, 1974.
2. Y.S.Chow and H.Teicher, Probability Theory, Springer Verlag. Berlin, 1988. (2nd Edition)
3. R.Durrett, Probability: Theory and Examples, (2nd Edition) Duxbury Press, New York, 1996.
4. B.R.Bhat , Modern Probability Theory (3rd Edition), New Age International (P)Ltd, New Delhi, 1999.

11MA318 FUNCTIONAL ANALYSIS

Credits 4:0:0
Course Objectives:
To provide the student with the concept and the understanding in Banach spaces, Hilbert space and Banach Algebras.

Outcome:
Knowledge in Banach spaces and commutative Banach Algebras.
Unit I: Banach Spaces
Definition – Some examples – Continuous Linear Transformations – The Hahn-Banach Theorem – The natural embedding of N in N**.

Unit II: Banach spaces and Hilbert spaces: Open mapping theorem – conjugate of an operator – Definition and some simple properties – Orthogonal complements – Orthonormal sets.
.
Unit III: Hilbert Space Conjugate space H* - Adjoint of an operator – Self-adjoint operator – Normal and Unitary Operators – Projections.

Unit IV: Preliminaries on Banach Algebras
Definition and some examples – Regular and single elements – Topological divisors of zero – spectrum – the formula for the spectral radius – the radical and semi-simplicity.

Unit V : Structure of commutative Banach Algebras
Gelfand mapping – Applications of the formula r(x) = lim 7 xn 71/n - Involutions in Banach Algebras – Gelfand-Neumark Theorem.

Contents and treatment as in : G.F.Simmons , Introduction to topology and Modern Analysis, McGraw Hill International Book Company, New York, 1963.

Unit 1: Chapter 9 : Sections 46 to 49.

Unit 2: Chapter 9: Sections 50 and 51 and Chapter 10: Sections 52, 53 and 54
Unit 3: Chapter 10: Sections 55, 56,57,58 and 59.
Unit 4: Chapter 12 : Sections 64 to 69.
Unit 5: Chapter 13: Sections 70 to 73.

Books for Supplementary Reading and Reference:

1. W. Rudin Functional Analysis, Tata McGraw-Hill Publishing Company, New Delhi, 1973.
2. G. Bachman & L.Narici, Functional Analysis Academic Press, New York ,1966.
3. H.C. Goffman and G.Fedrick, First course in Functional Analysis, Prentice Hall of India, New Delhi, 1987.
4. E. Kreyszig Introductory Functional Analysis with Applications, John wiley & Sons, New York.,1978.

11MA319 TOPOLOGY

Credits 4:0:0
Course Objectives:
To provide the student with the concept and the understanding in topological spaces and compact spaces.
Outcome:
Knowledge in continuous functions, connectedness and compactness.
Unit 1: Topological spaces
Topological spaces – Basis for a topology – The order topology – The product topology on X ×Y – The subspace topology – Closed sets and limit points.

Unit II: Continuous functions
Continuous functions – the product topology – The metric topology.

Unit III: Connectedness
Connected spaces- connected subspaces of the Real line – Components and local connectedness.
Unit IV: Compactness
Compact spaces – compact subspaces of the Real line – Limit Point Compactness – Local Compactness.

Unit V: Countability and Separation Axiom
The Countability Axioms – The separation Axioms – Normal spaces – The Urysohn Lemma – The Urysohn metrization Theorem – The Tietz extension theorem.

Contents and Treatment as in : James R. Munkres, Topology (2nd Edition) Pearson Education Pve. Ltd., Delhi-2002 (Third Indian Reprint).
Unit 1: Chapter 4 : Sections 30 to 35.
Unit 2: Chapter 2 : Sections 18 to 21 (Omit Section 22).
Unit 3: Chapter 3: Sections 23 to 25.
Unit 4: Chapter 3 : Sections 26 to 29.
Unit 5: Chapter 2: Sections 12 to 17.
Books for Supplementary Reading and Reference:

1. J. Dugundji , Topology , Prentice Hall of India, New Delhi, 1975.
2. George F.Sinmons, Introduction to Topology and Modern Analysis, McGraw Hill Book Co., 1963.
3. J.L. Kelly, General Topology, Van Nostrand, Reinhold Co., New York, 1955

4. L.Steen and J.Subhash, Counter Examples in Topology, Holt, Rinehart and Winston, New York, 1970.

11MA320 COMPLEX ANALYSIS- II

Credits 4:0:0

Course Objectives:
To provide the student with the concept and the understanding in equicontinuity, elliptic functions and analytic continuation.

Outcome:
Knowledge in Riemann mapping theorem and Weirstrass theorem.

Unit I: Riemann Zeta Function and Normal Families
Product development – Extension of ζ(s) to the whole plane – The zeros of zeta function – Equicontinuity – Normality and compactness – Arzela's theorem – Families of analytic functions – The Classcial Definition.

Unit II :
Riemann mapping Theorem : Statement and Proof – Boundary Behaviour – Use of the Reflection Principle.
Conformal mappings of polygons : Behaviour at an angle – Schwarz-Christoffel formula – Mapping on a rectangle.
Harmonic Functions : Functions with mean value property – Harnack's principle.

Unit III : Elliptic functions
Simply periodic functions – Doubly periodic functions.

Unit IV : Weierstrass Theory
The Weierstrass □-function – The functions ζ(s) and σ(s) – The differential equation – The modular equation λ(τ) – The Conformal mapping by λ(τ).

Unit V : Analytic Continuation
The Weiertrass Theory – Germs and Sheaves – Sections and Riemann surfaces – Analytic continuation along Arcs – Homotopic curves – The Monodromy Theorem – Branch points.

Contents and Treatment as in : Lars F. Ahlfors, Complex Analysis, (3rd Edition) McGraw Hill Book Company, New York, 1979.

Unit 1; Chapter 5 : Sections 4.1 to 4.4. and Chapter 5 : Sections 5.1 to 5.5.
Unit 2: Chapter 6 : Sections 1.1 to 1.3 (Omit Section1.4); Chapter 6 : Sections 2.1 to 2.3 (Omit section 2.4); Chapter 6 : Section 3.1 and 3.2.
Unit 3: Chapter 7 : Sections 1.1 to 1.3 and Sections 2.1 to 2.4.
Unit 4: Chapter 7 : Sections 3.1 to 3.5.
Unit 5: Chapter 8 : Sections 1.1 to 1.7.

Books for Supplementary Reading and Reference:

1. H.A. Presfly, Introduction to complex Analysis, Clarendon Press, oxford, 1990.
2. J.B. Corway, Functions of one complex variables, Springer - Verlag, International student Edition, Naroser Publishing Co., 1973
3. E. Hille, Analytic function Thorey (2 vols.), Gonm & Co, 1959.
4. M.Heins, Complex function Theory, Academic Press, New York,1968.

11MA321 DIFFERENTIAL GEOMETRY

Credits 4:0:0

Course Objectives:
To provide the student with the concept and the understanding in Space curves, Geodesics, Intrinsic and Non-Intrinsic properties of a surfaces.
Outcome:
Knowledge in Differential Geometry of surfaces.

Unit I - Space curves:
Definition of a space curve – Arc length – tangent – normal and binormal – curvature and torsion – contact between curves and surfaces- tangent surface- involutes and evolutes- Intrinsic equations – Fundamental Existence Theorem for space curves- Helies.

Unit II – Intrinsic properties of a surface
Definition of a surface – curves on a surface – Surface of revolution – Helicoids – Metric- Direction coefficients – families of curves- Isometric correspondence- Intrinsic properties.

Unit III – Geodesics
Geodesics – Canonical geodesic equations – Normal property of geodesics- Existence Theorems – Geodesic parallels – Geodesics curvature- Gauss- Bonnet Theorem – Gaussian curvature- surface of constant curvature.

Unit IV – Non Intrinsic properties of a surface
The second fundamental form- Principle curvature – Lines of curvature – Developable - Developable associated with space curves and with curves on surface - Minimal surfaces – Ruled surfaces.

Unit V – Differential Geometry of Surfaces
Compact surfaces whose points are umblics- Hilbert's lemma – Compact surface of constant curvature – Complete surface and their characterization – Hilbert's Theorem – Conjugate points on geodesics.

Contents and Treatment as in :T.J.Willmore, An Introduction to Differential Geometry, Oxford University Press,(17thImpression) New Delhi 2002. (Indian Print).
Unit 1: Chapter I : Sections 1 to 9.
Unit 2: Chapter II: Sections 1 to 9.
Unit 3: Chapter II: Sections 10 to 18.
Unit 4:Chapter IV : Sections 1 to 8 (Omit 9 to 15).
Unit 5: Chapter III: Sections 1 to 8.

Books for Supplementary Reading and Reference:

1. Struik, D.T. Lectures on Classical Differential Geometry, Addison – Wesley, Mass.1950.
2. Kobayashi. S. and Nomizu. K. Foundations of Differential Geometry, Interscience Publishers, 1963.
3. Wilhelm Klingenberg: A course in Differential Geometry, Graduate Texts in Mathematics, Springer-Verlag 1978.

4. J.A. Thorpe, Elementary topics in Differential Geometry, Under - graduate Texts in Mathematics, Springer - Verlag 1979.

11MA322 MATHEMATICAL STATISTICS

Credits: 4:0:0

Course Objectives:
To provide the student with the concept and the understanding in significance test, estimation, analysis of variance.

Outcome:
Knowledge in technique and methodology of Statistics.

Unit I : Sample Moments and their Functions
Notion of a sample and a statistic – Distribution functions of X , S^2 and (X , S^2) - χ^2 distribution – Student t-distribution – Fisher's Z-distribution – Snedecor's F- distribution – Distribution of sample mean from non-normal populations.

Unit II : Significance Test
Concept of a statistical test – Parametric tests for small samples and large samples - $\chi 2$ test – Kolmogorov Theorem 10.11.1 – Smirnov Theorem 10.11.2 – Tests of Kolmogorov and Smirnov type – The Wald-Wolfovitz and Wilcoxon-Mann-Whitney tests – Independence Tests by contingency tables.

Unit III : Estimation
Preliminary notion – Consistency estimation – Unbiased estimates – Sufficiency – Efficiency – Asymptotically most efficient estimates – methods of finding estimates – confidence Interval.

Unit IV : Analysis of Variance
One way classification and two-way classification.
Hypotheses Testing: Poser functions – OC function- Most Powerful test – Uniformly most powerful test – unbiased test.

Unit V : Sequential Analysis
SPRT – Auxiliary Theorem – Wald's fundamental identity – OC function and SPRT – E(n) and Determination of A and B – Testing a hypothesis concerning p on 0-1 distribution and m in Normal distribution.

Contents and Treatment as in : M. Fisz , Probability Theory and Mathematical Statistics, John Wiley and sons, New Your, 1963.

Unit 1: Chapter 9 : Sections 9.1 to 9.8.
Unit 2: Chapter 10 : Sections 10.11 and Chapter 11 : 12.1 to 12.7.
Unit 3: Chapter 13 : Sections 13.1 to 13.8 (Omit Section 13.9).
Unit 4: Chapter 15 : Sections 15.1 and 15.2 (Omit Section 15.3) and Chapter 16 : Sections 16.1 to 16.5 (Omit Section 16.6 and 16.7).
Unit 5: Chapter 17 : Sections 17.1 to 17.9 (Omit Section 17.10).

Books for Supplementary Reading and Reference:

1. E.J.Dudewicz and S.N.Mishra , Modern Mathematical Statistics, John Wiley and Sons, New York, 1988.
2. V.K.Rohatgi An Introduction to Probability Theory and Mathematical Statistics, Wiley Eastern Ltd., New Delhi, 1988(3rd Print).
3. G.G.Roussas, A First Course in Mathematical Statistics, Addison Wesley Publishing Company, 1973.
4. B.L.Vander Waerden, Mathematical Statistics, G.Allen & Unwin Ltd., London, 1968.

11MA323 FLUID DYNAMICS

Credits 4:0:0

Course Objectives:
To provide the student with the concept and the understanding in Kinematics of fluids in motion, two and three dimensional flows.
Outcome:
Knowledge in equations of motion of a fluid and viscous flows.
Unit I : Kinematics of Fluids in motion.
Real fluids and Ideal fluids- Velocity of a fluid at a point, Stream lines , path lines , steady and unsteady flows- Velocity potential - The vorticity vector- Local and particle rates of changes - Equations of continuity - Worked examples - Acceleration of a fluid – Conditions at a rigid boundary.

Unit II: Equations of motion of a fluid
Pressure at a point in a fluid at rest.- Pressure at a point in a moving fluid - Conditions at a boundary of two invircid immiscible fluids- Euler's equation of motion - Discussion of the case of steady motion under conservative body forces.

Unit III : Some three dimensional flows.
Introduction- Sources, ranks and doublets - Images in a rigid infinite plane - Axis symmetric flows – stokes stream function.

Unite IV : Some two dimensional flows
Meaning of two dimensional flow - Use of Cylindrical polar coordinate - The stream function - The complex potential for two dimensional , irrotational in compressible flow - Complex velocity potentials for standard two dimensional flows - Some worked examples - Two dimensional Image systems - The Milne Thompsan circle Theorem.

Unit V : Viscous flows
Stress components in a real fluid. - Relations between Cartesian components of stress- Translational motion of fluid elements - The rate of strain quadric and principle stresses - Some further properties of the rate of strain quadric - Stress analysis in fluid motion - Relation between stress and rate of strain- The coefficient of viscosity and Laminar flow - The Navier – Stokes equations of motion of a Viscous fluid.

Contents and Treatment as in : F. Chorlton, Text Book of Fluid Dynamics ,CBS Publications. Delhi ,1985.

Unit 1: Chapter 2. Sec 2.1 to 2.10.
Unit 2: Chapter 3. Sec 3.1 to 3.7.

Unit 3: Chapter 8. Sec 8.1 to 8.9.
Unit 4: Chapter 5. Sec 5.1 to 5.8.
Unit 5: Chapter 4 Sec 4.1, 4.2, 4.3, 4.5.

Books for Supplementary Reading and Reference:

1. Milne Thomson, Theoretical Hydrodynamics Macmillan ,1949.

11MA324 FUZZY SETS AND THEIR APPLICATIONS

Credits 4:0:0

Course Objectives:
To provide the student with the concept and the understanding in fuzzy graphs, relations and logic.
Outcome:
Knowledge in fuzzy sets and their applications.
Unit I
Fundamental Notions:

Unit II
Fuzzy Graphs:

Unit III
Fuzzy Relations:

Unit IV
Fuzzy Logic:

Unit V
The Laws of Fuzzy Composition:

Contents and Treatment as in : A.Kaufman, Introduction to the theory of Fuzzy subsets, Vol.I, Academic Press, New York, 1975.
Unit 1: Chapter IV: Sec.43 to 49.
Unit 2: Chapter II: Sec. 10 to 18.
Unit 3: Chapter I: Sec. 1 to 8.
Unit 4: Chapter III: Sec.31 to 40 (omit Sec. 37, 38, 41).
Unit 5: Chapter II: Sec. 19 to 29.

Books for Supplementary Reading and Reference:

1. H.J.Zimmermann, Fuzzy Set Theory and its Applications, Allied Publishers, Chennai, 1996.
2. George J.Klir and Bo Yuan, Fuzzy sets and Fuzzy Logic-Theory and Applications, Prentice Hall India, New Delhi, 2001.

11MA325 NUMBER THEORY AND CRYPTOGRAPHY

Credits 4:0:0

Course Objectives:

To provide the student with the concept and the understanding in classical crypto systems and quadratic residues.

Outcome:

Knowledge in public key cryptography, factoring and elliptic curves.

Unit I

Elementary Number Theory – Time Estimates for doing arithmetic – divisibility and Euclidean algorithm – Congruences – Application to factoring.

Unit II

Introduction to Classical Crypto systems – Some simple crypto systems – Enciphering matrices DES.

Unit III

Finite Fields and quadratic Residues – Reciprocity.

Unit IV

Public Key Cryptography.

Unit V

Primality , Factoring and Elliptic Curves.

Contents and Treatment as in: Neal Koblitz, A Course in Number Theory and cryptography, Springer-Verlag, New York,1987.

Books for Supplementary Reading and Reference:

1. Niven and Zuckermann, An Introduction to Theory of Numbers (Edn. 3), Wiley Eastern Ltd., New Delhi,1976.
2. David M.Burton, Elementary Number Theory, Wm C.Brown Publishers, Dubuque, Iowa,1989.
3. K.Ireland and M.Rosen, A Classical Introduction to Modern Number Theory, Springer Verlag, 1972.

11MA326 FORMAL LANGUAGES AND AUTOMATA THEORY

Credits 4:0:0

Course Objectives:

To provide the student with the concept and the understanding in regular sets and context –free grammars.

Outcome:

Knowledge in pushdown automat and context-free languages.

Unit I : Finite automata, regular expressions and regular grammars

Finite state systems – Basic definitions – Nondeterministic finite automata – Finite automata with ε moves – Regular expressions – Regular grammars.

Unit II : Properties of regular sets.

The Pumping lemma for regular sets – Closure properties of regular sets – Decision algorithms for regular sets – The Myhill-Nerode Theorem and minimization of finite automata.

Unit III : Context-free grammars
Motivation and introduction – Context-free grammars – Derivation trees- Simplification of context-free grammars – Chomsky normal form – Greibach normal form.

Unit IV : Pushdown automata
Informal description- Definitions-Pushdown automata and context-free languages – Normalforms for deterministic pushdown automat.

Unit V : Properties of context-free languages
The pumping lemma for CFL's – Closure properties for CFL's – Decision algorithms for CFL's.

Contents and Treatment as in : John E.Hopcraft and Jeffrey D.Ullman, Introduction to Automata Theory, Languages and Computation, Narosa Publishing House, New Delhi, 1987.

Unit 1: Chapter 2. Sections 2.1 to2.5 and Chapter 9 Section 9.1.
Unit 2: Chapter 3 : Sections 3.1 to 3.4.
Unit 3: Chapter 4 : Section 4.1 to 4.6.
Unit 4: Chapter 5 : Sections 5.1 to 5.3.
Unit 5: Chapter 6 : Sections 6.1 to 6.3.

Book for Supplementary Reading and Reference:

1. A. Salomaa, Formal Languages, Academic Press, New York, 1973.
2. John C. Martin, Introduction to Languages and theory of Computations (2nd Edition) Tata-McGraw Hill Company Ltd., New Delhi, 1997.

11MA327 PROGRAMMING IN C++ AND NUMERICAL METHODS

Credits 4:0:0

Course Objectives:
To provide the student with the concept and the understanding in programming in C++ and Curve Fitting.
Outcome:
Knowledge in Pointers – Virtual Functions and Polymorphism.

Unit I
Tokens, Expressions and Control Structures – Functions in C++.

Unit II Conversions.

Unit III
Inheritance – Pointers – Virtual Functions and Polymorphism.
.
Unit IV
The solution of Nonlinear Equations f(x)=0
Interpolation and Polynomial Approximation

Unit V
Curve Fitting.

Solution of Differential Equations

Contents and Treatment as in : John H.Mathews, Numerical Methods for Mathematics, Science and Engineering, (2nd Edn.) Prentice Hall, New Delhi, 2000.

Unit 1: Chapters: 3 and 4 (Balagurusamy).
Unit 2: Chapters : 5, 6 and 7(Balagurusamy).
Unit 3: Chapters 8 and 9 (Balagurusamy
Unit 4; Chapter2: Sec. 2.1 to 2.7 (John H.Mathews)**;** Chapter 4: 4.1 to 4.4 (omit Sec. 4.5 & 4.6)(John H.Mathews).
Unit 5: Chapter 5: Sec. 5.1 to 5.3 (omit Sec. 5.4)(John H.Mathews) and Chapter 9: Sec. 9.1 to 9.6 (omit 9.7 to 9.9) (John H.Mathews).

11MA328 DISCRETE MATHEMATICS

Credits 4:0:0

Course Objectives:
To provide the student with the concept and the understanding in lattices, polynomials and finite fields.
Outcome:
Knowledge in applications of lattices.

Unit I - Lattices
Properties of Lattices: Lattice definitions – Modular and distributive lattice; Boolean algebras: Basic properties – Boolean polynomials, Ideals; Minimal forms of Boolean polynomials.

Unit II - Applications of Lattices
Switching Circuits: Basic Definitions – Applications.

Unit III - Finite Fields

Unit IV : Polynomials
Irreducible Polynomials over Finite fields – Factorization of Polynomials.

Unit V – Coding Theory
Linear Codes and Cyclic Codes.

Contents and Treatment as in: Rudolf Lidl and Gunter Pilz, Applied Abstract Algebra, Spinger-Verlag, New York, 1984.
Unit 1: Chapter 1: § 1 A and B § 2A and B. § 3.
Unit 2: Chapter 2: § 1 A and B.
Unit 3:Chapter 3: § 2.
Unit 4:Chapter 3: § 3 and §4.
Unit 5:Chapter 4 § 1 and 2.

Books for Supplementary Reading and Reference :

1. A.Gill, Applied Algebra for Computer Science, Prentice Hall Inc., New Jersey.2., 1975

2. J.L.Gersting, Mathematical Structures for Computer Science(3rd Edn.), Computer Science Press, New York, 1983
3. S.Wiitala, Discrete Mathematics- A Unified Approach, McGraw Hill Book Co., 1987

11MA329 GRAPH THEORY

Credits 4:0:0

Course Objectives:
To provide the student with the concept and the understanding in graphs, Hamilton cycles and chromatic number.

Outcome:
Knowledge in Trees, Vertex Colourings and Plane and planar Graphs.

Unit I
Graphs, subgraphs and Trees : Graphs and simple graphs – Graph Isomorphism – The Incidence and Adjacency Matrices – Subgraphs – Vertex Degrees – Paths and Connection – Cycles – Trees – Cut Edges ana Bonds – Cut Vertices.

Unit II
Connectivity, Euler tours and Hamilton Cycles : Connectivity – Blocks – Euler tours – Hamilton Cycles.

Unit III
Matchings, Edge Colourings : Matchings – Matchings and Coverings in Bipartite Graphs – Edge Chromatic Number – Vizing's Theorem.

Unit IV
Independent sets and Cliques, Vertex Colourings : Independent sets – Ramsey's Theorem – Chromatic Number – Brooks' Theorem – Chromatic Polynomials.

Unit V
Planar graphs : Plane and planar Graphs – Dual graphs – Euler's Formula – The Five- Colour Theorem and the Four-Colour Conjecture.

Contents and Treatment as in : J.A.Bondy and U.S.R. Murthy , Graph Theory and Applications, Macmillan, London, 1976.

Unit 1: Chapter 1 (Section 1.1 – 1.7); Chapter 2 (Section 2.1 – 2.3)
Unit 2: Chapter 3 (Section 3.1 – 3.2); Chapter 4 (Section 4.1 – 4.2).
Unit 3: Chapter 5 (Section 5.1 – 5.2); Chapter 6 (Section 6.1 – 6.2).
Unit 4: Chapter 7 (Section 7.1 – 7.2); Chapter 8 (Section 8.1 – 8.2, 8.4).
Unit 5: Chapter 9 (Section 9.1 – 9.3, 9.6); Chapter (Section).

Books for Supplementary Reading and Reference:

1. J.Clark and D.A.Holton , A First look at Graph Theory, Allied Publishers, New Delhi, 1995.
2. R. Gould. Graph Theory, Benjamin/Cummings, Menlo Park, 1989.
3. A.Gibbons, Algorithmic Graph Theory, Cambridge University Press, Cambridge, 1989.

4. S.A.Choudum, A First Course in Graph Theory, MacMillan India Ltd. 1987.

11MA330 JAVA PROGRAMMING

Credits 4:0:0

Course Objectives:
To provide the student with the concept and the understanding in Java statements, arrays and multithreaded programming.

Outcome:
Knowledge in operators and Applet Programming

Unit I:
Java Tokens – Java statements – Constants – Variables – Data types

Unit II :
Operators – Expressions – Decision making and Branching.

Unit III :
Classes – Objects – Methods – Arrays – Strings – Vectors – Multiple Inheritance.

Unit IV
Multithreaded Programming – Managing errors and Exceptions.

Unit V
Applet Programming.

Contents and Treatment as in : E. Balagurusamy, Programming with Java – A primer , Tata McGraw Hill Publishing Company Limited, New Delhi, 1998.

Unit 1: Chapter 14.
Unit 2: Chapters 5,6 and 7.
Unit 3: Chapters 8, 9 and 10.
Unit 4: Chapters 12 and 13.
Unit 5: Chapters 3 and 4.

Books for Supplementary Reading and Reference:

1. Mitchell Waite and Robert Lafore, Data Structures and Algorithms in Java, Techmedia (Indian Edition), New Delhi, 1999.
2. Adam Drozdek, Data Structures and Algorithms in Java, (Brown/Cole), Vikas Publishing House, New Delhi, 2001.

11MA331 OPERATIONS RESEARCH

Credits 4:0:0

Course Objectives:

To provide the student with the concept and the understanding in Markovian Decision Process and Inventory Theory.

Outcome:

Knowledge in Network Analysis and Queueing Theory.

Unit – I : Decision Theory

Decision Environments - Decision making under certainty - Decision making under risk - Decision making under uncertainty.

Markovian Decision Process

Scope of the **Markovian Decision Problem** - Gardner example - Finite stage Dynamic Programming model - Infinite stage model - Linear Programming solution.

Unit II : Deterministic and Probabilistic Dynamic Programming

Recursive nature of computations in DP – Selected DP Applications – Problem of Dimensionality – A Game of chance - Investment Problem – Maximization of the event of Achieving a Goal.

Unit – III : Network Analysis

Network Definitions - Minimal spanning tree algorithm - Shortest route Problem – Maximum flow Model - Minimum cost capacitated flow problem - Linear Programming formulation - Network Simplex method – CPM and PERT.

Unit – IV : Inventory Theory

Basic Elements of an Inventory model - Deterministic models of the following types: Single item static model with and without price breaks - Multiple item static model with storage limitation. Probabilistic Models: Continuous Review model - Single period models.

Unit – V : Queueing Theory

Basic elements of a queueing model - Role of Poisson and Exponential distributions – Pure Birth and Death models – Specialised Poisson Queues – M/G/1 queue - Pollaczek - Khintchine formula.

Contents and Treatment as in : Hamdy A. Taha , Operations Research (sixth edition), Prentice - Hall of India Private Limited, New Delhi.
Unit 1: Chapter 14 : Sections 14.1 to 14.4; Chapter 19 : Sections 19.1 to 19.4.
Unit 2: Chapter 10 : Sections 10.1 to 10.5; Chapter 15 : Sections 15.1 to 15.4.
Unit 3: Chapter 6, Sections 6.1 to 6.7.
Unit 4: Chapter 11. Sections 11.1 to 11.3; Chapter 16. Sections 16.1 to 16.3.
Unit 5: Chapter 17. Sections 17.2 to 17.7; Omit 17.6.4.

Books for Supplementary Reading and Reference:

1. F.S. Hiller and J.Lieberman -,Introduction to Operations Research (7th Edition), Tata McGraw Hill Publishing Company, New Delhui, 2001.
2. Beightler. C, D.Phillips, B. Wilde ,Foundations of Optimization (2nd Edition),Prentice Hall Pvt Ltd., New York, 1979.
3. Bazaraa, M.S; J.J.Jarvis, H.D.Sharall ,Linear Programming and Network flow, John Wiley and sons, New York 1990.
4. Gross, D and C.M.Harris, Fundamentals of Queueing Theory, (3rd Edition), Wiley and Sons, New York, 1998.

11MA332 FINANCIAL MATHEMATICS

Credits 4:0:0

Course Objectives:
To provide the student with the concept and the understanding in Binomial Trees and Stochastic Calculus.

Outcome:
Knowledge in Brownian Motion and Block-Scholes model.

Unit I : Single Period Models
Definitions from Finance – Pricing a forward – One-step Binary Model – a ternary Model – Characterization of no arbitrage – Risk-Neutral Probability Measure.

Unit II : Binomial Trees and Discrete parameter martingales
Multi-period Binary model – American Options – Discrete parameter martingales and Markov processes – Martingale Theorems – Binomial Representation Theorem – Overture to Continuous models.

Unit III : Brownian Motion
Definition of the process – Levy's Construction of Brownian Motion – The Reflection Principle and Scaling – Martingales in Continuous time.

Unit IV : Stochastic Calculus
Stock Prices are not differentiable – Stochastic Integration – Ito's formula – Integration by parts and Stochastic Fubini Theorem – Girsanov Theorem – Brownian Martingale Representation Theorem – Geometric Brownian Motion – The Feynman – Kac Representation.

Unit V : Block-Scholes Model
Basic Block-Scholes Model – Block-Scholes price and hedge for European Options – Foreign Exchange – Dividends – Bonds – Market price of risk.

Contents and Treatment as in : Alison Etheridge, A Course in Financial Calculus, Cambridge University Press, Cambridge, 2002.

Books for supplementary reading and Reference :

1. Martin Boxter and Andrew Rennie, Financial Calculus : An Introduction toDerivatives Pricing, Cambridge University Press, Cambridge, 1996.
2. Damien Lamberton and Bernard Lapeyre , (Translated by Nicolas Rabeau and Farancois Mantion), Introduction to Stochastic Calculus Applied to Finance, Chapman and Hall, 1996.
3. Marek Musiela and Marek Rutkowski, Martingale Methods in Financial Modeling,Springer Verlag, New York, 1988.
4. Robert J.Elliott and P.Ekkehard Kopp, Mathematics of Financial Markets, Springer Verlag, New York, 2001 (3rd Printing).

11MA333 STOCHASTIC PROCESSES

Credits 4:0:0

Course Objectives:
To provide the student with the concept and the understanding in Markov Chains and Renewal processes.

Outcome:
Knowledge in Renewal Theorem and its applications.

Unit I : Markov Chains
Classification of General Stochastic Processes – Markov Chain – Examples – Transition Probability Matrix – Classifications of States – Recurrence – Examples of recurrent Markov Chains.

Unit II: Limit Theorems of Markov Chains
Discrete renewal equation and its proof – Absorption probabilities – criteria for recurrence – Queuing models – Random walk.

Unit III: Continuous Time Markov Chains
Poisson Process – Pure Birth Process – Birth and Death Process – Birth and Death process with absorbing states – Finite State Continuous time Markov Chains.

Unit IV: Renewal Processes
Definition and related concepts – Some special Renewal processes – Renewal equation and Elementary Renewal Theorem and its applications.

Unit V: Brownian Motion
Definition – Joint probabilities for Brownian Motion – Continuity of paths and the maximum variables – Variations and extensions – Computing some functionals of Brownian Motion by Martingale methods.

Contents and Treatments as in : S.Karlin and H.M.Taylor. A First Course in Stochastic Processes (2nd edition), Academic Press, New York, 1975.

Unit 1: Chapter 1: Section 3 only; Chapter 2: Sections 1 to 6 (Omit section 7).
Unit 2: Chapter 3: Sections 1 to 7.
Unit 3: Chapter 1: Section 2 (Poisson Process); Chapter 4: Sections 1, 2 and 4 to 7 (Omit sections 3 and 8).
Unit 4: Chapter 5: Sections 1 to 6.
Unit 5: Chapter 1 : Section 2 (Brownian Motion); Chapter 6 : Sections 1 to 5 and 7A only (Omit Sections 6, and 7B,C).

Books for supplementary reading:
1. Cinler E., Introduction to Stochastic Processes, Prentice Hall Inc., New Jersey, 1975.
2. Cox D.R. & H.D.Miller, Theory of Stochastic Processes (3rd Edn.), Chapman and Hall, London, 1983.
3. Kannan D., An Introduction to Stochastic Processes, North Holland, New York 1979
4. H.W.Taylor and S.Karlin, An Introduction to Stochastic Modeling (3rd Edition), Academic Press, New York, 1998.

11MA334 RELATIONAL DATABASE MANAGEMENT SYSTEMS

Credits 4:0:0

Course Objectives:
To provide the student with the concept and the understanding in Information Processing, Database Architecture , Relational Algebra and Relational Calculus.
Outcome:
Knowledge in Database security, Query processing and Optimization.
Unit I :
Data, Information and Information Processing – Secondary storage devices – Files, File Organization and File structure – Indexing and Hashing – Introduction to DBMS – Software development Life-cycle – Database Development Life cycle – Introduction to RDBMS.

Unit II:
Database Architecture and Data Modeling – Entity-Relationship (E-R) Modeling – Enhanced Entity-Relationship Model – Data Normalization.

Unit III :
Relational Algebra and Relational Calculus – Tables – SQL – Tables – Views – and Indexes – Nulls – Queries and subqueries – Aggregate functions.

Unit IV:
Insert, update and delete operations – cursors – Joins and Unions – programming with SQL – Query-by-example – QUEL-Triggers – Query processing and Optimization.
Unit V:
Database security – Data integrity – Transaction management and concurrency control – Backup and Recovery.

Contents and Treatment as in : A. Leon and M. Leon. Database Management Systems, Leon Vikas, Chennai, 2002.Computer Laboratory Exercises (MS Access).

Unit 1: Chapters 1 to 7.
Unit 2: Chapters 8 to 11.
Unit 3: Chapters 12 to 18.
Unit 4: Chapters 19 to 26.
Unit 5: Chapters 27 to 30.

11MA335 STATISTICAL MATHEMATICS

Credits: 4:0:0
Course Objectives:
To make an inference about a population based on information contained in a sample and to provide an associated measure of goodness for the inference

Outcome: Knowledge in Calculus and applications of statistics.

Unit I. Fundamental statistics
Central tendencies: Mean, Median and Mode - Measures of dispersion: Range, Quartiles,Standard Deviation - Distributions: Binomial, Poisson, and Normal.

Unit II. Correlation and Regression

Linear correlation- Coefficient of correlation-Coeffient of rank Correlation- Multiple & partial Correlation. Linear regression and Multiple regressions.

Unit III. Testing of hypothesis
Large Samples- Proportions, population mean –two sample Means. Small Samples- Student's t – test, F – test and Chi-square test for Goodness of fit.

Unit IV. Differential & Integral calculus
Differentiation- Trigonometry, polynomial, exponential, logarithmic, Implicit, hyperbolic & inverse circular functions. Integration- Trigonometric, exponential, logarithmic and Rational functions. Double and Triple Integrals.

Unit V. Differential equations
Linear differential equation of the type Second order, Euler- homogeneous linear differentialand Simultaneous differential equations.

Text Books:
1. Differential Calculus by T.K. Manickavasagam Pillai S.Vishvanathan Printers &Publishers Pvt. Ltd.
2. Engineering Mathematics (Volume-III & I) by P. Kandasamy, K. Thilagavathy and K. Gunavathy, S. Chand & Company Ltd.

11MA336 RESEARCH METHODOLOGY

M. Phil. (MATHEMATICS)

Credits 4:0:0

Course Objectives: To provide the student with the concept and the understanding in spectral theory and separation theorems in the plane.
Outcome:
Knowledge in Semigroups of Linear Operators and applications.
Unit I: Bounded Linear Operators:
Uniformly continuous semigroups of bounded linear operators – Strongly continuous semigroups of bounded linear operators – The Hille-Yosida theorem – The Lumer Phillips theorem.

Unit II: Infinitesimal Generators and Semigroups:
The characterization of the infinesimal generators of C_0 -semigroups – Groups of bounded operators – The inversion of the Laplace transform – Two exponential formulas.

Unit III: Spectral Theory:
Weak equal strong – Spectral mapping theorem – Semigroups of compact operator – Differentiability – Analytic semigroups.

Unit IV: Fundamental Group:
Homotopy of Paths – Fundamental Group – Covering Spaces – Fundamental Groups of the Circle and Sn.

Unit V: Separation Theorems in the Plane:
Jordan Separation Theorem – Invariance of Domain – Jordan Curve Theorem.

