COURSE CURRICULUM
M.SC- MATHEMATICS

Semester- I

ABSTRACT ALGEBRA

Paper Code: 0505101 Time : 3 Hours

Max. Marks: 75 Credits: 5

Note for Examiners and Students:

1. There will be eight questions covering the entire syllabus out of which four are to be attempted by the student selecting one from each section. Q. No. 1 will be compulsory (short answer type five parts are to be attempted out of six) 3X5=15. All questions carry equal marks.
2. Internal evaluation is to be made on the basis of the parameters to be decided by the concerned faculty in the consultation with the Head of the department.

UNIT – I

Zassenhaus lemma, Normal and subnormal series, Composition series, Jordan-Holder theorem, Solvable series, Derived series, Solvable groups, Solvability of S_n – the symmetric group of degree n ≥ 2. Structure theorem for finitely generated Abelian groups. **(15 hrs)**

UNIT – II

Review of group theory, the class equation, Cauchy`s theorem, Sylow p-subgroups and its applications, Direct product of groups, description of group of order p^2 and pq, where p and are q distinct primes(In general survey of groups upto order 15). **(17hrs)**

UNIT – III

Extension fields. Finite, algebraic, and transcendental extensions. Splitting fields. Simple and normal extensions. Perfect fields. Primitive elements. Algebraically closed fields. **(14hrs**)

UNIT – IV

Automorphisms of extensions. Galois extensions. Fundamental theorem of Galois Theory. Galois group over the Rationals. **(14hrs)**

Books Recomended :

1. I. N. Herstein, Topics in Algebra, Wiley Eastern Ltd., New Delhi, 1975.
2. Joseph Gallian, Contemporary abstract algebra, Narosa Publishing House.
3. V. K. Khanna and S. K. Bhammbri, A Course in Abstract Alegebra, Vikas Publishing house.
4. P. B. Bhattacharya, S. K. Jain and S. R. Nagpaul, Basic Abstract Algebra, 2nd Edition, Cambridge University Press, Indian Edition, 1997.
5. S. Lang, Algebra, Addison-Wesley, 3rd editioin, 1993.
6. S. Luther and I. B. S. Passi, Algebra, Vol. I-Groups, Vol. II-Rings, Narosa Publishing House (Vol. I – 1996, Vol. II –1990).

7. P. M. Cohn, Algebra, Vols. I & II, John Wiley & Sons, 1991.
8. N. Jacobson, Basic Algebra, Vol. I & II, W. H. Freeman, 1980
9. P. M. Cohn, Algebra, Vols. I & II, John Wiley & Sons, 1991.
10. N. Jacobson, Basic Algebra, Vol. I & II, W. H. Freeman, 1980.

ORDINARY DIFFERENTIAL EQUATIONS

Paper Code: Time Allowed: 3 Hours

Max. Marks: 75 Credits: 5

Note for Examiners and Students:

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2. Internal evaluation is to be made on the basis of the parameters to be decided by the concerned faculty in the consultation with the Head of the department.

UNIT-I

Preliminaries, ε-approximate solution, Cauchy-Euler construction of an ε-approximate solution of an initial value problem, Equicontinuous family of functions, Ascoli-Arzela Lemma, Cauchy-Peano existence theorem. Lipschitz condition, Picards-Lindelof existence and uniqueness theorem for dy/dt =f(t,y), Solution of initial-value problems by Picards method, Dependence of solutions on initial conditions ***(Relevant topics from the books by Coddington & Levinson, and Ross)***.

(15hrs)

UNIT – II

Linear systems, Matrix method for homogeneous first order system of linear differential equations, Fundamental set of solutions, Fundamental matrix of solutions, Wronskian of solutions, Basic theory of the homogeneous linear system, Abel-Liouville formula, Non-homogeneous linear system. Strum Theory, Self-adjoint equations of the second order, Abel formula, Strum Separation theorem, Strum Fundamental comparison theorem.

(16hrs)

(Relevant topics from chapters 7 and 11 of book by Ross)

UNIT – III

Nonlinear differential systems, Phase plane, Path, Critical points, Autonomous systems, Isolated critical points, Path approaching a critical point, Path entering a critical point, Types of critical points- Center, Saddle points, Spiral points, Node points, Stability of critical points, Asymptotically stable points, Unstable points, Critical points and paths of linear systems. Almost linear systems. **(Relevant topics from chapter 13 of book by Ross)**.

(**15hrs)**

UNIT – IV

Nonlinear conservative dynamical system, Dependence on a parameter, Liapunov direct method, Limit cycles, Periodic solutions, Bendixson nonexistence criterion, Poincore-Bendixson theorem(statement only), Index of a critical point. Strum-Liouville problems, Orthogonality of characteristic functions. **(Relevant topics from chapters 12 and 13 of the book by Ross)**. **(14hrs)**

Books Recommended :

1. S.L.Ross, Differential Equations, Wiley, India, 3rd Edition
2. F Simmons, Differential equations with applications and historical notes, Tata McGraw Hill, New Delhi, 1974.
3. I. M. Gelfand, S. V. Fomin, Calculus of Variations, Dover Book Publication.
4. M.D. Raisinghania, Advanced Calculus, S.Chand & Company Ltd., New Delhi,2001
5. N. N. Lebedev, Special functions and their applications, Prentice Hall of India, New Delhi, 1965.
6. W.T. Reid, Ordinary Differential Equations, John Wiley and Sons, New York, 1971

OPERATION RESEARCH

Paper Code: Time Allowed: 3 Hours

Max. Marks: 75 Credits: 5

Note for Examiners and Students:

1. There will be eight questions covering the entire syllabus out of which four are to be attempted by the student selecting one from each section. Q. No. 1 will be compulsory (short answer type five parts are to be attempted out of six) 3X5=15. All questions carry equal marks.
2. Internal evaluation is to be made on the basis of the parameters to be decided by the concerned faculty in the consultation with the Head of the department.

UNIT - I

Operations Research: Origin, definition and scope. Linear Programming: Formulation and solution of linear programming problems by graphical, simplex methods, Big - M and two phase methods, Degeneracy, Duality in linear programming, sensitivity analysis. **(15hrs)**

UNIT - II

Transportation Problems: Basic feasible solutions, optimum solution by stepping stone and modified distribution methods, unbalanced and degenerate problems, transhipment problem. Assignment problems: Solution by Hungarian method, unbalanced problem, case of maximization, travelling salesman and crew assignment problems. **(16hrs)**

UNIT - III

Queuing models: Basic components of a queuing system, General birth-death equations, steady-state solution of Markovian queuing models with single and multiple servers (M/M/1. M/M/C, M/M/1/k, M/M/C/k). (**12 hrs)**

UNIT- IV

Game Theory : Two person zero sum game, Game with saddle points, rule of dominance; Algebraic, graphical and linear programming, concept of mixed strategy. Sequencing problems: Processing of n jobs through 2 machines, n jobs through 3 machines, 2 jobs through m machines, n jobs through m machines. **(17hrs)**

Books Recomended:

1. Kanti Swarup, P.K.Gupta & Man Mohan, S. Chand publisher.
2. Taha, H.A., Operation Research-An introducton, Printice Hall of India.
3. Gupta, P.K. and Hira, D.S., Operations Research, S. Chand & Co.
4. Sharma, S.D., Operation Research, Kedar Nath Ram Nath Publications.
5. Sharma, J.K., Mathematical Model in Operation Research, Tata McGraw Hill

MATHEMATICAL STATISTICS

Paper Code: Time Allowed: 3 Hours

Max. Marks: 75 Credits: 5

Note for Examiners and Students:

1. There will be eight questions covering the entire syllabus out of which four are to be attempted by the student selecting one from each section. Q. No. 1 will be compulsory (short answer type five parts are to be attempted out of six) 3X5=15. All questions carry equal marks.
2. Internal evaluation is to be made on the basis of the parameters to be decided by the concerned faculty in the consultation with the Head of the department.

UNIT - I

Measures of central tendency and dispersion, moments, Measures of skewness and kurtosis, Correlation and regression. Axiomatic approach to the theory of probability, Sample space, additive and multiplicative law of probability, conditional probability. Definition and properties of random variables, discrete and continuous random variables, probability mass and density functions, distribution function. Concepts of bivariate random variables. **(16hrs)**

UNIT - II

Mathematical Expectation: Definition and its properties. Variance, Covariance, Moment generating function- definitions and their properties. Discrete distributions: Binomial, Poisson and geometric distributions with their properties. **(14hrs)**

UNIT - III

Continuous distributions: Uniform, Exponential, Gamma and Normal distributions with their properties. Chebychev's inequality, Central Limit Theorem. **(14 hrs)**

UNIT – IV

Statistical estimation, Testing of Hypothesis: Null and alternative hypotheses, Simple and composite hypotheses, Two types of errors, t, F and Chi-Square as sampling distribution and applications. (**16 hrs)**

Books Recomended:

1. S.C. Gupta and V.K. Kapoor, Fundamentals of Mathematical Statistics, Sultan Chand & Sons, 2002.
2. Baisnab and M. Jas, Element of Probability and Statistics, Tata McGraw Hill, 1993.
3. P. L. Meyer, Introductory Probability and Statistical Applications, Addison-Wesley Publishing Company, 1970.

