Course Structure and Code of UG (BE, B. Ph., B. Arch., Bio. Tech.)

1.	MA 1101	Mathematics I (BE)
2.	MA 1103	Remedial Mathematics (B Ph)
3.	MA 1104	Remedial Mathematics Sessional (B Ph)
4.	MA 1105	Mathematics for Architect (B. Arch.)
5.	MA 1201	Engineering Mathematics
	MA 2101	Mathematics-II(BE)
6.	MA 2103	Mathematics-I (B Ph)
7.	MA 2201	Advanced Engineering Mathematics
8.	MA 3101	Mathematics III(BE)
9.	MA 3103	Mathematics-II(B Ph)
10.	MA 3105	Statistics for Biologists [Bio-Tech]
11.	MA 4101/CS 4103	Scientific Computing
12.	MA 4102/ CS 4104	Scientific Computing Lab
13.	MA 4103/CS 4101	Discrete Mathematical Structures
14.	MA 4105/IT 4101	Discrete Mathematics & Graph Theory
15.	MA 4107	Industrial Statistics (Production Engg.)
16.	MA 4109	Probability, Statistics And Numerical Techniques
17.	MA4110	Probability, Statistics And Numerical Techniques Lab
18.	CL 4011	Numerical methods for Chemical Engineers
19.	MA 5101	Finite Element Methods & Statistics
20.	MA 5103	Computation Methods
21.	MA 5104	Computation methods Lab
22.	MA 5105	Numerical Techniques in Engineering
23.	MA 5106	Numerical Techniques in Engineering lab
24.	MA 6101	Operations Research
25.	MA 7101	Optimization Techniques

MA 1101 Mathematics I (BE)

Analytical Trigonometry:

Module I

De-Moivre's Theorem and its applications. Expansion of Sinx and Cosx in powers of x. Complex arguments. Separation into real and imaginary parts Gregory's Result. Expansions. Summation of trigonometric Series. Hyperbolic functions. [8L]

Differential Calculus:

Module II

Successive Differentiation. Leibnitz's Theorem. Rolle's Theorem. Lagrange's and Cauchy's Mean value Theorem. Generatalised Mean value Theorem. Taylor's and Maclaurin's infinite series. [4L]

Module III

Cartesion and polar subtangenent and Subnormal. Pedal equations. Orthogonal intersection of curves. Curvature and radius of Curvature in case of Cartesian parametric, polar, pedal and trangential polar forms. Centre of curvature and evolute. Indeterminate forms L Hospital's Rule. Concavity, convexity and points of inflexion. Asymptotes (cartesian Co-ordinates only). [5L]

Module IV

Functions of two variables. Partial derivatives. Euler's Theorem on Homogeneous functions. Its generalisation and extension. Total differential and derivatives. Errors and Approximations. Jacobians. [4L]

Module V

Taylor's series in case of two variables. Maxima and Minima of two variables. Lagrange's method of Undertermined multipliers in case of two and three variables. Envelope of curves. Tangent planes and Normal lines. [4L]

Module VI

Integral Calculus:

Reduction Formula. Beta and gamma functions. Area, length, volume and surface area without the use of multiple integrals. [5L]

Module VII

Infinite series:

Convergency and Divergency of infinite series. Tests for Convergence. Comparison Test, p series test, Cauchy's root test. D' Alembert's ratio test, Razabe's Test, Gauss's Test, Logarithmic and Higher logarithmic ratio test (No proof). Leibnitz's Rule for alternating series test. [5L]

Books Recommended

1. Higher Trigonometry. Das and Mukherjee (U.N. Dhur & Co.)
2. Differential Calculus. Pran Nath and Agarwal. Tara Publications, Varanasi
3. Integral Calculus. Das and Mukherjee (U.N. Dhur & Co.)
4. Engineering Mathematics. H.K. Dass
5. Higher Engineering Mathematics B.S. Grewal (Khanna Publishers)

MA 1201 Engineering Mathematics (3-1-0-4)

Module I

Sequences, bounded sequences, upper and lower bounds, monotonic sequences, limits of a sequence, convergence of sequence, Cauchy's general principle of convergence, Cauchy's theorems on limits (No proof). [3L]

Module II

Convergence of series of real numbers of positive terms. P series test, comparison tests, Cauchy's root test, D' Alembert's ratio test, Raabe's test. Gauss's Ratio Test, Logarithmic and Higher logarithmic Ratio Test, Absolute and conditional convergence, Leibnitz's Rule for Alternating series Test. [6L]

Module III

Generalized Mean Value Theorem, Maclaurin's series, Taylor's series of functions.
Functions of several variables, level cures, limits, countinuity. Partial Derivatives. Euler's theorem on Homogeneous functions, chain Rule, transformation of independent variables, Total differential. Jacobians Taylor's series in two or more variables. Maximum, minimum and saddle points of functions of two variables. Several independent variables Lagrange's method of Undetermined Multipliers. [8L]

Module IV

Beta and Gamma functions, Double integrals, area, change of order of integration, Evaluation of integrals by transforming into polar co-ordinates. Evaluation of Triple integrals. Volume and surface area by double and Triple integration by transforming in to cylindrical and spherical polar co-ordinates. [5L]