Treatment as in: A. PAZY, Semigroups of Linear Operators and Applications to Partial Differential Equations, Springer-Verlag, New York, 1983.

Unit I: Chapter 1 Sections 1.1 – 1.4.
Unit II: Chapter 1 Sections 1.5 – 1.8.
Unit III: Chapter 2 Sections 2.1 – 2.5.
J.R. Munkres, Topology, 2nd Edition, Pearson Education (Singapore) Pvt. Ltd., 2000.
Unit IV: Chapter 9 Sections 51.54, 57 and 59.
Unit V: Chapter 10 Sections 61-63.

Reference Books:

1. A.V. Balakrishnan, Applied Functional Analysis, Springer-Verlag, New York, 1976.
2. J.A. Goldstein, Semigroups of Linear Operators and Applications, Oxford University Press, New York, 1985.
3. J. Dugundji, Topology, Allyn and Bacon, Boston, 1966.
4. W.S. Massey, Algebraic Topology-An Introduction, Springer-Verlag, New York, 1976.

11MA337 MATHEMATICAL METHODS

Credits 4:0:0

Course Objectives:
To provide the student with the concept and the understanding in fixed point theorem, finite element methods and finite volume method.

Outcome:
Knowledge in fixed point for compact maps and Perturbation Methods.

Unit I: Elementary Fixed Point Theorems:
Fixed point spaces – Forming new fixed point spaces from old – Topological transversality – Factorization technique – Banach contraction principle – Elementary domain invariance – Continuation method for contractive maps – Nonlinear alternative for contractive maps – Extensions of the Banach theorem – Miscellaneous results and examples.

Unit II: Fixed Points for Compact Maps in Normed Linear Spaces:
Compact and completely continuous operators – Schauder projection and approximation theorem – Extension of the Brouwer and Borsuk theorems – Topological transversability. Existence of essential maps – Equation $x = F(x)$. The Leray-Schauder principle – Equation $x = \lambda F(x)$. Birkhoff-Kellogg theorem – Compact fields – Equation $y = x - F(x)$. Invariance of domain – Miscellaneous results and examples.

Treatment as in: A. Granas and J. Dugundji, Fixed Point Theory, Springer, 2003.
Unit I: Chapter 0: Sections 1-4 and Chapter 1: Sections 1-6.
Unit II: Chapter 6: Sections 1-9.

Unit III: Perturbation Methods:
Parameter Perturbations – An algebraic equation – The Van der pol oscillator – Coordinate perturbations – Bessel equation of zeroth order – A simple example – Order symbols and Guage functions – Asymptotic series – Asymptotic expansions – Uniqueness of Asymptotic expansions – Convergent versus asymptotic series – Nonuniform expansions – Elementary operations on

asymptotic expansions – Straight forward expansions and sources of Nonuniformity – Infinite domains – The Duffing equation – A model for weak nonlinear instability – A small parameter multiplying the highest derivative – A second order example – Relaxation oscillations – Type change of a partial differential equation – A simple example – The presence of singularities – Shift in singularity – The earth-moon spaceship problem – The role of coordinate systems – The method of strained parameters – The Lindstedt-Poincare Method – transition curves for the Mathieu equation – Lighthill's Technique – A first order differential equation.

Treatment as in: A.H Nayfeh, Perturbation Methods, John Wiley & Sons, New York, 1973.
Chapter 1Sections 1.1-1.7
Chapter 2 Sections 2.1.1, 2.1.2, 2.2.1, 2.2.3, 2.3.1, 2.4.1, 2.4.2 & 2.5.
Chapter 3 Sections 3.1.1, 3.1.2, 3.2.1.

Unit IV: Finite Element Methods:
Finite elements – Line segment – Triangular element – Linear Lagrange polynomial – Numerical Integration over finite element – Finite element methods – Ritz finite element method – Least square finite element method – Galerkin finite element method – Convergence analysis – Boundary value problems in ordinary differential equations – Assembly of element equations – Mixed Boundary Conditions – Galerkin method.

Treatment as in: M.K. Jain, Numerical Solution of Differential Equations, New Age International Pvt. Ltd., New Delhi, 2002.
Chapter 8 (Relevant sections only from sections 8.4, 8.5 and 8.6.

Unit V: Finite Volume Method:
Finite volume method for Diffusion Problems: Finite volume for one dimensional steady state diffusion – Worked examples – Finite volume method for two dimensional diffusion problems – Finite volume method for three dimensional diffusion problems – Summary of discretised equations for diffusion problems. Finite volume method for Convection-Diffusion Problems: Steady one dimensional convection and diffusion – The central differencing schemes.

Treatment as in: H.K. Versteeg and W. Malalasekera, An Introduction to Computational Fluid Dynamics, Longman Scientific & Technical, England, 1995.
Chapter 4
Chapter 5 Sections 5.1-5.4.

Reference Book:

S.V Patankar, Numerical Heat Transfer and Fluid Flow, Hemisphere Publishing Corporation, New York, 1980.

11MA338 GRAPHS AND NETWORKS

Credits 4:0:0

Course Objectives:
To provide the student with the concept and the understanding in graphs.

Outcome:
Knowledge in random graphs, matroids and labeling of graphs.

Unit I: Connectivity and Networks:

K-connected Graphs: 2-Connected graphs – Connectivity of digraphs – K-Connected and Kedge connected graphs – Applications of Monger's theorem. Network Flow Problems: Maximum network flow – Integral flows – Supplies and Demands.

Unit II: Perfect Graphs:
The perfect graph theorem – Chordal graphs revisited – other classes of perfect graphs – Imperfect graphs – the strong perfect graph conjecture.

Unit III: Matroids:
Hereditary systems and examples – Properties of matroids – the span function and duality – minors and planar graphs – matroid intersection and matroid union.

Unit IV: Random Graphs:
Existence and Expectation – Properties of Almost All Graphs – Threshold Functions –Evolution and properties of Random Graphs – Connectivity, Cliques and Coloring – martingales.

Treatment as in: Douglas B. West, Introduction to Graph Theory, Prentice Hall of India, 1999.
Unit I: Chapter 4 – Sections: 4.2 and 4.3 (Pages 144-172).
Unit II: Chapter 8 – Section: 8.1 (Pages 288-320).
Unit III: Chapter 8 – Section 8.2 (Pages 320-347).
Unit IV: Chapter 8 – Section 8.5 (Pages 405-429).

Unit V: Decompositions and Labelings:
Factorizations and Decompositions of Graphs – Labelings of graphs.

Treatment as in: G. Chartrand and L. Leshiak, Graphs and Digraphs, Chapman and Hall/CRC, 1996.
Chapter 9: Sections 9.2 and 9.3.

11MA339 FUZZY MATHEMATICS

Credits 4:0:0

Course Objectives:
To provide the student with the concept and the understanding in fuzzy sets, fuzzy relations and fuzzy numbers.

Outcome:
Knowledge in Fuzzy Computational Models.

Unit I: Basic Notions and Concepts of Fuzzy Sets:
Set Membership and Fuzzy Sets-Types of Membership Functions-Characteristics of a Fuzzy Set-Generalization of Fuzzy Sets-Fuzzy Set Operations.

Unit II: Characterization of Fuzzy Sets:
Entropy Measures of Fuzziness-Energy Measures of Fuzziness-Specificity of a Fuzzy Set—Decoding Mechanisms for Pointwise Data-Distance between Fuzzy Sets.

Unit III: Fuzzy Relations:

Relations and Fuzzy Relations-Operations on Fuzzy Relations-Binary Fuzzy Relations-Some Classes of Fuzzy Relations-Fuzzy Relational Equations-Generalizations of Fuzzy Relational Equations.

Unit IV: Fuzzy Numbers:
Definition-Interval Analysis and Fuzzy Numbers-Computing with Fuzzy Numbers- Triangular Fuzzy Numbers and Basic Operations-Fuzzy Numbers and Approximate Operations. Fuzzy Logic: Introduction-Propositional Calculus-Predicate Logic-Many Valued Logic-Fuzzy Logic-Computing with Fuzzy logic.

Unit V: Fuzzy Computational Models:
Rule-Based Computations-Syntax of Fuzzy Rules-Computing with fuzzy Rules- Rule consistency and Completeness-Neural Networks-Logic Based Neurons-Fuzzy Neural Network-Fuzzy Cellular Automata.

Reference Books:

1. Witold Pedrycz and Fernando Gomide, An Introduction to Fuzzy Sets-Analysis and Design, Prentice-Hall of India Pvt. Ltd, 2005.
2.Zimmermann, H.J.,Fuzzy Set Theory and its Applications, Dordrecht, Kluwer,1985.

11MA340 DIFFERENCE EQUATIONS

Credits 4:0:0

Course Objectives:
To provide the student with the concept and the understanding in First Order Difference equations and Higher Order Difference equations.
Outcome:
Knowledge in Asymptotic and Oscillatiory behavior of Difference Equations.
Unit I: Dynamics of First Order Difference Equations:
Introduction – Linear First Order Difference equations – Equilibrium points – Criteria for Asymptotic of equilibrium points – Period points and cycles – The Logistic equation and Bifurcation.

Unit II: Linear Difference Equations of Higher order:
Difference calculus – General theory of linear difference equations – Linear homogeneous equations with constant coefficient – Linear nonhomogeneous equations – Limiting behavior of variation of constants (parameters) – Nonlinear equations transformable to linear equation.

Unit III: Systems of Difference Equations:
Autonomous(time-Invariant) systems – The Basic Theory – The Jordan Form: Autonomous(Time-Invariant) – linear periodic systems – Applications.

Unit IV: Asymptotic Behavior of Difference Equations:
Tools of approximation – Pioneer's theorem – Second order difference equations – Asymptotically diagonal systems – High order Difference equations – Nonlinear difference equations.

Unit V: Oscillation Theory:

Three term difference equations – Nonlinear difference equation – Self-adjoint second order Equations.

Treatment as in: Sabe N. Elaydi, An Introduction to Difference Equations, 1st Edition, Springer-Verlag, New York Berlin, 1996.

11MA341 OPTIMIZATION TECHNIQUES

Credits 4:0:0

Course Objectives:
To provide the student with the concept and the understanding in Dynamic and nonlinear programming Inventory Models and Queuing Models.
Outcome:
Knowledge in applications of optimization techniques.
Unit I: Dynamic programming:
Elements of the DP Model: The Capital Budgeting – More on the Definition of the state – Examples of DP models and computations – Problem of Dimensionality in Dynamic Programming – Solution of Linear programs by Dynamic Programming.

Unit II: Decision Theory and Games:
Decisions under Risk – Decision under Uncertainty – Game Theory.

Unit III: Inventory Models:
The ABC Inventory system – A Generalized Inventory Models – Deterministic Models – Just-in-Time (JIT) manufacturing system.

Unit IV: Queuing Models:
Role of Poisson and Exponential Distribution – Processes Birth and Death – Queues with Combined Arrival and Departures – Non-Poisson Queues – Queues with Priorities for Service – Tandem or Series Queues.

Unit V: Nonlinear Programming:
Unconstrained Extremal Problems – Constrained Extremal problems – Constrained Extremal problems – Nonlinear Programming Algorithm – Unconstrained Nonlinear Algorithms – Constrained Nonlinear Algorithms.
Treatment as in: Operations Research – An Introduction (Fifth Edition-1996) H. A. Taha, Prentice Hall of India (P) Limited, New Delhi, 1996.

Unit 2: Chapter 12
Unit 3: Chapter 14
Unit 4: Chapter 15
Unit5: Chapter 19; Chapter 20

Reference Books:

1. Operations Research: Principals and Practice, DON'T PHILLIPS, Ravindran, J. Solberg, John Wiley & Sons, 1976.
2. Engineering Optimization: Singiresu S. Rao, 3rd Edition, New Age International (P) Ltd., New Delhi, 1996.

11MA342 RELATIONAL DATABASE MANAGEMENT SYSTEMS

Credit 0:0:2

Course Objectives:

To provide the student with the concept and the understanding in Information Processing, Database Architecture , Relational Algebra and Relational Calculus.

Outcome:

Knowledge in Database security, Query processing and Optimization.

1. Student Information System
2. Hospital Management system
3. Airlines Booking system
4. Personal Information system
5. Personnel Information system
6. Library Information System
7. Inventory Management system
8. Pay Bill Preparation
9. Electricity Billing System (for a region)
10. Students mark sheet processing.

11MA343 JAVA PROGRAMMING

Credits 0:0:2

Course Objectives:

To provide the student with the concept and the understanding in Java statements, arrays and multithreaded programming.

Outcome:

Knowledge in operators and Applet Programming

Section 1. CLASSES, OBJECTS, INHERITANCE, INTERFACE

1. Write a program that randomly fills a 3 by 4 array the prints the largest and smallest values in the array.
2. Design a class to represent a bank Account.Include the following members:

Data Members:	Methods:
(1) Name of the Depositor	(1)To Assign initial values.
(2)Account Number	(2)To deposit an amount.
(3)Type of account	(3)To withdraw an amount after checking the balance.
(4)Balance	(4)To display the name and balance.

Write a Java program for handling 10 customers.

3. Java lacks a complex datatype. Write a complex class that represents a single Complex number and includes methods for all the usual operations, ie: addition, subtraction, multiplication, division.

4. Create a class called Publication. Create class Tape and class Book from Publication. Describe properties for subclasses. Create an array of publication references to hold combination of books and tapes.
5. Assume that the test results of a batch of students are stored in 3 different classes. Class Student stores the Roll number. Class test stores the marks obtained in two subjects and Class Result contains the total marks. The Class Result can inherit the details of marks and Roll Number of students. The Weightage is stored in a separate interface Sports. Implement the above multiple inheritance problem by using interface.

Section 2 : EXCEPTION HANDLING, MULTITHREADING AND PACKAGES

6. Write a Java program to handle different types of exceptions using try, catch and finally statements.

7. Write a Java program to implement the behavior of threads.
   (a) To create and run threads.
   (b) To suspend and stop threads.
   (c) To move a thread from one state to another.
   (d) By assigning a priority for each thread.

8. Create two Threads subclasses, one witha sun() that starts up, captures the handle of the second Thread object and then calls wait(). The other class run() should call notifyall() for the first Thread after some number of seconds have passed, so that the first thread after some seconds have passed, so the first thread after some number of seconds have passed, so that the first thread can print out a message.

9. Create a thread to copy the contents of one file to another file. Write a program to implement this thread. Create multiple threads within the program to do multiple file copies.

10. Create three classes Protection, Derived and SamePackage all in same package. Class Protection is a base class for the class Derived and SamePackage is a seperate class. Class Protection has three variables each of type private,protected and public. Write a program that shows the legal protection modes of all the different variables.

Section 3: APPLET PROGRAMMING

11. Write an applet to draw the following shapes : a) Cone b)Cylinder c)Cube d) Square inside a circle e) Circle inside a square.

12. Design applet to display bar chart for the following table which shows the annual turnover of XYZ company during the period 1997 to 2000.

year :	1997	1998	1999	2000
Turnover (in Crore) :	110	150	100	180

13. Creating a Java applet which finds palindromes in sentences. Your applet will have two input controls; One input will be a text field for entering sentences, the other input will be a text field or scroll bar for selecting the minimum length a palindrome to be shown. Your applet will output the first 10 palindromes it finds in the sentence.

14. Write a program which displays a text message coming down the screen by moving left to right and modify the above program instead of text moving from left to right it moves top to bottom.

15. Create a thread in an applet that draws an image and makes it move along the screen.

Section 4 : AWT FORMS DESIGN USING FRAMES

16. Create a frame with two text fields and three buttons (Cut, Copy & Paste). Data entered in the first text field should response, according to the buttons clicked.

17. Create a frame that contains 3 text fields and four buttons for basic arithmetic operations. You have to enter two numbers in first two text fields. On clicking the respective button that answer should be displayed in the last text filed.

18. Create a frame with check box group containing Rectangle, Circle, Triangle, Square. If the particular value is true then the corresponding shape should be displayed.

19. Using AWT create a frame which contains four text field name,age,sex and qualification lay out using the flow layouted manager. Run the program and give the values of all text fields in the command line. Initially all the values of text field should be blank. On clicking the click button all the text fields should contain the command line inputs.

20. A car company called Maruthi is selling four models of cars. They are shown below

CODE	CAR MODEL	PRICE
800	Maruthi 800	Rs 2.14 Lakhs
1000	Maruthi 1000	Rs 3.72 Lakhs
Esteem	Maruthi Esteem	Rs 3.69 Lakhs
Zen	Maruthi Zen	Rs 3.91 Lakhs .

Design a frame with 4 buttons called 800, 1000, Esteem, Zen. When we click a button the details of a particular model must appeared in an exclusive background color,text color and font.

11MA344 PROGRAMMING IN C++ AND NUMERICAL METHODS

Credits 0:0:2

Course Objective:

To provide the student with the concept and understanding in programme in C++ and curve cutting.

Course Outcome

Knowledge in pointers, Virtual functions and polymorphism.

Computer Laboratory Practice Exercises : (50 marks)

Section I : Computer Language Exercises for Programming in C++ :

1 a) Define a class to represent a bank account. Include the following members : Name, Acc-no, Acc-Type, Balance. Member functions: To assign initial values, Deposit an amt, withdraw an amt after checking the balance . Write a main program to test the program for handling 10 customers.

1 b) Write a class to represent a vector (a series of float values). Include member functions to perform the following tasks: To create the vector, To modify the value of a given element, To multiply by a scalar value, To display the vector in the form (10, 20, 30,…). Write a program to test your class.

2 a) Create two classes **DM** and **DB** which store the value of distances**. DM** stores distances in meters and centimeters and **DB** in feet and inches. Write a program that can read values for the class objects and add one object **DM** with another object **DB**. Use a friend function to carry out the addition operation. The object that stores the results may be a **DM** object or **DB** object, depending on the units in which the results are required. The display should be in the format of feet and inches or meters and centimeters depending on the object on display.

2 b) Create a class **FLOAT** that contains one float data member. Overload all the four arithmetic operators so that they operate on the objects of **FLOAT**.

3 a) Define a class **string**. Use overloaded == operator to compare two strings.

3 b) Write a class called employee that contains a name and an employee number. Include a member function to get data from the user for insertion into object, and another function to display the data. Write a main() program to create an array of employee information and accept information from the user and finally print the information.

4 a) Write a function called zersmaller() that is passed two arguments to reference and then sets the smaller of the two numbers to 0. Write a main() program to exercise this function.

4 b) Write a program which shows the days from the start of year to date specified. Hold the number of days for each month in an array. Allow the user to enter the month and the day of the year. Then the program should display the total days till the day.

5 a) Write a function called reversit() that reverse a string (an array of char). Use the for loop that swaps the first and last characters, then the second and next-to-last characters and so on. The string should be passed to reversit() as argument. Write a program to exercise reversit(). The program should get a string from the user, call reversit(), and print out the result. Use an input method that allows embedded blanks.

5 b) Write a program to use a common friend function to exchange the private values of two classes.

6 a) Write a program to read a set of integer numbers from the keyboard as long as the operator does not want to exit and find the maximum number entered. Use a constructor to count the number of integers entered. This counter should be initialized to 0. Use a constructor to initialize it.

6 b) Write a program to include all possible binary operator overloading using friend function.

7 a) Write a program to read an array of integer numbers and sort it in descending order. Use readdata, putdata, and arraymax as member functions in a class.

7 b) Write a program to read two values of time and to find the greater of the two overload the ‘<’ operator for comparison.

8 a) Write a program that has a class PUB with two derived classes BOOK and TAPE. Each of the 3 classes should have getdata() and putdata() functions to accept and display data respectively.

8 b) Write a program to read two character strings and use the overloaded '+' operator to append the second string to the first.

9 a) Write a program to accept employee information such as name, number and salary of 3 employees and display the record of the employee chosen by the user using pointers.

9 b) Write a function that takes two Distance values as arguments and returns the larger one. Include a main() program that accept two Distance values from the user, compare them and displays the larger.

10 a) Implement the concept of overloading Binary operator using friend function.

10 b) Write a program to implement the concept of object as function argument and returning objects.

11 a) Write a program for maintaining Employee Information System using Hierarchical Inheritance and stream.

11 b) Write a program to reverse a given string. "The world of computers is exciting" using pointers.

12. Develop a program Railway Reservation System using Hybrid Inheritance and Virtual Function.

13 a) i) Write a program for swapping 2 numbers using reference arguments.
ii) Write a program using inline function.

13 b) Using overloaded constructor in a class write a program to add two complex numbers.

14 a) Write a program to read the starting time of an event and the duration, the time at which the event will end. Define time as a class & start, duration, finish as objects belonging to class time. Define a function which will take as argument values of time add them and return the result.

14 b) Create a class MAT of size (m,n). Define all possible matrix operations for MAT type objects.

15 a) Write a program that determines whether a given number is a prime number or not and then prints the result using polymorphism.
15 b) Write a program to solve the general quadratic equation ax2 +bx +c=0 using the polymorphic technique.

Sections II Numerical Methods Exercises for Programming in C++:
1. Non-Linear Equations
1.1 Bisection Method
1.2 Regula-falsi Method
1.3 Newton-Raphson Method

1.4 Secant Method
1.5 Fixed Point Iteration
2. Interpolation
2.1 Lagrange's Interpolation Formula
2.2 Newton Interpolation Formula
3. Curve Fitting
3.1 Least-Square line
3.2 Least-Square polynomial
3.3 Non linear curve fitting
4. Numerical Solution to Differential Equations
4.1 Euler's Method
4.2 Taylor's Method of order 4
4.3 Runge-Kutta Method of order 4
4.4 Milne-Simpson Method.

LIST OF SUBJECTS

Sub. Code	Name of the Subject	Credits
11MA215	Probability and Random Process for Engineers	3:0:0
11MA345	Research Methodology	4:0:0
11MA346	Statistical Quality Control	4:0:0
11MA347	Advanced Acceptance Control	4:0:0
12MA201	Algebra, Differential Calculus and Analytical Geometry	4:0:0
12MA202	Multiple Integrals, Differential Equations And Laplace Transforms	4:0:0
12MA203	Algebra, Analytical Geometry and Calculus I	4:0:0
12MA204	Matrices, Differential Equations and Calculus II	4:0:0
12MA205	Complex Analysis, Statistics and Z-Transforms	4:0:0
12MA206	Fourier Series, Transforms and Partial Differential Equations	4:0:0
12MA207	Mathematical Foundation	3:0:0
12MA208	Discrete Mathematics	4:0:0
12MA209	Discrete Mathematics and Numerical Methods For Bioinformaticists	4:0:0
12MA210	Numerical Methods	4:0:0
12MA211	Numerical Methods For Biotechnologists	4:0:0
12MA212	Probability and Random Process	4:0:0
12MA213	Probability, Random Process and Numerical Methods	4:0:0
12MA214	Probability and Random Process For Engineers	3:0:0
12MA215	Operations Research	4:0:0
12MA216	Probability and Biostatistics	4:0:0
12MA217	Statistical Data Analysis and Reliability Engineering	4:0:0
12MA218	Partial Differential Equations and Transforms	4:0:0
12MA219	Biostatistics	4:0:0
12MA220	Computer Literacy With Numerical Analysis	4:0:0
12MA221	Probability Distribution And Random Process	4:0:0
12MA301	Probability and Statistics	4:0:0
12MA302	Discrete Mathematics	4:0:0
12MA303	Statistics and Numerical Methods	4:0:0
12MA304	Resource Management Techniques	4:0:0
12MA305	Applied Mathematics	4:0:0
12MA306	Graph Theory and Probability	4:0:0
12MA307	Numerical Methods And Biostatistics	4:0:0
12MA308	Probability and Biostatistics For Food Sciences	4:0:0
12MA309	Operations Research Techniques	4:0:0
12MA310	Basics of Mathematics & Statistics	4:0:0
12MA311	Mathematical and Statistical Methods	4:0:0
12MA312	Graph Theory and Optimization Techniques	4:0:0
12MA313	Applied Mathematics For Circuit Branches	4:0:0
12MA314	Computational Mathematics	4:0:0

12MA315	Graph Theory, Random Processes and Queues	4:0:0
12MA316	Linear Algebra	4:0:0
12MA317	Real Analysis –I	4:0:0
12MA318	Ordinary Differential Equations	4:0:0
12MA319	Mechanics	4:0:0
12MA320	Algebra	4:0:0
12MA321	Real Analysis – II	4:0:0
12MA322	Partial Differential Equations	4:0:0
12MA323	Fluid Dynamics	4:0:0
12MA324	Tensor Analysis and Special Theory Of Relativity	4:0:0
12MA325	Complex Analysis – I	4:0:0
12MA326	Probability Theory	4:0:0
12MA327	Functional Analysis	4:0:0
12MA328	Topology	4:0:0
12MA329	Complex Analysis- II	4:0:0
12MA330	Differential Geometry	4:0:0
12MA331	Mathematical Statistics	4:0:0
12MA332	Fuzzy Sets and Their Applications	4:0:0
12MA333	Number Theory and Cryptography	4:0:0
12MA334	Formal Languages and Automata Theory	4:0:0
12MA335	Programming In C++ and Numerical Methods	4:0:0
12MA336	Discrete Mathematics	4:0:0
12MA337	Graph Theory	4:0:0
12MA338	Java Programming	4:0:0
12MA339	Data Structures and Algorithms	4:0:0
12MA340	Operations Research	4:0:0
12MA341	Financial Mathematics	4:0:0
12MA342	Stochastic Processes	4:0:0
12MA343	Relational Database Management Systems	4:0:0
12MA344	Statistical Mathematics	4:0:0
12MA345	Research Methodology-I	4:0:0
12MA346	Mathematical Methods	4:0:0
12MA347	Graph Theory and Networks	4:0:0
12MA348	Fuzzy Mathematics	4:0:0
12MA349	Difference Equations	4:0:0
12MA350	Optimization Techniques	4:0:0
12MA351	Research Methodology-II	4:0:0
12MA352	Statistical Quality Control	4:0:0
12MA353	Advanced Acceptance Sampling	4:0:0
12MA354	Research Methodology-III	4:0:0
12MA355	Von Neumann Regular Rings	4:0:0
12MA356	Abstract Control Theory	4:0:0
12MA357	Theory of Near Rings	4:0:0
12MA358	Commutative Algebra	4:0:0
12IM301	Applied Calculus	4:0:0

12IM302	Applied Linear Algebra	4:0:0
12IM303	Industrial Mechanics	4:0:0
12IM304	Applied Analysis	4:0:0
12IM305	Probability and Distributions	4:0:0
12IM306	Applied Fuzzy Mathematics	4:0:0
12IM307	Matlab Programming	0:0:2
12IM308	Control Theory	4:0:0
12IM309	Discrete Mathematical Structures	4:0:0
12IM310	Reliability and Quality Control	4:0:0
12IM311	Mathematica	4:0:0
12IM312	Space Mechanics	4:0:0
12IM313	Convex Analysis	4:0:0
12IM314	Calculus of Variations and Integral Equations	4:0:0
12IM315	Advanced Statistics	4:0:0
12IM316	Digital Geometry	4:0:0
12IM317	Differential and Difference Equations	4:0:0
12IM318	Random Process and Queuing Theory	4:0:0

11MA215 PROBABILITY AND RANDOM PROCESS FOR ENGINEERS

Credits 3:0:0

Course Objective:
- To develop the skills of the students in the area of Probability & Random Process.

Course outcome:
- The students will be able to gain knowledge in probability theory and will be able to make simpler the mathematical descriptions or modeling of random signals.

Unit I
PROBABILITY THEORY: Axioms of probability, probability spaces, Joint and conditional probabilities, Independent event - Baye's Theorem.

Unit II
DISTRIBUTIONS: Densities and Distributions Example, Properties of distributions and density functions, Joint Distributions and Densities – Conditional Probability distribution and density function – Independent random variables.

Unit III
CHARACTERISTIC FUNCTION AND APPLICATIONS: Functions of random variables and random vectors-Statistical averages – Characteristic functions (problems only).

Unit IV
RANDOM PROCESS: Random Process Definition-Basic concepts and examples - Stationarity and ergodicity - Second order processes-Weakly stationary process.

Unit V
SPECIAL PROCESSES: Gaussian Process-Poisson process (properties and theorems – statements only).

Text Book
1. Veerarajan T, "Probability statistics and Random Process", Tata Mc Graw Hill, 2002.

Reference Books
1. Wong E.,"Introduction to Random Process", Spiringer verlag, 1983.
2. Stark H and Woods J.W., "Probability Random process and estimation theory for Engineers", Prentice Hall, 1994.

11MA345 RESEARCH METHODOLOGY

Credits: 4:0:0
Course Objective:

- To provide the student with the concept and the understanding in random variables and distributions.

Course Outcome:

- Knowledge in applications of probability and numerical methods.

Unit I

PROBABILITY: Concepts of probability – basic concepts – Mathematical, classical and statistical definition – conditional probability – Independent events – Baye's theorem – simple problems. Random variable – Definition – Distribution function – properties – discrete and continuous random variables – Probability mass function, probability density function – properties – simple problems.

Unit II

EXPECTATION: Expectation of a random variable – Definition – addition and multiplication theorems – conditional expectation and conditional variance. Moment generating function – properties – relation between moments and M.G.F. – cumulants - characteristic function – inversion theorem – uniqueness theorem (statement only) – simple problems – Weak law of large numbers (statement only) – Central limit theorem (concept only).

Unit III

SPECIAL DISTRIBUTIONS: Binomial, Poisson and Hyper geometric distribution – simple applications – Normal distribution – area property – Features – simple problems.

Unit IV

NUMERICAL EQUATIONS: Solution of numerical algebraic and transcendental equations. The Bisection method – Iteration method – Regula Falsi Method – Newton – Raphson method – Gauss elimination method – Method of triangularisation – Crout's method – Gauss-Jacobi method – Gauss Seidel method.

Unit V

NUMERICAL DIFFERENTATION: Finite differences: First and higher order differences – Forward differences and backward differences – Properties o operator – Differences of a polynomial – Fractional polynomials – Operator E – relation between E and D – Summation of series – Interpolation – Gregory-Newton forward interpolation formula – Equidistant terms with one or more missing values – Gauss forward interpolation formula – Gauss backward interpolation formula.

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Text Books

1. Gupta S.P., "Statistical Methods", Sultan Chand & Sons Publishers, 2008.
2. Gupta S.P and Kapoor S.P., "Fundamentals of Mathematical Statistics", Sultan Chand & Sons Publishers, 11^{th} Edition, 2002.
3. Agarwal B.L., "Basic Statistics", Wiley Eastern, 1980.
4. Hogg R.V and Craig, "Introduction to Mathematical Statistics", Prentice Hall, 1995.
5. Kandasamy P., "Numerical Methods", S.Chand & co. New Delhi, Reprint, 2010.

Reference Books

1 Mills F.C., "Statistical Methods" Part I, Holt, 1995.
1. Snedecor and Cochran, "Statistical Methods" Oxford-IBH, Pvt Co., 1967.
2. Brunk H.D., "An Introduction to Mathematical Statistics", Wiley, 1975.
3. Venkataraman M.K., "Numerical Methods", National Publishing Company, Reprint 2005.

11MA346 STATISTICAL QUALITY CONTROL

Credits: 4:0:0

Course Objective:

- To provide the student with the concept and the understanding in Statistical quality control and control charts.

Course Outcome:

- Knowledge in applications of SQC.

Unit I

QUALITY CONTROL: Statistical Quality Control – Definition – Need for SQC in industry – causes of variation – Chance and assignable causes – Natural and tolerance limits.

Unit II

CONTROL CHARTS AND SIMPLE PROBLEMS: Basis – Nature – Control charts for variables – Shewhart control charts for $\overline{X}$, R – Criteria for out of control – Control chart for attributes – p, np, c charts – OC and ARL of control charts – Modified control charts – simple problems.

Unit III

ACCEPTANCE SAMPLING: Meaning – Uses – Concepts – AQL, LQL, IQL, AOQL – Operating characteristic curves – Type A, Type B – Evaluation – Applications of Binomial, Poisson and Normal distribution – Designing sampling plans – Unity value and search procedure.

Unit IV

ACCEPTANCE SAMPLING [POWER SERIES APPROACH]: Power series approach of summing probabilities and their applications to acceptance sampling – Stochastic models – Markov chains – sampling problem as a stochastic processes – simple applications.

Unit V

MULTIPLE SAMPLING: Development of algorithms or usage of computer programs in acceptance sampling – Steps for obtaining the OC curves and other appropriate curves and for obtaining the parameters of the following plans only – single sampling plan – double sampling plan – multiple sampling plan – sequential sampling plan – chain sampling plan.

Text Books

1. Duncan A.J, "Quality control and Industrial Statistics, Irwin R.D, 4th Edition, 1974.
2. Gupta S.C and Kapoor V.K., "Fundamental of Applied Statistics" Sultan Chand & Sons Publishers, Third Edition 1990.
3. Grant E.L, "Statistical Quality Control" McGraw Hill, 2nd Edition, 1952.

Reference Books

1. Ekambaram S.K., "Statistical Basis of Acceptance Sampling", Asia Publishing House, Dec 1963.
2. Schilling E.G., "Acceptance Sampling in Quality Control", M. Dekker, 1982.

11MA347 ADVANCED ACCEPTANCE SAMPLING

Credits: 4:0:0

Course Objective:

- To provide the student with the concept and the understanding in different sampling plans.

Course Outcome:

- Knowledge in applications of sampling plans.

Unit I
Basic Concepts of Acceptance Sampling: Attributes Sampling Plans Single, Double, Multiple and item by item Sequential Sampling Plans, Dodge and Romig LTPD and AOQL Tables, ABC Standard, Philip's System, Golub's Minimization Approach, Sampling Plans for Isolated Lots MAPD Plans, MAAOQ Plans, Incentive Index Plans.

Unit II
Variable Sampling Plans: Known and Unknown – Sigma Plans, MIL-STD- 414 .

Unit III
Continuous Sampling Plans:CSP-1, CSP-2, CSP-3 and Multilevel Continuous Sampling Plans MIL-STD-1235(ORD)

Unit IV
Special Purpose Plans: Chain Sampling Plans, Skip-lot Plans, Demerit Rating Plans, Cumulative Results Plan.

Unit V
OQPL Plans, RGS Plans, Plans based on the Theory of Runs, Indian Standards, Lot Sensitive Sampling Plans , Tightened-Normal – Tightened Plan with Fixed and Different s and t, Quick Switching System, Administration of Sampling Inspection Plan.

REFERENCES

1. American Society for Quality Control (1978), American National Standards: Terms, Symbols and Definitions for Acceptance Sampling, ANSI/ASQC A2(1978), American Society for Quality Control, Milwaukee, Wisconsin.

2. Burr Irving, W., (1976), Statistical Quality Control Methods, Marcel Dekker, Inc., New York

Schilling Edward G,(1982), Acceptance Sampling in Quality Control, Statistics: Text Book and

Monographs, Vol.42, Marcel Dekker, Inc., New York.

3. Dodge Harold, F and Romig, H.G., (1959), Sampling Inspection Tables, single and double Sampling, John wiley, New York.

4. MIL-STD-105D (1963), Sampling Procedures and Tables for Inspection by Attributes, Us Govt., Printing Office, Washing DC.Dodge Harod, F (1969), A General Procedure for Sampling Inspection by Attributes – Based on the AQL Concept. Technical Report 10.The Statistics Centre, Rutger State University, USA.

5. Hamaker, H.C., (1949), Lot Inspection by Sampling, Philips Technical Review, Vol.11, No.6, pp. 176-182. Hamaker, H.C., (1950), The Theory of Sampling Inspection Plan, Philips Technical Review, Vol.11, No.9, pp.260-270.

6. Hamaker, H.C., Taudin Chabot, J.J.N. and Willemze, F.G., (1950), The Practical Application of Sampling Inspection Plans and Tables, Philips Technical Review, Vol.11, pp.362-370.