GEC COURSES OFFERED TO PG STUDENTS FROM OTHER DEPARTMENTS

PROGRAMMING IN C

Paper Code: Time Allowed: 3 Hours

Max. Marks: 75 Credits: 3

Note for Examiners and Students:

1. There will be eight questions covering the entire syllabus out of which four are to be attempted by the student selecting one from each section. Q. No. 1 will be compulsory (short answer type five parts are to be attempted out of six) 3X5=15. All questions carry equal marks.
2. Internal evaluation is to be made on the basis of the parameters to be decided by the concerned faculty in the consultation with the Head of the department.

UNIT-I

Overview of C: History of C, Importance of C, Elements of C: C character set, identifiers And keywords, Data types, Constants and Variables, Assignment statement, Symbolic Constant, Structure of a C Program, printf (), scanf () Functions.

Operators & Expression: Arithmetic, relational, logical, bitwise, unary, assignment, shorthand assignment operators, conditional operators and increment and decrement operators, operator hierarchy &associativity. **(15 Hrs.)**

UNIT-II

Decision making & branching: Decision making with IF statement, IF-ELSE statement, Nested IF statement, ELSE-IF ladder, switch statement, goto statement.

Decision making & looping: For, while, and do-while loop, jumps in loops, break, continue Statement, Nested loops. **(15 Hrs.)**

UNIT-III

Functions: Standard Mathematical functions, Input/output: Unformatted & formatted I/O Function in C, Input functions viz. getch (), getche (), getchar (), gets (), output functions viz. Putch (), putchar (), puts ().

User defined functions: Introduction/Definition, prototype, Local and global variables, Passing parameters, recursion. **(15 Hrs.)**

UNIT-IV

Arrays, strings and pointers: Definition, types, initialization, processing an array.
Strings and pointers :String constant and variables, Declaration and Initialization of string, Input/output of string data, Introduction to pointers,File handling in C. **(15 Hrs.)**

Books Recommended:

1. Gottfried, Byron S., Programming with C, Tata McGraw Hill
2. Gill Nasib Singh: Computing Fundamentals and Programming in C, Khanna Books Publishing Co., New Delhi.
3. Balagurusamy, E., Programming in ANSI C, 4E, Tata McGraw-Hill
4. Jeri R. Hanly & Elliot P. Koffman, Problem Solving and Program Design in C, Addison Wesley.
5. Yashwant Kanetker, Let us C, BPB.

PROGRAMMING IN C (PRACTICAL)

Paper Code: Time Allowed: 3 Hours
Max. Marks: 50 Credits: 1

1. Write a C program to Add Two Integers.
2. Write a C program to Multiply Two floating point numbers.
3. Write a C program to Find ASCII Value of a character.
4. Write a C program to Compute Quotient and Remainder.
5. Write a C program to find the size of int, float, double and char.
6. Write a C program to Swap Two Numbers.
7. Write a C program to check whether a Character is Vowel or consonant.
8. Write a C program to check whether a Number is Even or odd.
9. Write a C program to find the largest number among three numbers.
10. Write a C program to Check Leap year.
11. Write a C program to Calculate the Sum of Natural Numbers.
12. Write a C program to find Factorial of a Number.
13. Write a C program to check whether a number is Positive or Negative.
14. Write a C program to count numbers of digits in an integer.
15. Write a C program to print Fibonacci Series.
16. Write a C program to reverse a Number.
17. Write a C program to check whether a number is Palindrome or Not
18. Write a C program to check whether a number is Prime or Not.
19. Write a C program to check whether a number is Armstrong number or Not.
20. Write a C program to Make Simple Calculator Using Switch...Case.
21. Write a C program to find sum of Natural Numbers Using Recursion.
22. Write a C program to calculate average using arrays.
23. Write a C program to find the largest element of an Array.
24. Write a C program to Add to Matrix Using Multi-dimensional Arrays.
25. Write a C program to Concatenate Two Strings.
26. Write a C program to store Information of students using Structure.

27. Write a C program to Display its Own Source Code as Output.
28. Write a C program to Create Pyramid and Pattern.

INFORMATION THEORY

Paper Code: Time Allowed: 3 Hours

Max. Marks: 75 Credits: 4

Note for Examiners and Students:

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2. Internal evaluation is to be made on the basis of the parameters to be decided by the concerned faculty in the consultation with the Head of the department.

UNIT-I

Measure of Information – Axioms for a measure of uncertainty. The Shannon entropy and its properties. Joint and conditional entropies. Transformation and its properties. Axiomatic characterization of the Shannon entropy due to Shannon and Fadeev. **(15hrs)**

UNIT-II

Noiseless coding - Ingredients of noiseless coding problem. Uniquely decipherable codes. Necessary and sufficient condition for the existence of instantaneous codes. Construction of optimal codes. **(15hrs)**

UNIT-III

Discrete Memoryless Channel - Classification of channels. Information processed by a channel. Calculation of channel capacity. Decoding schemes. The ideal observer. The fundamental theorem of Information Theory and its strong and weak converses. **(15hrs)**

UNIT-IV

Continuous Channels - The time-discrete Gaussian channel. Uncertainty of an absolutely continuous random variable. The converse to the coding theorem for time-discrete Gaussian channel. The time-continuous Gaussian channel. Band-limited channels. **(15hrs)**

Books Recomended:

1. R. Ash, Information Theory, Interscience Publishers, New York, 1965.
2. F.M. Reza, An Introduction to Information Theory, MacGraw-Hill Book Company Inc., 1961.
3. J. Aczel and Z. Daroczy, On Measures of Information and their Characterizations, Academic Press, New York.

DIGITAL IMAGE PROCESSING

Paper Code: Time Allowed: 3 Hours

Max. Marks: 75 Credits: 3

Note for Examiners and Students:

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UNIT- I

Introduction: What is Digital Image Processing, Origin of Digital Image Processing Fundamental to Digital Image Processing, Fundamental steps in Digital Image Processing, Components of Digital Image Processing System, Image sensing and acquisition, Image sampling, Quantization and representation, Basic relationship between pixels. **(15hrs)**

UNIT - II

Image Enhancement in the Spatial Domain: Background, Basic gray level transformation, Histogram processing, Basics of spatial filtering, Smoothing and Sharpening Spatial filters Frequency domain and Image Enhancement: Introduction to Fourier Transform and the Frequency Domain, Discrete Fourier Transform, Smoothing and Sharpening Frequency-Domain filters. **(16hrs)**

UNIT - III

Image Restoration: Image Degradation/Restoration Process, Types of degradations in digital images, Noise models, Restoration in presence of noise using filters: Mean filter, Minimum Mean Square Filtering, Non Linear filters: Anisotropic diffusion, total variation. **(16hrs)**

UNIT - IV

Color Image Processing: Color Fundamentals, Color models, Basis of full color image processing, Color transformations. **(13hrs)**

Books Recommended:

1. Rafael C.Gonzalez & Richard E. Woods, Digital Image Processing, 2002, Pearson Education
2. A.K. Jain, Digital Image Processing, 1995,-PHI
3. Abhishek Yadav and Poonam Yadav, Digital Image Processing, University Science Press
4. Shashi Kumar Singh, Digital Image Processing, University Science Press
5. Alasdair McAndrew, Introduction to Digital Image Processing with Matlab, Thomson Course Technology.

DIGITAL IMAGE PROCESSING PRACTICAL

List of experiments to be performed in lab using software (Matlab)

Paper Code: Time Allowed: 3 Hours

Max. Marks: 50 Credits: 1

1. Image I/O and Display.
2. Classes and Image Types.
3. Conversion between data classes and image types.
4. Array Indexing
5. M-Function Programming.
6. Flow Control
7. Intensity Transformation Functions
8. Generating and Plotting Image Histograms.
9. Histogram Equalization.
10. Spatial Filtering
11. Computing and visualizing the 2D DFT.
12. Sharpening frequency domain filtering.
13. Adding of noise in a digital image
14. Direct Inverse Filtering.
15. Color image representation in MATLAB.
16. Converting to other color spaces.

    Spatial filtering of color images.