Module V

Sketching polar equations of conic section, equation of tangent and normal line to a conic section equation of tangent and normal line to a conic section including chord of contact, director circle and asymptote. [4L]

Model VI

First order differential equations linear and Bernoulli's equation, Reduction of order curvature, normal vector, torsion and TNB frame, tangential and normal components of velocity and acceleration, radical and transverse acceleration. Motion in polar. And cylindrical coordinates. Directional derivatives, Gradient, Divergence and curl. Expansions, identities. Tangent plane and normal lines Gradient, divergence and curl in curvilinear co-ordinates. [5L]

Module VII

Line integrals, Work, Circulation, Flux, Paths independence, Potential function, Conservative field, Green's theorem in plane, surface and volume integrals Gauss's Divergence theorem, Stoke's theorem. Applications. [4L]

Text Books:

1: M.D. Weir, J. Hass and F. R. Giordano: Thomas' Calculus, 11th editionh, Pearson Educations, 2008.
2: Dennis G. Zill, Warren S. Wright: Advanced Engineering Mathematics, 4th edition. Jones Nad Bartlertt Publishers, 2010
3: E. Kreyszig: Advanced Engineering Mathematics, 8th Edition John Wiley and sons 1999.
4: T.M. Apostol: Calculus Vols 1 and 11.2nd Edition. John Wiley and sons, 1967 and 1969,

MA 1103 Remedial Mathematics(B.Ph.)

Algebra:

Module I

Complex number; Definition, Fundamental operations with complex numbers, modulus. Amplitude, conjugate of a complex number, Graphical representation of complex numbers. Demoivre's theorem, Roots of complex numbers. [5L]

Module II

Arithmetic, Geometric and Harmonic progressions, Binomial theorem, Exponential and logarithmic series. [4L]

Co-ordinate Geometry (Two dimensional):

Module III

Cartesian & Polar Co-ordinates, Distance between two points, Area of a triangle, Equation of a straight line, Angle between two lines, Distance of a point from a straight line,Equations of circle, parabola, ellipse, and Hyperbola. [6L]

Determinants and Matrices:

Module IV

Determinants and their properties. Cramer's rule,
Types of matrices. Addition, Multiplication, Transpose, Adjoint and Inverse of a matrix,
Solution of linear system of equations by matrix inversion method. [5L]

Trigonometry:

Module V

Circular Functions, trigonometric functions and equations,
Sides of a trangle and T-ratios, Inverse trigonometric functions, multiple and submultiple angles. [6L]

Differential Calculus:

Module VI

Function, Limit and Continuity, Differential coefficients, Differentiation of Algebraic Inverse and Transcendental functions, Differentiation by substitution, Differentiation of Implicit functions. Logarithmic differentiation, Differentiation of parametric function. [6L]

Module VII

Geometrical meaning of the derivative Equation of tangent and normal lines to a curve. Rate measure and approximations. [3L]

Books Suggested:

1. Agarwal: "Senior Secondary School Mathematics," Bharti Bhawan Publications
2. Sharma: "Mathematics," Dhanpat Rai Publication
3. Sinha: "A Text Book of Algebra and Coordinate Geometry," Students Friends Publications.
4. Das Mukherjee: "Differential Calculus, " U.N. Dhar Publications.

MA 1104 Remedial Mathematics Sessional (B Ph)

MA 1105 Mathematics for Architect (B. Arch.)

Module I

Matrix: Adjoin, Transpose and Inverse of Matrices, Orthogonal matrix, Rank of Matrix, Consistency and Inconsistency of a linear Equation. Eigen Value and Eigen Vector. [6L]

Module II

Statistics & Probability: Measure of Central Tendency and Measure of Dispersion. Kurtosis, Curve fitting, Method of least Squares (Straight Line and Parabola), Correlation and Regression. [5L]

Module III

Differential Calculus: Successive differentiation, Leibnitz's Theorem, Tangent and Normal, Curvature (Cartesian and parametric forms only), Indeterminate forms [4L]

Module IV

Taylor's and Maclaurin's expansion, Maxima, Minima for a function of one variable, Point of Inflexion , Concavity and Convexity. [5L]

Module V

Partial differentiation, Euler's Theorem, Total Differential Coefficient, Change of variables, Telor's and Maclaurin's expansion for two variable, Maxima, Minima for a function of two variable. [5L]

Module VI

Integral Calculus: Reduction Formula. [4L]

Module VII

Introduction to Double and Triple integrals. Calculation of areas in simple cases without the use of multiple integrals. [6L]

Books Recommended

1. Differential Calculus. Das and Mukherjee (U.N. Dhur & Co.)
2. Integral Calculus. Das and Mukherjee (U.N. Dhur & Co.)
3. Engineering Mathematics. H.K. Dass
4. Higher Engineering Mathematics B.S. Grewal (Khanna Publishers)
5. Probability and statistics-Gupta and kapur

MA 2101 Mathematics-II(BE)

Integral Calculus:

Module I

Operations under the sign of integration, Multiple integrals, change of order of integration, Transformation of Co-ordinates, Area, Volume and Surface area of solids using multiple integrals. [5L]

Ordinary Differential Equations:

Module II

Linear differential equations: Bernoulli's from Exact equations, Nonlinear equations, Clairaut's form, Higher order equations with constant coefficients. Cauchy's and Legendre's differential equations. Solution of higher order equation by the change of independent variable, Method of variation of Parameters in Simple cases. Applications to Engieering problems. [7L]

Module III

Series solution of Differential equations by the method of Frobenius.(Roots differing by non integer and equal roots). [4L]

Algebra of Matrices:

Module IV

Rank of a matrix. Consistency and inconsistency of a system of linear equations. Eigen values and eigen vectors. Cayley Hamiliton Theorem. [4L]

Vector spaces:

Module V

Definition, examples and some simple properties. Subspaces, linear combination, linear dependence and independence, Basis and dimension. Norm of a vector, Inner Product. Cauchy-schwartz inequality, orthogonal sets. Gram-schmidt process of construction of orthogonal sets. Parallelogram law and Pythagorian theorem. [5L]

Vector Calculus

Module V

Differentiation of vectors, Radial and transverse, tangential and normal acceleration of a particle moving on a plane curve. Directional derivatives, Gradient, Divergence and Curl. Expansion Identities. Vector integration. Conservative system of forces. Solenoidal and Irrotational vectors. Theorems of Green, Stoke and Gauss and their applications. [7L]

Tensor Analysis

Module I

Tensors, transformation of Co-ordinates, contravariant and covariant vectors and Tensors. Rank of a tensor. Addition and multiplication of tensors. Mixed tensors Contraction. [3L]

Books Recommended

1. Advanced Engineering Mathematics byE. Kreyszig
2. Advanced Mathematics for Engineers By Chandrika Prasad (Prasad Mudranalaya)
3. Advanced Engineering Mathematics By H.K. Das.

MA 2201 ADVANCED ENGINEERING MATHEMATICS

Module I

Linear Differential Equations of Higher Order with constant coefficients Differential Equations with Variable Coefficients: Reducible to Equations with Variable Coefficients:- Cauchy – Euler Differential Equation. Legendre Linear Differential Equation. Solution of Differential Equation by transformation (or, change) of Independent Variable. [5L]

Module II

Reduction of Differential Equation to Normal Form (by reducing the order of the Differential Equation). Solution by the method of Variation of Parameters. Series Solution of differential Equations. [5L]

Module III

Bessel's differential Equation and its General solution**.** Bessel's Functions and its properties. Legendre's Differential Equation and Legendre Polynomials. Properties of Legendre Polynomials. Introduction to Hypergeometric Equation. Introduction to Hermite Differential Equations. Introduction to Chebyshev Polynomials. [5L]

Module IV

Eigen Values and Eigen Functions. Sturm – Liouville Problems.

Periodic Functions. Dirichlet's Conditions on Fourier Series. Euler's Formulae for Fourier Coefficients. Half – range Series. Fourier Series of Functions with Arbitrary period. [5L]

Module V

Function of Complex Variables. Limit, Continuity, Differentiability of a Complex Variable. Cauchy – Riemann Differential Equations in Cartesian and Polar Forms. Analytic Function. Cauchy's Integral Theorem. Cauchy's Integral Formula. [5L]

Module VI

Taylor Series, Laurent Series. Residues, Poles, Residue Theorem. Residue at Poles. Contour Integrals of Trigonometric $(0 \text{ to } 2\pi)$ and Algebraic Equations $(-\infty \text{ to } \infty)$. Conformal Mapping and Bilinear Transformation. [5L]

Module VII

Partial Differential Equation, Lagrange's Method, Homogeneous and Non-homogeneous Higher Order Equations(with Constant Coefficients). One dimensional Heat Equation. One dimensional Wave Equation [5L]

Text Books:

1. Simmons G. F., Differential Equations with Applications and Historical Notes. TMH, 2nd ed., 2003.
2. R. V. Churchill and J. W. Brown, Complex Variables and Applications, 8th ed., 2009, McGraw – Hill.
3. Dennis G. Zill, Warren S. Wright, Advanced Engineering Mathematics,4th ed.2011
4. E. Kreyszig, Advanced Engineering Mathematics, Jhon Wiley and Sons, 8th ed., 1999

Reference Books:

1. Edwards and Penney, Differential Equations and Boundary Value Problems, Pearson Education, 3rd ed.
2. Shepley L. Ross, Differential Equations Wiley India Pvt. Ltd., 3rd ed.
3. Birkhoff and Rota, Ordinary Differential Equations, Wiley India Pvt. Ltd., 4th ed.
4. Zill, Differential Equations, Thomson Learning, 5th ed., 2004
5. A.D. Wunsch, Complex Variables with Applications, Pearson Education Inc., 3rd ed.
6. M.J. Ablowitz and A.S.Fokas, Complex Variables Introduction and Applications, Cambridge Texts, 2nd ed.
7. Murray R Spiegel, Theory and Problems of Vector Analysis and an Introduction to Tensor Analysis, McGraw-Hill, Schaum's Outline Series.

MA 2103 Mathematics I (B.PH.)