7. Golub, Abraham (1953), Designing Single Sampling Inspection Plans, when the sample size is fixed, Journal of the American Statistical Association Vol.48, pp. 278-288.

8. Camerion J.M., (1952), Tables for Constructing and for Computing the Operating Characteristics of Single Sampling Plans, Industrial Quality Control, Vol.9, pp.37-39.

9. Soundararajan,V., (1975), Maximum Allowable Percent Defective (MAPD) Single Sampling Inspection by Attributes Plans, Journal of Quality Technology, Vol 7., No.4, pp. 173-182.

10. Suresh, K.K., and Ramkumar, T.B., (1996): Selection of a sampling Plan Indexed with Maximum allowable Average Outgoing Quality, Journal of Applied Statistics, Vol.23, No.6, pp.645-654.

11. Suresh,K.K., and Sri Venkataramana, T., (1996): Selection of Single Sampling Plan using Producer and Consumer Quality Level, Journal of Applied Statistical Science, Vol.3, No.4, pp.273-280

12. Eizenhart, Hastay and Wallis (1947), Techniques of Statistical Analysis, McGraw Hill,London (Chapter 1 Only) MIL _STD –414 (1977), Sampling Procedure and Tables for Inspection by Variables for Percent Defective, US, Govt., Printing Office, Washington, DC. Duncan, A.J., (1974), Quality Control and Industrial Statistics, 4th Edition, Richard D Irwing, Home wood , Illinois.

13. Stephens, K.S., (1979): How to perform Continuous Sampling Plan?, ASQC Basic reference series, V-2. MIL-STD-1233(ORD) (1962): Single and Multilevel Continuous Sampling Procedures and Tables for Inspection by Attributes, Department of Defence, Washington

DC.MIL-STD A (1974): Single and Multilevel Continuous Sampling Procedures and Tables for Inspection by Attributes, US Department of Defence, Washington DC.

14. Dodge, H.F.,(1955): Chain Sampling Inspection Plan, Industrial Quality Control, Vol.II, No.5, pp. 10-13. Soundararajan, V(1978): Procedures and Tables for Construction and Selection of Chain Sampling Plans (ChSP-1) Part – I and II, Journal of Quality Technology, Vol.10, No.2 and 3, pp. 56-60. and pp. 99-103. Dodge, H.F., (1955): Skip-Lot Sampling Plans, Industrial Quality Control, Vol.11, No.5, pp.5-6.

15. Perry, R.L., (1974): Skip-Lot Sampling Plans, Journal of Quality Technology, Vol.5, pp. 123-130.

16. Dodge, H.F., (1956): A Check Inspection and Demerit Rating Plan, Industrial Quality Control, Vol.13, No.1,pp.5-12.

17. Cone, A.F., and Dodge, H.F., (1963): A Cumulative Results Plan for Small Sample Inspection, Industrial Quality Control, Vol.21, No.1, pp.4-9.

18. Rhodes, R.C., (1964): An outgoing Quality Probability Limit, (OQPL), Sampling Plan, Industrial Quality Control, Vol.21, No.3, pp.122-130.

19. Sherman Robert, E: Design and Evaluation of a Repetitive Group Sampling Plan, Technometrics, Vol.7, No.1, pp. 11-21.

20. Praire, R.R. , Zimmer, W.J., and Brook House, T.K., (1962): Some Acceptance Sampling Plans Based on Theory of Runs, Technometrics, Vol.4, No.2, pp. 177-185.

21. Vance, L.C., and Mc Donald, G.C., : A Class of Multiple Runs Acceptance Sampling Plan, Technometrices, Vol.21, No.2, pp. 141-146.

22. Indian Standard Sampling Inspection Tables – Part-I, Inspection by Attributes and by Count of Defects IS 2500 (Part-I) 1973. Indian Standard Sampling Inspection Tables Part II. Inspection by Variables for percent Defective IS 2500 (Part-II) 1965.

23. Schilling, E.G., (1982): Acceptance Sampling in Quality Control, Marcell Dekker, Inc., New York, pp.474- 488. Suresh, K.K., and Balamurali,S (1993) : Designing of Tightened – Normal-Tightened(TNT) Plans Indexed by MAPD, Communications in statistics, Theory and Methods, Vol.22, No.7, pp. 2043-2056, Suresh.K.K., and Balamurali, S., (1994) : Construction and Selection of Tightened- Normal- Tightened Plans Indexed by Maximum Allowable Percent Defectives, Journal of Applied Statistics, vol.21, No.6,pp. 589–595.

24. Schilling, E.G(1982): Acceptance Sampling in Quality Control, Marcel Dekker, Inc., New York, pp. 564-591. Schilling, E.G., (1985): The Role of Acceptance Sampling in Modern Quality Control, Communications in Statistics Theory and Methods , Vol.14, No.11., pp. 2769 –2777

12MA201 ALGEBRA, DIFFERENTIAL CALCULUS AND ANALYTICAL GEOMETRY

Credits: 4:0:0

Course Objective:

- To provide the students with the concept and an understanding of Theory of Equations, Matrices, Analytical Geometry, Differential Calculus and Functions of several variables for Analysis and Modeling in Technology.

Course Outcome:

- Students will be able to relate their subject knowledge with their engineering subjects during their course of study.

Unit I

THEORY OF EQUATIONS: Fundamental theorem of Algebra (statement only) - Relations between coefficients and roots. Irrational and imaginary roots – symmetric functions of the roots – transformation of equations – Reciprocal equations and formation of equation whose roots are given.

Unit II

MATRICES: Characteristic equation – Eigen values and Eigen vectors of a real matrix – Properties of Eigen values – Cayley Hamilton theorem – Orthogonal reduction of a symmetric matrix to diagonal form – Orthogonal matrices – Reduction of quadratic form to canonical form by orthogonal transformation.

Unit III

THREE DIMENSIONAL ANALYTICAL GEOMETRY: Direction cosines and ratios – Angle between two lines – Equation of a plane – Equation of a straight line – Co-planar lines – Shortest distance between skew lines

Unit IV

GEOMETRICAL APPLICATIONS OF DIFFERENTIAL CALCULUS: Curvature – Cartesian and polar co-ordinates – Circle of curvature – Involutes and Evolutes – Properties of envelopes – Evolutes as envelope of normals.

Unit V

FUNCTIONS OF SEVERAL VARIABLES: Functions of two variables – Partial derivatives – Total differential – Differentiation of implicit functions – Taylor's expansion – Maxima and Minima – Constrained Maxima and Minima by Lagrange's – Multiplier method – Jacobians.

Text Books

1. Veerarajan T., "Engineering Mathematics", Tata McGraw Hill, New Delhi, 2011.
2. Kandasamy P., Thilagavathi K and Gunavathi K., "Engineering Mathematics", Volume I (4 th revised Edition), S Chand & Co., New Delhi, 2002.

Reference Books

1. Kreyszig E., "Advanced Engineering Mathematics", (8^{th} Edition), John Wiley and Sons (Asia) Pvt Ltd., Singapore, 2000.
2. Grewal B.S., "Higher Engineering Mathematics" , (6^{th} Edition) Khanna Publisher, New Delhi, 2001.

12MA202 MULTIPLE INTEGRALS, DIFFERENTIAL EQUATIONS AND LAPLACE TRANSFORMS

Credits: 4:0:0

Course Objective:

- To provide the students with the concept and an understanding of Multiple Integrals , Beta and Gamma Integrals , Ordinary differential Equations, Vector Calculus and Laplace Transforms for Analysis and Modeling in Technology.

Course Outcome:

- Students will be able to relate their subject knowledge with their engineering subjects during their course of study.

Unit I

MULTIPLE INTEGRALS: Evaluation of double and triple Integrals, Change of order of Integration, Application of Multiple Integrals to find area enclosed by plane curves and volume of solids.

Unit II

BETA AND GAMMA INTEGRALS: Definition, relation connecting Beta and Gamma integrals, properties, evaluation of definite integrals in terms of Beta and Gamma functions.

Unit III

ORDINARY DIFFERENTIAL EQUATIONS: Simultaneous linear equations with constant coefficients – Linear equations of higher order with constant coefficients – Homogeneous equation of Euler type – Method of variation of parameters.

Unit IV

VECTOR CALCULUS: Gradient, Divergence, Curl – Line, surface & volume integrals – Statements of Green's, Gauss divergence and Stoke's theorems (without proof) – verification and simple problems.

Unit V

LAPLACE TRANSFORMS: Transforms of simple functions – Basic operational properties – Transforms of derivatives and integrals – Inverse transforms – Convolution theorem (Statement only) – Periodic function – Applications of Laplace transforms of solving linear ordinary differential equations up to second order with constant coefficients.

Text Book

1. Veerarajan T., "Engineering Mathematics", Tata McGraw Hill, New Delhi, 2011.

Reference Books

1. Kreyszig E., "Advanced Engineering Mathematics" (8^{th} Edition), John Wiley and Sons (Asia) Pvt Ltd., Singapore, 2000.
2. Grewal, B.S., "Higher Engineering Mathematics" (6^{th} Edition) Khanna Publisher, New Delhi, 2001.

12MA203 ALGEBRA, ANALYTICAL GEOMETRY AND CALCULUS I

Credits: 4:0:0

Course Objective:

- To provide the students with the concept and an understanding of trigonometry, differentiation & integration techniques, analytical geometry and theory of equations.

Course Outcome:

- Students will be able to relate their subject knowledge with their engineering subjects during their course of study.

Unit I

TRIGONOMETRY: Trigonometrical ratios and identities – Compound angles – Inverse trigonometrical functions – De Moivre's theorem.

Unit II

DIFFERENTIATION TECHNIQUES: Derivatives of elementary function from first principle – Derivatives of inverse functions –Logarithmic differentiation – Differentiation of parametric functions – Second order derivatives.

Unit III

INTEGRATION TECHNIQUES: Integrals of functions – Methods of integration – Decomposition method – Method of substitution – Integration by parts.

Unit IV

ANALYTICAL GEOMETRY: Locus – Straight lines – Family of straight lines – Circle – Definition of a conic – Parabola, Ellipse, Hyperbola – Standard form.

Unit V

THEORY OF EQUATIONS: Relations between coefficients and roots. Irrational and imaginary roots – symmetric functions of the roots – transformation of equations – Reciprocal equations and formation of equation whose roots are given.

Text Book

1. Hepzibah Christinal A., Porselvi K., Selvamani R., "Foundation Mathematics", H.S.I Publications, New Delhi, 2011.

Reference Book

1. Grewal B.S., "Higher Engineering Mathematics", (6^{th} Edition) Khanna Publisher, New Delhi, 2001.

12MA204 MATRICES, DIFFERENTIAL EQUATIONS AND CALCULUS II

Credits: 4:0:0

Course Objective:

- To provide the students with the concept and an understanding of matrices, ordinary differential equations, multiple integrals, vector calculus and functions of several variables.

Course Outcome:

- Students will be able to relate their subject knowledge with their engineering subjects during their course of study.

Unit I

MATRICES: Characteristic equation – Eigen values and Eigen vectors of a real matrix – Properties of Eigen values – Cayley Hamilton theorem (without proof) – Orthogonal reduction of a symmetric matrix to diagonal form.

Unit II

ORDINARY DIFFERENTIAL EQUATIONS: Linear equations of higher order with constant coefficients – Homogeneous equation of Euler type – Method of variation of parameters.

Unit III

MULTIPLE INTEGRALS: Evaluation of Multiple Integrals, Application of Multiple integrals to find area enclosed by plane curves and volume of solids.

Unit IV

VECTOR CALCULUS: Scalar and vector functions – differentiation – gradient, divergence and curl – directional derivative – irrotational and solenoidal fields.

Unit V

FUNCTIONS OF SEVERAL VARIABLES: Functions of two variables – Partial derivatives – Total differential – Differentiation of implicit functions – Taylor's expansion – Maxima and Minima – Constrained Maxima and Minima by Lagrange's – Multiplier method – Jacobians

Text Book

1. Veerarajan T., "Engineering Mathematics", Tata Mcgraw Hill, New Delhi, 2011.

Reference Books

1. Kreyszig E., "Advanced Engineering Mathematics", (8th Edition), John Wiley and Sons (Asia) Pvt Ltd., Singapore, 2000.
2. Grewal B.S., "Higher Engineering Mathematics" , (6^{th} Edition) Khanna Publisher, New Delhi, 2001.

12MA205 COMPLEX ANALYSIS, STATISTICS AND Z-TRANSFORMS

Credits: 4:0:0

Course Objective:

- To provide basic concepts about analytic functions, complex integration and certain methods in solving difference equations using Z-transform.

Course Outcome:

- Students will be able to relate their subject knowledge with their engineering subjects during their course of study.

Unit I

ANALYTIC FUNCTIONS: Cauchy Riemann equations–Properties of analytic functions – Determination of harmonic conjugate – Milne – Thomson's method – Conformal mappings w = z + a, az, 1/z, z^2 and bilinear transformation.

Unit II

COMPLEX INTEGRATION: Cauchy's theorem – Statement and application of Cauchy's integral formulae – Taylor's and Laurent's expansions – Singularities – Classification – Residues – Cauchy's Residue theorem – Contour integration – Circular and semi Circular contours (excluding poles on real axis)

Unit III

STATISTICS: Moments, skewness and kurtosis (based on moments only) – Linear correlation-Coefficient of correlation – Rank correlation and regression lines – Theoretical Distributions – Binomial – Poisson – Normal.

Unit IV

TESTING OF HYPOTHESIS: Tests based on large samples - Small samples: t for single mean and difference of means – χ^2 test for goodness of fit and attributes and F - distribution.

Unit V

Z – TRANSFORMS: Z-transforms of standard functions, inverse Z-transform (Partial fraction expansions and residues), properties of Z-transform, Convolution Theorem (statement only) and simple problems-Solution of difference equations.

Text Books

1. Kandasamy P., Thilagavathi K and Gunavathi K., "Engineering Mathematics" volume II and III (6th revised Edition), S. Chand & Co., New Delhi, 2006.
2. Kandasamy P., Thilagavathi K, and Gunavathy K., "Engineering Mathematics" Volume II, S.Chand and Co, New Delhi 2000.

Reference books

1. Kreyszig E., "Advanced Engineering Mathematics", (8th Edition), John Wiley and Sons (Asia) Pvt Ltd., Singapore, 2000.
2. Grewal B.S., "Higher Engineering Mathematics" , (6^{th} Edition) Khanna Publisher, New Delhi, 2001.

12MA206 FOURIER SERIES, TRANSFORMS AND PARTIAL DIFFERENTIAL EQUATIONS

Credits: 4:0:0

Course Objective:

- To provide basic concepts about Fourier series, applications of PDE and Fourier-transforms.

Course Outcome:

- Students will be able to relate and apply their subject knowledge with their engineering subjects during their course of study.

Unit I

FOURIER SERIES: Euler's formula – Dirichlet's conditions convergence statement only – Change of interval odd and even functions- Half range series – RMS value, Parseval's formula – Complex form of Fourier series – Harmonic analysis.

Unit II

PARTIAL DIFFERENTIAL EQUATIONS: Formation of equations by elimination of arbitrary constants and arbitrary functions –solution of equations – General, particular and complete integrals – Lagrange's linear equation – Standard type of first order equations – Second order and higher order equations with constant coefficients, homogeneous equations.

Unit III

ONE-DIMENSIONAL WAVE EQUATIONS AND HEAT EQUATION: One dimensional wave equation – Transverse vibration of finite elastic string with fixed ends – Boundary and initial value problems – Fourier series solution-One dimensional heat equation – Steady and unsteady states, boundary and initial value problems – Fourier series solution. (Proofs and derivations not needed).

Unit IV

TWO DIMENSIONAL HEAT EQUATION: Two dimensional heat equations – Steady state heat flow in two dimensions – Laplace equations in Cartesian and polar co ordinates Fourier series solution. (Proofs and derivations not needed).

Unit V

FOURIER TRANSFORMS: The infinite Fourier transform – Sine and cosine transforms – Properties (Proof not needed) – Fourier Inversion formula – Convolution theorem (statement only) and simple problems – Parseval's identity – Transform of derivatives. (Proofs and derivations not needed)- Finite Fourier Transform – Sine and cosine transforms –Simple problems

Text Book

1. Kandasamy P., "Engineering Mathematics", S. Chand & Co., New Delhi, Volume – III, 2010.

Reference Books

1. Erwin Kreyzig., "Advanced Engineering Mathematics", Wiley & Co, 2000.
2. Venkataraman M.K., "Higher Engineering Mathematics", National Publishing Co., 2005.

12MA207 MATHEMATICAL FOUNDATION

Credits: 3:0:0

Course Objective:

- To provide the basic concepts about trigonometry, matrices, differential and vector calculus.

Course Outcome:

- Students will be able to relate their subject knowledge with their engineering subjects during their course of study.

Unit I

TRIGONOMETRY: Expansions of sin nθ and cos nθ in powers of cos θ and sin θ. Expansions of tan nθ in powers of tan θ. Expansions of sin nθ and cos nθ in terms of sines and cosines of multiple of θ. Expansions of sin θ and cos θ in power of θ. Hyperbolic functions – inverse hyperbolic Functions- Separating real and imaginary parts of complex functions.

Unit II

MATRICES: Rank of a matrix – linear independence and dependence of vectors – consistency and inconsistency of a system of m linear equations in n unknowns – Eigen values and Eigen vectors – properties – Cayley Hamilton theorem and problems.

Unit III

CALCULUS: Curvature in Cartesian coordinates and polar coordinates – circle of curvature – radius of Curvature- Integration Techniques - Definition – Integration by Substitution- Integration by Parts.

Unit IV

DIFFERENTIAL EQUATIONS: Second order linear differential equations with constant coefficients with RHS of the form e^{ax}, x^n, sin ax, cos ax, e^{ax} f(x) where f(x) is sin bx (or) cos bx.

Unit V

VECTOR CALCULUS: Scalar and vector functions – differentiation – gradient, divergence and curl – directional derivative – identities (without proof) – irrotational and solenoidal fields.

Text Book

1. Veerarajan T., "Engineering Mathematics", (4th Edition)Tata McGraw Hill, New Delhi, 2009.

Reference Book

1. Kandasamy P., Thilagavathy K. and Gunavathy K., "Engineering Mathematics Vol.I" S.Chand & Co. New Delhi, 2009.

12MA208 DISCRETE MATHEMATICS

Credits: 4:0:0

Course Objective:

- To provide the student with the concept and the understanding of basic concepts in logic relations and digraphs, lattice and Boolean algebra, graph theory and automata theory for analysis and modeling for computer science and engineering.

Course Outcome:

- The students will be able to develop fundamental ideas of discrete mathematics, a foundation for the development of more advanced mathematical concepts. Also they will gain training for writing good computer programmes.

Unit I

FUNDAMENTALS: Set and subsets – operation on sets – sequences – division in the integers – matrices –Logic: propositions and logical operation – conditional statements – methods of proof Mathematical induction – Recurrence relation

Unit II

RELATIONS AND DIGRAPH: Products sets and partitions – relations and digraphs – paths in Relations and digraphs – properties of relations – equivalence of relations — operations on relations – transitive closure and Warshall's algorithm. Functions: functions – permutation-functions. (Theorems Statement only)

Unit III

ORDER RELATIONS AND STRUCTURES: Partially ordered sets – extremal elements of partially ordered sets – lattices – finite Boolean algebras – functions on Boolean algebra.
Trees: trees – labeled trees – tree searching – undirected trees – minimal spanning trees.(Theorems statement only)

Unit IV

TOPICS IN GRAPHS THEORY: Graphs –Euler paths and circuits –Hamiltonian Paths and circuits –transport networks – matching problems – coloring graphs. Semi-groups and groups: binary operations revisited – semi-groups – groups – definitions with examples only (Theorems statement only)

Unit V

LANGUAGES AND FINITE STATE MACHINES : Languages – representations of special grammars and languages – finite state machines – monoids ,machines and languages – machines and regular languages – simplification of machines. Groups and coding: coding of binary information (Theorems statement only)

Text Book

1. Bernard Kolman, Robert C. Busby, Sharon Cutler Ross, "Discrete Mathematical Structures", 5th Edition, Pearson Education, 2004.

Reference Book

1. Iyengar N.Ch.S., Chandrasekharan V., Venkatesh K.A. and Arunachalam P.S., "Discrete mathematics", Vikas Publishing, 2003.

12MA209 DISCRETE MATHEMATICS AND NUMERICAL METHODS FOR BIOINFORMATICISTS

Credits: 4:0:0

Course Objective:

- To provide basic concepts about sets, graph theory and finding solutions of different types of equations using numerical methods to suit the need for bio informaticists.

Course Outcome:

- Students will be able to relate their subject knowledge with their biological experiments during their course of study.

Unit I
FUNDAMENTALS OF SET OPERATIONS
Foundations: Sets and Operations on sets – Relations and functions. Combinatorics: Basics of Counting – Combinations and permutations – Counting combinatorial identities.

Unit II
TREES
Graph Theory: Trees-Labeled Trees-Tree searching-Undirected trees-Minimal spanning trees(Theorems and derivations not included).

Unit III
PATHS AND COLOURING
Graph Theory: Euler paths and circuits-Hamiltonian paths and circuits-Transport networks-Coloring graphs (Theorems and derivations not included).

Unit IV
NUMERICAL SOLUTIONS TO EQUATIONS
Solution of Numerical, Algebraic and transcendental equations – bisection method – Newton-Raphson method (methods only).Simultaneous equation – Gauss elimination, Gauss seidal method – Interpolation formula – Newton – Gregory formula (forward and backward difference) – Principles of Least Squares – Fitting a straight line.

Unit V
NUMERICAL INTEGRATION AND DIFFERENTIATION
Numerical integration - Trapezoidal rule – Simpson's one third rule (with derivation) – Numerical differentiation – Taylor series method (1st order only) – Euler's method – Runge-Kutta method (2nd and 4th order only).

Text Books

1. Iyengar N.Ch.S., Chandrasekharan V., Venkatesh K.A. and Arunachalam P.S., "Discrete mathematics", Vikas Publishing, 2003.
2. Kandasamy P., "Numerical Methods", S.Chand and Co, Reprint 2010.

Reference Books

1. Venkataraman M.K. "Numerical methods in Science and Engineering" , National Publishing Company, Revised Edition, 2005.

2. Bernard Kolman, Robert C. Busby ,Sharon Cutler Ross, “Discrete Mathematical Structures”,5th Edition, Pearson Education, 2004.

12MA210 NUMERICAL METHODS

Credits : 4:0:0

Course Objective:

- To provide the students with the concept of solving algebraic and transcendental equations, interpolation, initial and boundary value problems.

Course Outcome:

- The students will be able to solve different kinds of problems that occur in engineering numerically.

Unit I

CURVE FITTING: Emperical laws and curve fitting – the linear law – Laws reducible to the linear law – Method of group averages – Principle of Least squares – Fitting a straight line – Fitting a parabola – Fitting an exponential curve – Fitting a curve of the form $y = ax^b$ – Calculation of the sum of the squares of the residuals – Method of moments.

Unit II

NUMERICAL SOLUTION TO SIMULTANEOUS EQUATIONS: Solution of numerical algebraic and transcendental equations. The Bisection method – Iteration method - Regula Falsi Method – Newton – Raphson method – Gauss elimination method - Method of triangularisation – Crout’s method – Gauss-Jacobi method – Gauss- Seidel method.

Unit III

INTERPOLATION : Finite differences: First and higher order differences – Forward differences and backward differences – Properties of operator – Differences of a polynomial – Factorial polynomials – Operator E – Relation between δ and E and D - Summation of series – Interpolation – Gregory-Newton forward Interpolation formula – Equidistant terms with one or more missing values – Gauss forward interpolation formula – Gauss backward interpolation formula.

Unit IV

NUMERICAL DIFFERENTIATION AND INTEGRATION: Interpolation with unequal intervals – Divided differences – Newton’s divided difference formula – Lagrange’s interpolation formula – Numerical differentiation and Integration – Newton’s forward and backward differences to compute derivatives – The trapezoidal rule – Simpson’s one third rule – Simpson’s 3/8 rule – Difference Equations – Linear difference equations - Linear homogeneous difference equations with constant coefficients – Nonhomogeneous difference equations with constant coefficients.

Unit V

NUMERICAL SOLUTION TO DIFFERENTIAL EQUATIONS: Numerical solutions of ordinary differential equations – Power series approximations – Solution by Taylor series – Euler method – Runge – Kutta method (4th Order) – Numerical solutions of partial differential equations – Laplace's equations and its solution by Liebmann's process – Solution of Poisson's equation – Solutions of parabolic and hyperbolic equations.

Text Book

1. Kandasamy P., "Numerical Methods", S. Chand & Co. New Delhi, 2003.

Reference Book

1. Venkataraman., " Numerical Methods", National Publishing Company, 1991.

12MA211 NUMERICAL METHODS FOR BIOTECHNOLOGISTS

Credits 4:0:0

Course Objective

- To provide the knowledge to find the solution of algebraic and transcendental equations, which suit the need of Bio-Technologists.

Course Outcome:

- Students will be able to relate their subject knowledge with their biological experiments during their course of study.

UNIT I

EMPIRICAL FORMULAE AND CURVE FITTING: Curve fitting - method of group averages - Principle of least squares - fitting a straight line (y =ax + b), a parabola ($y = ax^2 + bx + c$), exponential curve ($y = ae^{bx}$), the curve ($y = ax^b$).

UNIT II

SOLUTION OF ALGEBRAIC EQUATIONS: Newton – Raphson method – Gauss elimination method, Gauss-Jordan method – Gauss-Jacobi –Gauss-Seidel method.

UNIT III

INTERPOLATION: Newton forward Interpolation, Newton backward Interpolation - Gauss forward interpolation formula, Gauss backward interpolation formula– Lagrange's Interpolation formula.

UNIT IV

NUMERICAL DIFFERENTIATION AND INTEGRATION: Numerical differentiation – Newton's forward difference formula, Newton's backward difference formula, Numerical Integration - Trapezoidal rule and Simpson's rule.

UNIT V

NUMERICAL SOLUTION FOR ORDINARY DIFFERENTIAL EQUATION: Taylor series- Euler's method - Fourth order Runge – kutta method to solve first and second order differential equations.

Text Book

1. Venkataraman M.K., "Numerical methods in Science and Engineering" , National Publishing Company, Revised Edition, 2005.

Reference Books

1. Kandasamy P., "Numerical Methods", S.Chand and Co, Reprint 2010.
2. Veerarajan T., "Numerical Methods with programs in C', Tata McGraw Hill, 3rd Reprint, 2009.

12MA212 PROBABILITY AND RANDOM PROCESS

Credits: 4:0:0

Course Objective:

- To develop the skills of the students in the area of Probability and Random Process

Course outcome:

- The students will be able to gain knowledge in Probability theory and will be able to make simpler the mathematical descriptions or modeling of random signals

Unit I

INTRODUCTION TO PROBABILITY: Axioms of probability – Probability spaces – Joint and conditional probabilities – Independent events.

Unit II

MARGINAL AND CONDITIONAL DISTRIBUTIONS: Densities and distributions – Example, Properties of distribution and density functions – Joint distributions and densities – Conditional probability distribution and density functions – Independent random variables.

Unit III

RANDOM VARIABLES AND VECTORS: Function of random variables and random vectors – Statistical averages – Characteristic functions – Inequalities of Tchebyshev and Cauchy Schwartz – Convergence concepts and the central limit theorem (Statement only).

Unit IV

RANDOM PROCESSES: Random process definitions – Basic concepts and examples – Stationarity and ergodicity – Second order processes – Weekly stationary process – Covariance functions and their Properties (statement only) – Wiener Khinchine theorem.

Unit V

SPECIAL RANDOM PROCESSES: Linear operations – Gaussian process – Poisson process – Low-pass and Band-pass process noise representations.(Properties- statement only)

Text Book

1. Veerarajan T., "Probability statistics and Random Process" Tata Mc Graw Hill,Second Edition, 2007.

Reference Book

1. Stark H and Woods J.W., “Probability, Random process and estimation theory for Engineers”, Prentice Hall, 2002.

12MA213 PROBABILITY, RANDOM PROCESS AND NUMERICAL METHODS

Credits: 4:0:0

Course Objective:

- To develop the skills of the students in the area of Probability & Random Process. To provide the students with the concept of solving algebraic and transcendental equations, interpolation, numerical differentiation and integration.

Course Outcome:

- The students will be able to gain knowledge in probability theory and will be able to make simpler the mathematical descriptions or modeling of random signals, and also they can solve the engineering problems numerically.

Unit I

INTRODUCTION TO PROBABILITY: Axioms of probability – Probability spaces – Joint and conditional probabilities – Independent event – Theorem of Total probability – Baye’s Theorem.

Unit II

MARGINAL AND CONDITIONAL DISTRIBUTIONS: Densities and distributions – Example, Properties of distribution and density functions – Joint distributions and densities – Conditional probability distribution and density functions – Independent random variables – characteristic function – Moment Generating function – Tchebycheff Inequality.

Unit III

RANDOM PROCESSES: Random process definitions – Basic concepts and examples –Weakly stationary process – Autocorrelation function – cross correlation function – Ergodicity – Power spectral density function.

Unit IV

NUMERICAL SOLUTION TO EQUATIONS: Numerical Errors – Roots of transcendental equations **–** bisection method – Newton – Raphson method (methods only). Simultaneous equation – Gauss elimination, Gauss seidal method – Interpolation formula – Newton – Gregory formula (forward and backward difference) – Principles of Least Squares – Fitting a straight line.

Unit V

NUMERICAL DIFFERENTIATION AND INTEGRATION: Numerical integration - Trapezoidal rule – Simpson’s one third rule (with derivation) – Numerical differentiation – Taylor series method (1st order only) – Euler’s method – Runge Kutta method (2nd and 4th order only).

Text Books

1. Veerarajan T., “Probability statistics and Random Process” Tata Mc Graw Hill, 2002.
2. Kandasamy P., “Numerical Methods”, S. Chand & Co. New Delhi, 2003.

Reference Books

1. Papoulis A., "Probability, Random Variables and Stochastic Processes" second edition , McGrawHill, 1991.
2. Venkataraman M.K., "Numerical Methods", National Publishing Company, 1991.

12MA214 PROBABILITY AND RANDOM PROCESS FOR ENGINEERS

Credits 3:0:0

Course Objective:

- To develop the skills of the students in the area of Probability & Random Process.

Course Outcome:

- The students will be able to gain knowledge in probability theory and will be able to make simpler the mathematical descriptions or modeling of random signals.

Unit I

Axioms of probability, probability spaces, Joint and conditional probabilities, Independent event - Baye's Theorem.

Unit II

Densities and Distributions Example, Properties of distributions and density functions, Joint Distributions and Densities – Conditional Probability distribution and density function – Independent random variables.

Unit III

Functions of random variables and random vectors-Statistical averages – Characteristic functions (problems only)

Unit IV

Random Process Definition-Basic concepts and examples - Stationarity and ergodicity - Second order processes-Weekly stationary process

Unit V

Gaussian Process-Poisson process (properties and theorems – statement only)

Text Book

1. Veerarajan T, "Probability statistics and Random Process" Tata Mc Graw Hill, 2002.

Reference Books

1. Davenpor, "Probability and Random process for Scientists and Engineers", McGrawHill,1970.
2. Wong E,"Introduction to Random Process", Spiringer verlag, 1983.
3. Stark H and Woods J.W., "Probability, Random process and estimation theory for Engineers", Prentice Hall, 1986.

12MA215 OPERATIONS RESEARCH

Credits: 4:0:0

Course Objective:

- To provide the student with the concept and an understanding of basic concepts in Operations Research Techniques for analysis.

Course outcome:

- Students will be able to relate their subject knowledge with their engineering subjects during the course of study.

Unit I

LINEAR PROGRAMMING: The Linear Programming Problem - Introduction, formulation of Linear Programming problem, Graphical solution to L.P.P, Simplex Method, Artificial variable techniques, two phase Method, Variants of the Simplex Method.

Unit II

DUALITY AND TRANSPORTATION: Duality In Linear Programming - Concept of duality, Fundamental properties of Duality, Duality& simplex method, Dual simplex method. THE TRANSPORTATION PROBLEM: Introduction, Transportation Model, finding initial basic feasible solutions, moving towards optimality, Degeneracy.

Unit III

ASSIGNMENT AND INVENTORY CONTROL: Assignment Problem - Introduction, Solution of an Assignment problem, Multiple Solution, Hungarian Algorithm, Maximization in Assignment Model, Impossible Assignment. Inventory Models: Purchasing model: No Shortages, Manufacturing Model: No Shortages EOQ: System of Ordering. (Derivations and proofs not needed)

Unit IV

SEQUENCING AND QUEUEING: Sequencing - Job sequencing, n jobs through two machines, two jobs through m machines, n jobs through m machines. QUEUING THEORY: Introduction, Definition of terms in Queuing model, problem-involving M/M/1: ∞/FIFO queue (Derivations and proofs not needed)

Unit V

REPLACEMENT AND SIMULATION: Replacement Model - Replacement of items with gradual deterioration, items deteriorating with time value of money, items that fail completely and suddenly. Simulation Models: Elements of Simulation Model- Monte Carlo Technique

Text Book

1. Kanti Swarup, Manmohan, Gupta P.K., "Operations Research", Sultan Chand & Sons, 15th Edition,2011.

Reference Books

1.Dharani S., Ventakrishnan, "Operations Research, Principles and Problems", Keerthi Publishing House Private Ltd., 1992.

2.Venkatesan S.J., "Operation Research", JS Publications, 1998.

12MA216 PROBABILITY AND BIOSTATISTICS

Credits: 4:0:0

Course objective:

- To develop the skills of the students in the areas of probability and statistics. To understand the various design of experiments.

Course Outcome:

- Knowledge in the technique, methodology and application in probability and Statistics.

Unit I

PROBABILITY AND RANDOM VARIABLES: Probability concepts, random variables, moments, moment generating function, binomial, Poisson, Tchebychev's inequality.

Unit II

TWO-DIMENSIONAL RANDOM VARIABLES: Marginal and conditional distributions, covariance, correlation and regression, transformation of random variables.

Unit III

RANDOM PROCESS: Classification, stationary and markov processes, Poisson process markov chains, markovian queuing model (M/M/1:∞./FIFO)

Unit IV

RELIABILITY ENGINEERING: Concepts of reliability, hazard function, series and parallel systems, reliability and availability of markovian systems, maintainability, preventive maintenance (proof and derivations not needed).

Unit V

DESIGN OF EXPERIMENTS: Aim of the design of experiments – completely randomized design- analysis of variance for one factor of classification – randomized block design- analysis of variance for two factors of classification- Latin square design – analysis of design for three factors of classification comparison of RBD and LSD.

Text Books

1. Gupta S.C., Kapoor V.K., "Fundamentals of Mathematical Statistics", Sultan Chand & Sons, XI edition, New Delhi, 2002.
2. Veerarajan T., "Probability Statistics and Random Variables", Tata McGraw-Hill, New Delhi, 2004

Reference Books

1. Balagurusamy E., "Reliability Engineering", Tata McGraw Hill Publishers, New Delhi, 1984.
2. Bhat U.N., "Elements of Applied Stochastic Processes ", Wiley Series in Probability and Mathematical Statistics, New York, 1983.

12MA217 STATISTICAL DATA ANALYSIS AND RELIABILITY ENGINEERING

Credits: 4:0:0

Course Objective:

- To provide the students the concepts and the understanding of basics in statistics and reliability engineering.

Course Outcome:

- Knowledge in technique, methodology of solving the design of experiments. Basic understanding in the reliability engineering in solving engineering problems.

Unit I

CURVE FITTING AND CORRELATION: Method of least square - Correlation coefficients – correlation coefficients in terms of regression coefficients, Rank correlation.