GEC COURSES OFFERED TO PG STUDENTS OF OTHER DEPARTMENTS

INTRODUCTION TO MATHEMATICAL ANALYSIS

Paper Code: Time Allowed: 3 Hours

Max. Marks: 75 Credits: 4

Note for Examiners and Students:

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2. Internal evaluation is to be made on the basis of the parameters to be decided by the concerned faculty in the consultation with the Head of the department.

UNIT-I

Sets, different kinds of sets, infinite and finite sets, countability. Types of relations – void, universal, reflexive, symmetric, transitive and equivalence classes. Complex numbers, graphic representation and properties, polar form of complex numbers, De Movier's theorem. (**15hrs)**

UNIT-II

Functions, domain, co-domain, range, classification of real functions, algebraic and transcendental functions, even and odd functions, periodic functions, graphs of some important functions. **(14hrs)**

UNIT-III

Definition of sequence and its convergence, series and convergence. Quadratic equations and roots, nature of roots. **(14hrs)**

UNIT-IV

Limits, continuity and differentiability: Limit of a function, fundamental theorem on limits, methods of evaluating limits, existence of limit, left hand and right hand limit, continuity at a point, continuity in an interval, Differentiability of a function at a point and in an interval, Geometrical interpretation. **(17hrs)**

Books Recomended:

1. H. L. Royden, Real Analysis, Macmillan Pub. Co., Inc. 4th Edition, New York, 1993.
2. D. Somasundram and B. Chaudhary, A first course in Mathematical Analysis, Narosa Publishing House, New Delhi.
3. S. C. Malik and Savita Arora, Mathematical Analysis, New Age International Publisher

NUMERICAL METHODS

Paper Code: Time Allowed: 3 Hours

Max. Marks: 75 Credits: 4

Note for Examiners and Students:

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2. Internal evaluation is to be made on the basis of the parameters to be decided by the concerned faculty in the consultation with the Head of the department.

UNIT-I

Errors in approximation, Absolute, Relative and percentage errors. Solution of algebraic and transcendental equations: Bisection method, Regula-Falsi method, Newton Raphson method, Secant method. Systems of simultaneous Equations: Crammer's rule, Inversion method, Gauss elimination method, Gauss Jordon method, LU decomposition method, Iterative methods: Jacobi method and Gauss-Seidel method. **(15hrs)**

UNIT-II

Eigen values and Eigen vectors: Eigen values, Eigen vectors, Cayley Hamilton theorem, Power method for finding largest Eigen value. Curve fitting: Least square curve fit- Straight line fitting, parabolic curve fitting, fitting of exponential curve, fitting of other curves. **(15hrs)**

UNIT-III

Finite Differences: Forward difference, Backward difference, Central difference, Newton's forward, backward interpolation formulae, Lagrangian interpolation formula, Gauss forward, backward formulae, Stirling formula, Bessel formula. **(15hrs)**

UNIT-IV

Numerical Differentiation and Integration: Newton's forward difference, Newton's backward difference Formula for differentiation, Trapezoidal and Simpson's one third rules, Simpson's three eight rule for numerical integration, Boole's rule, Weddle's rule, Double integrals using trapezoidal and Simpsons's rules. **(15hrs)**

Books Recomended:

1. B.S. Grewal, Numerical Methods In Engineering, Khanna Publications.
2. M. K. Jain, S. R. K. Iyengar and R. K. Jain, Numerical Methods for Scientific & Engg. Computation, New Age International, 2003.
3. E. Isacson and H. B. Keller, Analysis of Numerical methods, John Wiley & Sons, 1994.
4. K. E. Atkinson, An Introduction to Numerical Analysis, John Wiley & Sons, 1989.
5. A. Maritava Gupta and Subash Chander Bose, Introduction to Numerical Analysis, Academic Publishers.
6. S.D. Conte and Carl De Boor, Elementary Numerical Analysis, An Algorithmic Approach, Tata McGraw Hill, New Delhi, 1981.

Semester II

LINEAR ALGEBRA AND REAL ANALYSIS

Paper Code: Time Allowed: 3 Hours

Max. Marks: 75 Credits: 5

Note for Examiners and Students:

1. There will be eight questions covering the entire syllabus out of which four are to be attempted by the student selecting one from each section. Q. No. 1 will be compulsory (short answer type five parts are to be attempted out of six) 3X5=15. All questions carry equal marks.
2. Internal evaluation is to be made on the basis of the parameters to be decided by the concerned faculty in the consultation with the Head of the department.

UNIT-I

Review of Vector Spaces, Linear Transformation(Basic), Change of Basis, Similarity, diagonalization, minimal polynomial, companion matrix, Canonical and Bilinear Forms: Triangular form, invariance, Primary decomposition, Jordon canonical form, Rational canonical Form, Bilinear and Quadratic forms. **(15hrs)**

UNIT-II

Riemann-Stieltjes integral, Existence and properties, Sequence and series of functions, Pointwise and uniform convergence, Cauchy criterion for uniform convergence, Weirstrass M-test, Abel and Dirichlet tests for uniform convergence, Uniform convergence and continuity, Uniform convergence and differentiation. (**15hrs)**

UNIT-III

Power series, uniform convergence and uniqueness theorem, Abel theorem, Tauber theorem. Functions of several variables, Linear Transformations, Euclidean space R^n, Derivatives in an open subset of R^n, Chain Rule, Partial derivatives, Continuously Differentiable Mapping, Young and Schwarz theorems. **(15hrs)**

UNIT-IV

Taylor theorem, Higher order differentials, Explicit and implicit functions, Implicit function theorem, Inverse function theorem, Change of variables, Extreme values of explicit functions, Stationary values of implicit functions, Lagrange multipliers method, Jacobian and its properties. **(15hrs)**

Books Recomended:

1. David C. Lay,Linear Algebra and its Applications.
2. Seymour Lipschutz, Marc Lipson: Linear Algebra, Third Edition, Tata McGraw-Hill.
3. S.C. Malik and Savita Arora, Mathematical Analysis, New Age International Limited, New Delhi, 2012.
4. K. Hoffman and R. Kunze: Linear algebra, Second Edition, Prentice Hall.
5. S. Axler: Linear Algebra Done Right, Second Edition, Springer-Verlag, 2004.
6. S. Lang: Undergraduate Texts in Mathematics, Third Edition, Springer-Verlag, NewYork, 2004

7. Walter Rudin, Principles of Mathematical Analysis (3rd edition) McGraw-Hill, Kogakusha, 1976, International Student Edition.

ELEMENTARY TOPOLOGY

Paper Code: Max. Marks: 75

Time Allowed: 3 Hours Credits: 5

Note for Examiners and Students:

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2. Internal evaluation is to be made on the basis of the parameters to be decided by the concerned faculty in the consultation with the Head of the department.

UNIT – I

Definition and examples of topological spaces, basis and sub-basis, neighbourhood, Open sets, Closed sets. Interior points, Closure points. Limit points, Boundary points, exterior points of a set, Closure of a set, Derived set. **(15hrs)**

UNIT – II

Relative Topology, Subspace topology, Continuous functions, projection mapping , open and closed mappings, Homeomorphism, Pasting lemma,Tychonoff Product Topology. Tychonoff product theorem. **(15hrs)**

UNIT – III

Connectedness, Continuity and connectedness, Connected subsets of the real line, component, product space, locally connected, locally path connected. Compactness and its characterizations, Compact subspace of the real line, Continuity and compact sets, Compactness and finite intersection property. **(15hrs)**

UNIT – IV

Countability and Separation axioms, T0, T1, T2, Lindelof spaces, Regular and Normal Spaces, Urysohn Lemma, Metrization Theorems (Urysohn Metrization, Nagata-Smirnov Metrization Theorem), Tietze Extension Theorem, one point Compactification. **(15hrs)**

Books Recomended:

1. K. D. Joshi, Introduction to General Topology, Wiley Eastern Ltd, 1983.

1. J. R. Munkres, Toplogy, PHI learning Pvt. Ltd., 2002.
2. George F. Simmons, Introduction to Topology and Modern Analysis, McGraw-Hill Book Company, 1963.
3. K. D. Joshi, Introduction to General Topology, Wiley Eastern Ltd, 1983.
4. J. L. Kelly, General Topology, Springer Verlag, New York, 1991.
5. W. J. Pervin, Foundations of General Topology, Academic Press, 1964.