Integral Calculus:

Module I

Integration as the inverse process of differentiation. Integration by the methods of substitution. By parts and by partial fractions. [5L]

Module II

The definite integrals and their simple applications to area. Length of curves. Volume and surface of revolution. [5L]

Differential Equations:

Module III

First order Orinary Differential Equations: Equations of first order and first degree. Equations with separable variables. Homogeneous. Linear and exact equations. [5L]

Module IV

Second order linear equations with constant coefficients. Simple applications in growth and Decay problems etc. [5L]

Laplace transfoms:

Module V

Definition. Transfrorms of elementary functions. Properties of linearity and shifting [5L]

Module VI

Inverse Laplace transforms, transforms of derivatives. [5L]

Module VII

Solution of ordinary and simultancous differential equations. [5L]

Suggested Books:

1. Integral calculus by Das and Mukherjee (U.N. Dhar Publications)
2. Differential equations By Schaum. McGraw Hill
3. The use of Integral transforms, By I.N. Sueddon. Tata McGraw Hill
4. Higher Engineering Mathematics. By B.S. Grewal. Khanna Publishers.

MA 3101 Mathematics III (BE)

Special Functions:

Module I

Bessel's equation: solution and Bessel's function of the first kind, Recurrence relations. Orthogonality of Bessel's Functions. Generating function and Bessel's integral. [4L]

Module II

Legendre's equation: solution and Legendre's polynomials, Rodrigue's Formula. Orthogonarity relations. Generating function and recurrence relation.

Definition of Hankekl's function.

Elliptic Integral of the first and second kind. Jacobi's form of elliptic integrals. [4L]

Complex Variables:

Module III

Continuity, differentiability and analyticity of a function of a complex variable, Cauchy Riemann differential equations in Cartesian and polar forms. Harmonic functions, Bilinear and conformal transformations. [4L]

Module IV

Complex integration, Cauchy's integral theorem and formula. Derivatives. Taylor's and Laurent's Series. Poles and Singularities. Cauchy's Residue Theorem. Contour integration (Poles on real axis excluded) [4L]

Partial differential equations:

Module V

Formation of partial differential equations. Lagrange's first order linear equations. Non linear equations. Higher order differential equations with constant Co-efficients. Non homogeneous equations. Solution by separation of variables. Boundary value Problems. wave equation in one dimension and its solution. Derivation of one dimensional heat equation and its solution. [7L]

Fourier Series and Fourier Transform:

Module VI

Periodic functions Existence conditions Euler's formulae. Half range series. Fourier series of functions with arbitrary period.

Fourier Integral Formula, Fourier Transform, Inversion Theorem, Fourier sine and cosine transforms and inversion formulae, Linearity property, Convolution or Faltung theorem. Relationship between Fourier and Laplace transform. Finite Fourier Transforms. Heaviside, Unit step function and Dirac Delta Function (8L)

Statistics:

Module VII

Mean and variance. Moments. Concept of Random variable. Probability density and Distribution functions Problems, Elements of error analysis (4L)

Books Recommended:

1. Engineering Mathematics – E. Kreyszig
2. Advanced Engineering Mathematics – C. Prasad
3. Fourier Transforms – I.N. Sneddon

MA 3103 Mathematics II (B.Ph.)

Biometrics:

Module I

Definition of data. Data organization, diagrammatic representation of data, bar. Pie. 2-D and 3-D diagrams. Measures of central tendency measures of dispersion standard deviation. Coefficient of variation, kurtosis skewness. [5L]

Module II

Correlation and regression analysis, method of least squares, statistical inference. [5L]

Module III

Probability and events, Baye's Therem, probability Theorems, probability distributions. [4L]

Module IV

Elementary ideas of binomial, Poisson and normal distribution.
Student's and paired t-test, elements of ANOVA.
Applications to pharmaceutical sciences. [6L]

Numerical Analysis:

Module IV

Numerical solutions of simple algebraic and transcendental equations by graphical and Newton-Raphson methods, Solution of system of simultaneous linear equations by Gauss-Seidal Method [7L]

Module IV

Interpolation, Newton's forward and backward interpolation formula. [3L]

Module IV

Numerical differentiation, Integration by Trapezoidal and Simpson's $1/3^{rd}$ rule. [5L]

Suggested Books

1. Pharmaceutical statistics – Practical and climical applications. 3^{rd} Editions By Marcel and Dekker, Stanford Bolton
2. Biostatistics – A foundation for analysis in Health sciences, By Daniel. John Willey
3. Mathematical statisties by Gupta and Kapoor
4. Numerical methods for Engineering problems By Raju and Muthu. Macmillan India Ltd.

MA 3105 **Statistics for Biologists [Bio-Tech-III]**

Population and samples, Types of variables, Plotting the data, Probability, Random samples, Bionomial, Poisson and normal distributions, Chi-squared tests: goodness-of-fit tests and contingency tables, Sampling distributions, Standard error, Confidence intervals for means, Significance tests on means, students't distribution, Analysis of variance, Fisher's F distribution, Simple linear regression, Correlation coefficient, Non parametric tests.

MA 4101 Scientific Computing

A– Numerical Computing

Module – I

High Speed Computation: Introduction, Computer Arithmetic, Errors, Machine Computation.