Unit II

TESTING OF HYPOTHESIS: Population- sample- one tailed and two tailed tests- Large samples-proportion and mean – Small Samples – t, F, Chi-square Distributions.

Unit III

DESIGN OF EXPERIMENTS: Aim of the design of experiments – completely randomized design- analysis of variance for one factor of classification – randomized block design- analysis of variance for two factors of classification- Latin square design – analysis of design for three factors of classification- comparison of RBD and LSD.

Unit IV

SQC: Introduction – Types of variation – types of control charts – X chart, R. Chart, Sigma Chart, C- Chart, Advantages and Limitations of SQC – Acceptance sampling – Single acceptance sampling plan, double sampling plan, multiple sampling plan, construction of a OC curve – AQL and LTPD, six σ concepts

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Unit V

RELIABILITY ENGINEERING: Concepts of reliability, hazard function, series and parallel systems, reliability and availability of markovian systems, maintainability, preventive maintenance. (Proof and derivations not needed)

Text Books

1. Gupta S.P., “Statistical Methods”, Sultan Chand and sons, New Delhi, 2008
2. Grewal P.S., “Method of Statistical Analysis”, Sterling publishers’ pvt.Ltd, New Delhi, 1990.
3. Balagurusamy E., "Reliability Engineering", Tata McGraw Hill Publishers, New Delhi, 1984.

Reference Book

1. Gupta S.C., and Kapoor V.K., “Fundamentals of Mathematical Statistics”, Sultan Chand & Sons, 2002.

12MA218 PARTIAL DIFFERENTIAL EQUATIONS AND TRANSFORMS

Credits: 4:0:0

Course Objective:

- To provide the student with the concept and the understanding of basics in Partial Differential Equations and Transforms.

Course Outcome:

- Knowledge in the Technique, methodology of solving Partial Differential Equations.
- A basic understanding in the Transforms which are useful in solving engineering problems.

Unit I

PARTIAL DIFFERENTIAL EQUATIONS – FIRST ORDER: Formation of equations by elimination of arbitrary constants and arbitrary functions – solutions of equations – general, particular and complete integrals – Lagrange's linear equations – standard type of first order equations.

Unit II

Partial Differential Equations – Higher Order: Second order and higher order equations with constant coefficients, homogeneous and non homogeneous equations.

Unit III

FOURIER SERIES: Euler's formula – Dirichlet's conditions (convergence statement only) – change of interval odd and even functions. Half range series – RMS value, Parseval's formula.

Unit IV

FOURIER TRANSFORMS: The infinite Fourier transform – sine and cosine transforms, properties (Proof not needed) –inversion theorem – convolution theorem – Parseval's identity – transform of derivatives – (Proof and derivations not needed).

Unit V

Z-TRANSFORMS: Z-transforms of standard functions, inverse Z-transforms (partial function expansions and residues). Properties of z-transform, Solution of difference equations.

Text Books

1. Kandasamy P., "Engineering Mathematics", S. Chand & Co., New Delhi, Vol. III, 2006.
2. Venkataraman M.K. "Higher Engineering Mathematics", National Publishing Co., 2001.

Reference Books

1. Erwin Kreyzig., "Advanced Engineering Mathematics", Wiley & Co., 8 th Edn. 2008.
2. Speigal M., "Advanced Engineering Mathematics", Schaum's Series, John Wiley & Co., 2006.

12MA219 BIOSTATISTICS

Credits: 4:0:0

Course Objective:

- To develop the skills of the students in the area of Probability & Statistics.
- To understand the various design of experiments.

Course Outcome:

- Knowledge in the Technique, Methodology and Application in Statistics. A basic knowledge in collection, presentation and tabulation of data.

Unit I

STATISTICS: Frequency distribution and measures of central tendency – measures of dispersion, moments, skewness and kurtosis – Linear correlation – rank correlation and regression lines.

Unit: II

TESTING OF HYPOTHESIS: Level of significance – type I, type II errors – critical value test – statistics – large sample tests – mean – difference of means proportion, difference of proportion – small sample test – t test – F test – Chi – square test.

Unit: III

PROBABILITY: Axioms of probability – probability spaces-joint and conditional probabilities – Independent Events – total probability theorem – Baye's theorem – Theoretical distributions – Binomial – Poisson – Normal.

Unit IV

DISTRIBUTIONS: Random Variables Densities and distribution – example, Properties of distribution and density functions – joint distribution and densities – conditional probability distribution and density function – Independent random variables.

Unit V

DESIGN OF EXPERIMENTS: Aim of the design of experiments – completely randomized design – analysis of variance for one factor of classification – randomized block design – analysis of variance for two factors of classification – Latin square design – analysis of design.

Text Books

1. Kapur J.N. and Saxena H.C., "Mathematical Statistics", S. Chand & Co. Ltd., New Delhi. 2003.
2. Singaravelu A, Rama R, Sivasubramanian, "Probability & Statistics", Meenakshi Agency, Chennai, 2007.

Reference Books

1. Balagurusamy E., "Reliability Engineering", Tata McGraw Hill Publishers, New Delhi, 1984.

2. Veerarajan T., "Probability & Random Process" Tata McGraw Hill Ltd. New Delhi. 2007.
3. Mille I.R. and Freund J.E., "Probability and Statistics for Engineers", Prentice Hall, second edition. 2004,

12MA220 COMPUTER LITERACY WITH NUMERICAL ANALYSIS

Credits: 4:0:0

Course Objective:

- To provide the student with the concept and an understanding of basic concepts in Computers and Control Structures and Numerical Methods for Analysis and Modeling in Technology.

Course outcome:

- Knowledge in algorithms, control structures and numerical methods

Unit I

INTRODUCTION: Computers- Classification of Computers- System Software- Software Lifecycle – Algorithms – Flowcharts – Pseudo code – Structured programming – Compilers – Operating Systems – Running C programs. Variables and Expressions: Introduction – Character set – Identifiers and keywords – Variables – Characters and Character strings. Basic Input-Output: Introduction – Single character Input Output – String Input and Output – Types of characters in format strings – Scanf width specifier – Input fields for scanf.

Unit II

CONTROL STRUCTURES: Introduction – If statement – Multiway decision – Compound statements – Loops – Break switch continue and Go to statements. Functions: Introductions – Function main – Functions accepting more than one parameter – User defined and Library functions – Functions parameters – Return. Arrays: Introduction – How arrays are useful – Multidimensional arrays

Unit III

NUMERICAL EQUATIONS: Bisection method– Successive approximation method – False position method – Newton Raphson method – Gauss Elimination method - Eigen values and Eigen vectors–Power Method.

Unit IV

NUMERICAL DIFFERENTIATION AND INTEGRATION: Numerical differentiation – Newton's forward difference formula. Integration-Trapezoidal rule-Simpsons 1/3rd rule-Newton's three eighth. Solution of differential equations-Predictor-corrector method-Runge Kutta method.

Unit V

IMPLEMENTATION OF NUMERICAL METHODS IN C PROGRAMMING:

Newton-Raphson method to find smallest positive root - Gauss-Seidel iteration method - Derivate at initial point by Newton's forward formula - Numerical integration using Trapezoidal rule & Simpson rule - Numerical differentiation using Runge-Kutta method.

Text Books

1. Venugopal K.R., Prasad S.R., "Mastering in C", Tata McGraw Hill Publishing Company Limited, 2 nd reprint 2007.
2. Thangaraj P., "Computer – Oriented Numerical methods", Prentice Hall of India (p) Ltd, 2008.

Reference Books

1. Veerarajan T., Ramachandran T., "Numerical Methods with Programs in C", Tata McGraw Hill (Second Edn.), 2008.
2. Kandasamy P., Thilagavathy K., Gunavathy K., "Numerical Methods" – S.Chand & Co. Ltd. 2009.

12MA221 PROBABILITY DISTRIBUTION AND RANDOM PROCESS

Credits: 4:0:0

Course Objective:

- To develop the skills of the students in the area of Probability & Random Process.

Course outcome:

- The students will be able to gain knowledge in probability theory and will be able to make simpler the mathematical descriptions or modelling of random signals.

Unit I

PROBABILITY THEORY: Axioms of probability – Probability spaces – Joint and conditional probabilities – Independent events.

Unit II

DISTRIBUTIONS: Densities and distributions – Example, Properties of distribution and density functions – Joint distributions and densities – Conditional probability distribution and density functions – Independent random variables.

Unit III

SPECIAL DISTRIBUTIONS: Binomial, Poisson, Uniform, Gaussian distribution.

Unit IV

CONVERGENCE IN PROBABILITY: Function of random variables and random vectors: statistical averages – Characteristic functions – Inequalities of Tchebyshev and Cauchy Schwartz – Convergence concepts and the central limit theorem (Statement only).

Unit V

RANDOM PROCESS: Definitions – Basic concepts and examples – Stationarity and ergodicity – Wiener Khinchine theorem.

Text Books

1. Veerarajan T., "Probability statistics and Random Process" Tata Mc Graw Hill, Reprint 2005.
2. Gupta S.C. and Kapoor V.K., "Fundamentals of Mathematical Statistics", 11th Edition, Sultan Chand and Sons, Educational Publisher, New Delhi, 2007.

Reference Books

1. Stark H. and Woods J.W., "Probability, Random process and estimation theory for Engineers", Prentice Hall, 2002.
2. Hwei Hsu, "Schaum's Outline of Theory and Problems of Probability, Random Variables and Random Processes", Tata McGraw-Hill edition, New Delhi, 2004.

12MA301 PROBABILITY AND STATISTICS

Credits: 4:0:0

Course Objectives:

- To provide the student with the concepts and an understanding of statistics and probability and random processes, needed for analysis and modeling in hydrology and water resources management.

Course Outcome:

- Students will be able to make logical conclusions using statistical concepts **.**

Unit I

BASIC STATISTICS: Measures of central tendency, dispersion, skewness and kurtosis – Correlation and regression.

Unit II

PROBABILITY AND DISTRIBUTIONS: Axioms of probability – Bayes' Theorem – Random variables – Binomial, Poisson, Exponential and Normal distributions – Expectation and variance.

Unit III

TESTING OF HYPOTHESIS: Population – sample – one tailed and two tailed tests - Tests based on large samples –proportion and mean – Small samples – t, F, chi square distributions.

Unit IV

DESIGN OF EXPERIMENTS: Aim of design of experiments – completely randomized design – analysis of variance for one factor of classification – Randomized block design – analysis of variance for two factors of classification – Latin square design – analysis of design for three factor of classification –comparison of RBD and LSD.

Unit V

RANDOM PROCESSES: Classification – Stationary random process – Markov process – Markov chain –Poisson process

Text Books

1. Gupta S.P., “Statistical Methods”, Sultan Chand and Sons, New Delhi, 37th Edn. 2009.
2. Veerarajan T., “Probability, Statistics and Random Processes”, Second Edition, Tata McGraw Hill publishing company, 2003.

Reference Book

1. Gupta S.C. and Kapoor V.K., “Fundamentals of Mathematical Statistics”, Sultan Chand & Co., 2007.

12MA302 DISCRETE MATHEMATICS

Credits: 4:0:0

Course Objective:

- To provide the student the concept and an understanding of basic concepts in sequences and graphs trees and languages and grammars in computer applications.

Course Outcome:

- The students will be able to logically handle problems and be competent in writing computer programmes

Unit I

LOGIC: Propositional Equivalences - Predicates and Quantifiers-Nested Quantifiers - Methods of Proof – Sets - Set operations - Functions (Chapter 1). Boolean Functions - Representing Boolean Functions – Logic Gates – Minimization of Circuits.

Unit II

SEQUENCES AND SUMMATIONS: Mathematical Induction – Recursive Definitions and Structural Induction – Recursive Algorithms (Chapter 3). Relations and their Properties – *n*-ary Relations and their applications – Representing Relations – Closure of Relations – Equivalence Relations – Partial Orderings.

Unit III

GRAPHS: Introductions - Graph Terminology – Representing Graphs and Graph Isomorphism –Connectivity – Euler and Hamiltonian Paths – Shortest Path Problems – Planar Graphs – Coloring Graphs.

Unit IV

TREES: Introductions - Applications of Trees – Tree Traversal – Spanning Trees – Minimum Spanning Trees.

Unit V

FINITE AUTOMATA: Languages and Grammars – Finite-State Machines with Output – Finite-State Machines with No Output –Language Recognition – Turing Machines.

Text Book

1. Kenneth Rosen H., "Discrete Mathematics and its Applications", Fifth Edition, Tata McGraw-Hill, Edition 2003.

Reference Books

1. Edgar Goodaire G., Michael Parmeter M., "Discrete Mathematics with Graph Theory", Third Edition, 2003.
2. Lipschultz, "Discrete Mathematics", Schaum's Series, 2002.

12MA303 STATISTICS AND NUMERICAL METHODS

Credits: 4:0:0

Course Objective:

- To provide the student with the concept and an understanding of basic concepts in Statistics, Probability and Numerical Methods for Analysis and Modeling in Computer Applications.

Course Outcome:

- The student will be able to apply the concepts in Statistics and Numerical methods.

Unit I

BASICS OF STATISTICS: Introduction–Statistics-Definition–Functions–Applications–Limitations.Classifications–Discrete Frequency distributions, Continuous Frequency distribution–Graphs of frequency Distribution–Histogram, Frequency Polygon. Measures of central Value–Mean, Median, Mode–Merits and Demerits– Measures of Dispersion– Range, Mean deviation, Standard deviation.

Unit II

CORRELATION AND REGRESSION ANALYSIS: Correlation - Scatter Diagram – Karl Pearson's Coefficient of correlation – Rank Correlation – Regression Analysis–Regression Lines–Regression Equations.

Unit III

PROBABILITY AND DISTRIBUTIONS: Probability and Expected value–Theorems of Probability–conditional probability-Bayes Theorem–Mathematical Expectation. Theoretical Distributions:- Binomial distribution, Poisson distribution and Normal distribution.

Unit IV

NUMERICAL EQUATIONS: The Solution of Numerical Algebraic and Transcendental Equations-Bisection method– Successive approximation method –False position method–Newton Raphson method– Simultaneous Linear Algebraic Equations-Gauss Elimination method-Jacobi method –Pivotal condensation-Gauss-seidal Gauss-Jordan -Eigen values and Eigen vectors–Power Method.

Unit V

NUMERICAL DIFFERENTIATION AND INTEGRATIONS: Newton's forward and backward difference formula. Integration-Trapezoidal rule-Simpsons 1/3rd rule-Newtons three eighth. Solution of differential equations-Taylor's series-Euler's Method, Predictor-corrector method-Runge-Kutta method.

Text Books

1. Gupta S.P., "Statistical Methods", 33rd edition, Sultan Chand & Co., 2004.
2. Venkataraman M.K., "Numerical Methods in Science and Engineering", 5th edition, The National Publishing Company, 1999.

Reference Books

1. Kandasamy P., Thilagavathy K., Gunavathy K., "Numerical Methods", S. Chand & Co. Ltd. Reprint 2009.
2. Veerarajan T., Ramachandran T., "Numerical Methods with Programs in C",Tata McGraw Hill Publishing Company Ltd, Second edition, 2006.

12MA304 RESOURCE MANAGEMENT TECHNIQUES

Credits: 4:0:0

Course Objective:

- To provide the student with the concept and an understanding of basic concepts in Operations Research Techniques for Analysis and Modeling in Computer Applications.

Course Outcome:

- Students will be able to relate their subject knowledge with their Engineering subjects.

Unit I

LINEAR PROGRAMMING PROBLEM: Introduction, formulation of Linear Programming problem, Limitations of L.P, Graphical solution to L.P.P, Simplex Method, Artificial variable techniques, two phase Method, Variants of the Simplex Method.

Unit II

DUALITY IN LPP AND TRANSPORTATION PROBLEMS: Duality In Linear Programming - Concept of duality, Fundamental properties of Duality, Duality & Simplex method, Dual simplex method. The transportation problem - Introduction, Transportation Model, transportation problem as an L.P model, finding initial basic feasible solutions, moving towards optimality, Degeneracy.

Unit III

ASSIGNMENT PROBLEM AND INVENTORY MODELS: Introduction, Mathematical formulation of the problem, Solution of an Assignment problem, Multiple Solution, Hungarian Algorithm, Maximization in Assignment Model, Impossible Assignment. Inventory Models:

Purchasing model: No Shortages, Manufacturing Model: No Shortages, EOQ: System of Ordering.

Unit IV

SEQUENCING AND QUEUING THEORY: Sequencing - Job sequencing, n jobs through two machines, two jobs through m machines, n jobs through m machines. Queuing theory - Introduction, Definition of terms in Queuing model, problem involving M\M\1: ∞\FIFO queue, M\M\c: ∞\FIFO.

Unit V

REPLACEMENT PROBLEMS AND SIMULATION MODELS: Replacement Of Model - Replacement of items with gradual deterioration, items deteriorating with time value of money, items that fail completely and suddenly, staff replacement problems. Simulation Models: Elements of Simulation Model- Monte Carlo Technique- Applications.

Text Book

1. Kanti Swarup, Manmohan, Gupta P.K., "Operations Research", Sultan Chand & Sons, 2008.

Reference Books

1. Sharma J.K., "Operations Research", Macmillan, III Edn. 2007.
2. Winston, "Operations Research, Applications and Algorithms " Cengage Learning, 2004, 4th Edn.
3. Hamdy Taha A., "Operations Research" (Sixth Edition) Prentice – Hall of India Private Limited, New Delhi. 2001.

12MA305 APPLIED MATHEMATICS

Credits: 4:0:0

Course Objective:

- To equip the students with some basic knowledge in number theory, algebra and graph theory, automata theory that have applications in software technology.
- To provide the students with soft computing techniques from random processes and queuing theory.

Course Outcome:

- The students will have good arithmetic ability and will have ability to write efficient programmes.

Unit I

BASIC CONCEPTS IN NUMBER THEORY: Divisibility, primes, fundamental theorem of arithmetic (statement only), Division Algorithm (statement Only), G.C.D & LCM, Modular Arithmetic, Applications of Congruences,Tryptology, Euclidean Algorithm (statement only), Some useful results on GCD & LCM, Linear Congruences, Chinese remainder theorem.

Unit II

BASIC CONCEPTS IN MODERN ALGEBRA: Definition of a group, Some examples of groups, some Preliminary Lemmas, Subgroups, Lagranges Theroem(statement only), normal subgroups, Quotient Groups, homomorphism, Fundamental Theorem on homeomorphisms(statement only), Definition & examples of rings and Some special classes of rings.

Unit III

GRAPH THEORY

Types of Graphs, Basic Terminology, Some special simple graphs, Representations of graphs, Connectivity, Shortest path algorithm and Trees.

Unit IV

AUTOMATA THEORY: Languages& Grammars, Phrase Structure Grammars & Types, Derivation trees, backus-Naur Form, Finite-state machines with outputs & types, Finite-state machines with no outputs, Regular sets, Kleene's theorem, Regular grammars.

Unit V

RANDOM PROCESSES & QUEUING THEORY: Classification of random processes, Special Classes, Average values of Random processes, Stationary, Autocorrelation Function, Cross-correlation Function & their properties (derivations are omitted), Ergodicity, Mean Ergodic Theroem(statement only) – Gaussian Process & its properties (derivations are omitted).
Characteristics of Queuing systems, Representation a queuing Model, Properties (derivations are omitted) of the models (M/M/1): (∞/FIFO) and (M/M/k): (∞/FIFO), Problems on the models (M/M/1): (∞/FIFO) and (M/M/k): (∞/FIFO).

Text Books

1. Kenneth Rosen H., "Discrete mathematics and its Applications", Fifth edition, Tata McGraw –Hill Edition, 1999 .
2. Herstain I.N., "Topics in Algebra", Second Edition, Wiley-India edition, Reprint: 2009.
3. Veerarajan T., "Probability, Statistics and Random Processes", Second edition, TataMcgraw-Hill, sixth reprint 2009.

Reference Books

1. Bernard Kolman, Robert Busby C., Sharon Cutler Ross, "Discrete Mathematical Structures", Fifth Edition, Pearson Education, 2004.
2. Richard Williams H., "Probability, Statistics and Random Process for Engineers", CENGAGE Learning, 2009.
3. Narsingh Deo, "Graph Theory with Application to Engineering and Computer Science", Prentice-Hall of India Private Ltd. 2004.
4. Kanti Swarup, Manmohan , Gupta P.K. "Operations Research" – Sultan Chand & Sons., 14th Edition. 2008.

12MA306 GRAPH THEORY AND PROBABILITY

Credits: 4:0:0

Course Objective:

- To develop skills of the students in the area of Graphs.
- To know more about Probability and Sampling Distribution.

Course Outcome:

- Knowledge in the technology, methodology and applications of Graphs.
- A basic understanding in Probability and Sampling Distributions.

Unit I

BASICS OF GRAPH THEORY: Introduction to Graphs –Graph terminology – Representing Graphs and Graph Isomorphism-connectivity- Euler and Hamiltonian paths-Networks and the maximum flow – Minimum cut theorem

Unit II

APPLICATIONS: Shortest path algorithm -Planar graphs – Graph Coloring– Chromatic number **–**Introduction to Trees – application of Trees- Tree traversal

Unit III

GRAPH ALGORITHM: Spanning trees – Rooted trees -Minimal spanning tree-– Kruskal and Prim's algorithms – DFS and BFS algorithms.

Unit IV

PROBABILITY: Addition Law – Multiplication law – Conditional Probability – Baye's Theorem. Distributions: Binomial, Poisson and Normal distributions.

Unit V

SAMPLING DISTRIBUTIONS: Tests based on large samples, Student's t, F and chi-square test for Goodness of fit, Independence of attributes - ANOVA applications for biological sciences (one way, two way classifications)

Text Books:

1. Kenneth Rosen H., "Discrete mathematics and its Applications", Fifth edition, Tata McGraw –Hill Edition, Fifth Edition, 1999.
2. Narsingh Deo, "Graph Theory with Applications to Engineering and Computer Science", Prentice Hall of India, 2007.
3. Gupta S.C., Kapoor V.K., "Fundamentals of Mathematical Statistics", Sultan Chand & Sons, New Delhi 2008.

Reference Books:

1. Bondy A., and Moorthy U, "Graph Theory and Applications", McMillan, London,1976.
2. Clark J.and Holton D.A, "A First Look at graph Theory", Allied Publishers, New Delhi, 1995.
3. Fisz M., "Probability theory and Mathematical statistics", John Wiley, 1997.

12MA307 NUMERICAL METHODS AND BIOSTATISTICS

Credits: 4:0:0

Course Objective:

- At the end of the course, the students would be acquainted with the basic concepts in numerical methods and their uses.
- Upon completion of this course, students will understand and be able to apply basic techniques in descriptive and inferential statistics.

Course Outcome:

- With the present development of the computer technology students will be developing efficient algorithms for solving problems in science, engineering and technology.
- Students will be able solve different kinds of problems occur in engineering numerically.

Unit I

ITERATIVE METHODS AND SOLUTION OF SIMULTANEOUS EQUATIONS: Introduction, Newton's relations, Evaluation of polynomials, Solution of quadratic equation, Bisection method, Newton-Raphson method, Existence of solutions, Gauss-Seidel iteration method, Gauss-Jordan method, Gauss-Jordan Matrix inverse, Eigenvalues and Eigenvectors.

Unit II

INTERPOLATION AND NUMERICAL INTEGRATION: Introduction, linear interpolation, polynomial interpolation, Difference tables, Gregory-Newton interpolation, Trapezoidal rule, Simpson's rule, Newton's Three-eights rule, Gaussian Quadrature

Unit III

SOLUTION OF DIFFERENTIAL EQUATIONS: Introduction, Euler's Method, Taylor's Method, Runge-Kutta Methods, Predictor Corrector Methods, Automatic Error Monitoring and Stability of solution

Unit IV

DISTRIBUTIONS: Frequency Distribution: Sampling, frequency distribution, measure of central tendency: mean, median and mode, measure of dispersion, moments: arithmetic mean, variance, skewness and kurtosis, Probability Distribution: probability, binomial distribution, Poisson distribution

Unit V

CURVE FITTING AND CORRELATION: Linear least square fit, nonlinear fit, polynomial fit, coefficient of correlation, multiple correlation, partial correlation, rank correlation

Text Books

1. Balagurusamy E., "Computer Oriented Statistical and Numerical Methods", MacMillan series, Madurai (1988).(Theory And Problems Only)
2. Rajaraman V., "Computer oriented numerical methods", Prentice-Hall publications, 2007.

Reference Book

1. Jain M.K., Iyengar S.R.K. and Jain R.K., "Numerical methods for scientific and Engineering Computation", Third Edition, New Age International, 1993.

12MA308 PROBABILITY AND BIOSTATISTICS FOR FOOD SCIENCES

Credits: 4:0:0

Course Objective:

- To provide the student with the concept and an understanding of basic concepts in Statistics, Testing of Hypothesis for analysis

Course outcome:

- Students will be able relate their subject knowledge with their engineering subjects during the course of study

Unit I

STATISTICS: Measures of central tendency – Measures of Dispersion — Binomial –Poisson – Normal distributions.(Proofs and derivations not included)

Unit II

CORRELATION: Correlations and regression, - Correlations coefficients – correlations coefficients in terms of regression coefficients, Rank correlation and repeated ranks. (Proofs and derivations not included)

Unit III

TESTING OF HYPOTHESIS: Population – sample – one tailed and two tailed tests - Tests based on large samples –proportion and mean – Small samples – t, F, chi square distributions.

UNIT IV

DESIGN OF EXPERIMENTS AND QUALITY CONTROL: Aim of the design of experiments – completely randomized design- analysis of variance for one factor of classification – randomized block design- analysis of variance for two factors of classification- Latin square design – analysis of design for three factors of classification-comparison of RBD and LSD.

Unit V

SQC: Introduction – Types of variation – types of control charts – X chart, R. Chart, Sigma Chart, C Chart,Advantages and Limitations of SQC – Acceptance sampling – Single acceptance sampling plan, double sampling plan, multiple sampling plan, construction of a OC curve – AQL and LTPD.

Text Books

1. Gupta S.P., "Statistical Methods", Sultan Chand and sons., New Delhi, 2009.
2. Veerarajan T., "Probability, Statistics and Random Processes", Second Edition, Tata McGraw Hill publishing company, 2007

Reference Book

1. Gupta S.C. and Kapoor V.K., "Fundamentals of Mathematical Statistics", Sultan Chand & Co., 2007.

12MA309 OPERATIONS RESEARCH TECHNIQUES

Credit: 4:0:0

Course Objective:

- To provide the student with the concept and an understanding of basic concepts in Operations Research Techniques for Analysis and Modeling in Food Technology.

Course Outcome:

- Students are able to relate their subject knowledge with the engineering subjects

Unit I

LINEAR PROGRAMMING PROBLEM: The Linear Programming Problem - Introduction, formulation of Linear Programming problem, Graphical solution to L.P.P, Simplex Method, Artificial variable techniques, Two phase Method, Variants of the Simplex Method.

Unit II

DUALITY & TRANSPORTATION: Duality In Linear Programming - Concept of duality, Fundamental properties of Duality, Duality & Simplex method, Dual simplex method.
THE TRANSPORTATION PROBLEM: Introduction, Transportation Model, finding initial basic feasible solutions, moving towards optimality, Degeneracy.

Unit III

ASSIGNMENT & SEQUENCING: Assignment Problem - Introduction, Solution of an Assignment problem, Multiple Solution, Hungarian Algorithm, Maximization in Assignment Model, Impossible Assignment. Sequencing - Job sequencing, n jobs through two machines, two jobs through m machines, n jobs through m machines.

Unit IV

QUEUING MODELS: Introduction, Definition of terms in Queuing model, problem involving M\M\1: ∞\FIFO queue, M\M\c: ∞\FIFO

Unit V

NETWORK MODEL & SIMULATION: Network analysis– PERT & CPM- network diagram-probability of achieving completion date- crash time- cost analysis. Simulation models. Elements of simulation model-Monte Carlo technique – applications.

Text Book

1. Kanti Swarup, Manmohan, Gupta P.K., "Operationals Research" Sultan Chand &Sons., 14th Edn.2008.

Reference Books

1. Winston, "Operations Research, Applications and Algorithms" – Cengage Learning, 4th Edition, 2004.
2. Hamdy Taha. A., "Operations Research" (Sixth Edition) Prentice – Hall of India Private Limited, New Delhi, 1997.
3. Natarajan A.M., Balasubramani P., Tamilarasi A., "Operations Research", Pearson Education, I Edn, 2003.
4. Srinivasan G., "Operations Research", Eastern Economy Edition, I Edn. 2007.

12MA310 BASICS OF MATHEMATICS AND STATISTICS

Credits: 4:0:0

Course Objective:

- To provide the students with the basic knowledge in Statistics, Testing of Hypothesis, Differential and Integral Calculus at PG chemistry level.

Course outcome:

- Students will be able relate their subject knowledge with their science subjects during the course of study.

Unit – I

DIFFERENTIAL & INTEGRAL CALCULUS: Differentiation - trigonometry, polynomial, exponential, logarithmic functions and second order differentiation. Integration-Integrals of the type

$$\int \frac{f'(x)}{f(x)}dx, \quad \int \frac{1}{ax^2+bx+c}dx, \int \frac{dx}{\sqrt{ax^2+bx+c}}, \int \sqrt{ax^2+bx+c}\ dx, \int \frac{px+q}{ax^2+bx+c}dx,$$

$\int \frac{px+q}{\sqrt{ax^2+bx+c}}dx, \int \frac{dx}{(px+q)\sqrt{ax^2+bx+c}}$ and integration by partial fractions, integration by parts.

Unit –II

DIFFERENTIAL EQUATIONS: Linear differential equation of second order, Euler-homogeneous linear differential and Simultaneous differential equations.

Unit -III

FUNDAMENTAL STATISTICS: Measures of dispersion: Range, Quartile Deviation, Mean Deviation, Standard Deviation –Moments, Skewness- Kurtosis (based on moments only).

Unit –IV

CORRELATION AND REGRESSION: Linear correlation-coefficient of correlation – rank correlation and regression lines –Theoretical Distributions: Binomial, Poisson, and Normal

Unit – V

TESTING OF HYPOTHESIS: Tests based on large samples - Small samples: Student's t-test on mean and difference of means –χ^2 test for goodness of fit and attributes and F - test.

Text Books

1. Narayanan S., and Manicavachagom Pillay T.K., "Calculus" Vol. I, S.Viswanathan (Printers and Publishers) PVT. LTD. 2003.
2. Kandasamy P., Thilagavathy K. and Gunavathy K., "Engineering Mathematics", Volume II (Third Semester), Fifth Revised and Enlarged Edition, S. Chand & Company Ltd., 2000.

Reference Book

1. Kandasamy P., Thilagavathy K. and Gunavathy K., "Engineering Mathematics", Volume I (Third Semester), Fifth Revised and Enlarged Edition, S. Chand & Company Ltd, 2000.

12MA311 MATHEMATICAL AND STATISTICAL METHODS

Credits: 4:0:0

Course Objective:

- To develop skills of the students in the area of probability and statistics.
- To know more about descriptive and inferential statistics.
- To know about the various reliability methods.
- To understand the various application design experiments.

Course Outcome:

- Knowledge in the technique, methodology and Application of statistics.
- A basic understanding in collection, presentation and drawing conclusion about biological data.

Unit I

BASIC MATHEMATICS: Algebra - Binomial Theorem (Statement only)- Summation of series – coefficient of x^n (using binomial theorem). Differentiation – Product and Quotient Rule (simple problems) –Maxima and Minima of f(x).Integration: Bernoulli's uv integration.
Second order differential equations with constant coefficients.

Unit II

PROBABILITY AND DISTRIBUTIONS: Probability – Axiomatic definition of probability – Independent events – Addition Theorem –Binomial, Poisson Distributions — Normal Distribution – Properties of Normal Distribution —Importance of Normal Distribution —Normal probability curve — fitting Binomial, Poisson Distributions – problems (proofs and derivations not included).

Unit III

RELIABILITY ENGINEERING AND CURVE FITTING: Concepts of reliability – Hazard function – Series and parallel systems – Reliability of systems (proofs and derivations not included). Method of least squares – fitting a straight line – fitting a curve of the Form ($y=ab^x$) – fitting a curve of the form ($y=ax^b$)

Unit IV

TESTING OF HYPOTHESIS: Population – sample – one tailed and two tailed tests - Tests based on large samples –proportion and mean – Small samples – t, F, chi square distributions.

Unit V

DESIGN OF EXPERIMENTS: Aim of design of experiments – completely randomized design – analysis of variance for one factor of classification – Randomized block design – analysis of variance for two factors of classification – Latin square design – analysis of design for three factor of classification –comparison of RBD and LSD.

Text Books

1. Gupta S.P., "Statistical Methods", New Delhi, S.Chand & Co., 37th Edition 2009.
2. Veerarajan T., "Probability, Statistics and Random Processes", Second Edition, Tata McGraw Hill publishing company, 2003
3. Kandasamy P., Thilagavathi K and Gunavathy K., "Engineering Mathematics", Volume I, S.Chand & Co., 2001.
4. Kandasamy P., Thilagavathi K and Gunavathy K., "Numerical Methods", S.Chand & Co., 2009.

Reference Books

1. Manickavasagam Pillai T.K. , "Algebra" , Volume I & II , S. Viswanathan publishers, 2002.
2. Gupta S.C. and Kapoor V.K., "Fundamentals of Mathematical Statistics", Sultan Chand & Co., 2007.

12MA312 GRAPH THEORY AND OPTIMIZATION TECHNIQUES

Credits: 4:0:0

Course Objective:

- To provide the student with the concept and an understanding of basic concepts in Graphs and optimization techniques and statistics for analysis

Course Outcome:

- Students will be able relate their subject knowledge with their engineering subjects during the course of study

Unit I

BASICS OF GRAPH THEORY: Graphs – Data structures for graphs – Sub graphs – Operations on Graphs Connectivity –Networks and the maximum flow – Minimum cut theorem - Trees – Spanning trees – Rooted trees – Matrix representation of graphs.

Unit II
TYPES OF GRAPHS: Eulerian graphs and Hamiltonian graphs – Standard theorems – Planar graphs – Euler's formula -Five colour theorem – Coloring of graphs – Chromatic number (vertex and edge) properties and examples – Directed graphs.

Unit III
GRAPH ALGORITHM: Computer Representation of graphs – Basic graph algorithms – Minimal spanning tree algorithm – Kruskal and Prim's algorithm - Shortest path algorithms – Dijsktra's algorithm – DFS and BFS algorithms.

Unit IV
OPTIMIZATION TECHNIQUES: Linear Programming – Graphical methods – Simplex method (Artificial variables not included)-transportation and Assignment problems.

Unit V
STATISTICS: Tchebyshev's inequality – Maximum likelihood estimation – Correlation – Partial correlation– Multiple correlations – Regression – Multiple regression.

Text Books

1. Gupta S.C., Kapoor V.K., "Fundamentals of Mathematical Statistics", Sultan Chand &Sons, 2002.
2. Narsingh Deo, "Graph Theory with Applications to Engineering and Computer Science",Prentice Hall of India (p) Ltd. 1988.
3. Haffmann and Kunze "Linear Algebra", PHI, 1994.
3. Kanti Swarup, Man Mohan, Gupta P.K., "Operations Research", Sultan Chand & Sons, 2000.

Reference Books

1. Walpole Myers, Myers, Ye, "Probability & Statistics for Engineers and Scientists" PearsonEducation, first Indian reprint, 2002.
2. Gupta S.C., Kapoor V.K., "Fundamentals of Applied Statistics", Sultan Chand & Sons, 2002.
3. Veerarjan T., "Theory of Probability and Random Process", Tata McGraw Hill PublishingCompany Science, PHI, 2005.