6. T.B.Singh, Elements of Topology, CRC Press, Taylor francis.

NUMERICAL ANALYSIS (Part A)

Paper Code: Max. Marks: 75

Time Allowed: 3 Hours Credits: 4

Note for Examiners and Students:

1. There will be eight questions covering the entire syllabus out of which four are to be attempted by the student selecting one from each section. Q. No. 1 will be compulsory (short answer type five parts are to be attempted out of six) 3X5=15. All questions carry equal marks.
2. Internal evaluation is to be made on the basis of the parameters to be decided by the concerned faculty in the consultation with the Head of the department.

UNIT-I

Errors in approximation, Absolute, Relative and percentage errors. Solution of algebraic and transcendental equations: Bisection method, Regula Falsi method, Newton Raphson method. Systems of simultaneous Equations: Gauss elimination method, Gauss Jordon method, LU decomposition method, Iterative methods: Jacobi method and Gauss-Seidel method. Curve fitting: Straight line fitting, parabolic curve fitting, fitting of exponential curve, fitting of other curves. Introduction to splines, B-Splines. **(15hrs)**

UNIT-II

Finite Differences, Interpolation techniques: Interpolation with equal intervals-Newton Forward, Newton Backward, Gauss forward, Gauss Backward, Stirling, Bessel formulae. Interpolation with unequal intervals-Newton's divided difference, Lagrange interpolation technique. Numerical Differentiation using Newton Forward, Newton Backward formulae. **(15hrs)**

UNIT-III

Numerical Integration: Newton-Cotes Formulas, Trapezoidal rule, Simpson rule, Romberg's integration, Gauss-Legendre, Gauss-Chebychev formulas.

Solution of Ordinary differential equations: Single step methods: Taylor series method, Picard's method,
Euler method, Euler modified method, Runge – Kutta methods, Multistep methods: Milne's and Adam's predictor and corrector methods. **(15hrs)**

UNIT-IV

Classification of PDEs. Solution of partial differential equations by finite difference method. Solution of Laplace equation: standard and diagonal five point formula for solving Laplace and Poisson equations, Solution of One dimensional Heat equation: Schmidt method, Crank-Nicolson method, Solution of wave equation. **(15hrs)**

Books Recomended:

1. John H. Mathews, Numerical Methods for Mathematics, Sciences and Engineering, Prentice –hall International Editions, 1992
2. B.S. Grewal ,Numerical Methods for Engineers, Khanna Publications
3. Steven C. Chapra and Raymond P. Canale, Numerical Methods for Engineers, McGraw Hill International Edition, 1998.

4. Richard H. Bartels, John C. Bealty, and John C. Beatty, An Introduction to Spline for use in Computer Graphics and Geometric Modeling, Morgan Kaufmann Publisher, 2006.
5. Carl de Boor, A Practical Guide to Splines, Springer Verlag, 2001.

***Note: There will separate Practical exam course based on Part (A), named as Part (B)**

Practical (Part B)

List of experiments to be performed in lab using software (C/C++/Matlab)

Paper Code: Time Allowed: 3 Hours
Max. Marks: 50 Credits: 1

1. To Solve Non-linear equation by Bisection Method.

2. To Solve Non-linear equation by Newton –Raphson Method.

3. To Solve Non-linear equation by Regula- False Method.

4. To Solve Simultaneous system of linear equations by Gauss-Seidel Method.

5. To Solve Ordinary Differential Equations by Euler's Method.

6. To Solve Ordinary Differential Equations by Modified Euler's Method.

7. To Solve Ordinary Differential Equations by Runga-Kutta Method.

8. To Solve Ordinary Differential Equations by Predictor-Corrector Method.

9. To solve Integration using Trapezoidal Method, Simpson's Method.

10. To solve Integration using Simpson's $3/8^{th}$ Method.

PARTIAL DIFFERENTIAL EQUATIONS

Paper Code: Max. Marks: 75

Time Allowed: 3 Hours Credits: 5

Note for Examiners and Students:

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2. Internal evaluation is to be made on the basis of the parameters to be decided by the concerned faculty in the consultation with the Head of the department.

UNIT – I

Method of separation of variables to solve Boundary Value Problems (B.V.P.) associated with one dimensional heat equation. Steady state temperature in a rectangular plate, Circular disc, Semi-infinite plate. The heat equation in semi-infinite and infinite regions. Solution of three dimensional Laplace equations, Heat Equations, Wave Equations in cartesian, cylindrical and spherical coordinates. Method of separation of variables to solve B.V.P. associated with motion of a vibrating string. Solution of wave equation for semi-infinite and infinite strings. (Relevant topics from the book by O'Neil) **(16hrs)**

UNIT - II

Partial differential equations: Examples of PDE classification. Transport equation – Initial value problem. Non-homogeneous equations.

Laplace equation – Fundamental solution, Mean value formula, Properties of harmonic functions, Green function. **(14hrs)**

UNIT - III

Heat Equation – Fundamental solution, Mean value formula, Properties of solutions, Energy methods, Wave Equation – Solution by spherical means, Non-homogeneous equations, Energy methods. **(15hrs)**

UNIT - IV

Non-linear first order PDE – Complete integrals, Envelopes, Characteristics, Hamilton Jacobi equations (Calculus of variations, Hamilton ODE, Legendre transform, Hopf-Lax formula, Weak solutions, Uniqueness). **(15hrs)**

Books Recommended:

1. M.D. Raisinghania, Advanced Differential equations, S. Chand & Co.
2. T. Amarnath, An Elementary course in PDE, Narosa Publications.
3. K.S. Bhamra, Partial Differential Equations, PHI.
4. I.N. Sneddon, Elements of Partial Differential Equations, McGraw Hill, New York.
5. Peter V. O'Neil, Advanced Engineering Mathematics, ITP.
6. L.C. Evans, Partial Differential Equations: Second Edition (Graduate Studies in Mathematics) 2nd Edition, American Mathematical Society, 2010.

7. H.F. Weinberger, A First Course in Partial Differential Equations, John Wiley & Sons, 1965.

DSEC COURSES OFFRED TO M.SC. (MATHEMATICS) STUDENTS ONLY

RINGS AND MODULES

Paper Code: Max. Marks: 75

Time Allowed: 3 Hours Credits: 5

Note for Examiners and Students:

1. There will be eight questions covering the entire syllabus out of which four are to be attempted by the student selecting one from each section. Q. No. 1 will be compulsory (short answer type five parts are to be attempted out of six) 3X5=15. All questions carry equal marks.
2. Internal evaluation is to be made on the basis of the parameters to be decided by the concerned faculty in the consultation with the Head of the department.

UNIT-I

Rings, Examples (including polynomial rings, formal power series rings, matrix rings and group rings, integral domains, division rings , fields), ideals, prime and maximal ideals, rings of fractions, Chinese Remainder Theorem for pair wise co maximal ideals. Homeomorphisms and isomorphism's of rings. **(16hrs)**

UNIT-II

Factorization in domains, Euclidean Domains, Principal Ideal Domains and Unique Factorizations Domains. Polynomial rings over UFD', Polynomial rings over field, Irreducibility Criteria. **(15hrs)**

UNIT-III

Vector Spaces, Modules, Direct Products and Direct Sums, Quotients and monomorphisms of modules, Modules over PIDs and applications, Various Canonical Forms. **(15hrs)**

UNIT-IV

Simple and semi simple modules, Semi simple rings, Wedderburn-Artin structure Theory. **(14hrs)**

Books recomended:

1. I. N. Herstein, Topics in Algebra, Wiley Eastern Ltd., New Delhi, 1975.
2. P. B. Bhattacharya, S. K. Jain and S. R. Nagpaul, Basic Abstract Algebra (2nd Edition), Cambridge University Press, Indian Edition, 1997.
3. P. B. Bhattacharya, S. K. Jain and S. R. Nagpaul, Basic Abstract Algebra (2nd Edition), Cambridge University Press, Indian Edition, 1997.
4. M. F. Atiyah & I. G. Macdonald, Introduction to Commutative Rings, Addison Wesley.
5. P. M. Cohn, Algebra, Vols. I, II & III, John Wiley & Sons, 1982, 1989, 1991.
6. C. W. Curtis and I. Reiner, Representation Theory of finite Groups and Associative Algebras, Wiley and Sons, 1962.
7. F. W. Anderson and K. R. Fuller, Rings and Categories of Modules, Springer-Verlag New York, 1992.
8. T. Y. Lam, Lectures on Modules and Rings, GTM Vol. 189, Springer-Verlag, 1999.
9. D.S. Dummit and R.M. Foote: Abstract Algebra.
10. S. Lang: Algebra.

DISCRETE MATHEMATICS

Paper Code: Max. Marks: 75
Time Allowed: 3 Hours Credits: 5

Note for Examiners and Students:

1. There will be eight questions covering the entire syllabus out of which four are to be attempted by the student selecting one from each section. Q. No. 1 will be compulsory (short answer type five parts are to be attempted out of six) 3X5=15. All questions carry equal marks.
2. Internal evaluation is to be made on the basis of the parameters to be decided by the concerned faculty in the consultation with the Head of the department.
3.