Transcendental and Polynomial Equations: Introduction, Bisection Method, Iterative Methods, Rate of Convergence, Methods for Complex Roots, Polynomial Equations. [4L]

Module –II

System of Linear Algebraic Equations and Eigenvalue Problems: Introduction, Direct Methods, Error analysis,j Iteration Methods, Eigenvalues and Eigen Vectors. Interpolation and Approximation: Introduction to Lagrange and Newton Interpolations, Finite difference operators, Interpolating polynomial using finite differences, Hermit interpolations, Piecewise and spine interpolation. [6L]

Module – III

Differentiation and Integration: Introduction, Numerical differentiation, Numerical integration, Methods based on interpolation. Ordinary Differential Equatjions: Introduction, Euler methods, Single and Multistep methods, Predictor-corrector methods. [5L]

B-Statistical Computing

Module– IV

Empirical andf kProbability Distributions: Basic Concepts, The Mean variance, and Standard Deviation, Continuous – Type Data, Exploratory Data Analysis, Graphical Comparisons of Data Sets, Probability Density and Mass Functions.

Probability: Properties of Probability, Methods of Enumeriation, Conditional Probability, Independent Events, Bayes Theorem. [5L]

Module – V & VI

Discrete, Continues & Multivariable Distributions: Random Variables of the Discrete Type, Mathematical Expectation, Bernoulli Trials and the Binomial Distribution, The Moment – Generating Function, The Poisson Distribution, Random Variables of the Continuous Type, The Uniform and Exponential Distributions, The Gamma and Chi-Square Distributions, The Normal Distribution, Distributions of Functions of a Random Variable, Distributions of Two Random Variables.

Sampling Distribution Theory: Independent Random Variables, Distributions of Sums of Independent Random Variables, Random Functions Associated with Normal Distributions, The Central Limit Theorem, Approximations for Discrete Distributions, The t and F Distribution. [10L]

Module – VII

Estimation & Tests of Statistical Hypotheses: Point Estimajtion, Confidence Intervals for Means, Confidence Intervals for Difference of Two Means, Sample Size, Tests about Proportions, Tests of the Equality of Two Normal Distributions, Chi-Square Goodness of Fit Tests, Contingency Tables, Tests of the Equality of Several Means. [5L]

Text Books:

1. Jain, M.K., etal: Numerical Methods for Scientific and Engineering Computation, 3rd Edn. New Age Publication, New Delhi , 1999
2. Hogg, R.V. & Ranis E. A. : Probability and Statistical Inference, 6th Edn., Pearson Education, New Delhi.

Reference Books:-

1. Sastrty, S.S. – Introductory Methods of Numerical Analysis, 4th Edn., PHI, New Delhi, 2005
2. Hines, W.W. et al – Probability and Statististics in Engineering, 4th edn., John Witey, Singapore (Indian Reprint), 2003.
3. Veerarajan, T. – Probability, Statististics and Random Processes, 2nd Edn., TMH, New Delhi, 2003.

MA 4102 Scientific Computing Lab

MA 4103 Discrete Mathematical Structures

Module – I & II

Logic and Mathematical Reasoning: Logic, Propositional Equivalences, Predicates and Quantifiers, Methods of Proof, Mathematical Induction, Recursive Definition and Algorithms, Program Correctness. [8L]

Module – III & IV

Functions and Relations: Functions, Sequences and Summations, The Growth Functions, Relations and Their Properties, Non – array Relations & Their Applications, Representing Relations, Closures of Relations, Equivalence Reloads, Partial Orderings. [8L]

Module – V

Graphs: Introduction to Graphs, Graph Terminology and Representation, Connectivity, Euler and Hamiltonian Paths, Shortest Path Programs,. [6L]

Module – VI

Trees: Introduction and applications of trees, Tree Traversal, Spanning Trees, Minimum Spanning trees. [5L]

Module – VII

Subgroups, Groups and Coding: Binary Operations, Semi groups, Products and Quotients of Semi groups, Groups, Product and Quotients of Groups, Coding of Binary Information and Error Correction, Decoding and Error Correction. [8]

Text Books:

1. B.Kolman et.al – Discrete mathematical Structures, 5th Edn, Pearson Education, New Delhi – 2004
2. K.H. Rosen – Discrete Mathematics and Its Applications – 4th Edn, Tata McGraw Hill, New Delhi – 2001.

Reference Books:

J.P. Tremblay et.al – Discrete Mathematical Structures with Applications to Computer Science, TMH, New Delhi – 2004.