12MA313 APPLIED MATHEMATICS FOR CIRCUIT BRANCHES

Credits: 4:0:0

Course Objective:

- To provide the students with the concept and understanding of basic concepts for analysis

Course Outcome:

- Students will be able to relate their subject knowledge with their engineering subjects during the course of study.

Unit I

CALCULUS OF VARIATIONS: Maximum and Minimum of functions of several independent variables –Lagrangian method of multipliers. Variational problems of fixed boundaries only simplest Variational problems – Euler equation – Brachisto Chrone problem – Variational problems involving several unknown functions – Functional involving first and second order derivations –Functional involving two or more independent variables – Isoperimetric problems.

Unit II:

LINEAR INTEGRAL EQUATIONS: Different types of integral equations – Fredholm and Volterra integral equations – Relation between differential and integral equations – Green's function – Fredholm equation with separable kernal – Interactive method of solving equation of second kind –Properties of symmetric kernels.

Unit III:

VECTOR SPACE: Definition and examples of linear space – Linear dependence and independence –Basis and Dimension – Subspace – Inner Product space – Orthogonalisation process.

Unit IV:

FUNCTIONS AND RELATIONS: Injective and Surjective, bijective functions – Compositions, identity,inverse functions – properties of relations.

Unit V:

GRAPH THEORY: Introduction – Basic terminology – Representations of graphs – connected Graphs – Matrix representation of graphs (excluding graphs), Applications – Critical path method – Shortest path problems – trees – definition – Binary tree. Z – Transforms: Definition – Z – Transform of standard functions: Applications to signals and linear time invariant system.

Text Books

1. Venkataraman M.K., "Higher Mathematics for engineering and Science", National Publishing Company, 2002.
2. Narsingh Deo, "Graph Theory with Applications to Engineering and Computer Science",Prentice Hall of India (P) Ltd.,2000.
3. Hoffmann and Kunze, "Linear Algebra" second edition, Prentice Hall India Limited, 1994.

Reference Books

1. Tremblay J.P. and Manohar R., “Discrete Mathematical Structures with Applications to Computer Science”, McGraw Hill, 1987
2. John Proakis G., “Digital Signal Processing”, Prentice Hall of India (P) Ltd., 1995.

12MA314 COMPUTATIONAL MATHEMATICS

Credits: 4:0:0

Course Objective:

- To provide the student with the concept and the understanding of basic concepts in Variations, Partial Differential Equations and Numerical Methods for analysis and modeling for higher engineering.

Course Outcome:

- Students will be able to relate their subject knowledge with their engineering subjects during the course of study.

Unit I

VARIATIONS: Introduction – Variation – Properties of variation – Euler’s equation – Functional dependant on its first derivatives – Functional dependant on its higher derivatives – Problems – Kantorvich method

Unit II

DIFFERENTIAL EQUATIONS AND APPLICATIONS: Classification of partial differential equation of second order – Solution of Laplace equation by Liebmann method – Solution of Poisson equation by Liebmann method – Differential Equation by explicit – Bender Schmidt method – Differential equation by implicit – Crank Nicholson method – Solution of wave equation by explicit method

Unit III

INITIAL VALUE AND BOUNDRAY VALUE PROLEMS: Introduction initial value problems – Picard’s method – Euler method – Improved Euler method and modified Euler method – Adam’s predictor corrector method – Eigen value problems – power & inverse power method – Jacobi & given methods – Boundary value problems – Raleigh-Ritz, collocation, Galerkin methods.

Unit IV

NUMERICAL METHODS: Homer’s method Muller, Chebyshew, Graffe’s root, Birge Vita methods – Gauss elimination, Gauss-Jordan, Gauss-Jacobi, Relaxation methods – System of non linear equation – Newton Raphson methods.

Unit V

NUMERICAL INTEGRATIONS: Newton- cotes quadrature formula – Weddle’s rule (Single & Double integral) – Romberg’s method – Gaussian quadrature, Natural cubic spline functions formula – Beizer curves.

Text Books

1. Kandasamy P., et al “Numerical Methods”, S. Chand & Co. Ltd., 2005.
2 Veerarajan T., Ramachandran T., “Numerical Methods”, Tata McGraw Hill, 2003.
3. Naveenkumar, “An Elementary course on Variational problems in calculus”, Narosa Publishing House, 2003.

Reference Book

1. Curtis F-Gerald, “Applied Numerical Analysis”, 5th edition, Addition Wesley Publishing Company, 2001.

12MA315 GRAPH THEORY, RANDOM PROCESSES AND QUEUES

Credits: 4:0:0

Course Objective:

- To provide the student with the concept and an understanding of basic concepts in graphs, Trees, probability, Random Process and queuing theory for analysis.

Course outcome:

- Students will be able relate their subject knowledge with their engineering subjects during the course of study

Unit I

TOPICS IN GRAPH THEORY: Graphs – Euler paths and Circuits – Hamiltonian paths and circuits – Transport Networks – Matching Problems - Coloring graphs.

Unit II

TREES: Trees – Labeled Trees – Tree Searching – Undirected Trees – Minimal Spanning Trees.

Unit III

PROBABILITY THEORY: Axiomatic definition of Probability – Conditional Probability – Independent events – Theorem of Total probability – Baye’s Theorem – Discrete Random Variable – Probability function – Continuous Random variable – Probability Density function – Cumulative Distribution Function(Cdf) – Properties of Cdf — Mean and Variance ,MGF of Binomial and Poisson distribution.

Unit IV

RANDOM PROCESSES: Classification – Methods of Description – Special classes – Average Values – Stationary – Example of SSS – Analytical representations – Weiner Process function – Auto correlation – Properties of R(τ) – cross Correlation – Properties – Ergodicity – Mean Ergodic theorem – Correlation Ergodic process – Power spectral density and its properties.

UNIT V

QUEUING THEORY: Introduction- definition of terms in queuing model involving M/M/I: ∞/FIFO queue, M/M/C: ∞/FCFS, M/M/I: N/FCFS, M/M/C: N/ FCFS (Derivations are not included – simple problems to be asked)

Text Books

1. Bernard Kolman, Robert Busby C. and Sharon Ross, “Discrete Mathematical Structures”, 5th Edition, Pearson Education, 2004.
2. Veerarajanv T., “Probability Statistics and Random processes”, second Edition, Tata McGraw Hill, 2006.
3. Kanti Swarup, Man Mohan, Gupta P.K., “Operations Research”, Sultan Chand & Sons, 2000.

Reference Books

1. Narsingh Deo, “Graph Theory with Application to Engineering and Computer Sciences”, Prentice-Hall of India Private Ltd., 2000.
2. Hamdy Taha A., “Operation Research”, Maxwell Macmillan, Revised Edition, 2000.
3. Kandasamy P., Thilagavathy K, Gunavathy K., “Probability, Random Process and Queuing Theory”, S. Chand & Co. New Delhi, 2007.

12MA316 LINEAR ALGEBRA

Credits: 4:0:0

Course Objective:

- To provide the student with the concept and the understanding in vector spaces, linear transformations and inner product spaces.

Course Outcome:

- Knowledge in the methodology and applications of linear transformations

Unit I

VECTOR SPACES: Vector Spaces – Subspaces – Bases and dimension – Coordinates – Summary of Row – Equivalence – Computations concerning subspaces.

Unit II

LINEAR TRANSFORMATIONS: Linear Transformations – The Algebra of Linear Transformations– Isomorphism – Representation of Transformation by Matrices – Linear Functional.

Unit III

ELEMENTARY CANONICAL FORMS: Introduction – Characteristic Values – Annihilating Polynomials – Invariant Subspaces – Simultaneous Triangulation; Simultaneous Diagonalization

Unit IV

THE RATIONAL AND JORDAN FORMS: Cyclic Subspaces and Annihilators – Cyclic Decompositions and the Rational Form – The Jordan Form – Computations of Invariant Factors.

Unit V

INNER PRODUCT SPACES: Inner Products – Inner Product Spaces – Linear Functionals and Adjoints – Unitary Operators – Normal Operators.

Text Book

1. Kenneth, Hoffman and Ray Kunze, "Linear Algebra" (II Edition), Prentice-Hall of India Pvt. Ltd., New Delhi, 2000.

Reference Books

1. Halmos P. "Finite Dimensional Vector Spaces", D. Van Nostrand Co., Princeton, 1958.
2. Herstein I.N., "Topics in Algebra", II Edition. Wiley Eastern Limited, New Delhi, 2000.
3. Artin M., "Algebra", Prentice Hall of India, 1991.
4. Bhattacharya P.B., Jain S.K. and Nagpaul S.R., "Basic Abstract Algebra" (II Edition) Cambridge University Press, 1997 (Indian Edition).

12MA317 REAL ANALYSIS –I

Credits: 4:0:0

Course Objective:

- To provide the student with the concept and the understanding in functions of bounded variation, Riemann-Stieiltjes integral and sequences of functions.

Course Outcome:

- Knowledge in sequences of functions.

Unit I

FUNCTIONS OF BOUNDED VARIATION: - Introduction - Properties of monotonic functions - Functions of bounded variation - Total variation - Additive property of total variation – Total variation on [a, x] as a function of x - Functions of bounded variation expressed as the difference of two increasing functions - Continuous functions of bounded variation. Infinite Series**:** Absolute and conditional convergence - Dirichlet's test and Abel's test - Rearrangement of series - Riemann's theorem on conditionally convergent series.

Unit II

THE RIEMANN- STIELTJES INTEGRAL: - Introduction - Notation - The definition of the Riemann -Stieltjes integral - Linear Properties - Integration by parts- Change of variable in a Riemann - Stieltjes integral - Reduction to a Riemann Integral – Euler's summation formula - Monotonically increasing integrators, Upper and lower integrals - Additive and linearity properties of upper and lower integrals - Riemann's condition - Comparison theorems.

Unit III

THE RIEMANN STIELTJES INTEGRAL: - Integrators of bounded variation-Sufficient conditions for the existence of Riemann-Stieltjes integrals-Necessary conditions for the existence of Riemann-Stieltjes integrals- Mean value theorems for Riemann - Stieltjes integrals – The integrals as a function of the interval - Second fundamental theorem of integral calculus- Change of variable in a Riemann integral-Second Mean Value Theorem for Riemann integral-Riemann-Stieltjes integrals depending on a parameter-Differentiation under the integral sign-Lebesgue criteriaon for the existence of Riemann integrals.

Unit IV

INFINITE SERIES AND INFINITE PRODUCTS: - Double sequences - Double series – Rearrangement theorem for double series - A sufficient condition for equality of iterated series - Multiplication of series - Cesaro summability - Infinite products. Power series - Multiplication of power series - The Taylor's series generated by a function -Bernstein's theorem - Abel's limit theorem - Tauber's theorem.

Unit V

SEQUENCES OF FUNCTIONS: - Pointwise convergence of sequences of functions - Examples of sequences of real - valued functions - Definition of uniform convergence – Uniform convergence and continuity - The Cauchy condition for uniform convergence – Uniform convergence of infinite series of functions - Uniform convergence and Riemann – Stieltjes integration - Uniform convergence and differentiation - Sufficient condition for uniform convergence of a series - Mean convergence.

Text Book

1. Tom Apostol M., "Mathematical Analysis", 2nd Edition, Addison-Wesley Publishing Company Inc. New York, 1974.

Reference Books

1. Bartle R.G**.,** "Real Analysis", John Wiley and Sons Inc., 1976.
2. Rudin W., "Principles of Mathematical Analysis", 3rd Edition. McGraw Hill Company, New York, 1976.
3. Malik S.C., and Savita Arora, "Mathematical Anslysis", Wiley Eastern Limited.New Delhi, 1991.
4. Sanjay Arora and Bansi Lal, "Introduction to Real Analysis", Satya Prakashan, New Delhi, 1991.
5. Gelbaum B.R. and Olmsted J., "Counter Examples in Analysis", Holden day, SanFrancisco, 1964.

12MA318 ORDINARY DIFFERENTIAL EQUATIONS

Credits: 4:0:0

Course Objective:

- To provide the student with the concept and the understanding in linear equations with constant coefficients and variable coefficients.

Course Outcome:

- Knowledge in ordinary differential equations.

Unit I

LINEAR EQUATIONS WITH CONSTANT COEFFICIENTS: Second order homogeneous equations-Initial value problems-Linear dependence and independence-Wronskian and a formula for Wronskian-Non-homogeneous equation of order two.

Unit II

LINEAR EQUATIONS WITH CONSTANT COEFFICIENTS: Homogeneous and non-homogeneous equation of order n –Initial value problems- Annihilator method to solve non-homogeneous equation- Algebra of constant coefficient operators.

Unit III

LINEAR EQUATIONS WITH VARIABLE COEFFICIENTS: Initial value problems - Existence and uniqueness theorems – Solutions to solve a nonhomogeneous equation – Wronskian and linear dependence – reduction of the order of a homogeneous equation – homogeneous equation with analytic coefficients-The Legendre equation.

Unit IV

LINEAR EQUATIONS WITH REGULAR AND SINGULAR POINTS: Euler equation – Second order equations with regular singular points –Exceptional cases – Bessel Function.

Unit V

EXISTENCE AND UNIQUENESS OF SOLUTIONS TO FIRST ORDER EQUATIONS: Equation with variable separated – Exact equation – method of successive approximations – the Lipschitz condition – convergence of the successive approximations and the existence theorem.

Text Book

1. Coddington E.A., "A Introduction to Ordinary Differential Equations" (3rd Printing), Prentice-Hall of India Ltd.,New Delhi, 1987.

Reference Books

1. Williams Boyce E. and Richard C. DI Prima, "Elementary differential equations and boundary value problems", John Wiley and sons, New York, 1967.
2. George Simmon F., "Differential equations with applications and historical notes", Tata McGraw Hill, New Delhi, 1974.
3. Lebedev N.N., "Special functions and their applications," Prentice Hall of India, New Delhi, 1965.
4. Reid W.T., "Ordinary Differential Equations", John Wiley and Sons, New York, 1971
5. Hartman P., "Ordinary Differential Equations", John Wiley and Sons, New York, 1964.
6. Raisinghania M.D., "Advanced Differential Equations", S.Chand & Company Ltd. New Delhi, 2001
7. Rai B., Choudary D.P. and Freedman H.I., "A Course in Ordinary Differential Equations", Narosa Publishing House, New Delhi, 2002.

12MA319 MECHANICS

Credits: 4:0:0

Course Objective:

- To provide the student with the concept and the understanding in Mechanical systems, Lagrange's equations and Hamilton's equations.

Course Outcome:

- Knowledge in Mechanical systems.

Unit I

MECHANICAL SYSTEMS: The Mechanical system- Generalised coordinates – Constraints - Virtual work - Energy and Momentum.

Unit-II

LAGRANGE'S EQUATIONS: Derivation of Lagrange's equations- Examples- Integrals of motion.

Unit - III

HAMILTON'S EQUATIONS: Hamilton's Principle - Hamilton's Equation - Other variational principle.

Unit – IV

HAMILTON-JACOBI THEORY: Hamilton Principle function – Hamilton-Jacobi Equation – Separability.

Unit-V

CANONICAL TRANSFORMATION: Differential forms and generating functions – Special Transformations– Lagrange and Poisson brackets.

Text Book

1. Greenwood D., "Classical Dynamics", Prentice Hall of India, New Delhi, 1985.

Reference Books

1. Goldstein H., "Classical Mechanics", (2nd Edition) Narosa Publishing House, New Delhi, 2002.
2. Rane N.C. and Joag P.S.C., "Classical Mechanics", Tata McGraw Hill, 1991.
3. Synge J.L. and Griffth B.A., "Principles of Mechanics" (3rd Edition) McGraw Hill Book Co., New York, 1970.

12MA320 ALGEBRA

Credits: 4:0:0

Course Objective:

- To provide the student with the concept and the understanding in Algebra.

Course Outcome:

- Knowledge in Finite Abelian groups and elements of Galois Theory .

Unit I

INTRODUCTION: Another Counting Principle – Class Equations for Finite Groups and its Applications – Sylow's Theorems – Different types of Sylow Theorem proofs.

Unit II

GROUPS: Solvable Groups – Direct Products – Finite Abelian Groups – Modules – Solvability by Radicals.

Unit III
FIELDS: Extension Fields – Roots of Polynomial – More about roots – multiple roots – irreducible Polynomial.

Unit IV
GALOIS THEORY: Elements of Galois Theory- Automorphism- Field of rational functions – Spilitting field – Galois Group.

Unit V
FIELDS AND RINGS: Finite Fields – Wedderburn's theorem on finite division rings.

Text Book

1. I.N. Herstein., "Topics in Algebra" (II Edition), Wiley Eastern Limited, New Delhi, 1975.

Reference Books

1. Artin M., "Algebra", Prentice Hall of India, 1991.
2. Bhattacharya P.B., Jain S.K. and Nagpaul S.R., "Basic Abstract Algebra" (II Edition), Cambridge University Press, 1997. (Indian Edition)
3. Luther I.S. and Passi I.B.S., "Algebra", Vol. I –Groups (1996); Vol. II Rings, Narosa Publishing House , New Delhi, 1999.
4. Malik D.S., Mordeson J.N. and Sen M.K., "Fundamental of Abstract Algebra", McGraw Hill (International Edition), New York. 1997.
5. Jacobson N., "Basic Algebra", Vol. I & II W.H.Freeman (1980); also published by Hindustan Publishing Company, New Delhi.

12MA321 REAL ANALYSIS – II

Credits: 4:0:0

Course Objective:

- To provide the student with the concept and the understanding in Measure on the Real line, Fourier series and Fourier integrals and Multivariable Differential Calculus.

Course Outcome:

- Knowledge in evaluating Fourier integrals and solving extremum problems.

Unit –I
MEASURE ON THE REAL LINE: Lebesgue Outer Measure - Measurable sets - Regularity - Measurable Functions - Borel and Lebesgue Measurability.

Unit - II
INTEGRATION OF FUNCTIONS OF A REAL VARIABLE: Integration of Non- negative functions – The General Integral - Riemann and Lebesgue Integrals.

Unit – III

FOURIER SERIES AND FOURIER INTEGRALS: Introduction - Orthogonal system of functions – The theorem on best approximation - The Fourier series of a function relative to an orthonormal system - Properties of Fourier Coefficients - The Riesz-Fischer Theorem - The convergence and representation problems in for trigonometric series - The Riemann - Lebesgue Lemma - The Dirichlet Integrals - An integral representation for the partial sums of Fourier series - Riemann's localization theorem - Sufficient conditions for convergence of a Fourier series at a particular point - Cesaro summability of Fourier series- Consequences of Fejes's theorem - The Weierstrass approximation theorem.

Unit – IV

MULTIVARIABLE DIFFERENTIAL CALCULUS: Introduction - The Directional derivative - Directional derivative and continuity - The total derivative - The total derivative expressed in terms of partial derivatives - The matrix of linear function - The Jacobian matrix - The chain rule - Matrix form of chain rule - The mean - value theorem for differentiable functions – A sufficient condition for differentiability - A sufficient condition for equality of mixed partial derivatives - Taylor's theorem for functions of R^n to R^1

Unit V

IMPLICIT FUNCTIONS AND EXTREMUM PROBLEMS: FUNCTIONS with non-zero Jacobian determinants – The inverse function theorem-The Implicit function theorem-Extrema of real valued functions of severable variables-Extremum problems with side conditions.

Text Books

1. De Barra G., "Measure Theory and Integration", Wiley Eastern Ltd., New Delhi, 1981.(for Units I and II)
2. Tom Apostol M., "Mathematical Analysis", 2nd Edition, Addison-Wesley Publishing Company Inc. New York, 1974. (for Units III, IV and V)

Reference Books

1. Burkill J.C., "The Lebesgue Integral", Cambridge University Press, 1951.
2. Munroe M.E., "Measure and Integration", Addison-Wesley, Mass.1971.
3. Roydon H.L., "Real Analysis", Macmillan Publishing Company, New York,1988.
4. Rudin W., "Principles of Mathematical Analysis", McGraw Hill Company, NewYork,1979.
5. Malik S.C. and Savita Arora., "Mathematical Analysis", Wiley Eastern Limited.New Delhi, 1991.
6. Sanjay Arora and Bansi Lal., "Introduction to Real Analysis", Satya Prakashan, New Delhi, 1991.

12MA322 PARTIAL DIFFERENTIAL EQUATIONS

Credits: 4:0:0

Course Objective:

- To provide the student with the concept and the understanding in Partial Differential Equations, Laplace and Fourier Transform method.

Course Outcome:

- Knowledge in solving elliptic, parabolic and hyperbolic equations.

Unit I

PARTIAL DIFFERENTIAL EQUATIONS OF FIRST ORDER: Formation and solution of PDE Integral surfaces – Cauchy Problem order equation- Orthogonal surfaces – First order non-linear – Characteristics – Csmpatible system – Charpit method. Fundamentals: Classification and canonical forms of PDE.

Unit II

ELLIPTIC DIFFERENTIAL EQUATIONS: Derivation of Laplace and Poisson equation – BVP – Separation of Variables – Dirichlet's Problem and Newmann Problem for a rectangle – Interior and Exterior Dirichlets's problems for a circle – Interior Newmann problem for a circle – Solution of Laplace equation in Cylindrical and spherical coordinates – Examples.

Unit III

PARABOLIC DIFFERENTIAL EQUATIONS: Formation and solution of Diffusion equation – Dirac-Delta function – Separation of variables method – Solution of Diffusion Equation in Cylindrical and spherical coordinates Examples.

Unit IV

HYPERBOLIC DIFFERENTIAL EQUATIONS: Formation and solution of one-dimensional wave equation – canocical reduction – IVP- d'Alembert's solution – Vibrating string – Forced Vibration – IVP and BVP for two-dimensional wave equation – Periodic solution of one-dimensional wave equation in cylindrical and spherical coordinate systems – vibration of circular membrane – Uniqueness of the solution for the wave equation – Duhamel's Principle – Examples.

Unit V

GREEN'S FUNCTION: Green's function for laplace Equation – methods of Images – Eigen function Method – Green's function for the wave and Diffusion equations.Laplace Transform method: Solution of Diffusion and Wave equation by Laplace Transform. Fourier Transform Method: Finite Fourier sine and cosine franforms – solutions of Diffusion, Wave and Lpalce equations by Fourier Transform Method.

Text Book

1. Sankar Rao S., "Introduction to Partial Differential Equations", 2nd Edition, Prentice Hall of India, New Delhi. 2005

Reference Books

1. McOwen R.C., "Partial Differential Equations" 2nd Edn. Pearson Eduction, New Delhi, 2005.
2. Sneddon I.N., "Elements of Partial Differential Equations", McGraw Hill, New Delhi, 1983.
3. Dennemeyer R., "Introduction to Partial Differential Equations and Boundary Value Problems", McGraw Hill, New York, 1968.
4. Raisinghania M.D., "Advanced Differential Equations", S.Chand & Company Ltd., New Delhi, 2001.

12MA323 FLUID DYNAMICS

Credits: 4:0:0

Course Objective:

- To provide the student with the concept and the understanding in Kinematics of fluids in motion, two and three dimensional flows.

Course Outcome:

- Knowledge in equations of motion of a fluid and viscous flows.

Unit I

KINEMATICS OF FLUIDS IN MOTION: Real fluids and Ideal fluids- Velocity of a fluid at a point, Stream lines , path lines , steady and unsteady flows- Velocity potential - The vorticity vector- Local and particle rates of changes - Equations of continuity - Worked examples - Acceleration of a fluid – Conditions at a rigid boundary.

Unit II

EQUATIONS OF MOTION OF A FLUID: Pressure at a point in a fluid at rest.- Pressure at a point in a moving fluid - Conditions at a boundary of two invircid immiscible fluids- Euler's equation of motion - Discussion of the case of steady motion under conservative body forces.

Unit III

SOME THREE DIMENSIONAL FLOWS: Introduction- Sources, ranks and doublets - Images in a rigid infinite plane - Axis symmetric flows – stokes stream function.

Unite IV

SOME TWO DIMENSIONAL FLOWS: Meaning of two dimensional flows - Use of Cylindrical polar coordinate - The stream function - The complex potential for two dimensional, irrigational in compressible flow - Complex velocity potentials for standard two dimensional flows - Some worked examples - Two dimensional Image systems - The Milne Thompsan circle Theorem.

Unit V

VISCOUS FLOWS: Stress components in a real fluid. - Relations between Cartesian components of stress- Translational motion of fluid elements - The rate of strain quadric and principle stresses - Some further properties of the rate of strain quadric - Stress analysis in fluid motion - Relation between stress and rate of strain- The coefficient of viscosity and Laminar flow - The Navier – Stokes equations of motion of a Viscous fluid.

Text Book

1. Chorlton F., "Text Book of Fluid Dynamics" ,CBS Publications. Delhi ,1985.

Reference Books

1. Milne Thomson., "Theoretical Hydrodynamics" Macmillan, 1949.
2. DE Rutherford., "Fluid Dynamics", Oliver & Boyd, 1959.

12MA324 TENSOR ANALYSIS AND SPECIAL THEORY OF RELATIVITY

Credits: 4:0:0

Course Objective:

- To provide the student with the concept and the understanding in Tensor algebra, Tensor calculus and Special theory of relativity.

Course Outcome:

- Knowledge in relativistic dynamics.

Unit I

TENSOR ALGEBRA: Systems of Different orders – Summation Convention – Kronecker Symbols – Transformation of coordinates in Sn – Invariants – Covariant and Contra variant vectors – Tensors of Second Order – Mixed Tensors – Zero Tensor – Tensor Field – Algebra of Tensors – Equality of Tensors – Symmetric and Skew-symmetric tensors – Outer multiplication, Contraction and Inner Multiplication – Quotient Law of Tensors – Reciprocal Tensor of Tensor – Relative Tensor – Cross Product of Vectors.

Unit II

TENSOR CALCULUS: Riemannian Space – Christoffel Symbols and their properties

Unit III

TENSOR CALCULUS(CONTD): Covariant Differentiation of Tensors – Riemann-Christoffel Curvature Tensor – Intrinsic Differentiation.

Unit-IV

SPECIAL THEORY OF RELATIVITY: Galilean Transformation – Maxwell's equations – The ether Theory – The Principle of Relativity

Relativistic Kinamatics : Lorentz Transformation equations – Events and simultaneity – Example – Einstein Train – Time dilation – Longitudinal Contraction – Invariant Interval – Proper time and Proper distance – World line – Example – twin paradox – addition of velocities – Relativistic Doppler effect.

Unit-V

RELATIVISTIC DYNAMICS : Momentum – Energy – Momentum-energy four vector – Force – Conservation of Energy – Mass and energy – Example – inelastic collision – Principle of equivalence – Lagrangian and Hamiltonian formulations. Accelerated Systems: Rocket with constant acceleration – example – Rocket with constant thrust.

Text Books

1. De Absos Ali Shaikh U.C. and Joydeep Sengupta, "Tensor Calculus", arosa Publishing House, New Delhi, 2004.
2. Greenwood D., "Classical Dynamics", Prentice Hall of India, New Delhi, 1985.

Reference Books

1. Chaki M.C., “A Text Book of Tensor Calculus”, Calcutta Publishers, 2000.
2. Spain B., “Tensor Calculus”, Radha Publishing House, Kolkatta(3rd Edn), 1995.
3. Sokolnikoff I.S., “Tensor Analysis”, John Wiley and Sons, Inc. 1964.

12MA325 COMPLEX ANALYSIS – I

Credits: 4:0:0

Course Objectives:
- To provide the student with the concept and the understanding in Cauchy’s theorem, partial fractions and entire functions.

Course Outcome:
- Knowledge in evaluation of Definite Integrals and Harmonic Functions.

Unit I
CAUCHY’S INTEGRAL FORMULA: The Index of a point with respect to a closed curve – The Integral formula – Higher derivatives. Local Properties of analytical Functions: Removable Singularities-Taylors’s Theorem – Zeros and poles – The local Mapping – The Maximum Principle.

Unit II
THE GENRAL FORM OF CAUCHY’S THEOREM: Chains and cycles- Simple Continuity - Homology - The General statement of Cauchy’s Theorem - Proof of Cauchy’s theorem - Locally exact differentials- Multiply connected regions - Residue theorem - The argument principle.

Unit III
EVALUATION OF DEFINITE INTEGRALS AND HARMONIC FUNCTIONS: Evaluation of definite integrals - Definition of Harmonic function and basic properties - Mean value property - Poisson formula.

Unit IV
HARMONIC FUNCTIONS AND POWER SERIES EXPANSIONS: Schwarz theorem - The reflection principle - Weierstrass theorem – Taylor’s Series – Laurent series .

Unit V
PARTIAL FRACTIONS AND ENTIRE FUNCTIONS
Partial fractions - Infinite products – Canonical products – Gamma Function- Jensen’s formula – Hadamard’s Theorem.

Text Book

1. Lars Ahlfors V., "Complex Analysis", (3rd edition) McGraw Hill Co., New York, 1979.

Reference Books

1. Presfly H.A., "Introduction to complex Analysis", Clarendon Press, oxford, 1990.
2. Conway J.B., "Functions of one complex variables", Springer Verlag, International student Edition, Narose Publishing Company, 1989.
3. Hille E., "Analytic function Thorey" (2 vols.), Gonm & Co, 1959.
4. Heins M., "Complex function Theory", Academic Press, New York, 1968.

12MA326 PROBABILITY THEORY

Credits: 4:0:0

Course Objective:

- To provide the student with the concept and the understanding in Random Events , Random Variables, characteristic functions and probability distributions.

Course Outcome:

- Knowledge in the technique and applications of probability theory.

Unit I

RANDOM EVENTS AND RANDOM VARIABLES: Random events – Probability axioms – Combinatorial formulae – conditional probability – Bayes Theorem – Independent events – Random Variables – Distribution Function – Joint Distribution – Marginal Distribution – Conditional Distribution – Independent random variables – Functions of random variables.

Unit II

PARAMETERS OF THE DISTRIBUTION: Expectation- Moments – The Chebyshev Inequality – Absolute moments – Order parameters – Moments of random vectors – Regression of the first and second types.

Unit III

CHARACTERISTIC FUNCTIONS: Properties of characteristic functions – Characteristic functions and moments – semi invariants – characteristic function of the sum of the independent random variables – Determination of distribution function by the Characteristic function – Characteristic function of multidimensional random vectors – Probability generating functions.

Unit IV

SOME PROBABILITY DISTRIBUTIONS: One point , two point , Binomial – Polya – Hyper geometric – Poisson (discrete) distributions – Uniform – normal gamma – Beta – Cauchy and Laplace (continuous) distributions.

Unit V

LIMIT THEOREMS: Stochastic convergence – Bernaulli law of large numbers – Convergence of sequence of distribution functions – Levy-Cramer Theorems – DeMoivre-Laplace Theorem – Poisson, Chebyshev, Khintchine Weak law of large numbers – Lindberg Theorem – Lapunov Theroem – Borel-Cantelli Lemma - Kolmogorov Inequality and Kolmogorov Strong Law of large numbers.

Text Book

1. Fisz M., "Probability Theory and Mathematical Statistics", John Wiley and Sons, New York, 1963.

Reference Books

1. Ash R.B., "Real Analysis and Probability", Academic Press, New York, 1972
2. Chung K.L., "A course in Probability", Academic Press, New York, 1974.
3. Chow Y.S. and Teicher H., "Probability Theory", Springer Verlag. Berlin, 1988. (2ndEdition)
4. Durrett R., "Probability: Theory and Examples", (2nd Edition) Duxbury Press, NewYork, 1996.
5. Rohatgi V.K., "An Introduction to Probability Theory and Mathematical Statistics", Wiley Eastern Ltd., New Delhi, 1988(3rd Print).
6. Resnick S.I., "A Probability Path", Birhauser, Berlin, 1999.
7. Bhat B.R., "Modern Probability Theory" (3rd Edition), New Age International (P) Ltd, New Delhi, 1999.
8. Romano J.P., and Siegel A.F., "Counter Examples in Probability and Statistics",Wadsworth and Brooks / Cole Advanced Books and Software, California, 1968.

12MA327 FUNCTIONAL ANALYSIS

Credits: 4:0:0

Course Objective:

- To provide the student with the concept and the understanding in Banach spaces, Hilbert space and Banach Algebras.

Course Outcome:

- Knowledge in Banach spaces and commutative Banach Algebras.

Unit I

BANACH SPACES: Definition – Some examples – Continuous Linear Transformations – The Hahn-Banach Theorem – The natural embedding of N in N**.

Unit II

BANACH SPACES AND HILBERT SPACES: Open mapping theorem – conjugate of an operator – Definition and some simple properties – Orthogonal complements – Orthonormal sets.

Unit III

HILBERT SPACE: Conjugate space H* - Adjoint of an operator – Self-adjoint operator – Normal and Unitary Operators – Projections.

Unit IV

PRELIMINARIES ON BANACH ALGEBRAS: Definition and some examples – Regular and single elements – Topological divisors of zero – spectrum – the formula for the spectral radius – the radical and semi-simplicity.

Unit V

STRUCTURE OF COMMUTATIVE BANACH ALGEBRAS:Gelfand mapping – Applications of the formula r(x) = lim 7 xn 71/n - Involutions in Banach Algebras – Gelfand-Neumark Theorem.

Text Book

1. Simmons G.F., "Introduction to Topology and Modern Analysis", Tata McGraw Hill International Book Company, New York, 1963.

Reference Books

1. Rudin W. "Functional Analysis", Tata McGraw-Hill Publishing Company, New Delhi, 1973.
2. Bachman G. and Narici L., "Functional Analysis", Academic Press, New York, 1966.
3. Goffman H.C. and Fedrick G, "First course in Functional Analysis", Prentice Hall of India, New Delhi, 1987.
4. Kreyszig E., "Introductory Functional Analysis with Applications", John Wiley & Sons, New York, 1978.

12MA328 TOPOLOGY

Credits: 4:0:0

Course Objective:

- To provide the student with the concept and the understanding in topological spaces and compact spaces.

Course Outcome:

- Knowledge in continuous functions, connectedness and compactness.

Unit 1

TOPOLOGICAL SPACES: Topological spaces – Basis for a topology – The order topology – The product topology on X ×Y – The subspace topology – Closed sets and limit points.

Unit II

CONTINUOUS FUNCTIONS: Continuous functions – the product topology – The metric topology.

Unit III

CONNECTEDNESS: Connected spaces- connected subspaces of the Real line – Components and local connectedness.

Unit IV
COMPACTNESS: Compact spaces – compact subspaces of the Real line – Limit Point Compactness – Local Compactness.

Unit V
COUNTABILITY AND SEPARATION AXIOM: The Countability Axioms – The separation Axioms – Normal spaces – The Urysohn Lemma – The Urysohn metrization Theorem – The Tietz extension theorem.

Text Book

1. James R. Munkres, Topology (2nd Edition) Pearson Education Pve. Ltd., Delhi, 2002. (Third Indian Reprint).

Reference Books

1. Dugundji J., "Topology" , Prentice Hall of India, New Delhi, 1975.
2. George Sinmons F., "Introduction to Topology and Modern Analysis", McGraw Hill Book Co., 1963.
3. Steen L. and Subhash J., "Counter Examples in Topology", Holt, Rinehart and Winston, New York, 1970.
4. Willard, S., "General Topology", Addison - Wesley, Mass., 1970.

12MA329 COMPLEX ANALYSIS- II

Credits: 4:0:0

Course Objective:

- To provide the student with the concept and the understanding in equicontinuity, elliptic functions and analytic continuation.

Course Outcome:

- Knowledge in Riemann mapping theorem and Weirstrass theorem.

Unit I
RIEMANN ZETA FUNCTION AND NORMAL FAMILIES: Product development – Extension of $\zeta(s)$ to the whole plane – The zeros of zeta function – Equicontinuity – Normality and compactness – Arzela's theorem – Families of analytic functions – The Classcial Definition.