UNIT-I

Mathematical Logic: Statement and notations, proposition and logic operations, connectives (conjunction, disjunction, negation), statement formulas and truth tables, propositions generated by set, equivalence of formulas and implication laws of logic, mathematical systems, propositions over a universe, principal of mathematical induction, variables, quantifiers. **(15hrs)**

UNIT-II

Relation and Function: Binary relations, Properties of binary relation in a set, Equivalence relations, Composition of binary relations, Partial ordering and Partial Order set, Hasse diagram, Function and Pigeon hole Principle. Recursion definition, many faces of recursion, Recurrence relations, common recurrence relations, generating functions and their solutions. **(15hrs)**

UNIT-III

Posets, lattice and basic properties of Boolean algebraic, Principle of duality, distributive and complemented lattices, uniqueness of finite Boolean algebra, Boolean functions and Boolean expressions, Normal forms of Boolean expression and simplifications of Boolean expressions, Basic circuits and theorems, Logical gates and relations of Boolean function. **(15hrs)**

UNIT-IV

Basic terminology of graph theory, Paths, Circuits, Graph connectivity, Eulerian paths, Multigraphs, Weighted graphs. Trees, Spanning trees, Binary trees, Rooted trees. Planar graphs, Eulers theorem. The Konigsberg Bridge problem and Eulerian graphs,Hamiltonian graphs. **(15hrs)**

Books Recommended :

1. Kenneth H. Rosen , Discrete Mathematics and Its Applications, Seventh Edition, Tata McGraw Hill.
2. J. P. Trembley and R. Manohar, A First Course in Discrete Structure with applications to Computer Science, Tata McGraw Hill (1999).
3. Vijay K. Khanna, Lattices and Boolean Algebras, PHI publication.
4. Babu Ram, Discrete Mathematics, Vinayak Publications.
5. C. L. Liu, Elements of Discrete Mathematics, Tata McGraw Hill.

DIFFERENTIAL GEOMETRY

Paper Code: Max. Marks: 75

Time Allowed: 3 Hours Credits: 5

Note for Examiners and Students:

1. There will be eight questions covering the entire syllabus out of which four are to be attempted by the student selecting one from each section. Q. No. 1 will be compulsory (short answer type five parts are to be attempted out of six) 3X5=15. All questions carry equal marks.
2. Internal evaluation is to be made on the basis of the parameters to be decided by the concerned faculty in the consultation with the Head of the department.

UNIT-I

Curves with torsion: Tangent, Principal Normal, Curvature, Binormal, Torsion, Serret Frenet formulae, Locus of centre of spherical Curvature. **(15hrs)**

UNIT-II

Envelopes: Surfaces, Tangent plane, Envelope, Characteristics, Edge of regression, Tangent, Principal normal. Curvature, Binomial Torsion, Serret-Frenet formulae, Loous of centre of curvature, Spherical curvature. **(16hrs)**

UNIT-III

Curvilinear Co-ordinates: First order magnitude, Directions on a surface, Second order magnitudes, Derivative of unit normal, Principal directions and curvatures. **(15hrs)**

UNIT-IV

Geodesics: Geodesic property, Equations of geodesics, Torsion of a geodesic. **(14hrs)**

***Books Recomended**:*

1. C.E., Weatherburn, Differential Geometry of Three Dimensions, Cambridge University Press.
2. S. Sokolnikoff, Tensor Calculus and Application to Geometry and Mechanics.
3. T. J. Wilmore, An Introduction to Differential Geometry, Oxford University Press India.
4. Bary Spain, Tensor Calculus: A concise course, Dover Publications.

ADVANCED ABSTRACT ALGEBRA

Paper Code: Max. Marks: 75

Time Allowed: 3 Hours Credits: 5

Note for Examiners and Students:

1. There will be eight questions covering the entire syllabus out of which four are to be attempted by the student selecting one from each section. Q. No. 1 will be compulsory (short answer type five parts are to be attempted out of six) 3X5=15. All questions carry equal marks.
2. Internal evaluation is to be made on the basis of the parameters to be decided by the concerned faculty in the consultation with the Head of the department.

UNIT – I

Cyclic modules, Simple and semi-simple modules, Schur's lemma, Free modules, Fundamental structure theorem of finitely generated modules over principal ideal domain and its applications to finitely generated abelian groups. **(15hrs)**

UNIT - II

Uniform modules, Primary modules and Neother- Lasker theorem. Neotherian and Artinian modules and rings with simple properties and examples. **(15hrs)**

Unit – III

Nilpotent ideals in Neotherian and Artinian rings, Hilbert Basis theorem, Nakayama's lemma, Nilradical and Jacobson radicals, Opertions on ideals , Extension and contraction. **(15hrs)**

UNIT – IV

Hom(R,R), Opposite rings, Wedderburn - Artin theorem, Maschk's theorem, Equivalent statement for left Artinian rings having non-zero nilpotent ideals. **(15hrs)**

Books Recomended:

1. I. N. Herstein, Topics in Algebra, Wiley Eastern Ltd., New Delhi, 1975.
2. P. B. Bhattacharya, S. K. Jain and S. R. Nagpaul, Basic Abstract Algebra (2nd Edition), Cambridge University Press, Indian Edition, 1997.
3. M. F. Atiyah & I. G. Macdonald, Introduction to Commutative Rings, Addison Wesley.
4. P. M. Cohn, Algebra, Vols. I, II & III, John Wiley & Sons, 1982, 1989, 1991.
5. C. W. Curtis and I. Reiner, Representation Theory of finite Groups and Associative Algebras, Wiley and Sons, 1962.
6. F. W. Anderson and K. R. Fuller, Rings and Categories of Modules, Springer-Verlag New York, 1992.

GEC COURSES OFFRED TO PG STUDENTS FROM OTHER DEPARTMENTS

MULTIVARIATE ANALYSIS

Paper Code: Max. Marks: 75

Time Allowed: 3 Hours Credits: 4

Note for Examiners and Students:

1. There will be eight questions covering the entire syllabus out of which four are to be attempted by the student selecting one from each section. Q. No. 1 will be compulsory (short answer type five parts are to be attempted out of six) 3X5=15. All questions carry equal marks.
2. Internal evaluation is to be made on the basis of the parameters to be decided by the concerned faculty in the consultation with the Head of the department.

UNIT - I

Multivariate normal distribution, Marginal and conditional distributions, Characteristic function. Distribution of linear combinations of normal vector. **(15hrs)**

UNIT - II

Maximum likelihood estimators of mean vector and covariance matrix. Distribution of sample mean vector, Distribution of quadratic forms. Correlation coefficient of a bivariate sample, Partial and multiple correlation coefficients. **(15hrs)**

UNIT - III

Derivation of generalised T^2 -statistic and its distribution, Uses of T^2 -statistic.The problem of classification, Procedures of classification of one of the two populations with known probabilities, Wishart matrix - its distribution(without proof) and properties. Generalized variance. **(15hrs)**

UNIT - IV

Principal components, Maximum likelihood estimators of principal components and their variances, Canonical correlations and variates, Estimation of canonical correlations and variates, Cluster analysis. **(15hrs)**

Books Recomended:

1. T.W. Anderson, An Introduction to Multivariate Statistical Analysis, John Wiley
2. C.R. Rao, Linear Statistical Inference and its Applications, John Wiley
3. R.A. Johnson and D.W. Wichern, (2001), Applied Multivariate Statistical Analysis, Prentice Hall of India
4. A.C. Rencher, (2002), Methods of Multivariate Analysis, 2nd Ed., John Wiley & Sons.

CODING THEORY

Paper Code: Max. Marks: 75
Time Allowed: 3 Hours Credits: 4

Note for Examiners and Students:

1. There will be eight questions covering the entire syllabus out of which four are to be attempted by the student selecting one from each section. Q. No. 1 will be compulsory (short answer type five parts are to be attempted out of six) 3X5=15. All questions carry equal marks.
2. Internal evaluation is to be made on the basis of the parameters to be decided by the concerned faculty in the consultation with the Head of the department.