MA 4105 Discrete Mathematics & Graph Theory

Module – I

Introduction to Logic: Compound Statements, Proofs in Mathematics, Truth Tables, The Algebra of Propositions, Logical Arguments. [5L]

Module – II

Induction and Recursion: Mathematical Induction, Recursively Defined Sequences, Solving Recurrence Relations; The Characteristic Polynomial, Solving Recurrence Relations; Generating Functions. [5L]

Module – III

Principles of Counting and Algorithms: The Principle of Inclusion – Exclusion, The Addition and Multiplication Rules, The Pigeon-Hole Principle, What is an Algorithm?, Complexity, Searching and Sorting, Enumeration of Permutations and Combinations [5L]

Module – IV & V

Graphs, Paths and Circuits and Applications: A Gentle Introduction, Definitions and Basic Properties, Isomorphism, Euler Ian Circuits, Hamiltonian Cycles, The Adjacency Matrix, Shortest Path Algorithms, The Chinese Postman Problem, Digraphs, Tournaments, Scheduling Problems. [8L]

Module – VI

Trees and Searching: What is a Tree?, Properties of Trees, Spanning Trees, Minimum Spanning Tree Algorithms, Acyclic Digraphs and Bellman's Algorithm, Depth – First Search. [6L]

Module – VII

Planar Graphs, Colorings and Maximal Flows: Planar Graphs, Coloring Graphs, Flows and Cuts, Constructing Maximal Flows, Applications. [6L]

Text Books:

E.G. Goodaire & M.M. Parmenter –Discrete Mahmatics with Graph Theory, 2nd Edn Pearson Education, New Delhi – 2002.

Reference Books:

1. B. Kolman et.al-Discrete mathematical Structures, 5th Edn, Pearson Education, New Delhi – 2004
2. K.H. Rosen – Discrete Mathematics and Its Applications – 4th Edn, Tata Mc Graw Hill, New Delhi – 2001
3. D.B. West – Introduction to Graph Theory, 2nd Edn, Pearson Education, New Delhi 2002
4. N. Deo – Graph Theory with Application to Engineering and Computer Science, PHI, New Delhi – 2004.

MA-4107 **Industrial Statistics (Production Engg.)**

Module – I
Methods of least squares, Linear and parabolic trends. [4L]

Module – II
Bivariate distribution, Correlation, Rank correlation, Linear regression. [5L]

Module – III
Sample space, Random experiments and random variables, Concept of probability, Conditional probability, Addition and multiplication laws Bay's theorem. [6L]

Module – IV
Probability distribution: Binomial, Poison and Normal Distributions, Concept of geometric hypergeometric and exponential distributions, their properties and applications to industrial problems. [5L]

Module – V
Central limit theorem, Simple sampling and sampling of variables, Sample tests, Tests of significance, Chi-square test, Student 't' test. 'F' test and their properties and applications. [5L]

Module – VI
Analysis of variance: Analysis of variance of one and two criterion of classifications, [4L]

Module – VII
Design of experiments, Basic principle of experimental design, Latin squares, Randomised block design, Concept of control charts and its applications in process control. [6L]

Suggested Books:

1. Erwin Miller and John E. Freund – Probability and Statistics for Engineers
2. Sharma and Goyal – Mathematical statistics.

MA 4109 Probability, Statistics and Numerical Techniques

Module – I

High Speed Computation: Introduction, Computer Arithmetic, Errors, Machine Computation.
Transcendental and Polynomial Equations: Introduction, Bisection Method, Iterative Methods, Rate of Convergence, Methods for Complex Roots, Polynomial Equations. [5L]

Module –II

System of Linear Algebraic Equations and Eigen value Problems: Introduction, Direct Methods, Error analysis, Iteration Methods, Eigen values and Eigen Vectors. Interpolation and Approximation: Introduction to Lagrange and Newton Interpolations, Finite difference operators, Interpolating polynomial using finite differences, Hermit interpolations, Piecewise and spine interpolation. [5L]

Module – III

Differentiation and Integration: Introduction, Numerical differentiation, Numerical integration, Methods based on interpolation. Ordinary Differential Equations: Introduction, Euler methods, Single and Multistep methods, Predictor-corrector methods. [5L]

Module– IV

Graphical Statistics-histogram, scatter plot, ogive, bar diagrams (including multiple and percentage), average, dispersion, skewness and kurtosis and their statistical measures, Exploratory Data Analysis, Empirical and classical definitions of Probability, Addition theorem, Conditional Probability, multiplication theorem, Independent Events, Bayes Theorem. [5L]

Module – V

Random variables and Probability distributions, Discrete, Continues & Multivariable Distributions: Mathematical Expectation, Bernoulli Trials and the Binomial Distribution, The Moment – Generating Function, The Poisson Distribution, The Uniform and Exponential Distributions, The Normal Distribution, Distributions of Functions of a Random Variable, Distributions of Two Random Variables. [5L]

Module VI

Sampling Distribution Theory: Independent Random Variables, Distributions of Sums of Independent Random Variables, Random Functions Associated with Normal Distributions, The Central Limit Theorem, Approximations for Discrete Distributions, The t and F Distribution. The Gamma and Chi-Square Distributions. [5L]

Module – VII

Estimation & Tests of Statistical Hypotheses: Point Estimation, test of significance and Confidence Intervals for Means, Confidence Intervals for Difference of Two Means, Sample Size, Tests about Proportions, Tests of the Equality of Two Normal Distributions, Chi-Square Goodness of Fit Tests, Contingency Tables, Tests of the Equality of Several Means, F test for equality of two population variances [5L]

Text Books:

3. Jain, M.K., et. al: Numerical Methods for Scientific and Engineering Computation, 3rd Edn. New Age Publication, New Delhi , 1999
4. S. C. Gupta and V. K. Kapoor, Fundamentals of Mathematical Statistics, Sultan Chand and Sons, New Delhi.