Unit II
RIEMANN MAPPING THEOREM: STATEMENT and Proof – Boundary Behavior – Use of the Reflection Principle. Conformal mappings of polygons: Behavior at an angle – Schwarz-Christoffel formula – Mapping on a rectangle. Harmonic Functions: Functions with mean value property – Harnack's principle.

Unit III
ELLIPTIC FUNCTIONS: Simply periodic functions – Doubly periodic functions.

Unit IV
WEIERSTRASS THEORY: The Weierstrass $\wp$-function – The functions $\zeta(s)$ and $\sigma(s)$ – The differential equation – The modular equation $\lambda(\tau)$ – The Conformal mapping by $\lambda(\tau)$.

Unit V
ANALYTIC CONTINUATION: The Weiertrass Theory – Germs and Sheaves – Sections and Riemann surfaces – Analytic continuation along Arcs – Homotopic curves – The Monodromy Theorem – Branch points.

Text Book

1. Lars Ahlfors F., "Complex Analysis", (3rd Edition) McGraw Hill Book Company, New York, 1979.

Reference Books

1. Presfly H.A., "Introduction to complex Analysis", Clarendon Press, oxford, 1990.
2. Conway J.B., "Functions of one complex variables", Springer - Verlag, International student Edition, Naroser Publishing Co., 1989.
3. Hille E., "Analytic function Theory", (2 vols.), Gonm & Co, 1959.
4. Heins M., "Complex function Theory", Academic Press, New York, 1968

12MA330 DIFFERENTIAL GEOMETRY

Credits: 4:0:0

Course Objective:
- To provide the student with the concept and the understanding in Space curves, Geodesics, Intrinsic and Non-Intrinsic properties of a surfaces.

Course Outcome:
- Knowledge in Differential Geometry of surfaces.

Unit I
SPACE CURVES: Definition of a space curve – Arc length – tangent – normal and binomial – curvature and torsion – contact between curves and surfaces- tangent surface- involutes and evolutes- Intrinsic equations – Fundamental Existence Theorem for space curves- Helies.

Unit II
INTRINSIC PROPERTIES OF A SURFACE: Definition of a surface – curves on a surface – Surface of revolution – Helicoids – Metric- Direction coefficients – families of curves- Isometric correspondence- Intrinsic properties.

Unit III

GEODESICS: Geodesics – Canonical geodesic equations – Normal property of geodesics- Existence Theorems – Geodesic parallels – Geodesics curvature- Gauss- Bonnet Theorem – Gaussian curvature- surface of constant curvature.

Unit IV

NON INTRINSIC PROPERTIES OF A SURFACE: The second fundamental form- Principle curvature – Lines of curvature – Developable - Developable associated with space curves and with curves on surface - Minimal surfaces – Ruled surfaces.

Unit V

DIFFERENTIAL GEOMETRY OF SURFACES: Compact surfaces whose points are umblics- Hilbert's lemma – Compact surface of constant curvature – Complete surface and their characterization – Hilbert's Theorem – Conjugate points on geodesics.

Text book

1. Willmore T.J., "An Introduction to Differential Geometry", Oxford University Press,(17thImpression) New Delhi 2002. (Indian Print).

Reference books

1. Struik D.T., "Lectures on Classical Differential Geometry", Addison – Wesley, Mass.1950.
2. Kobayashi S. and Nomizu K., "Foundations of Differential Geometry", Interscience Publishers, 1963.
3. Wilhelm Klingenberg, "A course in Differential Geometry", Graduate Texts in Mathematics, Springer-Verlag 1978.
4. Thorpe J.A., "Elementary topics in Differential Geometry", under - graduate Texts in Mathematics, Springer - Verlag 1979.

12MA331 MATHEMATICAL STATISTICS

Credits: 4:0:0

Course Objective:

- To provide the student with the concept and the understanding in significance test, estimation, analysis of variance.

Course Outcome:

- Knowledge in technique and methodology of Statistics.

Unit I

SAMPLE MOMENTS AND THEIR FUNCTIONS: Notion of a sample and a statistic – Distribution functions of X , S^2 and (X , S^2) - χ^2distribution – Student t-distribution – Fisher's Z-distribution – Snedecor's F- distribution – Distribution of sample mean from non-normal populations.

Unit II

SIGNIFICANCE TEST: Concept of a statistical test – Parametric tests for small samples and large samples - χ^2 test – Kolmogorov Theorem– Smirnov Theorem – Tests of Kolmogorov and Smirnov type – The Wald-Wolfovitz and Wilcoxon-Mann-Whitney tests – Independence Tests by contingency tables.

Unit III

ESTIMATION: Preliminary notion – Consistency estimation – Unbiased estimates – Sufficiency – Efficiency – Asymptotically most efficient estimates – methods of finding estimates – confidence Interval.

Unit IV

ANALYSIS OF VARIANCE: One way classification and two-way classification.

Hypotheses Testing: Poser functions – OC function- Most Powerful test – Uniformly most powerful test – unbiased test.

Unit V

SEQUENTIAL ANALYSIS: SPRT – Auxiliary Theorem – Wald's fundamental identity – OC function and SPRT – E(n) and Determination of A and B – Testing a hypothesis concerning p on 0-1 distribution and m in Normal distribution.

Text Book

1. Fisz M., "Probability Theory and Mathematical Statistics", John Wiley and sons, New Your, 1963.

Reference Books

1 Dudewicz E.J. and Mishra S.N., "Modern Mathematical Statistics", John Wiley and Sons, New York, 1988.

2 Rohatgi V.K., "An Introduction to Probability Theory and Mathematical Statistics", Wiley Eastern Ltd., New Delhi, 1988(3rd Print).

3 Roussas G.G., "A First Course in Mathematical Statistics", Addison Wesley Publishing Company, 1973.

4 Vander Waerden B.L., "Mathematical Statistics", G.Allen & Unwin Ltd., London, 1968.

12MA332 FUZZY SETS AND THEIR APPLICATIONS

Credits: 4:0:0

Course Objective:

- To provide the student with the concept and the understanding in fuzzy graphs, relations and logic.

Course Outcome:

- Knowledge in fuzzy sets and their applications.

Unit I

CRISP TO FUZZY: Introduction – crisp sets – fuzzy sets: basic types and concepts – characteristics and significance of the paradigm shift – Additional properties of α – cuts – representation of fuzzy sets – Extension principle for fuzzy sets.

Unit II
OPERATIONS ON FUZZY SETS: Types of operations – fuzzy complements - fuzzy intersections: t-norms – Fuzzy Uniforms: t- conforms – combinations of operations – aggregation operations

Unit III
FUZZY ARITHMETIC: Fuzzy numbers – Linguistics variables – arithmetic operation on intervals – arithmetic operation on fuzzy numbers – fuzzy equations.

Unit IV
FUZZY RELATIONS: Crisp versus fuzzy relations – projections and cylindrical extensions – binary fuzzy relations on a single sets – fuzzy equivalence relations – fuzzy combatively relations fuzzy ordering relations – fuzzy morphism – sup w_i compositions of fuzzy relations – inf w_i compositions of fuzzy relations
Unit V
FUZZY RELATION EQUATIONS AND APPLICATIONS: General discussion of fuzzy relation equations – problem portioning – solution method – fuzzy relation equations base on sup-w_i compositions – fuzzy relation equations based in inf-w_i compositions – approximate solutions. The uses of Neural Networks.
Text Book

1. George Klir J. and Bo Yuan, "Fuzzy sets and Fuzzy Logi Theory and Applications", Prentice Hall India, New Delhi, 2005.

Reference Books
1. Kaufman A., "Introduction to the theory of Fuzzy subsets", Vol.I, Academic Press, New York, 1975.
2. Zimmermann H.J., "Fuzzy Set Theory and its Applications", Allied Publishers, Chennai, 1996.

12MA333 NUMBER THEORY AND CRYPTOGRAPHY
Credits: 4:0:0

Course Objective:
- To provide the student with the concept and the understanding in classical crypto systems and quadratic residues.

Course Outcome:
- Knowledge in public key cryptography, factoring and elliptic curves.

Unit I

BASIC NUMBER THEORY: Elementary Number Theory – Time Estimates for doing arithmetic – divisibility and Euclidean algorithm – Congruence's – Application to factoring.

Unit II
CLASSICAL CRYPTO SYSTEMS: Introduction to Classical Crypto systems – Some simple crypto systems – Enciphering matrices DES.

Unit III
APPLICATIONS OF NUMER THEORY: Finite Fields and quadratic Residues – Reciprocity.

Unit IV
CRYPTOGRAPHY: Introduction- Public Key Cryptography- Applications.

Unit V
ELLIPTIC CURVES: Introduction-Primarily - Factoring and Elliptic Curves.

Text book

1. Neal Koblitz., "A Course in Number Theory and cryptography", Springer-Verlag, New York, 1987.

Reference Books

1. Niven and Zuckermann., "An Introduction to Theory of Number"s (Edn. 3), Wiley Eastern Ltd., New Delhi, 1976.
2. David Burton M., "Elementary Number Theory", Wm C.Brown Publishers, Dubuque, Iowa, 1989.
3. Ireland K. and Rosen M., "A Classical Introduction to Modern Number Theory", Springer Verlag, 1972.

12MA334 FORMAL LANGUAGES AND AUTOMATA THEORY

Credits: 4:0:0

Course Objective:

- To provide the student with the concept and the understanding in regular sets and context –free grammars.

Course Outcome:

- Knowledge in pushdown automat and context-free languages.

Unit I
FINITE AUTOMATA, REGULAR EXPRESSIONS AND REGULAR GRAMMARS: Finite state systems – Basic definitions – Nondeterministic finite automata – Finite automata with ε-moves – Regular expressions – Regular grammars.

Unit II
PROPERTIES OF REGULAR SETS: The Pumping lemma for regular sets – Closure properties of regular sets – Decision algorithms for regular sets – The Myhill-Nerode Theorem and minimization of finite automata.

Unit III
CONTEXT-FREE GRAMMARS: Motivation and introduction – Context-free grammars – Derivation trees- Simplification of context-free grammars – Chomsky normal form – Greibach normal form.

Unit IV
PUSHDOWN AUTOMATA: Informal description- Definitions-Pushdown automata and context-free languages – Normalforms for deterministic pushdown automat.

Unit V
PROPERTIES OF CONTEXT-FREE LANGUAGES: The pumping lemma for CFL's – Closure properties for CFL's – Decision algorithms for CFL's.

Text book
1. John Hopcraft E. and Jeffrey Ullman D., "Introduction to Automata Theory Languages and Computation", Narosa Publishing House, New Delhi, 1987.

Reference Books
1. Salomaa A., "Formal Languages", Academic Press, New York, 1973.
2. John Martin C., "Introduction to Languages and theory of Computations" (2nd Edition) Tata-McGraw Hill Company Ltd., New Delhi, 1997.

12MA335 PROGRAMMING IN C++ AND NUMERICAL METHODS

Credits: 4:0:0

Course Objective:
- To provide the student with the concept and the understanding in programming in C++ and Curve Fitting.

Course Outcome:
- Knowledge in Pointers – Virtual Functions and Polymorphism.

Unit I
TOKENS, EXPRESSIONS, CONTROL STRUCTURES AND FUNCTIONS IN C++: Introduction – Tokens – Keywords – Identifiers and constants – Basic data types – User-Defined data types – Derived data types – Symbolic constants – Type compatibility – Declaration of variables – Dynamic initialization of variables – Reference variables – Operators in C++ - Scope resolution operator – Member deferencing operators – memory management operators – Manipulators – Type cast Operator – Expressions and their types – Special Assignment expressions – implicit conversions – Operator precedence – Control structures. Introduction: The

Main Function- Function Prototyping- Call by Reference- Return by Reference-Inline Functions- Default Arguments-Const Arguments-Function Overloading-Friend and Virtual Functions- Math Library Functions.

Unit II

CLASSES AND OBJECTS: Introduction-C Structure Revisited- Specifying a Class-Defining Member Functions-A C++ Program with Class- Making an Outside Function Inline-Nesting of Member Functions- Private Member Functions- Arrays within a Class-Memory Allocations for Objects- Static Data Members- Static Member Functions- Arrays of Objects- Objects as Function Arguments- Friendly Functions-Returning Objects-const Member Functions- Pointers to Members- Local Classes-Constructors and Destructors: Introduction-Constructors-Parameterized Constructors- Multiple Constructors in a Class- Constructors with Default Arguments- Dynamic Initialization of Objects-Copy Constructor-Dynamic Constructors-Constructing Two-Dimensional Arrays- const Objects- Destructors-Operator Overloading and Type Conversions: Introduction- Defining Operator Overloading- Overloading Binary Operators-Overloading Binary Operators Using Friends- Manipulation of Strings Using Operators- Rules for Overloading Operators- Type Conversions.

Unit III

INHERITANCE: EXTENDING CLASSES: Introduction- Defining Derived Classes- Single Inheritance- Making a Private Member Inheritable- Multilevel Inheritance-Hierarchical Inheritance-Hybrid Inheritance- Virtual Base Classes-Abstract Classes-Constructors in Derived Classes- Member Classes: Nesting of Classes-Pointers, Virtual Functions and Polymorphism: Introduction-Pointers to Objects-this Pointer-Pointer to Derived Classes-Virtual Functions- Pure Virtual Functions.

Unit IV

NUMERICAL SOLUTIONS: The solution of Numerical and Transcendental Equations f(x)=0 – Bisection Method – Newton-Raphson Method – Interpolation – Lagrangian Polynomials – Divided Difference – Newton forward and backward difference formulae.

Unit V

SOLUTION OF DIFFERENTIAL EQUATIONS: Taylor series and methods – Euler and Modified Euler methods – Fourth order Runge-Kutta method for solving first and second order equations – Milne's and Adam's predictor and corrector methods.

Text book

1. Balagurusamy E., "Object Oriented Programming with C++", Tata McGraw-Hill Publishing Company Ltd, New Delhi, 2003.
2. Kandasamy P, Thilagavathy K and Gunavathy K., "Numerical Methods", S.Chand & Company Ltd, New Delhi, 2010.

Reference Book

1. John Mathews H., "Numerical Methods for Mathematics", Science and Engineering, (2nd Edn.) Prentice Hall, New Delhi, 2000.

2. Venkataraman M.K., “Numerical Methods”, National Publishing Company, Reprint 2005

12MA336 DISCRETE MATHEMATICS

Credits: 4:0:0

Course Objective:

- To provide the student with the concept and the understanding in lattices, polynomials and finite fields.

Course Outcome:

- Knowledge in applications of lattices.

Unit I

LATTICE: Properties of Lattices: Lattice definitions – Modular and distributive lattice; Boolean algebras: Basic properties – Boolean polynomials, Ideals; Minimal forms of Boolean polynomials.

Unit II

APPLICATIONS: Switching Circuits: Basic Definitions-switching- Switching functions- Series connections- switching circuits- parallel connections– Applications-Half Adders, full adders.

Unit III

FIELD THEORY: Finite Fields-Quotient Fields-Extension fields-Kroneckers Theorem – Transcendental Extension – Galois Field.

Unit IV

POLYNOMIALS: Irreducible Polynomials over Finite fields-Order of the Field – Primitive Polynomial – irreducible polynomial – Factorization of Polynomials – Chinese Reminder Theorem.

Unit V

CODING THEORY: Linear Codes – Basic Definitions – Parity check matrix – Systematic linear (n,k) codes – Repetition code - Cyclic Codes - Code polynomial – Decoding Algorithm – Mattson-Solomon Polynomial- Spectrum.

Text Books

1. Rudolf Lidl and Gunter Pilz, “Applied Abstract Algebra”, Spinger-Verlag, New York, 1984.

Reference Books

1. Gil A., “Applied Algebra for Computer Science”, Prentice Hall Inc., New Jersey, 1976
2. Gersting J.L., “Mathematical Structures for Computer Science”(3rd Edn.), Computer Science Press, New York, 2006.
3. Wiitala S, “Discrete Mathematics a Unified Approach”, McGraw Hill Book Co., 2010.

12MA337 GRAPH THEORY

Credits: 4:0:0

Course Objective:

- To provide the student with the concept and the understanding in graphs, Hamilton cycles and chromatic number.

Course Outcome:

- Knowledge in Trees, Vertex Colorings and Plane and planar Graphs.

Unit I

GRAPHS, SUBGRAPHS AND TREES: Graphs and simple graphs – Graph Isomorphism – The Incidence and Adjacency Matrices – Sub graphs – Vertex Degrees – Paths and Connection – Cycles – Trees – Cut Edges and Bonds – Cut Vertices.

Unit II

CONNECTIVITY, EULER TOURS AND HAMILTON CYCLES: CONNECTIVITY – Blocks – Euler tours –Hamilton Cycles.

Unit III

MATCHINGS, EDGE COLOURINGS: Matchings – Matchings and Coverings in Bipartite Graphs –Edge Chromatic Number – Vizing's Theorem.

Unit IV

INDEPENDENT SETS AND CLIQUES, VERTEX COLOURINGS: Independent sets – Ramsey's Theorem –Chromatic Number – Brooks' Theorem – Chromatic Polynomials.

Unit V

PLANAR GRAPHS: PLANE and planar Graphs – Dual graphs – Euler's Formula – The Five-Colour Theorem and the Four-Colour Conjecture.

Text Book

1. Bondy J.A. and Murthy U.S.R., "Graph Theory and Applications", Macmillan, London, 1976.

Reference Books

1. Clark J. and Holton D.A., "A First look at Graph Theory", Allied Publishers, New Delhi, 1995.
2. Gould R., "Graph Theory", Benjamin/Cummings, Menlo Park, 1989.
3. Gibbon A.S, "Algorithmic Graph Theory", Cambridge University Press, Cambridge, 1989.
4. Wilson R.J. and Watkins J.J., "Graphs an Introductory Approach", John Wiley and Sons, New York, 1989.
5. Choudum S.A., "A First Course in Graph Theory", MacMillan India Ltd. 1987.

12MA338 JAVA PROGRAMMING

Credits: 4:0:0

Course Objective:

- To provide the student with the concept and the understanding in Java statements, arrays and multithreaded programming.

Course Outcome:

- Knowledge in operators and Applet Programming

Unit I
BASICS IN JAVA: Java Tokens – Java statements – Constants – Variables – Data types

Unit II
DECISION AND BRANCHING: Operators – Expressions – Decision making and branching.

Unit III
INHERITANCE: Classes – Objects – Methods – Arrays – Strings – Vectors – Multiple Inheritances.

Unit IV
ERRORS AND EXCEPTIONS: Multithreaded Programming – Managing errors and Exceptions.

Unit V
SPECIAL PROGRAMMING: Applet Programming - Introduction-How Applets Differ from Applications- Preparing to Write Applets- Building Applet Code- Applet Life Cycle- Creating an Executive Applet- Designing a Web Page- Applet Tag- Adding Applet to HTML File- Running the Applet- More About Applet Tag- Passing Parameters to Applets- Aligning the Display- More About HTML Tags- Displaying Numerical Values- Getting Input from the User.

Text Book

1. Balagurusamy E., “Programming with Java a primer”, Tata McGraw Hill Publishing Company Limited, New Delhi, 1998.

Reference Books

1. Mitchell Waite and Robert Lafore, “Data Structures and Algorithms in Java”, Techmedia (Indian Edition), New Delhi, 1999.
2. Adam Drozdek, “Data Structures and Algorithms in Java”, (Brown/Cole), Vikas Publishing House, New Delhi, 2001.

12MA339 DATA STRUCTURES AND ALGORITHMS

Credits: 4:0:0

Course Objective:

- To provide the student with the concept and the understanding in Data Structures and Algorithms.

Course Outcome:

- Knowledge in Data Structures and Algorithms.

Unit I
ALGORITHMS AND ELEMENTARY DATA STRUCTURES: Algorithms – Structured programs – Analysis of algorithms - Stacks and Queues – Trees – Heaps and Heapsort – Sets and disjoint set union – Graphs – Hashing.

Unit II
THE DIVIDE AND CONQUER METHOD: The general method – Binary search – Finding the maximum and minimum – Merge sort – Quicksort – Selection sort – Strassen's matrix multiplication.

Unit III
THE GREEDY METHOD: The General method – Optimal storage on tapes – Knapsack problem – Job scheduling with deadlines – Optimal merge pattern – Minimum spanning trees – Single source shortest paths.

Unit IV
BACKTRACKING : The general methods – The 8-queens problem – sum of subsets – Graph coloring – Hamiltonian Cycles – Knapsack problem.

Unit V
BRANCH-AND-BOUND AND NP-HARD AND NP-COMPLETE PROBLEMS: Branch and Bound Method – 0/1 knapsack problem – Traveling salesperson – Efficiency Considerations- Basic concepts of NP-Hard problems – Cook's theorem- NP-Hard graph problems – NP-Hard Scheduling Problems.

Text Book

1. Alfred Aho V., John Hopcrof E. T and Ullman J.D., "Data Structures and Algorithms", Pearson Education, 1999.

Reference Book

1. Tanenbaum S., Langsam Y. and Augenstein M.J., "Data Structures Using C and C++", Second Edition, PHI/ Pearson Education, 1996.

12MA340 OPERATIONS RESEARCH

Credits: 4:0:0

Course Objective:

- To provide the student with the concept and the understanding in Markovian Decision Process and Inventory Theory.

Course Outcome:

- Knowledge in Network Analysis and Queuing Theory.

Unit I

DECISION THEORY: Decision Environments - Decision making under certainty - Decision making under risk -Decision making under uncertainty. Markovian Decision Process Scope of the Markovian Decision Problem - Gardner example - Finite stage Dynamic Programming model - Infinite stage model - Linear Programming solution.

Unit II

DETERMINISTIC AND PROBABILISTIC DYNAMIC PROGRAMMING: Recursive nature of computations in DP – Selected DP Applications – Problem of Dimensionality – A Game of chance - Investment Problem – Maximization of the event of Achieving a Goal.

Unit III

NETWORK ANALYSIS: Network Definitions - Minimal spanning tree algorithm - Shortest route Problem – Maximum flow Model - Minimum cost capacitated flow problem - Linear Programming formulation - Network Simplex method – CPM and PERT.

Unit IV

INVENTORY THEORY: Basic Elements of an Inventory model - Deterministic models of the following types: Single item static model with and without price breaks - Multiple item static model with storage limitation. Probabilistic Models: Continuous Review model - Single period models.

Unit V

QUEUEING THEORY: Basic elements of a queuing model - Role of Poisson and Exponential distributions – Pure Birth and Death models – Specialized Poisson Queues – M/G/1 queue - Pollaczek - Khintchine formula.

Text Book

1. Hamdy Taha A., "Operations Research ", Prentice - Hall of India Private Limited, New Delhi, 2001.

Reference Books

1. Hiller F.S. and Lieberman J., "Introduction to Operations Research" (7th Edition), Tata McGraw Hill Publishing Company, New Delhi, 2001.
2. Beightler C., Phillips D., Wilde B., "Foundations of Optimization" (2nd Edition),Prentice Hall Pvt Ltd., New York, 1979.
3. Bazaraa M.S., Jarvis J.J., Sharall H.D., "Linear Programming and Network flow", John Wiley and sons, New York 1990.
4. Gross D and Harris C.M., "Fundamentals of Queueing Theory", (3rd Edition), Wiley and Sons, New York, 1998.

12MA341 FINANCIAL MATHEMATICS

Credits: 4:0:0

Course Objective:

- To provide the student with the concept and the understanding in Binomial Trees and Stochastic Calculus.

Course Outcome:

- Knowledge in Brownian Motion and Block-Scholes model.

Unit I

SINGLE PERIOD MODELS: Definitions from Finance – Pricing a forward – One-step Binary Model – a ternary Model –Characterization of no arbitrage – Risk-Neutral Probability Measure.

Unit II

BINOMIAL TREES AND DISCRETE PARAMETER MARTINGALES: Multi-period Binary model – American Options – Discrete parameter martingales and Markov processes – Martingale Theorems – Binomial Representation Theorem – Overture to Continuous models.

Unit III

BROWNIAN MOTION: Definition of the process – Levy's Construction of Brownian motion – The Reflection Principle and Scaling – Martingales in Continuous time.

Unit IV

STOCHASTIC CALCULUS: Stock Prices are not differentiable – Stochastic Integration – Ito's formula – Integration by parts and Stochastic Fubini Theorem – Girsanov Theorem – Brownian Martingale Representation Theorem – Geometric Brownian Motion – The Feynman – Kac Representation.

Unit V

BLOCK-SCHOLES MODEL: Basic Block-Scholes Model – Block-Scholes price and hedge for European Options – Foreign Exchange – Dividends – Bonds – Market price of risk.

Text Book

1. Alison Etheridge A., "Course in Financial Calculus", Cambridge University Press, Cambridge, 2002.

Reference Books

1. Martin Boxter and Andrew Rennie, "Financial Calculus: An Introduction to Derivatives" Pricing, Cambridge University Press, Cambridge, 1996.
2. Damien Lamberton and Bernard Lapeyre , (Translated by Nicolas Rabeau and Farancois Mantion), "Introduction to Stochastic Calculus Applied to Finance", Chapman and Hall, 1996.
3. Marek Musiela and Marek Rutkowski, "Martingale Methods in Financial Modeling",Springer Verlag, New York, 1988.

4. Robert Elliott J. and Ekkehard Kopp P., "Mathematics of Financial Markets", Springer Verlag, New York, 2001.

12MA342 STOCHASTIC PROCESSES

Credits: 4:0:0

Course Objective:

- To provide the student with the concept and the understanding in Markov Chains and Renewal processes.

Course Outcome:

- Knowledge in Renewal Theorem and its applications.

Unit I
MARKOV CHAINS: Classification of General Stochastic Processes – Markov Chain – Examples – Transition Probability Matrix – Classifications of States – Recurrence – Examples of recurrent Markov Chains.

Unit II
LIMIT THEOREMS OF MARKOV CHAINS: Discrete renewal equation and its proof – Absorption probabilities – criteria for recurrence – Queuing models – Random walk.

Unit III
CONTINUOUS TIME MARKOV CHAINS: Poisson Process – Pure Birth Process – Birth and Death Process – Birth and Death process with absorbing states – Finite State Continuous time Markov Chains.

Unit IV
RENEWAL PROCESSES: Definition and related concepts – Some special Renewal processes – Renewal equation and Elementary Renewal Theorem and its applications.

Unit V
BROWNIAN MOTION: Definition – Joint probabilities for Brownian Motion – Continuity of paths and the maximum variables – Variations and extensions – Computing some functionals of Brownian Motion by Martingale methods.

Text Book
1. Karlin S. and Taylor H.M., "A First Course in Stochastic Processes" (2nd edition), Academic Press, New York, 1975.

Reference Books
1. Cinler E., "Introduction to Stochastic Processes", Prentice Hall Inc., New Jersey, 1975.
2. Cox D.R. & H.D.Miller, "Theory of Stochastic Processes" (3rd Edn.), Chapman and Hall, London, 1983.
3. Kannan D., "An Introduction to Stochastic Processes", North Holland, New York 1979

4. Ross S.M., "Stochastic Processes", John Wiley and Sons, New York, 1983.
5. Taylor H.W. and Karlin S., "An Introduction to Stochastic Modeling" (3rd Edition), Academic Press, New York, 1998.

12MA343 RELATIONAL DATABASE MANAGEMENT SYSTEMS

Credits: 4:0:0

Course Objective:

- To provide the student with the concept and the understanding in Information Processing, Database Architecture, Relational Algebra and Relational Calculus.

Course Outcome:

- Knowledge in Database security, Query processing and Optimization.

Unit I
INTRODUCTION: Data, Information and Information Processing – Secondary storage devices – Files, File Organization and File structure – Indexing and Hashing – Introduction to DBMS – Software development Life-cycle – Database Development Life cycle – Introduction to RDBMS.

Unit II
DATABASE ARCHITECTURE AND DATA MODELING: Entity-Relationship (E-R) Modeling – Enhanced Entity-Relationship Model – Data Normalization.

Unit III
RELATIONAL ALGEBRA AND RELATIONAL CALCULUS: Tables – SQL – Tables – Views – and Indexes – Nulls – Queries and sub queries – Aggregate functions.

Unit IV
OPERATIONS: Insert, update and delete operations – cursors – Joins and Unions – programming with SQL – Query-by-example – QUEL-Triggers – Query processing and Optimization.

.**Unit V**
DATABASE SECURITY: Data integrity – Transaction management and concurrency control – Backup and Recovery.

Text Book
1. Leon and Leon M., "Database Management Systems", Leon Vikas, Chennai, 2002.
Reference Book
1. Sumathy.S, Esakkirajan S., "Fundamentals of Relational Database Management Systems", Springer, 2007.

12MA344 STATISTICAL MATHEMATICS

Credits: 4:0:0

Course Objective:

- To make an inference about a population based on information contained in a sample and to provide an associated measure of goodness for the inference

Course Outcome:

- Knowledge in Calculus and applications of statistics.

Unit I
FUNDAMENTAL STATISTICS: Central tendencies: Mean, Median and Mode - Measures of dispersion: Range, Quartiles, Standard Deviation - Distributions: Binomial, Poisson, and Normal.

Unit II
CORRELATION AND REGRESSION: Linear correlation- Coefficient of correlation-Coefficient of rank Correlation- Multiple & partial Correlation. Linear regression and Multiple regressions.

Unit III
TESTING OF HYPOTHESIS: LARGE Samples- Proportions, population mean –two sample Means. Small Samples- Student's t – test, F – test and Chi-square test for Goodness of fit.

Unit IV
DIFFERENTIAL & INTEGRAL CALCULUS: Differentiation- Trigonometry, polynomial, exponential, logarithmic, Implicit, hyperbolic & inverse circular functions. Integration-Trigonometric, exponential, logarithmic and Rational functions. Double and Triple Integrals.

Unit V
DIFFERENTIAL EQUATIONS: Linear differential equation of the type Second order, Euler-homogeneous linear differential and Simultaneous differential equations.

Text Books

1. Manickavasagam Pillai T.K., "Differential Calculus,Vol.1", S.V.Printers &Publishers Pvt. Ltd, 1997.
2. Kandasamy P., Thilagavathy K. and Gunavathy K., "Engineering Mathematics", (Volume-II& III) S. Chand & Company Ltd, 2006.
3. Manickavasagam Pillai T.K., "Integral Calculus,Vol.II", S.V.Printers &Publishers Pvt. Ltd, 2003.
4. Sharma.A.K, Text book of Elementary Statistics, Discovery Publishing House, 2005.

Reference Book

1.Vander Waerden B.L., "Mathematical Statistics", G.Allen & Unwin Ltd., London, 1968.

12MA345 RESEARCH METHODOLOGY I

Credits: 4:0:0

Course Objective:

- To provide the student with the concept and the understanding in spectral theory and separation theorems in the plane.

Course Outcome:

- Knowledge in Semi groups of Linear Operators and applications.

Unit I

BOUNDED LINEAR OPERATORS: Uniformly continuous semigroups of bounded linear operators – Strongly continuous semigroups of bounded linear operators – The Hille-Yosida theorem – The Lumer Phillips theorem.

Unit II

INFINITESIMAL GENERATORS AND SEMIGROUPS: The characterization of the infinitesimal generators of C_0 semi groups – Groups of bounded operators – The inversion of the Laplace transform – Two exponential formulas.

Unit III

SPECTRAL THEORY: Weak equal strong – Spectral mapping theorem – Semigroups of compact operator – Differentiability – Analytic semigroups.

Unit IV

FUNDAMENTAL GROUP: Homotopy of Paths – Fundamental Group – Covering Spaces – Fundamental Groups of the Circle and Sn.

Unit V

SEPARATION THEOREMS IN THE PLANE: Jordan Separation Theorem – Invariance of Domain – Jordan Curve Theorem.

Text Books

1. Pazy A., "Semigroups of Linear Operators and Applications to Partial Differential Equations", Springer-Verlag, New York, 1983.

2. Munkres J.R., "Topology", 2nd Edition, Pearson Education (Singapore) Pvt. Ltd., 2000.

Reference Books

1. Balakrishnan A.V., "Applied Functional Analysis", Springer-Verlag, New York, 1976.
2. Goldstein J.A., "Semigroups of Linear Operators and Applications", Oxford University Press, New York, 1985.
3. Dugundji J., "Topology", Allyn and Bacon, Boston, 1966.

4. Massey W.S., “Algebraic Topology-An Introduction”, Springer-Verlag, New York, 1976.

12MA346 MATHEMATICAL METHODS

Credits: 4:0:0

Course Objective:

- To provide the student with the concept and the understanding in fixed point theorem, finite element methods and finite volume method.

Course Outcome:

- Knowledge in fixed point for compact maps and Perturbation Methods.

Unit I
ELEMENTARY FIXED POINT THEOREMS: Fixed point spaces – Forming new fixed point spaces from old – Topological transversality – Factorization technique – Banach contraction principle – Elementary domain invariance – Continuation method for contractive maps – Nonlinear alternative for contractive maps – Extensions of the Banach theorem – Miscellaneous results and examples.

Unit II
FIXED POINTS FOR COMPACT MAPS IN NORMED LINEAR SPACES: Compact and completely continuous operators – Schauder projection and approximation theorem – Extension of the Brouwer and Borsuk theorems – Topological transversability. Existence of essential maps – Equation x = F(x). The Leray-Schauder principle – Equation x = λF(x). Birkhoff-Kellogg theorem – Compact fields – Equation y = x – F(x). Invariance of domain – Miscellaneous results and examples.

Unit III
PERTURBATION METHODS: Parameter Perturbations – An algebraic equation – The Van der pol oscillator – Coordinate perturbations – Bessel equation of zeroth order – A simple example – Order symbols and Guage functions – Asymptotic series – Asymptotic expansions – Uniqueness of Asymptotic expansions – Convergent versus asymptotic series – Nonuniform expansions – Elementary operations on asymptotic expansions – Straight forward expansions and sources of Non uniformity – Infinite domains – The Duffing equation – A model for weak nonlinear instability – A small parameter multiplying the highest derivative – A second order example – Relaxation oscillations – Type change of a partial differential equation – A simple example – The presence of singularities – Shift in singularity – The earth-moon spaceship problem – The role of coordinate systems – The method of strained parameters – The Lindstedt-Poincare Method – transition curves for the Mathieu equation – Lighthill’s Technique – A first order differential equation.

Unit IV
FINITE ELEMENT METHODS: Finite elements – Line segment – Triangular element – Linear Lagrange polynomial – Numerical Integration over finite element – Finite element methods – Ritz finite element method – Least square finite element method – Galerkin finite

element method – Convergence analysis – Boundary value problems in ordinary differential equations – Assembly of element equations – Mixed Boundary Conditions – Galerkin method.

Unit V
FINITE VOLUME METHOD: Finite volume method for Diffusion Problems: Finite volume for one dimensional steady state diffusion – Worked examples – Finite volume method for two dimensional diffusion problems – Finite volume method for three dimensional diffusion problems – Summary of discretized equations for diffusion problems. Finite volume method for Convection-Diffusion Problems: Steady one dimensional convection and diffusion – The central differencing schemes.

Text Books

1. Granas A., and Dugundji J., "Fixed Point Theory", Springer, 2003.
2. Nayfeh A.H., "Perturbation Methods", John Wiley & Sons, New York, 1973.
3. Jain M.K., "Numerical Solution of Differential Equations", New Age International Pvt. Ltd.,New Delhi, 2002.
4. Versteeg H.K. and Malalasekera W., "An Introduction to Computational Fluid Dynamics",Longman Scientific & Technical, England, 1995.

Reference Book

1. Patankar S.V., "Numerical Heat Transfer and Fluid Flow", Hemisphere Publishing Corporation,New York, 1980.

12MA347 GRAPH THEORY AND NETWORKS

Credits: 4:0:0

Course Objective:

- To provide the student with the concept and the understanding in graphs.