UNIT - I

The communication channel, The coding problem, Types of codes, Block codes, Types of codes such as repetition codes, Parity check codes and their error-detection and correction capabilities. Hamming metric, Relationship of error detection/correction with hamming distance, Maximum likelihood decoding procedure, Decoding by syndrome decoding and Coset leaders, Standard array. **(15hrs)**

UNIT - II

Linear codes (Binary and non binary), Minimum distance, Dimension, Modular representation of linear codes, Description of linear codes by matrices, Polynomial codes, Generator and parity check polynomials and matrices. **(15hrs)**

UNIT - III

Dual codes, Self duality, Weight distribution of dual of binary linear codes, Macwilliam identity(binary case) extending, Expurgating and augmenting a code, Lee metric, Convolutional codes, Description using matrices and polynomials, Encoding using (4,3,2) encoder. **(15hrs)**

UNIT - IV

Hamming codes (Binary and non-binary) and their properties, Perfect and quasi-perfect codes. Golay codes as perfect codes, Bounds on minimum distance for block codes, Plotkin bound, Hamming sphere. **(15hrs)**

Books Recommended

1. Ryamond Hill, A First Course in Coding Theory, Oxford University Press, 1986.
2. Man Young Rhee, Error Correcting Coding Theory, McGraw Hill Inc., 1989.
3. W.W. Peterson and E.J. Weldon, Jr., Error-Correcting Codes. M.I.T. Press, Cambridge Massachuetts, 1972.
4. E.R. Berlekamp, Algebraic Coding Theory, McGraw Hill Inc., 1968.
5. F.J. Macwilliams and N.J.A. Sloane, Theory of Error Correcting Codes, North-Holand Publishing Company.
6. J.H. Van Lint, Introduction to Coding Theory, Graduate Texts in Mathematics, 86, Springer, 1998.
7. L.R. Vermani, Elements of Algebraic Coding Theory, Chapman and Hall, 1996.

MECHANICS

Paper Code: Time Allowed: 3 Hours

Max. Marks: 75 Credits: 4

Note for Examiners and Students:

1. There will be eight questions covering the entire syllabus out of which four are to be attempted by the student selecting one from each section. Q. No. 1 will be compulsory (short answer type five parts are to be attempted out of six) 3X5=15. All questions carry equal marks.
2. Internal evaluation is to be made on the basis of the parameters to be decided by the concerned faculty in the consultation with the Head of the department.

UNIT-I

Vector Integration: Line integrals, Surface area and surface integrals, Volume integrals.
Integral Theorems: Green's theorem, Gauss divergence theorem, Stoke's theorem. **(12hrs)**

UNIT- II

Curvilinear Coordinates: Orthogonal coordinates, Unit vectors in curvilinear systems, Arc length and volume elements, the gradient, Divergence and curl, Special orthogonal coordinate systems.
Tensor Analysis: Coordinate transformations, Einstein summation convention, Tensors of different ranks, Contravariant, Covariant and mixed tensors, Symmetric and skew symmetric tensors, Addition, Subtraction, Inner and outer products of tensors, Contraction theorem, Quotient law, The line element and metric tensor, Christoffel symbols. **(16hrs)**

UNIT -III

Non Inertial Reference Systems: Accelerated coordinate systems and inertial forces, Rotating coordinate systems, Velocity and acceleration in moving system: Coriolis, Centripetal and transverse acceleration, Dynamics of a particle in a rotating coordinate system
Planar Motion of Rigid Bodies: Introduction to rigid and elastic bodies, Degrees of freedom, Translations, Rotations, instantaneous axis and center of rotation, Motion of the center of mass
Euler's theorem and Chasle's theorem, Rotation of a rigid body about a fixed axis: Moments and products of inertia of various bodies including hoop or cylindrical shell, circular cylinder, spherical shell, Parallel and perpendicular axis theorem, Radius of gyration of various bodies.
(16hrs)

UNIT- IV

Motion of Rigid Bodies in Three Dimensions: General motion of rigid bodies in space: Moments and products of inertia, Inertia matrix, The momental ellipsoid and equimomental systems, Angular momentum vector and rotational kinetic energy, Principal axes and principal moments of inertia, Determination of principal axes by diagonalizing the inertia matrix
Euler Equations of Motion of a Rigid Body: Force free motion, Free rotation of a rigid body with an axis of symmetry, Free rotation of a rigid body with three different principal moments
Euler's Equations, The Eulerian angles, Angular velocity and kinetic energy in terms of Euler

angles, Space cone, Motion of a spinning top and gyroscopes- steady precession, Sleeping top.

(16hrs)

Books Recommended:

1. G. E. Hay, *Vector and Tensor Analysis*, (Dover Publications, Inc., 1979)
2. G. R. Fowles and G. L. Cassiday, *Analytical Mechanics*, (Thomson Brooks/Cole, 2005)
3. H. Goldstein, C. P. Poole and J. L. Safko, *Classical Mechanics*, (Addison-Wesley, Publishing Co., 2001)
4. M. R. Spiegel, *Theoretical Mechanics*, (McGraw Hill Book Company, 1980)
5. M. R. Spiegel, *Vector Analysis*, (McGraw Hill Book Company, 1981)
6. D. C. Kay, *Tensor Calculus*, (McGraw Hill Book Company, 1988)
7. E. C. Young, *Vector and Tensor Analysis*, (Marcel Dekker, Inc., 1993)
8. L. N. Hand and J. D. Finch, *Analytical Mechanics*, (Cambridge University Press, 1998)

Semester III

Measure Theory and Integration

Paper Code: Time Allowed: 3 Hours

Max. Marks: 75 Credits: 5

Note for Examiners and Students:

3. There will be eight questions covering the entire syllabus out of which four are to be attempted by the student selecting one from each section. Q. No. 1 will be compulsory (short answer type five parts are to be attempted out of six) 3X5=15. All questions carry equal marks.
4. Internal evaluation is to be made on the basis of the parameters to be decided by the concerned faculty in the consultation with the Head of the department.

Unit-I (16 hrs.)

Lebesgue outer measure, elementary properties of outer measure, Measurable sets and their properties, Lebesgue measure of sets of real numbers, algebra of measurable sets, Borel sets and their measurability, characterization of measurable sets in terms of open, closed, F_σ and G_δ sets, existence of a non-measurable set.

Unit-II (14 hrs.)

Measurable functions and their equivalent formulations. Properties of measurable functions. Approximation of a measurable function by a sequence of simple functions, Measurable functions as nearly continuous functions, Egoroff theorem, Lusin theorem, Convergence in measure and F. Riesz theorem. Almost uniform convergence.

Unit-III (16 hrs.)

Shortcomings of Riemann Integral, Lebesgue Integral of a bounded function over a set of finite measure and its properties. Lebesgue integral as a generalization of Riemann integral, Bounded convergence theorem, Lebesgue theorem regarding points of discontinuities of Riemann integrable functions, Integral of non-negative functions, Fatou Lemma, Monotone convergence theorem, General Lebesgue Integral, Lebesgue convergence theorem.

Unit-IV **(14 hrs.)**

Differentiation of monotonic functions, Function of bounded variation and its representation as difference of monotonic functions, Differentiation of indefinite integral, Fundamental theorem of calculus, Absolutely continuous functions and their properties.

Books Recommended:

1. Walter Rudin, Principles of Mathematical Analysis (3rd edition) McGraw-Hill, Kogakusha,1976, International Student Edition.
2. T. M. Apostol, Mathematical Analysis, Narosa Publishing House, New Delhi, 1974.
3. H.L. Royden, Real Analysis, Macmillan Pub. Co., Inc. 4th Edition, New York, 1993.
4. G. De Barra, Measure Theory and Integration, Wiley Eastern Limited, 1981.
5. R.R. Goldberg, Methods of Real Analysis, Oxford & IBH Pub. Co. Pvt. Ltd, 1976.
6. R. G. Bartle, The Elements of Real Analysis, Wiley International Edition, 2011.
7. S.C. Malik and Savita Arora, Mathematical Analysis, New Age International Limited, New Delhi, 2012.

COMPLEX ANALYSIS

Paper Code: Time Allowed: 3 Hours

Max. Marks: 75 Credits: 5

Note for Examiners and Students:

1. There will be eight questions covering the entire syllabus out of which four are to be attempted by the student selecting one from each section. Q. No. 1 will be compulsory (short answer type five parts are to be attempted out of six) 3X5=15. All questions carry equal marks.
2. Internal evaluation is to be made on the basis of the parameters to be decided by the concerned faculty in the consultation with the Head of the department.

UNIT - I (14hrs.)

Function of a complex variable, Continuity, Differentiability, Analytic functions and their properties, Cauchy-Riemann equations in cartesian and polar coordinates, Power series, Radius of convergence, Differentiability of sum function of a power series, Branches of many valued functions with special reference to argz, logz and za.

UNIT - II (16hrs.)

Path in a region, Contour, Complex integration, Cauchy theorem, Cauchy integral formula, Extension of Cauchy integral formula for multiple connected domain, Poisson integral formula, Higher order derivatives, Complex integral as a function of its upper limit, Morera theorem, Cauchy inequality, Liouville theorem, Taylor theorem.