Reference Books:-

4. Sastrty, S.S. – Introductory Methods of Numerical Analysis, 4th Edn., PHI, New Delhi, 2005
5. Hines, W.W. et al – Probability and Statististics in Engineering, 4th edn., John Witey, Singapore (Indian Reprint), 2003.
6. Veerarajan, T. – Probability, Statististics and Random Processes, 2nd Edn., TMH, New Delhi, 2003

MA 4110 Probability, Statistics and Numerical Techniques Lab

MA-5101 Finite Element Methods & Statistics

Statistics:

Module – I

Measure of central tendency. Dispersion, Least square fit, [4L]

Module – II

Correlation, Regression, Analysis of Variance: One – way and Two-way ANOVA. [5L]

Module – III

Statistical quality control, Control charts: X & R chart, p-chart and c-chart. [5L]

Finite Element Method:

Module – IV

Fundamental concept, Importance and area of application, Basic steps. [4L]

Module – V

Variational formulation and approximation: Functional, variational formulation of boundary value problems, [5L]

Module – VI

Variational methods of approximation: Ritz Method, Weighted residual method and Galerkin method. Elements and Interpolating Function: Basic element shapes, Types of Nodes, Degree of freedom, [6L]

Module – VII

Interpolating polynomial. Finite element analysis of one-dimensional problems: Second and fourth order equation, Discretisation, Derivation of element equation. Assembly of element equations, application to heat transfer and bending of beam [6L]

Books Suggested:

1. A Treatise on Finite Element Method-O.C. Zeinkowiez.
2. An Introduction to Finite Element Method. J. F. Abel and C. S. Desai
3. An Introduction to Finite Element Method: J.N.Reddy

MA 5103 Computational methods (Prod. + Poly. Engg.)

Module I : Computational Errors, Approximations & Curve Fitting:
Numbers & their accuracy, Errors & their Analysis, Errors in a series approximation. Principle of least squares, Curve fitting: Fitting a straight line. Polynomial of second degree, Data fitting with cubic splines. [5L]

Module II : Solution of Algebraic & Transcendental Equations with Algorithms:
Graphical Method, The bisection method, The method of false position, Newton-Raphson Method & its rate of convergence. Solution of Non-linear equations in two variables by Newton-Raphson method & Bairstow's method for complex roots. [5L]

Module III : Solutions of System of Linear Algebraic Equations with Algorithm:
Direct Methods: Gaussian Elimination method. Gauss-Jordan Method & Decomposition method, Iteration methods: Jacobi & Gauss-Seidal Methods. [5L]

Module IV : Interpolation:
Finite differences, Newton's forward and backward interpolation formula, Gauss's Central Difference formula Sterling's & Bassel's interpolation for unevenly spaced points, Newton's general interpolation formula with divided differences. [5L]

Module V : Numerical Differentiation & Integration:
Differentiation by using Newton's forward. Backward and central difference formulas, Differentiation by cubic spline method. Integration by Trapezoidal Rule, Simpson's 1/3' rd Rule. '3/8th Rule. [5L]

Module VI : Computational Algorithm:
Solution of initial value problems of first order: Picard's method Taylor's series, Euler's method, Runge-Kutta method, Milne-Simpson method, Finite Difference algorithms for solutionj of a two point, Second order boundary value problem. [5L]

Module VII : Finite Difference:
Analogues of Partial Differential equations, Use jof standard five point algorithms and diagonal five point algorithms in solution of Laplace equation & Parabolic equations.
[5L]

Suggested Books:

1. Introductory method of Numerical analysis – Prentice – Hall of India New Delhi, S.S. Sastry
2. Computer Oriented Numerical Methods – Prentice-Hall of India – V. Rajaraman.
3. Finite Differences & Numerical Analysis – S. Chand & Co. Ltd. New Delhji – H.C. Saxena.
4. Introduction to Numerical Analysis – Addision – Wesley Publishing Company – Froberg.)

MA-5104 Computational methods Lab (Prod. + Poly. Engg.)

MA-5105 Numerical Techniques in Engineering (Mech. Engg.)

Module I

Types of errors and analysis, Errors in series approximation

Solution of non-linear algebric equations, Complex roots by lin-Bairstow method. [3L]

Module II

Solution of system of linear equations: Gauss elimination method, Gauss-Jordon elimination method, Crouts Reduction Method, Jacobi's method, Gauss-Seidal interation method .

Eigen value problems: Power method, Jacobi's method [7L]

Module III

Curve-fitting: Least Square's method, Fitting a straight fine, a parabola, curve of the form $y=ax^b$ and exponential curve. [4L]

Module IV

Interpolation: Newton's Forward Interpolation formula, Newton Backward Interpolation formula, Lagrange's Interpolation formula, Newton's Divided Difference interpolation formula. [4L]

Module V

Numerical Differentiation and integration: Differentiation using difference operator, Differentiation using Interpolation, Newton-Cotes Integration formula, Trapezoidal rule, Simpson's rule. [5L]

Module VI

Ordinary Differential Equation: Euler's Method, Range Kutta Method, Predictor-Corrector Method. . [4L]