Course Outcome:

- Knowledge in random graphs, matroids and labeling of graphs.

Unit I
CONNECTIVITY AND NETWORKS: K-connected Graphs: 2-Connected graphs – Connectivity of digraphs – K-Connected and Kedge connected graphs – Applications of Monger's theorem. Network Flow Problems: Maximum network flow – Integral flows – Supplies and Demands.

Unit II
PERFECT GRAPHS: The perfect graph theorem – Chordal graphs revisited – other classes of perfect graphs – Imperfect graphs – the strong perfect graph conjecture.

Unit III
MATROIDS: Hereditary systems and examples – Properties of matroids – the span function and duality – minors and planar graphs – matroid intersection and matroid union.

Unit IV

RANDOM GRAPHS: Existence and Expectation – Properties of Almost All Graphs – Threshold Functions –Evolution and properties of Random Graphs – Connectivity, Cliques and Coloring – martingales.

Unit V:

DECOMPOSITIONS AND LABELINGS: Factorizations and Decompositions of Graphs – Labelings of graphs.

Text Books

1. Douglas West B., "Introduction to Graph Theory", Prentice Hall of India, 1999.
2. Chartrand G. and Leshiak L., "Graphs and Digraphs", Chapman and Hall/CRC, 1996.

Reference Book

1. Kaufman A., "Introduction to the theory of Fuzzy Subsets", Volume 1, Academic Press, New York, 1975.

12MA348 FUZZY MATHEMATICS

Credits: 4:0:0

Course Objective:

- To provide the student with the concept and the understanding in fuzzy sets, fuzzy relations and fuzzy numbers.

Course Outcome:

- Knowledge in Fuzzy Computational Models.

Unit I

BASIC NOTIONS AND CONCEPTS OF FUZZY SETS: Set Membership and Fuzzy Sets-Types of Membership Functions-Characteristics of a Fuzzy Set-Generalization of Fuzzy Sets-Fuzzy Set Operations.

Unit II

CHARACTERIZATION OF FUZZY SETS: Entropy Measures of Fuzziness-Energy Measures of Fuzziness-Specificity of a Fuzzy Set— Decoding Mechanisms for Point wise Data-Distance between Fuzzy Sets.

Unit III

FUZZY RELATIONS: Relations and Fuzzy Relations-Operations on Fuzzy Relations-Binary Fuzzy Relations-Some Classes of Fuzzy Relations-Fuzzy Relational Equations-Generalizations of Fuzzy Relational Equations.

Unit IV

FUZZY NUMBERS: Definition-Interval Analysis and Fuzzy Numbers-Computing with Fuzzy Numbers- Triangular Fuzzy Numbers and Basic Operations-Fuzzy Numbers and Approximate Operations. Fuzzy Logic: Introduction-Propositional Calculus-Predicate Logic-Many Valued Logic-Fuzzy Logic-Computing with Fuzzy logic.

Unit V
FUZZY COMPUTATIONAL MODELS: Rule-Based Computations-Syntax of Fuzzy Rules-Computing with fuzzy Rules- Rule consistency and Completeness-Neural Networks-Logic Based Neurons-Fuzzy Neural Network-Fuzzy Cellular Automata.

Text Books

1. Witold Pedrycz and Fernando Gomide, "An Introduction to Fuzzy Sets-Analysis and Design", Prentice-Hall of India Pvt. Ltd, 2005.
2. Zimmermann H.J., "Fuzzy Set Theory and its Applications", Dordrecht, Kluwer,1985.

Reference Book

1. Kaufman A., "Introduction to the theory of Fuzzy Subsets", Volume 1, Academic Press, New York, 1975.

12MA349 DIFFERENCE EQUATIONS

Credits: 4:0:0

Course Objective:

- To provide the student with the concept and the understanding in First Order Difference equations and Higher Order Difference equations.

Course Outcome:

- Knowledge in Asymptotic and Oscillatory behavior of Difference Equations.

Unit I
DYNAMICS OF FIRST ORDER DIFFERENCE EQUATIONS: Introduction – Linear First Order Difference equations – Equilibrium points – Criteria for Asymptotic of equilibrium points – Period points and cycles – The Logistic equation and Bifurcation.

Unit II
LINEAR DIFFERENCE EQUATIONS OF HIGHER ORDER: Difference calculus – General theory of linear difference equations – Linear homogeneous equations with constant coefficient – Linear nonhomogeneous equations – Limiting behavior of variation of constants (parameters) – Nonlinear equations transformable to linear equation.

Unit III

SYSTEMS OF DIFFERENCE EQUATIONS: Autonomous (time-Invariant) systems – The Basic Theory – The Jordan Form: Autonomous (Time-Invariant) – linear periodic systems – Applications.

Unit IV

ASYMPTOTIC BEHAVIOR OF DIFFERENCE EQUATIONS: Tools of approximation – Pioneer's theorem – Second order difference equations – Asymptotically diagonal systems – High order Difference equations – Nonlinear difference equations.

Unit V

OSCILLATION THEORY: Three term difference equations – Nonlinear difference equation – Self-adjoint second order Equations.

Text Book

1. Sabe Elaydi N., "An Introduction to Difference Equations", 1st Edition, Springer-Verlag, New York Berlin, 1996.

Reference Book

1. Paul Cull, Mary Flahive E., Robert Robson O., "Difference Equations", Springer Verlag, 2005.

12MA350 OPTIMIZATION TECHNIQUES

Credits: 4:0:0

Course Objective:

- To provide the student with the concept and the understanding in Dynamic and nonlinear programmingInventory Models and Queuing Models.

Course Outcome:

- Knowledge in applications of optimization techniques.

Unit I

DYNAMIC PROGRAMMING: Elements of the DP Model: The Capital Budgeting – More on the Definition of the state –Examples of DP models and computations – Problem of Dimensionality in Dynamic Programming – Solution of Linear programs by Dynamic Programming.

Unit II

DECISION THEORY AND GAMES: Decisions under Risk – Decision under Uncertainty – Game Theory.

Unit III

INVENTORY MODELS: The ABC Inventory system – A Generalized Inventory Models – Deterministic Models – Just-in-Time (JIT) manufacturing system.

Unit IV

QUEUING MODELS: Role of Poisson and Exponential Distribution – Processes Birth and Death – Queues with Combined Arrival and Departures – Non-Poisson Queues – Queues with Priorities for Service – Tandem or Series Queues.

Unit V

NONLINEAR PROGRAMMING: Unconstrained Extremal Problems – Constrained Extremal problems – Constrained Extremal problems – Nonlinear Programming Algorithm – Unconstrained Nonlinear Algorithms – Constrained Nonlinear Algorithms.

Text Book

1. Taha H. A., "Operations Research" – An Introduction (Fifth Edition-1996), Prentice Hall of India (P) Limited, New Delhi, 1996.

Reference Books

1. Singiresu Rao S., "Engineering Optimization", 3rd Edition, New Age International (P) Ltd., New Delhi, 1996.

12MA351 RESEARCH METHODOLOGY II

Credits: 4:0:0

Course Objective:

- To provide the student with the concept and the understanding in random variables and distributions.

Course Outcome:

- Knowledge in applications of probability and numerical methods.

Unit I

PROBABILITY: Concepts of probability – basic concepts – Mathematical, classical and statistical definition – conditional probability – Independent events – Baye's theorem – simple problems. Random variable – Definition – Distribution function – properties – discrete and continuous random variables – Probability mass function, probability density function – properties – simple problems.

Unit II

EXPECTATION: Expectation of a random variable – Definition – addition and multiplication theorems – conditional expectation and conditional variance. Moment generating function – properties – relation between moments and M.G.F. – cumulants - characteristic function – inversion theorem – uniqueness theorem (statement only) – simple problems – Weak law of large numbers (statement only) – Central limit theorem (concept only).

Unit III

SPECIAL DISTRIBUTIONS: Binomial, Poisson and Hyper geometric distribution – simple applications – Normal distribution – area property – Features – simple problems.

Unit IV

NUMERICAL EQUAIONS: Solution of numerical algebraic and transcendental equations. The Bisection method – Iteration method – Regula Falsi Method – Newton – Raphson method – Gauss elimination method – Method of triangularisation – Crout's method – Gauss-Jacobi method – Gauss Seidel method.

Unit V

NUMERICAL DIFFERENTATION: Finite differences: First and higher order differences – Forward differences and backward differences – Properties o operator – Differences of a polynomial – Fractional polynomials – Operator E – relation between E and D – Summation of series – Interpolation – Gregory-Newton forward interpolation formula – Equidistant terms with one or more missing values – Gauss forward interpolation formula – Gauss backward interpolation formula.

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Text Books

1. Gupta S.P., "Statistical Methods", Sultan Chand & sons Publishers, 2008.
2. Gupta S.P and Kapoor S.P., "Fundamentals of Mathematical Statistics", Sultan Chand & Sons Publishers, 11th Edition 2002.
3. Agarwal B.L., "Basic Statistics", Wiley Eastern, 1980.
4. Hogg R.V and Craig A.T., "Introduction to Mathematical Statistics", Prentice Hall, 1995.
5. Kandasamy P., "Numerical Methods", S.Chand & co. New Delhi, Reprint 2010.

Reference Books

1. Mills F.C., "Statistical Methods" Part I, Holt, 1995.
2. Snedecor G.W and Cochran W.G., "Statistical Methods" Oxford-IBH, Pvt Co., 1967.
3. Brunk H.D., "An Introduction to Mathematical Statistics", Wiley (1975).
4. Venkataraman M.K., "Numerical Methods", National Publishing Company, Reprint 2005.

12MA352 STATISTICAL QUALITY CONTROL

Credits: 4:0:0

Course Objective:

- To provide the student with the concept and the understanding in Statistical quality control and control charts.

Course Outcome:

- Knowledge in applications of SQC.

Unit I

QUALITY CONTROL: Statistical Quality Control – Definition – Need for SQC in industry – causes of variation – Chance and assignable causes – Natural and tolerance limits.

Unit II

CONTROL CHARTS AND SIMPLE PROBLEMS: Basis – Nature – Control charts for variables – Shewhart control charts for $\overline{X}$, R – Criterial for out of control – Control chart for attributes – p, np, c charts – OC and ARL of control charts – Modified control charts – simple problems.

Unit III

ACCEPTANCE SAMPLING: Meaning – Uses – Concepts – AQL, LQL, IQL, AOQL – Operating characteristic curves – Type A, Type B – Evaluation – Applications of Binomial, Poisson and Normal distribution – Designing sampling plans – Unity value and search procedure.

Unit IV

ACCEPTANCE SAMPLING [POWER SERIES APPROACH]: Power series approach of summing probabilities and their applications to acceptance sampling – Stochastic models – Markov chains – sampling problem as a stochastic processes – simple applications.

Unit V

MULTIPLE SAMPLING: Development of algorithms or usage of computer programs in acceptance sampling – Steps for obtaining the OC curves and other appropriate curves and for obtaining the parameters of the following plans only – single sampling plan – double sampling plan – multiple sampling plan – sequential sampling plan – chain sampling plan.

Text Books

1. Duncan A.J., "Quality control and Industrial Statistics", R.D. Irwin, 4th Edition, 1974.
2. Gupta S.C and Kapoor V.K., "Fundamental of Applied Statistics", Sultan Chand & Sons Publishers, Third Edition, 1990.
3. Grant E.L., "Statistical Quality Control", McGraw Hill, 2nd Edition, 1952.

Reference Books

1. Schilling E.G., "Acceptance Sampling in Quality Control", M. Dekker (1982).

12MA353 ADVANCED ACCEPTANCE SAMPLING

Credits: 4:0:0

Course Objective:

- To provide the student with the concept and the understanding in different sampling plans.

Course Outcome:

- Knowledge in applications of sampling plans.

Unit I
BASIC CONCEPTS OF ACCEPTANCE SAMPLING: Attributes Sampling Plans Single, Double, Multiple and item by item Sequential Sampling Plans, Dodge and Romig LTPD and AOQL Tables, ABC Standard, Philip's System, Golub's Minimization Approach, Sampling Plans for Isolated Lots MAPD Plans, MAAOQ Plans, Incentive Index Plans.

Unit II
VARIABLE SAMPLING PLANS: Known and Unknown – Sigma Plans, MIL-STD- 414 .

Unit III
CONTINUOUS SAMPLING PLANS:CSP-1, CSP-2, CSP-3 and Multilevel Continuous Sampling Plans MIL-STD-1235(ORD)

Unit IV
SPECIAL PURPOSE PLANS: Chain Sampling Plans, Skip-lot Plans, Demerit Rating Plans, Cumulative Results Plan.

Unit V
SAMPLING INSPECTION PLAN: OQPL Plans, RGS Plans, Plans based on the Theory of Runs, Indian Standards, Lot Sensitive Sampling Plans , Tightened-Normal – Tightened Plan with Fixed and Different s and t, Quick Switching System, Administration of Sampling Inspection Plan.

REFERENCES

1. American Society for Quality Control (1978), American National Standards: Terms, Symbols and Definitions for Acceptance Sampling, ANSI/ASQC A2(1978), American Society for Quality Control, Milwaukee, Wisconsin.

2. Burr Irving W., "Statistical Quality Control Methods", Marcel Dekker, Inc., New York, 1976.

Schilling Edward G., "Acceptance Sampling in Quality Control, Statistics" Text Book, 1982, and Monographs, Vol.42, Marcel Dekker, Inc., New York.

3. Dodge Harold, F and Romig, H.G., (1959), Sampling Inspection Tables, single and double Sampling, John wiley, New York.

4. MIL-STD-105D (1963), Sampling Procedures and Tables for Inspection by Attributes, Us Govt., Printing Office, Washing DC.Dodge Harod, F (1969), A General Procedure for Sampling

Inspection by Attributes – Based on the AQL Concept. Technical Report 10.The Statistics Centre, Rutger State University, USA.

5. Hamaker, H.C., (1949), Lot Inspection by Sampling, Philips Technical Review, Vol.11, No.6, pp. 176-182. Hamaker, H.C., (1950), The Theory of Sampling Inspection Plan, Philips Technical Review, Vol.11, No.9, pp.260-270.Hamaker, H.C., Taudin Chabot, J.J.N. and Willemze, F.G., (1950), The Practical Application of Sampling Inspection Plans and Tables, Philips Technical Review, Vol.11, pp.362-370.

6. Golub, Abraham (1953), Designing Single Sampling Inspection Plans, when the sample size is fixed, Journal of the American Statistical Association Vol.48, pp. 278-288.

7. Camerion J.M., (1952), Tables for Constructing and for Computing the Operating Characteristics of Single Sampling Plans, Industrial Quality Control, Vol.9, pp.37-39.

8. Soundararajan,V., (1975), Maximum Allowable Percent Defective (MAPD) Single Sampling Inspection by Attributes Plans, Journal of Quality Technology, Vol 7., No.4, pp. 173-182.

9. Suresh, K.K., and Ramkumar, T.B., (1996): Selection of a sampling Plan Indexed with Maximum allowable Average Outgoing Quality, Journal of Applied Statistics, Vol.23, No.6, pp.645-654.

10. Suresh,K.K., and Sri Venkataramana, T., (1996): Selection of Single Sampling Plan using Producer and Consumer Quality Level, Journal of Applied Statistical Science, Vol.3, No.4, pp.273-280

11. Eizenhart, Hastay and Wallis (1947), Techniques of Statistical Analysis, McGraw Hill,London (Chapter 1 Only) MIL _STD –414 (1977), Sampling Procedure and Tables for Inspection by Variables for Percent Defective, US, Govt., Printing Office, Washington, DC. Duncan, A.J., (1974), Quality Control and Industrial Statistics, 4th Edition, Richard D Irwing, Home wood , Illinois.

12. Stephens, K.S., (1979): How to perform Continuous Sampling Plan?, ASQC Basic reference series, V-2. MIL-STD-1233(ORD) (1962): Single and Multilevel Continuous Sampling Procedures and Tables for Inspection by Attributes, Department of Defence, Washington DC.MIL-STD A (1974): Single and Multilevel Continuous Sampling Procedures and Tables for Inspection by Attributes, US Department of Defence, Washington DC.

13. Dodge, H.F.,(1955): Chain Sampling Inspection Plan, Industrial Quality Control, Vol.II, No.5, pp. 10-13. Soundararajan, V(1978): Procedures and Tables for Construction and Selection of Chain Sampling Plans (ChSP-1) Part – I and II, Journal of Quality Technology, Vol.10, No.2 and 3, pp. 56-60. and pp. 99-103. Dodge, H.F., (1955): Skip-Lot Sampling Plans, Industrial Quality Control, Vol.11, No.5, pp.5-6.

14. Perry, R.L., (1974): Skip-Lot Sampling Plans, Journal of Quality Technology, Vol.5, pp. 123-130.

15. Dodge, H.F., (1956): A Check Inspection and Demerit Rating Plan, Industrial Quality Control, Vol.13, No.1,pp.5-12.

16. Cone, A.F., and Dodge, H.F., (1963): A Cumulative Results Plan for Small Sample Inspection, Industrial Quality Control, Vol.21, No.1, pp.4-9.

17. Rhodes, R.C., (1964): An outgoing Quality Probability Limit, (OQPL), Sampling Plan, Industrial Quality Control, Vol.21, No.3, pp.122-130.

18. Sherman Robert, E: Design and Evaluation of a Repetitive Group Sampling Plan, Technometrics, Vol.7, No.1, pp. 11-21.

19. Praire, R.R. , Zimmer, W.J., and Brook House, T.K., (1962): Some Acceptance Sampling Plans Based on Theory of Runs, Technometrics, Vol.4, No.2, pp. 177-185.

20. Vance, L.C., and Mc Donald, G.C., : A Class of Multiple Runs Acceptance Sampling Plan, Technometrices, Vol.21, No.2, pp. 141-146.

21. Indian Standard Sampling Inspection Tables – Part-I, Inspection by Attributes and by Count of Defects IS 2500 (Part-I) 1973. Indian Standard Sampling Inspection Tables Part II. Inspection by Variables for percent Defective IS 2500 (Part-II) 1965.

22. Schilling, E.G., (1982): Acceptance Sampling in Quality Control, Marcell Dekker, Inc., New York, pp.474- 488. Suresh, K.K., and Balamurali,S (1993) : Designing of Tightened – Normal-Tightened(TNT) Plans Indexed by MAPD, Communications in statistics, Theory and Methods, Vol.22, No.7, pp. 2043-2056, Suresh.K.K., and Balamurali, S., (1994) : Construction and Selection of Tightened- Normal- Tightened Plans Indexed by Maximum Allowable Percent Defectives, Journal of Applied Statistics, vol.21, No.6,pp. 589–595.

23. Schilling, E.G(1982): Acceptance Sampling in Quality Control, Marcel Dekker, Inc., New York, pp. 564-591. Schilling, E.G., (1985): The Role of Acceptance Sampling in Modern Quality Control, Communications in Statistics Theory and Methods , Vol.14, No.11., pp. 2769 –2777

12MA354 RESEARCH METHODOLOGY - III

Credits: 4:0:0

Course Objective:

- To provide the students with the concept and understanding in applications of algebra, topology and geometry.

Course Outcome:

- Knowledge in Fundamental group, Jordan Separation Theorem, Topological vector spaces, Banach spaces and Hilbert spaces.

Unit I
FUNDAMENTAL GROUP: Homotopy of Paths- Fundamental Group-Covering Spaces-Fundamental groups of the circle and S_n .

Unit II
SEPARATION THEOREMS IN THE PLANE: Jordan Separation Theorem- Invariance of Domain- Jordan Curve Theorem.

Unit III

TOPOLOGICAL VECTOR SPACES: Introduction-Separation properties-Linear mappings-Finite dimensional spaces- Metrization-Boundedness and continuity-Seminorms and local convexity- quotient spaces.

Unit IV

COMPLETENESS: Bair category-The Banach-Steihaus theorem-The open mapping theorem-the closed graph theorem- Bilinear mappings.

Unit V

CONVEXITY AND BANACH SPACE: The Haun-Bnach theorems- weak topologies-Compact convex sets-The normed dual of a normed space- Adjoints- compact operators.

Text Books

1. Munkers J.R., "Topology", 2^{nd} Edition, Pearson Education, PVT. Ltd. 2000.
2. Walter Rudin, "Functional Analysis", T M H edition, 1974.

Reference Books

1. Dugundji J, "Topology", Allyn and Bacon, Boston, 1966.
2. Massey W.S., "Algebraic topology-An introduction", springer-Verlag,New York, 1976.
3. Edward Packel W., "Functional Analysis", International educational publishers, New York and London, 1974.

12MA355 VON NEUMANN REGULAR RINGS

Credits: 4:0:0

Course Objective:

- To provide the student about knowledge of higher modern algebra.

Course Outcome:

- Students will acquire the knowledge of algebraic structures in the sense of Von Neumann

Unit I

REGULAR RINGS AND PROPERTIES: Introduction-Regular rings – Idempontents and projective modules – Abelian regular rings

Unit II

UNIT REGULARITY: Unit regular rings – Least element – Greatest Element – Direct finiteness – rings with primitive factors artinian.

Unit III

BOUNDEDNESS OF NILPOTENT: Bounded index of nilpotence- Definitions and Theorems related to Boundedness – comparability – central idempotent - continuous regular rings.

Unit IV

RANK FUNCTIONS: Existence and Uniqueness of Rank functions - Pseudo – rank functions

Unit V

COMPLETIONS: Completions – N-completions-Natural Extention-Continuous extension - completions with respect to families of pseudo – rank functions

Text Book

1. Goodearl K.R., "Von Neumann Regular Rings", Pitman Publishing Limited, 1979.

Reference Books

1. Artin M., "Algebra", Prentice Hall of India, 1991.
2. Bhattacharya P.B., Jain S.K. and Nagpaul S.R., "Basic Abstract Algebra" (II Edition) Cambridge University Press, (Indian Edition), 1997.
3. Luther I.S. and Passi I.B.S., "Algebra", Vol. I –Groups, 1996, Vol. II Rings, Narosa Publishing House, New Delhi, 1999
4. Malik D.S., Mordeson J.N. and Sen M.K., "Fundamental of Abstract Algebra", McGrawHill (International Edition), New York,1997.
5. Jacobson N., "Basic Algebra", Vol. I & II W.H.Freeman ; also published by Hindustan Publishing Company, New Delhi, 1980.

12MA356 ABSTRACT CONTROL THEORY

Credits: 4:0:0

Course Objective:

- To provide the student with the concept and the understanding of basic concepts in Semigroups of Linear Operators, Applications to Partial Differential Equations and Infinite Dimensional Linear System Theory for higher mathematics.

Course Outcome:

- Knowledge in Semigroup and Control Theory.

Unit I

BOUNDED LINEAR OPERATORS: Uniformly continuous semigroups of bounded linear operators – Strongly continuous semigroups of bounded linear operators – The Hille-Yosida theorem –Semigroups of Compact operators – Differentiability.

Unit II

ABSTRACT CAUCHY PROBLEM: The Homogeneous Initial value problem – The in homogeneous initial value problem – Regularity of mild solutions for Analytical semigroups.

Unit III

EVOLUTION EQUATIONS: Evolution systems – Stable families of Generators – An Evolution system in the Hyperbolic case – Regular solutions in the Hyperbolic case – The inhomogeneous equation in hyperbolic case.

Unit IV

NONLINEAR EVOLUTION EQUATIONS:Lipschitz perturbation of linear evolution equations – Semilinear equations with compact semigroups – Semilinear equations with Analytical semigroups.

Unit V

BASIC CONCEPTS IN CONTROL THEORY: Controllability, Observability and Exponential stability.

Text Books

1. Pazy A., "Semigroups of Linear Operators and Applications to Partial Differential Equations", Springer-Verlag, New York, 1983.
2. Curtain R.F. and Zwart H. "Introduction to infinite dimensional linear systems theory" , Spinger-Verlag, New York, 1995.

Reference Books

1. James Munkres, "Topology", Second Edition, Prentice Hall, 2000.
2. Balachandran K. and Dauer J.P.," Elements of Control Theory", Narosa Publishing, 1999.

12MA357 THEORY OF NEAR-RINGS

Credits: 4:0:0

Objective:

To provide the student with the concept and the understanding of basic concepts in Near Rings, Theory and Applications for higher mathematics.

Outcome:

Students can get the knowledge of generalization of ring and ideal theory.

Unit I

THE ELEMENTS OF THEORY OF NEAR-RINGS: Fundamentals delimitations and properties – N-groups – Homomorphism and Ideal – Annihilators – Generated Objects. Constructions: Product, direct sums and sub-direct products – Near –rings of quotients – Free near – rings and N-groups.

Unit II

EMBEDDING: Embedding in M(Γ) – More beds – Some axiomatic considerations – Miscellaneous results – Related structures.

Unit III

IDEAL THEORY: Sums and Direct sums – Distributive sums – Chain Conditions – Decomposition Theorems

Unit IV
PRIME IDEALS: Product of subsets – Prime Ideals – Semi prime Ideals – Nil and Nilpotent

Unit V
DISTRIBUTIVELY GENERATED NEAR-RING: Elementary – Some axiomatic – constructions of distributively generated near-rings. More classes of near –ring: IFP near – rings – p-near-rings – Boolean near-rings

Text Book:

1. Gunder Pilz, "Near – rings The Theory and its Applications", North Holland Publishing Company, Amsterdam, 1977.

Reference Books:

1. Neal Henry McCoy, "The Theory of Rings", Bronx, N.Y.Chelsea Pub. Co. – 1973.
2. Herstain I.N., "Topics in Algebra", John Willey and Sons, New York, 2007.

12MA358 COMMUTATIVE ALGEBRA

Credits: 4:0:0
Course Objectives:

- Commutative Algebra is one of the fundamental and basic for all the disciplines in Mathematics. This programme aims at providing basic tools and exposure to the students who intend to pursue research in Commutative Algebra at the international level.

Course Outcome:

- Knowledge in the Technology, Methodology and applications of Commutative Algebra.

Unit I
RINGS, IDEALS AND MODULES: Rings and ring homomorphism – Ideals, Quotient rings – Zero-divisor, nilpotent elements – prime ideals and maximal ideals – Nil Radical and Jacobian Radical – Operations on Ideals – Extensions and contraction - Modules and module homomorphism - Sub modules and quotient modules - Operations on sub modules - Finitely generated modules – Exact sequences.

Unit II
MODULE FRACTIONS: Local properties - Extended and contracted Ideals in Rings of fractions – Primary Decomposition.

Unit III

INTEGRAL DEPENDENCE AND VALUATIONS: Integral dependence - The going-up theorem - Integrally closed integral domains – The going-down theorem - Valuation rings - Chain conditions.

Unit IV

NOETHERIAN RINGS AND ARTIN RINGS: Primary decomposition in Noetherian Rings – Artin Rings.

Unit V
DISCRETE VALUATION RINGS AND DEDEKIND DOMAINS: Discrete valuation Rings - Dedekind domains - Fractional Ideals.

Text Book:

1. Atiyah and Macdonald, "Introduction to Commutative Algebra", Addison – Wesley Publishing Company, 1969.

Reference Books:

1. Neal Henry McCoy, "The theory of Rings", Chelsea Publishing Company, 1973.
2. Herstein I.N., "Topics in Algebra", John Wiley and Sons. New York. 2007.

12IM301 APPLIED CALCULUS

Credits 4:0:0

Course Objective:

- To provide the student with an understanding of basic concepts in calculus and its applications.

Course Outcome:

- This paper enables the students to apply the techniques of calculus to the industry related problems.

Unit I
APPLICATIONS OF DIFFERENTIATION: Application of differentiations, partial differentiation and integration – multiple integrals and applications

Unit II
APPLICATIONS OF DIFFERENTIAL EQUATION: Applications of first order and second order differential equations.

Unit III
FOURIER SERIES: Fourier series – Even and Odd Function Fourier series – Parsevals identity – Convolution Theorem - applications.

Unit IV
LAPLACE TRANSFORM: Laplace transforms – Laplace Transform of Standard functions – Properties – Laplace transform of Derivatives – Inverse Laplace Transforms and its application to ordinary differential equations.

Unit V

FOURIER TRANSFORMS: Fourier transforms – Definition – Properties – Inverse Fourier Transform – Finite Fourier Transform - its applications.

Text Book

1. Grewal B.S., "Higher Engineering Mathematics", Khanna Publisher, 37th Edition (2003).

Reference Books

1. Geoffrey Berresford C., Andrew Mansfield Rockett, "Applied Calculus", 5th Edition, Cengage Learning, 2010.
2. Soo Tan T., "Applied Calculus for the Managerial Life and Social Sciences: A Brief Approach", 9th Edition, Cengage Learning, 2009.

12IM302 APPLIED LINEAR ALGEBRA

Credits 4:0:0

Course Objective:

- To provide the student with an understanding of basic concepts in Linear Algebra and its applications.

Course Outcome:

- This paper enables the students to have the knowledge of Linear Transformations, matrices and Bilinear Forms.

Unit I

VECTOR SPACES: Vector spaces-Subspaces-Bases and Dimension- Coordinaes- summary of Row equivalence-Computations concerning Subspaces.

Unit II

LINEAR TRANSFORMATIONS: Linear Transformations- The Algebra of Linear Transformations, Isomorphism-Representation of Transformations by matrices- Linear Functionals- The Double Dual.

Unit III

CANONICAL FORMS: Characteristic Values-Annihilating Polynomials-invariant Subspaces-Simultaneous Triangulation-simultaneous Diagonalization- Direct-Sum Decompositions-Invariant Direct Sums- The primary Decomposition Theorem

Unit IV

INNER PRODUCT SPACES: Inner products-Inner product spaces- Linear Functional and Adjoints-Unitary Operators-Normal Operators.

Unit V

BILINEAR FORMS: Forms on Inner product spaces- Positive Forms- Bilinear Forms- Symmetric Bilinear Forms-Skew-Symmetric Bilinear Forms- Groups preserving Bilinear Forms.

Text Book

1. Kenneth Hoffman and Ray Kunze, “Linear Algebra”, Second Edition, Eastern Economy Edition, 2002.

Reference Books

1. Datta K.B., “Matrix and Linear Algebra”, PHI, New Delhi, 2004.
2. Garret Birkoff and Saunders Mac Lane, “A Survey of Modern Algebra”, University Press, 2003.

12IM303 INDUSTRIAL MECHANICS

Credits : 4:0:0

Course Objective:

- To give brief mathematical modeling on the behavior of materials due to axial, bending and tensional and combined loads.

Course Output:

- The computational aspects of these methods are emphasized by introducing mathematical equations. The modeling addresses diverse topics from mechanical science and engineering.

Unit I

STRESS AND STRAIN: Stress and Strain – Hooke’s Law – Elastic constants and their relationship– Statically determinate cases - bar with uniform and varying section statically indeterminate cases –composite bar. Thermal Stresses – stresses due to freely falling weight.

Unit II

STRESSES IN BEAMS: Shear force and bending moment diagrams for simply supported and cantilever beams – Bending stresses in straight beams – Shear Stresses in bending of beams with various cross sections – beams of uniform strength.

Unit III

DEFLECTION OF BEAMS: Double integration method – Finite element method - Area moment method – Conjugate beam method.

Unit IV

TORSION: Torsion of circular shafts, cylinder, disc - shear stresses and twist in solid and hollow circular shafts – closely coiled helical springs.

Unit V

BI AXIAL STRESSES: Stresses in thin circular cylinder and spherical shell under internal pressure – volumetric Strain. Combined loading – Principal Stresses and maximum Shear Stresses - Analytical and Graphical methods.

Text Books

1. Nash William – “Strength of Materials”, Tata McGraw Hill, 1998.
2. Ramamurtham S, “Strength of Materials”, Dhanpat Rai Publishing Co,New Delhi.2008.

Reference Book

1. Timoshenko S. and Young D.H., “Elements of strength materials Vol. I and Vol. II”, T. Van Nostrand Co-Inc Princeton-N.J, 1990.

12IM304 APPLIED ANALYSIS

Credits 4:0:0

Course Objective:

- To familiarize the students with the concepts of Mathematical Analysis.

Course Outcome:

- This will enable the students to know the applications of continuous functions in industrial engineering.

Unit I

THE RIEMANN – STIELTEJES INTEGRALS: Definitions and existence of the integral – Properties of the integral – Integration and differentiation – Rectifiable curves.

Unit II

SEQUENCES AND SERIES OF FUNCTIONS: Uniform convergence – Uniform convergence and continuity – Uniform convergence and integration – Uniform convergence and differentiation – The Stone – Weierstrass Theorem.

Unit III

SOME SPECIAL FUNCTIONS: Power Series – The exponential and logarithmic functions – The trigonometric functions – Fourier series – The Gamma functions.

Unit IV

FUNCTIONS OF SEVERAL VARIABLES: Linear Transformations – Differentiation – The contraction principle – The inverse function theorem – The implicit function theorem.

Unit V

LEBESGUE THEORY: Set functions – Construction of the Lebesgue measure – Measure spaces – Measurable functions – Simple function – Integration.

Text Book

1. Walter Rudin, **“**Principles of Mathematical Analysis”, (3rd Edition), Tata McGraw Hill, Kogakusha, International Students Edition,1976.

Reference Books

1. Apostol T. M., **“**Mathematical Analysis”, Narosa Publishing House, New Delhi, 1985.
2. Burkill J. C. and Burkill H., **“**A second course in Mathematical Analysis”, Cambridge University Press, 1970.
3. Serge Lang, **“**Analysis- I and II”, Addison Wesley Publishing Company, Inc. 1969

12IM305 PROBABILITY AND DISTRIBUTIONS

Credits 4:0:0

Course Objective:

- To equip the students with basic concepts in probability and distributions.

Course Outcome:

- This will help the students to equip the knowledge of basic concepts in probability and distributions which have applications in almost all the domains.

Unit I

PROBABILITY SET FUNCTION: Review of probability set function, random variable and expectations – Tchebyshev's Inequality – Multivariate distributions – some special distributions.

Unit II

DISTRIBUTIONS: Distributions of functions of random variables- Convergence in Probability – Convergence in Distributions–Central Limit Theorem - Limiting distributions.

Unit III

STATISTICAL INFERENCES: Sampling and Statistics-Order Statistics-Tolerance for distributions – More on Confidence Interval – Sufficient Statistics – Measure of Quality of Estimators – A Sufficient Statistic for a parameter – Properties of Sufficient Statistic.

Unit IV

ESTIMATIONS: Maximum likelihood estimations – Rao-Cramer Lower bound and efficiency – Maximum likelihood tests.

Unit V

TESTING OF HYPOTHESIS: Most powerful tests – uniformly most powerful tests – likelihood ratio test – The sequential probability ratio test – Minimax procedure.

Text Book

1. Robert Hogg V. and Allen Craig T., "Introduction to Mathematical Statistics", 5th Edition Pearson Education Asia, 2007.

Reference Book

1. Gupta S.C., Kapoor V.K., "Statistical Methods", S Chand and Sons Co.,(XI Edition), New Delhi, 2002.

12IM306 APPLIED FUZZY MATHEMATICS

Credits 4:0:0

Course Objective:

- To provide the students about the application of fuzzy mathematics to science and engineering.

Course Outcome:

- Students will be familiar with the applications of fuzzy mathematics to controllers, decision making systems, neural networks etc.

Unit I

FUZZY SETS: Basic Types and Basic concepts, Properties of α- cuts, Representation of α-cuts, Extension Principal, Operations on Fuzzy sets- Types of Operations, Fuzzy complements, Fuzzy Intersections, t-norms.

Unit II

FUZZY ARITHMETIC: Fuzzy Numbers, Linguistic Variables, Arithmetic Operations on Intervals & Fuzzzy numbers, Lattice of fuzzy Numbers, Fuzzy equations.