UNIT - III (16hrs.)

Zeros of an analytic function, Laurent series, Isolated singularities, Cassorati- Weierstrass theorem, Limit point of zeros and poles. Maximum modulus principle, Schwarz lemma, Meromorphic functions, Argument principle, Rouche theorem, Fundamental theorem of algebra, Inverse function theorem.

UNIT - IV (14hrs.)

Calculus of residues, Cauchy residue theorem, Evaluation of integrals, Definitions and examples of conformal mappings .

Space of analytic functions and their completeness, Hurwitz theorem, Montel theorem, Riemann mapping theorem.

Books Recommended:

1. H.A. Priestly, Introduction to Complex Analysis, Clarendon Press, Oxford, 1990.
2. J.B. Conway, Functions of One Complex Variable, Springer-Verlag, International student-Edition, Narosa Publishing House, 2002.
3. Liang-Shin Hann & Bernand Epstein, Classical Complex Analysis, Jones and Bartlett Publishers International, London, 1996.
4. E.T. Copson, An Introduction to the Theory of Functions of a Complex Variable, Oxford University Press, London, 1972.
5. E.C. Titchmarsh, The Theory of Functions, Oxford University Press, London.
6. Ruel V. Churchill and James Ward Brown, Complex Variables and Applications, McGraw-Hill Publishing Company, 2009.
7. H.S. Kasana, Complex Variable Theory and Applications, PHI Learning Private Ltd, 2011.
8. Dennis G. Zill and Patrik D. Shanahan, A First Course in Complex Analysis with Applications, John Bartlett Publication, 2nd Edition, 2010.

FUNCTIONAL ANALYSIS

Paper Code: Time Allowed: 3 Hours

Max. Marks: 75 Credits: 5

Note for Examiners and Students:

1. There will be eight questions covering the entire syllabus out of which four are to be attempted by the student selecting one from each section. Q. No. 1 will be compulsory (short answer type five parts are to be attempted out of six) 3X5=15. All questions carry equal marks.
2. Internal evaluation is to be made on the basis of the parameters to be decided by the concerned faculty in the consultation with the Head of the department.

UNIT - I **(15hrs.)**

Normed linear spaces, Metric on normed linear spaces, Completion of a normed space, Banach spaces, subspace of a Banach space, Holder and Minkowski inequality, Completeness of quotient spaces of normed linear spaces. Completeness of l_p, L^p, R^n, C^n and C[a,b]. Incomplete normed spaces.

UNIT - II **(16hrs.)**

Finite dimensional normed linear spaces and Subspaces, Bounded linear transformation, Equivalent formulation of continuity, Spaces of bounded linear transformations, Continuous linear functional, Conjugate spaces. Hahn-Banach extension theorem (Real and Complex form).

UNIT - III **(14hrs.)**

Riesz Representation theorem for bounded linear functionals on L^p and C[a,b]. Second conjugate spaces, Reflexive space, Uniform boundedness principle and its consequences, Open mapping theorem and its application, Projections, Closed Graph theorem.

UNIT - IV **(15hrs.)**

Equivalent norms, Weak and Strong convergence, Their equivalence in finite dimensional spaces. Weak sequential compactness, Solvability of linear equations in Banach spaces. Compact operator and its relation with continuous operator, Compactness of linear transformation on a finite dimensional space, Properties of compact operators, Compactness of the limit of the sequence of compact operators.

Books Recommended:

11. H.L. Royden, Real Analysis, MacMillan Publishing Co., Inc., New York, 4th Edition, 1993.
12. E. Kreyszig, Introductory Functional Analysis with Applications, John Wiley.
13. George F. Simmons, Introduction to Topology and Modern Analysis, McGraw-Hill Book Company, 1963.
14. A. H. Siddiqi, Khalil Ahmad and P. Manchanda, Introduction to Functional Analysis with Applications, Anamaya Publishers, New Delhi-2006.
15. K.C. Rao, Functional Analysis, Narosa Publishing House, Second edition.

CALCULUS OF VARIATION AND INTEGRAL EQUATIONS

Paper Code: Time Allowed: 3 Hours

Max. Marks: 75 Credits: 5

Note for Examiners and Students:

1. There will be eight questions covering the entire syllabus out of which four are to be attempted by the student selecting one from each section. Q. No. 1 will be compulsory (short answer type five parts are to be attempted out of six) 3X5=15. All questions carry equal marks.
2. Internal evaluation is to be made on the basis of the parameters to be decided by the concerned faculty in the consultation with the Head of the department.

UNIT - I (18hrs.)

Volterra integral equation, Fredholm integral equation, singular integral equation, non-linear integral equation, convolution integral, differentiation of a function under an integral sign, initial value problems reduced to Volterra integral equations, boundary value problems reduced to Fredholm integral equations

UNIT - II (18hrs.)

Method of successive approximation and substitution, Fredholm resolvent kernel as a ratio of two series, Fredholm equations with separable kernels and iterated kernels, approximation of a kernel by a separable kernel, fundamental functions

UNIT - III (13hrs.)

Motivating problems of calculus of variations, shortest distance, minimum surface of revolution, Brachistochrone problem, isoperimetric problem, geodesic, Fundamental lemma of calculus of variations

UNIT - IV (11hrs.)

Euler’s equation for one dependent function, generalization of Euler's equation to ‘n’ dependent functions and to higher order derivatives.

Books Recommended:

1. Linear integral equations, theory and techniques, R.P. Kanwal, Birkhauser books.
2. Calculus of variations, Gelfand, J.M. and Fomin, S.V., Prentice hall
3. Integral Equations, Shanti Swaroop and Shivraj Singh, Krishna Publications

DSEC COURSES OFFRED TO M.SC. (MATHEMATICS) STUDENTS ONLY

OBJECT ORIENTED PROGRAMMING WITH C++

Paper Code: Time Allowed: 3 Hours

Max. Marks: 75 Credits: 4

Note for Examiners and Students:

3. There will be eight questions covering the entire syllabus out of which four are to be attempted by the student selecting one from each section. Q. No. 1 will be compulsory (short answer type five parts are to be attempted out of six) 3X5=15. All questions carry equal marks.
4. Internal evaluation is to be made on the basis of the parameters to be decided by the concerned faculty in the consultation with the Head of the department.

UNIT - I **(15hrs.)**

Object Oriented Programming Concepts: Procedural Language and Object Oriented approach, Characteristics of OOP, user defined types, polymorphism and encapsulation;

Getting started with C++: syntax, data types, variables, string, function, namespace and exception, operators, flow control.

UNIT - II **(14hrs.)**

Abstracting Mechanism: classes, private and public, Constructor and Destructor, member function, Static members; Memory Management: new, delete, object copying, copy constructer, assignment operator, this input/output.

UNIT - III **(15hrs.)**

Inheritance and Polymorphism: Derived Class and Base Class, Different types of Inheritance;

Overriding member function, Abstract Class, Public and Private Inheritance, Ambiguity in Multiple inheritance , Virtual function, Friend function, Static function.

UNIT - IV **(16hrs.)**

Files, Templates, Exception Handling concepts: Template classes, Basics of C++ Exception Handling: Try Throw, Catch, Throwing an Exception, Catching an Exception, Handling Exceptions, Files and I/O Streams;

Unary and Binary Operators, Operator overloading, Function Overloading.

Books Recommended:

1. Balagurusamy, E.: Object-Oriented Programming With C++, Tata McGraw-Hill.
2. Subburaj, R.: Object-Oriented Programming With C++, Vikas Pub. House, New Delhi.
3. Rumbaugh, J. et. al.: Object-Oriented Modelling and Design, Prentice Hall of India.
4. Booch, Grady: Object-Oriented Analysis & Design, Addison Wesley.
5. Chndra, B.: Object Oriented Programming Using C++, Narosa Pub. House, New Delhi.
6. Stroustrup, B.: The C++ Programming Language, Addison-Wesley.
7. Lippman: C++ Primer, 3/e, Addison-Wesley.
8. Schildt, Herbert: C++: The Complete Reference, 2/e, Tata McGraw-Hill

OBJECT ORIENTED PROGRAMMING WITH C++ (PRACTICAL)

Paper Code: Time Allowed: 3 Hours

Max. Marks: 50 Credits: 1

List of experiments to be performed in lab using any software

1. Write a C++ program to find the sum of individual digits of a positive integer.

2. A Fibonacci sequence is defined as follows: the first and second terms in the sequence are 0 and
1. Subsequent terms are found by adding the preceding two terms in the sequence. Write a C++
program to generate the first n terms of the sequence.