Module VII

Partial Differential Equation: Classification of Partial Differential Equations, Solutions of Partial Differential Equations, Parabolic: Explicit Method, Implicit Methods, Elliptic: Interative Methods, Hyperbolic: Explicit Methods. [8L]

Books Skuggested:

1. Introductory mekthod of Numerical analysis – Prentice-Hall of India New Delhi, S.S. Sastry
2. Computer Orkiented Numerical Methods – Prenjtice Hall of India, - V. Rajaraman.
3. Finite Differences & Numerical Analysis – S. Chand & Co. Ltd. New Delhi – H.C. Saxena
4. Introduction to Numerical Analysis – Addision – Westley Publishing Ckompany – Proberg.
5. Introduction to Numerical Analysis – Tata Mc Graw-Hill Publishing Company – F.E. Hildebrand.
6. Numerical methods for Scientist and Engineers by K. Shankara Rao, Estern Economy Edition, kPHI, 2001.

MA-5106 Numerical Techniques in Engineering Lab (Mech. Engg.)

MA 6101 Operations Research (Mech. Engg.)

Module I

Treatment of the subject is to be application oriented, Theorems and derivations are not necessary.

Scope and limitations of O.R. (3L)

Module II

Linear Programming: Mathematical formulation of the problem, Graphical solution, The simplex method, Charnes method of penalties, Concept of duality, Dual simplex method. (7L)

Module III

Tansportation Model: Basic feasible solutions by different methods, Finding optimal solutions, Degeneracy in transportation problems, Unbalanaced transportation problems. (5L)

Module IV

Assignment Model: Balanced and Unbalanced assignments, Assignments to given schedules. (5L)

Module V

Sequencing:

Processing of 2 jobs through jmachines – graphical method.

Processingj of n jobns through twio machines.

Processing n j jobs through three machines. (5L)

Module VI

Queuing Model:

Queuing systems and their characteristics, The M/M/1/FIFO/ queuing systems. (5L)

Module VII

PERT & CPM:

Network construction, Determining the critical path, Floats: Total and free floats, Scheduling by networks, Project duration, Variance under probabilistic models, Prediction of date of completion, Elements of Crashing of simple networks. (5L)

Suggested Books:

1. Operations Research – Kanti Swaroop
2. Linear Programming – Hadley
3. Quantitative in Management Technique: N.D. Vohra
4. Operations Research j: P.K. Gupta & . S. Hira.

MA 7101 Optimization Techniques

Module I

Introduction To Linear Programming : Prototype Example. The Linear Programming Model Assumptions of Linear Programming. Additional Examples, Some Classic Case Studies. (2L)

Module II

Solving Linear Programming Problems. The Simplex Method: The Essence of the Simplex Method, Setting Up the Simplex Method. The Algebra of the Simplex Method, The Simplex Method in Tabular Form. The Breaking in the Simplex Method. Adapting to Other Model Forms, Postoptimiliry Analysis.

The Theory of the Simplex Method : Foundations of the Simplex Method, The revised Simplex Method. A Fundamental Insight. (5L)

Module III

Duality Theory and Sensitivity Analysis: The Essence of Duality Theory, Economic Interpretation of Duality, Primal-Dual relationships, Adapting to Other Primal Forms. The Role of Duality Theory in Sensitivity Analysis. (5L)

Module IV

Other Algorithms For Linear Programming: The Dual Simplex Method, Parametric Linear Programming. The Upper Bound Techniques. Al Interior-Point Algorithm

Network Optimization Models: Prototype Example. The Terminology of Networks. The shortest-Path Problem, The Minimum Spanning Tree Problem. The Maximum Flow Problem. The minimum Cost flow Problem. The Network Simplex Method.

Dynamic Programming: A Prototype Example for Dynamic Programming, Characteristics of Dynamic Programming Problems. Deterministic Dynamic Programming. Probabilistic Dynamic Programming. (8L)

Module V

Integer Programming: Prototype Example: Some BIP Applications, Innovative Uses of Binary Variables in Model Formulation, Some Formulation examples, Some Perspectives on Solving Integer Programming Problems. The Branch-and-Bound Technique and Its Application to Binary Integer Programming . A Branch-and –Bound Algorithm for Mixed Integer. (5L)

Module VI

Nonlinear Programming: Sample Applications, Graphical lihstration of Nonlinear Programming Problems. Type of Nonlinear Programmingj problems. One-variable Unconstrained Optimization. Multivariable Unconstrained Optimization. The Karush-Kuhn-Tucker (KKT) Conditions for Constrained Optimization. Quadratic Programming, Separable Programming. Convex Programming. (5L)

Module VII

Queneing Theory : Prototype Example, Basic Structure of queening Models, Examples of Real Queneing Systems. The role of the Exponential Distribution, The Birth-and-Death Process, Queueing Models Based on the Birth-and – Death Process Queueing Models Involving Nonexponential Distributions. (5L)

Text Book:

1. S. Hiller & G.J. KLiebeman – Operations Research 3th Edu. TMH, New Delhi – 2006

Reference Books:

1. H.A. Taha – Operations Research, 8/c, Pearson Eduction, New Delhi – 2007
2. J.K. Sharma – Operations Research, 3/e Mcmillan, India Ltd, 2007