Unit III

APPLICATIONS: multi valued logic – fuzzy propositions – fuzzy quantifiers – linguistic hedges – inference from conditional fuzzy propositions – inference from conditional and qualified propositions – inference from quantified propositions .

Unit IV

FUZZY SYSTEMS: Fuzzy controllers and its examples – fuzzy systems and neural networks – fuzzy neural networks – fuzzy automata – fuzzy dynamic systems.

Unit V

FUZZY DECISION MAKING: individual decision making – multi person decision making – multi criteria decision making – multistage decision making – fuzzy ranking methods.

Text Book

1. George Klir J. and Bo Yuan, “Fuzzy sets and Fuzzy Logic”, “Theory and applications”, Prentice-Hall of India Private Limited, New Delhi, 2005.

Reference Books

1. Zimmermann H.J., “Fuzzy Set Theory and its Applications”, Allied Publishers, Chennai, 1996.
2. George Klir J. and Bo Yuan, “Fuzzy sets and Fuzzy Logic-Theory and Applications”, Prentice Hall India, New Delhi, 2001.

12IM307 MATLAB PROGRAMMING

Credits 0:0:2

Course objectives

- Understand the MATLAB Desktop, Command Window and Graph Windows.
- To do simple and complex computations using MATLAB.
- To do numerical computations and analyze.
- To do problems in differential calculus, integral calculus and differential equations.
- To view, store and access images in MATLAB.

Course Outcome:

- The programming techniques of the students will be improved by studying this paper and Matlab commands will definitely help the students for their projects.

List of Practical Program:

MATLAB PROGRAMING LIST

1. Quadratic equations, Fibonacci series, Area and Volume.
2. Arrays, Matrices(Multiplication, Addition and Inversion).
3. Solving linear equation, Algebraic and Transcendental equations.
4. Differentiation and Integration.
5. Plotting xy-plane, Regression and three dimensional.
6. Curve fitting.
7. Statistics
8. Finding minimum and maximum of a function.
9. Finite Element Analysis.
10. Solving Ordinary differential equation.
11. Solving Partial differential equation.
12. Time series
13. State Flow

12IM308 CONTROL THEORY

Credits 4:0:0

Course Objective:

- To provide the students with an understanding of basic concepts in control theory.

Course Outcome:

- This will motivate the students to identify the problems in which the concepts of control theory are used.

Unit I

OBSERVABILITY: Linear Systems – Observability Grammian – Constant coefficient systems – Reconstruction kernel – Nonlinear Systems.

Unit II

CONTROLLABILITY: Linear systems – Controllability Grammian – Adjoint systems –Constant coefficient systems – steering function – Nonlinear systems.

Unit III

STABILITY: Stability – Uniform Stability – Asymptotic Stability of Linear Systems -Linear time varying systems – Perturbed linear systems – Nonlinear systems.

Unit IV

STABILIZABILITY: Stabilization via linear feedback control – Bass method –Controllable subspace – Stabilization with restricted feedback.

Unit-V

OPTIMAL CONTROL: Linear time varying systems with quadratic performance criteria– Matrix Riccati equation – Linear time invariant systems – Nonlinear Systems.

Text Book

1. Balachandran K. and Dauer J.P., “Elements of Control Theory”, Narosa, New Delhi, 1999.

Reference Books

1. Conti R., “Linear Differential Equations and Control”, Academic Press, London, 1976.
2. Curtain R.F. and Pritchard A.J., “Functional Analysis and Modern Applied Mathematics”, Academic Press, New York, 1977.
3. Klamka J., Kluwer, “Controllability of Dynamical Systems”, Academic Publisher,Dordrecht 1991.

12IM309 DISCRETE MATHEMATICAL STRUCTURES

Credits 4:0:0

Course Objective:

- To provide the students with an understanding of basic concepts in algebra, Boolean algebra, coding theory and finite fields.

Course Outcome:

- This will motivate the students to identify the problems in which the concepts of algebra are used.

Unit I

SET THEORY: Sets – Binary relations – Partially ordered sets – equivalence relations – functions – inductions – algorithms-Partially ordered set introduction – Hasse diagrams – subsets, isomorphism, and order-preserving maps – weak orders – semi ordered- interval ordered – social choice.

Unit II

BOOLEAN ALGEBRA: Finite Boolean algebra – switching circuits – Boolean polynomials and disjunctive normal forms – decomposition of functions – state tables and state diagrams – simple properties

Unit III

GROUP THEORY: Semi groups – groups – subgroups – permutation groups – homomorphisms – counting symmetries – monoids and machines – quotients groups. The Chinese remainder theorem – the integer modulo – Euclidean domain

Unit IV

CODING THEORY: Introduction to coding theory – cryptography – matrix encodings – scrambled codes – the hamming metric – binary group codes – equivalent cods

Unit V

FINITE FIELDS: Structure of finite fields – existence of finite fields – Existence of finite fields – latin squares – field of fractions – polynomial codes – BCH codes

Text Book

1. James Fisher L., "Application Oriented Algebra an Introduction to Discrete Mathematics", A Dun – Donnelley Publisher, New York, 1977.

Reference Books

1. Artin M., "Algebra", Prentice Hall of India, 1991.
2. Bhattacharya P.B.,Jain S.K. and Nagpaul S.R., "Basic Abstract Algebra" (II Edition) Cambridge University Press, 1997. (Indian Edition)
3. Luther I.S. and Passi I.B.S., "Algebra", Vol. I Groups,1996, Vol. II Rings, Narosa Publishing House, New Delhi, 1999
4. Malik D.S., Mordeson J.N. and Sen M.K., "Fundamental of Abstract Algebra", McGraw Hill (International Edition), New York. 1997.
5. Jacobson N., "Basic Algebra", Vol. I & II W.H.Freeman, also published by Hindustan Publishing Company, New Delhi, 1980.

12IM310 RELIABILITY AND QUALITY CONTROL

Credit: 4:0:0

Course Objectives:

- To develop the skills of the students in the area of Quality Control and Reliability.

Course Outcome:

- Knowledge in the technique, methodology and Applications of Quality Control and Reliability.

Unit I

CONTROL CHART TECHNIQUES: Introduction of Quality Control - Shewhart Control Charts for X, R, np, p, c etc., and their uses, OC and ARL of Control Charts, Modified Control Charts, CUSUM procedures, use of V-mask, Derivation of ARL.

Unit II

BASIC CONCEPTS OF ACCEPTANCE SAMPLING: Basic Concepts of Acceptance Sampling, Single, Double, Multiple and Sequential Sampling Plans for Attributes, Curtailed and Semi Curtailed Sampling. Dodge-Romig Tables-LTPD and AOQL protection (Single Sampling Plan only). MIL-STD-105D.

Unit III:

VARIABLE SAMPLING PLANS: Variable Sampling: Assumptions, Single and Double Variable Sampling Plans. Continuous Sampling Plans:CSP-1, CSP-2 and CSP-3. Special Purpose Plans: Chain Sampling Plans, Skip-lot Plans.

Unit IV

RELIABILITY: Concept of Reliability Function and Hazard Function. Mean Residual Life and Mean time to failure and their inter-relationships. Exponential, Gamma and Weibull Failure Models. Models for wear out failures.

Unit V

SYSTEM RELIABILITY: Concepts of System Reliability-Serial, parallel and mixed systems. Reliability and Availability of markovian systems, maintainability, preventive maintenance.

Text Books

1. Montgomary D.C., “Introduction to Quality Control”, John Wiley,1985.
2. Gerstbakh I.B., “Statistical Reliability Theory”, Marcel Dekker Inc., New York,1989.

Reference Books

1. Schilling E.G., “Acceptance Sampling in Quality Control”, Marcel Dekker, 1982.
2. Burr I.W., “Statistical Quality Control Methods”, Marcel Dekker, 1976.
3. Sinha S.K., “Reliability and Life-Testing”, Wiley Eastern Ltd., New Delhi, 1986.
4. Halpern S., “An Introduction to Quality Control and Reliability”, Prentice Hall of India, 1979.
5. Lawless J.R., “Statistical Methods for Lifetime Data”, John wiley & Sons, 1982.

12IM311 MATHEMATICA

Credits 4:0:0

Course objectives:

- To provide the ideas for solving mathematical problems using mathematica.

Course Outcome:

- The programming techniques of the students will be improved by studying this paper and Mathematica commands will definitely help the students for their projects.

Unit I

INTRODUCTION: Running Mathematica - Numerical calculations – Building up calculations – Using the Mathematica system – Algebraic calculations - Symbolic mathematics - Numerical mathematics.

Unit II

MATHEMATICA: Functions and programs – Lists – Graphics – Input and output in notebooks – The structure of graphics.

Unit III

CALCULUS IN MATHEMATICA: Numbers - Mathematical functions – Algebraic manipulation – Manipulating equations -Calculus.

Unit IV

ALGEBRA IN MATHEMATICA: Series, limits and residues - Linear algebra.

Unit V

NUMERICAL OPERATIONS: Numerical operations on data – Numerical operations on functions.

Text Book

1. “The Mathematica Book” by S. Wolfram, Fourth Edition, Cambridge University Press,Cambridge, 1999.

Reference Book

1. “The Mathematica Book” by S. Wolfram, Fifth Edition, Wolfram Media, 2003.

12IM312 SPACE MECHANICS

Credits 4:0:0

Course Objective:

- To provide the student about rocket launching and position of artificial satellite in space.

Course Outcome:

- Students will get the knowledge of satellite dynamics and rocket launching.

Unit I

LEGRANGES EQUATION: Introduction – Classification of a Dynamical system – Lagrange's Equations for Simple system – Principle of Virtual Work – D'Alemberts Principle – Lagrange Equation for General System – Hamilton's Equations – Ignorable Coordinates – The Routhian Function.

Unit II

HAMILTON'S THEOREM: Introduction – Hamilton's principle – Hamilton's principle for a conservative system – principle of least action - characteristic function and Hamilton – Jacobi equation – phase space and liouvilles theorem – special transformations – large brackets – Poisson brackets.

Unit III

LORENTZ THEORY: Some fundamental concepts – the Lorentz transformation – immediate consequences of Lorentz transformation – the mass of a moving particle – equivalence of mass and energy.

Unit IV

THEORY OF ROCKETS: Introduction – equation of a motion for variable mass – performance of a single-state rockets – exhaust speed parameters – effect of gravity – performance of a two-state rockets – optimization of a multi-stage rocket.

Unit V

3 – BODY PROBLEMS: Introduction – mathematical formulation of n-body problem – integrals of motion – the virial theorem – the equation of relative motion – the general three body problem – mathematical formulation of general three-body problem – equations of relative motion of three bodies – stationary solutions of three- body problem.

Text Book

1. Sankara Rao K., "Classical Mechanics", Prentice-Hall of India Privae Limited, New Delhi, 2005.

Reference Books

1. Goldstein H., "Classical Mechanics", (2nd Edition), Narosa Publishing House, New Delhi, 1980.
2. Rane N.C. and Joag P.S.C., "Classical Mechanics", Tata McGraw Hill, 1991.
3. Synge J.L. and Griffth B.A., "Principles of Mechanics", 3rd Editio, McGraw Hill Book Co., New York, 1970.

12IM313 CONVEX ANALYSIS

Credits 4:0:0

Course Objective:

- To provide the students in the knowledge of convexity and concavity in Euclidean spaces.

Course Outcome:

- Students can acquire the knowledge of convex sets & convex functions and apply their properties to the real world problems.

Unit I

CONVEXITY: Affine sets – convex sets and cones – the algebra of convex sets – convex functions – functional operations.

Unit II

APPLICATIONS OF CONVEXSITY: Relative interiors of convex sets – closures of convex functions – recession cones and unboundedness – some closedness criteria – continuity of convex functions

Unit III

SEPARATIONS: Separation theorems – conjugates of convex functions – support functions – polar of convex sets – polars of convex functions – dual operations.

Unit IV

HELLY'S THEOREM: Caratheodory's theorem – extreme points and faces of convex sets – polyhedral convex sets and functions – some applications of polyhedral convexity – Helly's theorem and system of inequalities – Linear inequalities.

Unit V

DIFFERENTIAL THEORY: Directional derivatives and sub gradients – differential continuity and monotonicity – differentiability of convex functions – the Legendre transformation.

Text Book

1. Tyrrell Rockafellar R., "Convex Analysis", Princeton University Press, 1997.

Reference books

1. Tyrrell Rockafellar R., "Convex analysis", Princeton University Press, 1970
2. Jean Baptiste Hiriart Urruty, Claude Lemaréchal, "Fundamentals of convex analysis", Springer , Verlag Berlin Heidelberg, New York, 2001.

12IM314 CALCULUS OF VARIATIONS AND INTEGRAL EQUATIONS

Credits 4:0:0

Course Objective:

- To provide the students about the applications of calculus and functions to the social sciences.

Course Outcome:

- Students will understand the applications of variational principle and Integral equations such as Fredholm type and Volterra type integral equations.

Unit I

CALCULUS OF VARIATIONS: maxima and minima – The simplest case – Illustrative examples – The variational notations – The more general case.

Unit II

APPLICATIONS: Constraints and Lagrange multipliers – Variable and points – Strum Lioville problems – Hamiltion's principles – Lagrange equations.

Unit III

LINEAR INTEGRAL EQUATIONS: Integral equations: Introduction – relation between differential and integral equations – The Green's function – Alternative definition of Green's functions

Unit IV

FREDHOLM EQUATIONS: Linear equations in cause and effect: The influence function – Fredholm equations – with separable kernals – Illustrative examples.

Unit V

FREDHOLM THEORY: Hilber Schmidt theory – Iterative methods – for solving equations of the second kind- Fredholm theory.

Text Book

1. Francis B., Methods of Applied Mathematics, Hildebrand, 1992.

Reference Books

1. Fomin S. V., Richard Silverman A., "Calculus of variations", Courier Dover Publications, 2000.
2. George Ewing M., "Calculus of variations with applications", Courier Dover Publications, 1985.

12IM315 ADVANCED STATISTICS

Credits 4:0:0

Course Objective:

- To provide the students about the utility of the probability theory to the real life problems.

Course Outcome:
- Students will get the knowledge of analysis of variance and test of independence.

Unit I
THEORY OF ESTIMATION: Estimation – Confidence intervals

Unit II
STATISTICAL TESTS: Statistical tests – certain best tests – Uniformly most powerful test Likelihood Ratio tests.

Unit III
SPECIAL TESTS: Chi-square tests – Non central and F – Analysis of variance – Test of stochastic independence.

Unit IV
CONFIDENCE INTERVALS: Confidence intervals for distribution quantities – Tolerance Limits for distribution – sign test – A test of Wilcoxan.

Unit V
APPLICATIONS: Equality of two distributions – Mann – Whitney – Wilcoxan test – distributions under alternative hypothesis – Linear rank statistics.

Text Book
1. Robert Hogg V. and Allen Craig T. "An introduction to Mathematical Statistics", 14th editions, Macmillan Publishing Company, 1978.

Reference Books

1. Dudewicz E.J. and Mishra S.N., "Modern Mathematical Statistics", John Wiley and Sons, New York, 1988.
2. Rohatgi V.K., "An Introduction to Probability Theory and Mathematical Statistics", Wiley Eastern Ltd., New Delhi, 3rd Print, 1988.
3. Roussas G.G., "A First Course in Mathematical Statistics", Addison Wesley Publishing Company, 1973.
4. Vander Waerden B.L., "Mathematical Statistics", G.Allen & Unwin Ltd., London, 1968.

12IM316 DIGITAL GEOMETRY

Credits 4:0:0
Course Objective:
- To provide the students about the knowledge of digital pictures and digital images. Also to provide the students about the knowledge of digitalizing the concepts in topology and geometry.

Course Outcome:

- Students will get the knowledge of digitalizing the concepts in topology.

Unit I
INTRODUCTION: Pictures – Digital Geometry and Related Disciplines – The Grid Point and Grid Cell Models – Connected Components – Digitization Models – Property Estimation.

Unit II
GRIDS: Basics about Metrics – Grid Point Metrics – Grid Cell Metric – Metrics on Pictures.

Unit III
BASIC GRAPH THEORY: Graphs – Adjacency Structures and Adjacency Graph – Some Basic of Graph Theory – Oriented Adjacency Graphs – Combinatorial Graphs – Combinatorial Maps.

Unit IV
INCIDENCE STRUCTURES: Boundaries, Frontiers, and the Euler's Characteristics – The Regular Case – Pictures on Incidence Grids

Unit V
DIGITAL TOPOLOGY: Topology – Digital Topology – Topological Concepts – Combinatorial Topology – Curves in the Euclidean Topology – Curves in Incidence Grids – Curve in Adjacency Grids – Surfaces in the Euclidean Topology – surfaces and Separations in 3D Grids

Text Book

1. Reinhard Klette and Azriel Rosenfeld, "Digital Geometry Geometric Methods for Digital Picture Analysis", Morgan Kaufmann Publishers ,An Imprint of Elsevier, 2004.

Reference Books

1. Yung Kong T., Azriel Rosenfeld, "Topological algorithms for digital image processing", Elsevier Science B. V, 1996.
2. John Goutsias, Luc Vincent M., Dan Bloomberg S., "Mathematical morphology and its applications to image and signal processing", Kluwer Academic Publisher, 2000

12IM317 DIFFERENTIAL AND DIFFERENCE EQUATIONS

Credits 4:0:0

Course Objective:

- To provide the student about difference and differential equations basic logic and their application.

Course Outcome:

- Students will know about the applications difference and differential equations to the real world problems.

Unit I

LINEAR EQUATION WITH REGULAR SINGULAR POINTS: Linear equation with regular singular points: Euler equation - second order equations with regular singular points – Exceptional cases – Bessel equation.

Unit II

EXISTENCE AND UNIQUENESS: Existence and uniqueness of solutions to first order equations: Equation with variables separated – Exact equations – Method of successive approximations – The Lipschitz condition –convergence of the successive approximations and the existence theorem.

Unit III

DYNAMICS OF FIRST ORDER DIFFERENCE EQUATIONS: Introduction – Linear First Order Difference equations – Equilibrium points – Criterion for the Asymptotic stability of equilibrium points – Period points and cycles – The Logistic equation and Bifurcation.

Unit IV

LINEAR DIFFERENCE EQUATIONS OF HIGHER ORDER: Difference calculus – General theory of linear difference equations – Linear homogeneous equations with constant coefficient – Nonhomogeneous equations: Methods of undermined coefficients – Limiting behaviour of variation of constants (parameters) – Nonlinear equations transformable to linear equation.

Unit V

SYSTEMS OF DIFFERENCE EQUATIONS: Autonomous (time-Invariant) systems – The Basic Theory – The Jordan Form: Autonomous (Time-Invariant) – Linear Periodic Systems – Applications.

Text Books

1. Earl Coddington A., “A introduction to Ordinary Differential Equations”, 3rd Printing , Prentice-Hall of India Ltd., New Delhi, 1987.
2. Saber Elaydi N., “An Introduction to Difference Equations”, 3rd Edition, Springer-Verlag, New York Berlin, 2005.

Reference Books

1. Simmons G.F., “Differential Equations with Applications and Historical Notes”, Tata McGraw Hill, New Delhi, 1974.
2. Taishinghania M. D. R., “Advanced Differential Equations”, S. Chand & Company Ltd, New Delhi, 2001.

12IM318 RANDOM PROCESS AND QUEUING THEORY

Credits 4:0:0

Course Objective:

- To provide the students about the application of probability and distribution to the real valued problems.

Course Outcome:

- Students will get the knowledge in random process and queuing techniques.

Unit I

QUEUING SYSTEMS: Elements of a Queuing Model – Role of Exponential Distribution – Pure Birth and Death Models: Pure Birth Model and Pure Death Model.

Unit II

GENERALIZED POISSON QUEUING MODEL – SPECIALIZED POISSON QUEUES: Steady-State Measures of Performance – Single-server Models – Multiple-server. Models – Machine servicing model – (M/M/R):(GDIKIK), R<K – (M/G/1): (GD/infinite/infinite) – Pollaczek-Khintchine(P-K) Formula – Other Queuing Models.

Unit III

DEFINITION OF RANDOM PROCESS AND A RANDOM FIELD: Kolmogorov consistency theorem – poisson process and problems. Markov processes with a finite state space: Definition of a Markov process – infinitesimal matrix – a construction of a markov process – a problem in queuing theory and problems.

Unit IV

WIDE-SENSE STATIONARY RANDOM PROCESSES: Hilbert space generated by a stationary process – law of large numbers for stationary random processes – bochner theorem and other useful facts – spectral representation of stationary random processes – orthogonal random processes – linear prediction of stationary random processes – stationary random processes with continuous time and problems.

Unit V

STRICTLY STATIONARY RANDOM PROCESSES: stationary processes and measure preserving transformations – birkhoff ergodic theorem – ergodicity, mixing, and regularity – stationary processes with continuous time and problems

Generalized random processes: generalized functions and generalized random processes – Gaussian processes and white noise.

Text Book

1. Leonid Koralov B., Yakov Sinai G., "Theory of probability and random processes", 2nd edition, Springer Berlin Heidelberg, New York, 2007.

Reference Books

1. Oliver Ibe C., "Fundamentals of Applied probability and Random processes", Elsevier, First Indian Reprint, 2007.
2. Miller S.L and Childers S.L., "Probability and Random Processes with applications to Signal Processing and Communications", Elsevier Inc., First Indian Reprint 2007.
3. Yates and Goodman D.J., "Probability and Stochastic Processes", John Wiley and Sons, Second edition, 2005.

LIST OF SUBJECTS

Sub. Code	Name of the Subject	Credits
12MA359	Research Methodology IV	4:0:0
13MA201	Basic Mathematics to Engineering	3:1:0
13MA202	Calculus and Statistics	3:1:0
13MA301	Applied Mathematics	4:0:0
13MA302	Applied Mathematics	4:0:0
13MA303	Optimization Techniques	4:0:0

12MA359 RESEARCH METHODOLOGY – IV

Credits: 4:0:0

Objective:

- To learn about the introduction to research, literature reviews.
- To learn about research designs and data analysis and various problem solving methods.
- To learn about how to write research papers and presentation methodology.
- To learn about the basic concepts of Groups and Ring Theory.

Outcome:

- Students can get the knowledge of research work, writing research paper and basic algebra.

Unit I

INTRODUCTION TO RESEARCH: Introduction – Objective of Research – Types of Research – Research Methods and Research Methodology – Identification of Research Topic and Problems – Various Stages of Research – Literature Survey – Reference Collection – Mode of Approach – Research Design.

Unit II

PRESENTATION AND RESEARCH PAPER WRITING: Presenting a Scientific Seminar – Oral Report – Art of Writing a Research Paper and Thesis – Characteristics of a Good Report – Layout of a Research Report – Typing the Report – Acknowledgement – Appendices – References/Bibliography.

Unit III

GROUP THEORY: Introduction to Groups, Semi-groups and Monoids – Finite Groups; Subgroups – Cyclic Groups – Group Homomorphism – Isomorphism – Cosets and Lagrange's Theorem – Normal Subgroups and Factor Groups – External Direct Product of groups.

Unit IV

IDEALS AND HOMOMORPHISM OF A RING: Ideals – Sums and Direct Sums of Ideals – Ideals Products and Nilpotent Ideals – Some Conditions on Ideals – Ideals in Complete Matrix Rings – Residue Class Rings – Homomorphism – Prime Ideals and m-systems – Semi-prime Ideals.

Unit V

JACOBSON AND PRIME RADICALS OF A RING: Prime Radical – Prime Rings – The Descending Chain Condition and the Prime Radical - Jacobson Radical – Preliminary Concepts, Definitions and Simple Properties, Further Properties of the Jacobson Radical, The Descending Chain Condition.

Text Books:

1. C. R. Kothari, "Research Methodology: Methods and Techniques", New- Age International, 2008.
2. Herstein I.N., "Topics in Algebra", II Edition. Wiley Eastern Limited, New Delhi, 2000.
3. Neal H.McCoy, The Theory of Rings, The MacMillan Company, New York, 1964.

Reference Books:

1. R. Burns, "Introduction to Research Methods", Addison Wesley Longman, 3rd Edition, 1997.
2. Artin M., "Algebra", Prentice Hall of India, 1991.
3. Bhattacharya P.B., Jain S.K. and Nagpaul S.R., "Basic Abstract Algebra" (II Edition) Cambridge University Press, 1997 (Indian Edition).
4. Malik D.S., Mordeson J.N. and Sen M.K., "Fundamental of Abstract Algebra", McGraw Hill (International Edition), New York. 1997.
5. Jacobson N., "Basic Algebra", Vol. I & II W.H.Freeman (1980); also published by Hindustan Publishing Company, New Delhi.

13MA201 BASIC MATHEMATICS TO ENGINEERING
(Common to all branches in B. Tech.)

Credits: 3:1:0

Objective:

- To provide the students with the Basic Knowledge and an understanding of Algebra, Calculus, Taylor's Series and Partial Differentiation, Vectors and Matrix Algebra.

Outcome:

- Students will be able to relate their subject knowledge with their engineering subjects during their course of study.

Unit I

ALGEBRA: Simple functions and equations – Trigonometric identities – Coordinate geometry – Partial fractions – Binomial expansion – Properties of Binomial coefficients.

Unit II

CALCULUS: Differentiation from the first principle – Rules of differentiation: Addition rule – Product Rule – Quotient rule – Chain rule – Implicit differentiation – Logarithmic differentiation – Integration as the reverse process of differentiation – Methods of integration – Integration by parts.

Unit III

TAYLORS SERIES AND PARTIAL DIFFERENTIATION: Taylor's series for functions of one variable – Standard Maclaurin series – Partial derivatives – Total differentiation and Total derivative – Chain rule – Change of Variables – Taylor's series for functions of two variables.

Unit IV

VECTORS: Scalars and Vectors – Addition and subtraction of vectors – Multiplication by a scalar – Magnitude of a vector – Multiplication of vectors – Equations of lines and planes.

Unit V

MATRIX ALGEBRA: Introduction to matrices – Matrix addition – Multiplication by a scalar – Matrix multiplication – The transpose of a Matrix – The trace of a matrix – The determinant of a matrix – Properties of determinants(Excluding the proof) – The inverse of a matrix – The rank of a matrix – Special types of square matrix – Eigen values and Eigen vectors (Problems only).

Text Book

1. Lecture Notes on "Basic Mathematics to Engineering", Department of Mathematics, Karunya University, 2013.

Reference Books

1. Hepzibah Christinal A, Selvamani R, Porselvi K, "Basic Engineering Mathematics", HIS Publications, Coimbatore, 2011.
2. Grewal. B.S, "Higher Engineering Mathematics", 40th Edition, Khanna Publications, Delhi, 2007.
3. James Steward, "Calculus", 5th Edition, Thomson Brooks/Cole, Micro Print Pvt. Ltd., Chennai, 2003.
4. Riley K F, Hobson M P and Bence S J, "Mathematical Methods for Physics and Engineering, 2nd Edition, Cambridge Low - Price Editions, Cambridge University Press, 2004.

13MA202 CALCULUS AND STATISTICS
(Common to all branches in B. Tech.)

Credits: 3:1:0

Objective:

- To provide the students with the concept and an understanding of differential equations, Beta and Gamma Integrals, Multiple integrals, and Statistics for Analysis and Modeling in Technology.

Outcome:

- Students will be able to relate their subject knowledge with their engineering subjects during their course of study.

Unit I
ORDINARY DIFFERENTIAL EQUATIONS: Higher order linear differential equations with constant coefficients – Method of variation of parameters – Cauchy's and Legendre's linear equations – Simultaneous first order linear equations with constant coefficients.

Unit II
DOUBLE AND TRIPLE INTEGRALS: Double integral in Cartesian and polar co-ordinates – Change of order of integration – Triple integrals in Cartesian co-ordinates –Evaluation of double integrals by using change of variables between Cartesian and polar coordinates.

Unit III
BETA AND GAMMA INTEGRALS: Definitions of Beta and Gamma integrals – Properties – Relation between beta and gamma integrals – Evaluation of definite integrals in terms of beta and gamma functions.

Unit IV
PARTIAL DIFFERENTIAL EQUATIONS: Formation of partial differential equations – Solution of partial differential equations – Lagrange's linear equation – Non-linear equations of the first order(excluding Charpit's method) – Homogeneous linear equations with constant coefficients.

Unit V
STATISTICAL METHODS: Introduction – Graphical representation of data – Measures of central tendency – Measures of dispersion – Correlation – Regression – Rank correlation.

Text Book:

1. Grewal. B.S, "Higher Engineering Mathematics", 40th Edition, Khanna Publications, Delhi, 2007.

Reference Books

1. Veerarajan T., "Engineering Mathematics", Tata McGraw Hill, New Delhi, 2011.
2. Kandasamy P., Thilagavathi K and Gunavathi K., "Engineering Mathematics", 9th Revised Edition, S Chand & Co., New Delhi, 2010.

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13MA301 APPLIED MATHEMATICS
(For M.Tech. Structural Engineering)

Credits: 4:0:0

Objective:

- To familiarize the students in the fields of advanced calculus, Numerical Integration and eigen value problems to solve problems associated with engineering applications.

Outcome:

- Students will be able to relate their subject knowledge with their engineering subjects during their course of study.

Unit I

ONE DIMENSIONAL WAVE AND HEAT EQUATIONS: One dimensional wave equation – Displacements in a finite stretched string with fixed ends – One dimension heat equation – Steady and unsteady states problems of insulated rods.

Unit II

TWO DIMENSIONAL HEAT EQUATIONS: Laplace equations in cartesian and polar coordinates – Steady state temperature distribution in infinite strips; in finite strips; in circular and semicircular plates.

Unit III

CALCULUS OF VARIATIONS: Concept of variation and its properties – Euler's equation – Functional dependant on first and higher order derivatives – Functionals dependant on functions of several independent variables – Variational problems with moving boundaries –Direct methods: Kantorovich Method.

Unit IV

EIGEN VALUE PROBLEMS: Methods of solutions: Faddeev – Leverrier method, Power method with deflation – Approximate method: Rayleigh – Ritz method.

Unit V

NUMERICAL INTEGRATION: Gaussian quadrature – One and Two dimensions – Gauss Hermite quadrature – Monte Carlo method – Multiple integration by using mapping function.

Text Books

1. Grewal B S, "Higher Engineering Mathematics", 40th Edition, Khanna Publications, Delhi, 2007. (for Unit I and Unit II).
2. Rajasekaran S, "Numerical Methods in Science and Engineering A Practical Approach", A.H.Wheeler and Company Private Limited, 1986. (For Unit IV and Unit V).
3. Gupta A S, "Calculus of Variations with Applications", Prentice Hall of India Pvt. Ltd., New Delhi, 1997. (for Unit III)

Reference Books

1. Kandasamy P, "Engineering Mathematics," Volume – III, S. Chand & Co., New Delhi, 2010.
2. Venkatraman M K, "Higher Mathematics for Engineering and Science" National Publishing Company, 2002.

13MA302 APPLIED MATHEMATICS
(For M.Tech. in Electrical Branches)

Credits: 4:0:0

Objective:

- To familiarize the students in the fields of Matrices, Computational Methods, Linear programming, random variables and Queuing models to solve the problems associated with engineering applications.

Outcome:

- Students will be able to relate their subject knowledge with their engineering subjects during their course of study.

Unit I

MATRICES: Introduction – Special matrices – Laws of a matrix – Determinant – Properties (Excluding the proof) – Eigen values and Eigen vectors – Eigen-values using QR transformations – Decompositions of symmetric matrices: Cholesky Method, Crouts Procedure – Transformation of the Generalized eigen value problem to a standard problem.

Unit II

COMPUTATIONAL METHODS IN ENGINEERING: Boundary value problems – Classifications of Linear second order partial differential equations – Finite Difference Method – One dimension – Two dimensions – Elliptic Equations – Parabolic equations - Hyperbolic equations (Excluding the programming parts).

Unit III

LINEAR PROGRAMMING: Two Variable LP Model – Graphical LP Solution – Simplex Method – Two Phase Method – Transportation and Assignment Models.

Unit IV

ONE DIMENSIONAL RANDOM VARIABLES: Random variables - Probability function – Moments – moment generating functions and their properties – Binomial, Poisson, Geometric, Uniform, Exponential, Gamma and Normal distributions – Function of a Random Variable.

Unit V

RANDOM PROCESS AND QUEUEING MODELS: Classification of Random Processes- Poisson process- Properties(Excluding the proof)- Queuing Models: Poisson Queuing Systems- (M/M/1):(∞/FIFO), (M/M/s):(∞/FIFO), (M/M/1):(k/FIFO), (M/M/s):(k/FIFO) – Problems (Excluding the derivations).

Text Books

1. Rajasekaran.S, “Numerical Methods in Science and Engineering A Practical Approach”, A.H.Wheeler and Company Private Limited, 1986. (for Units I & II).
2. Taha, H.A., “Operations Research – An Introduction”, Prentice Hall of India (P) Limited, New Delhi, 8th Edition, 2008. (for Unit III).
3. Veerarajan T, “Probability, Statistics and Random Processes” 2nd Edition, Tata McGraw Hill, New Delhi, 2006. (for Units IV and V).

Reference Books

1. Bronson R., “Matrix Operation, Schaum’s outline series’, McGraw Hill, New York, 1989.
2. Walpole R E, Myers R H, Myers S L, and Ye K, “Probability and Statistics for Engineers & Scientists”, Asia, 8th Edition, 2007.
3. Grewal, B S, “Numerical Methods in Engineering and Science”, 7th Edition, Khanna Publishers, 2002.
4. Donald Gross and Carl M. Harris, “Fundamentals of Queuing theory”, 2nd Edition, John Wiley and Sons, New York, 1985.

13MA303 OPTIMIZATION TECHNIQUES

Credits: 4:0:0

Objective:

- To familiarize the students in the fields of Dynamic programming, Inventory models, Decision Theory, Queuing Models and Non-linear programming to solve the problems associated with engineering applications.

Outcome:

- Students will be able to relate their subject knowledge with their engineering subjects during their course of study.

Unit I

DETERMINISTIC DYNAMIC PROGRAMMING: Recursive nature of computations in Dynamic Programming – Forward and backward recursion – Cargo Loading Model – Problem of dimensionality – Application to LPP.

Unit II

DETERMINISTIC INVENTORY MODELS: General inventory model – Role of demand in the development of inventory models – Static EOQ models – Dynamic EOQ models: No setup model – Setup model – Dynamic programming algorithms with constant or decreasing marginal costs.

Unit III

DECISION ANALYSIS AND GAMES: Decisions under certainty – Analytic Hierarchy Process(AHP) - Decision making under risk – Decision tree analysis – Decision under uncertainty - Game theory: Two person zero sum games – Mixed strategy games – Graphical method - Linear programming solution of games.

Unit IV

QUEUING MODELS: Introduction – Elements of a queuing model – Role of Exponential distribution – Pure birth and death models (excluding the derivation) – Generalized Poisson queuing model – Specialized Poisson queues – Pollaczek Khintchine (P-K) formula (without proof).

Unit V

NONLINEAR PROGRAMMING: Unconstrained problems: Necessary and Sufficient conditions to have extrema (excluding the proof) – The Newton Raphson method - Constrained problems: Jacobian method – Application to LPP - Lagrangean method – Inequality constraints – Karush-Kuhn-Tucker (KKT) conditions(excluding derivations) - Non linear programming algorithms: Unconstrained algorithms: Gradient method – Constrained algorithms: Separable convex programming – Quadratic programming.

Text Books

1. Taha H A, “Operations Research – An Introduction”, 8th Edition, Prentice Hall of India (P) Limited, New Delhi, 2008.

Reference Books

1. Gupta P K and Hira D S, “Practical problems in Operations Research”, Sultan & Chand Sons, New Delhi, 2008.
2. Singaresu Rao, S. “Engineering Optimization”, 3rd Edition, New Age International (P) Ltd., New Delhi, 1996.