3. Write a C++program to generate all the prime numbers between 1 and n , where n is a value supplied by the user.

4. Write a C++program to find the factorial of a given integer

5. Write a C++program to find the GCD of two given integers

6. Write a C++ program that uses a recursive function for solving Towers of Hanoi problem.

7. Write a C++program to implement call by value and call by reference parameters passing

8. Write a C++ program to implement function templates

9. Write a program to implement Overloading and Overriding

10. Write a C++ program to implement the matrix ADT using a class. The operations supported by
this ADT are:

a. Reading a matrix.

b. Printing a matrix

c. Addition of matrices

d. Subtraction of matrices

e. Multiplication of matrices

11. Write C++programs that illustrate how the Single inheritance, Multiple inheritance Multi level
inheritance and Hierarchical inheritance forms of inheritance are supported

12. Write a C++program that illustrates the order of execution of constructors and destructors when
new class is derived from more than one base class

13. Write a C++ program that illustrates how run time polymorphism is achieved using virtual functions

MATHEMATICAL MODELING

Paper Code: Time Allowed: 3 Hours

Max. Marks: 75 Credits: 5

Note for Examiners and Students:

1. There will be eight questions covering the entire syllabus out of which four are to be attempted by the student selecting one from each section. Q. No. 1 will be compulsory (short answer type five parts are to be attempted out of six) 3X5=15. All questions carry equal marks.
2. Internal evaluation is to be made on the basis of the parameters to be decided by the concerned faculty in the consultation with the Head of the department.

UNIT - I (16hrs.)

Introduction and the technique of mathematical modeling, Classification and characteristics of mathematical models. Mathematical modeling through algebra, Finding the radius of the earth, Motion of planets, Motions of satellites. Linear and Non-linear growth and decay models, Population growth models. Effects of Immigration and Emigration on Population size, Decrease of temperature, Diffusion, Change of price of a commodity, Logistic law of population growth. A simple compartment model. Diffusion of glucose or a Medicine in the blood stream.

UNIT - II (15hrs.)

Mathematical modeling of epidemics, A simple epidemics model, A susceptible – infected - susceptible (SIS) model, SIS model with constant number of carriers, Simple epidemic model with carriers, Model with removal, Model with removal and immigration. Mathematical modeling in economics, Domar macro model, Domar first debt model, Domar second debt model, Samuelson investment model, Stability of market equilibrium. Mathematical modelling in medicine, Arms race and battles: A model for diabetes mellitus, Richardson model for arms race, Lamechester combat model.

UNIT - III (15hrs.)

Mathematical modeling through partial differential equations: Mass-balance Equations, Momentum-balance Equations, Variational principles, Probability generating function, modeling for traffic on a highway.

UNIT - IV **(14hrs.)**

Stochastic models of population growth, Need for stochastic models, Linear birth death immigration-emigration processes, Linear birth-death process, Linear birth-death immigration process, Linear birth-death-emigration process, Non-linear birth-death process.

Books Recommended:

1. J.N. Kapur, Mathematical Modeling, New Age International Limited.
2. J.N. Kapur, Mathematical Models in Biology and Medicine, Affiliated East-West Press (P) Ltd.
3. Mathematical Models in the Social, Management and Life Sciences, D.N. Burghes and A.D. Wood, John Wiley & Sons.
4. Mathematical Modeling, J.G. Andrews & R.R Mclone, Butterworths (Pub.) Inc.

COMMUTATIVE ALGEBRA

Paper Code: Time Allowed: 3 Hours

Max. Marks: 75 Credits: 5

Note for Examiners and Students:

1. There will be eight questions covering the entire syllabus out of which four are to be attempted by the student selecting one from each section. Q. No. 1 will be compulsory (short answer type five parts are to be attempted out of six) 3X5=15. All questions carry equal marks.
2. Internal evaluation is to be made on the basis of the parameters to be decided by the concerned faculty in the consultation with the Head of the department.

UNIT - I **(15hrs.)**

Rings and ideals - Rings and ring homomorphisms, Ideals, Quotient rings, zero-divisors, nilpotent elements, units, prime ideals and maximal ideals.

UNIT - II **(14hrs.)**

The prime spectrum of a ring, the nil radical and Jacobson radical, operation on ideals, extension and contraction.

UNIT - III **(15hrs.)**

Modules - Modules and modules homomorphisms, submodules and quotient modules, Direct sums, Free modules, Finitely generated modules, Nakayama Lemma, Simple modules, Exact sequences of modules.

UNIT - IV **(16hrs.)**

Modules with chain conditions - Artinian and Noetherian modules, modules of finite length, Artnian rings, Noetherian rings, Hilbert basis theorem.

Books Recommended:

1. M. F. Atiyah and I. G. Macdonald – Introduction to Commutative Algebra, Addison-Wesley.

2. C. Musili – Introduction to Rings and Modules, Narosa Publishing House.

3. Miles Reid – Under-graduate Commutative Algebra, Cambridge University Press.

4. N. S. Gopalakrishnan, Commutative Algebra, Oxonian Press.

COMPLEX ANALYSIS II

Paper Code: Time Allowed: 3 Hours

Max. Marks: 75 Credits: 5

Note for Examiners and Students:

1. There will be eight questions covering the entire syllabus out of which four are to be attempted by the student selecting one from each section. Q. No. 1 will be compulsory (short answer type five parts are to be attempted out of six) 3X5=15. All questions carry equal marks.
2. Internal evaluation is to be made on the basis of the parameters to be decided by the concerned faculty in the consultation with the Head of the department.

UNIT - I (16hrs.)

Analytical continuation, Uniqueness of direct analytic continuation, Uniqueness of analytic continuation along the curve, power series method of analytic continuation, Schwarz reflection principle

UNIT - II (16hrs.)

Weierstrass factorisation theorem, Gamma function and its properties, Riemann Zeta function, Riemann's functional equation, Mittage leffler's theorem

UNIT - III (14hrs.)

Canonical product, Jensen's formula, Poisson Jensen's formula, Hadmard's three circle theorem, order of entire function, Exponent of convergence, Hadmard's factorization theorem

UNIT - IV (14hrs.)

The range of an analytical theorem, Bloch's theorem, The Little Picard's theorem, Schottky's theorem, Montel Caratheodory, Univalent functions, Bieberbach's conjecture(Statement only)

Books Recommended:

1. FOUNDATIONS OF COMPLEX ANALYSIS, S. PONNUSAMY, NAROSA PUBLISHING HOUSE

2. COMPLEX VARIABLES THEORY AND APPLICATIONS, H. S. KASANA, PRENTICE HALL

3. COMPLEX VARIABLES AND APPLICATIONS, CHURCHILL, R. V. AND BROWN, J.W., MCGRAW HILL EDUCATION

4. FUNCTIONS OF ONE COMPLEX VARIABLE, JOHN B. CONWAY, NAROSA PUBLISHING HOUSE

SEMINAR

Paper Code: Hours: 30 Hrs.

Max. Marks: 50 Credits: 2

Note for Examiners and Students:

(1) The seminar, participation in discussion, the submitted slides/write-up and attendance will form the basis of evaluation.

(2) Topic is to be decided by faculty (In consultation with student). Each student must present at least one seminar of 60 minutes followed by discussion/question session by audience comprising of students and faculties.

(3) Each student must submit the slides/write-up of presentation content to faculty supervisor/in-charge.

Semester IV

PROJECT/ DISSERTATION

Paper Code: Credits: 10/20

Note for Examiners and Students:

(A) For students who opt for dissertation/project in Starex university campus:

Topic of dissertation will be based on special paper or elective papers and topics of current interest. Topic is to be decided by supervisor/guide concerned.

Evaluation: Report is evaluated by committee constituted by head having at least one external member. Students should submit bound copies (along with soft copy in a CD) of research work performed by him/her duly certified by supervisor.

(B) For students who opt dissertation/project at other institute/outstation:

Topic of dissertation will be based on special paper or elective papers and topics of current interest. Topic is to be decided by supervisor/guide concerned.

Evaluation: Report is evaluated by committee constituted by head having at least one external member. Students should submit bound copies (along with soft copy in a CD) of research work performed by him/her duly certified by superviso

DSEC COURSES OFFRED TO M.SC. (MATHEMATICS) STUDENTS ONLY

WAVELET ANALYSIS

Paper Code: Time Allowed: 3 Hours

Max. Marks: 75 Credits: 5

Note for Examiners and Students:

1. There will be eight questions covering the entire syllabus out of which four are to be attempted by the student selecting one from each section. Q. No. 1 will be compulsory (short answer type five parts are to be attempted out of six) 3X5=15. All questions carry equal marks.
2. Internal evaluation is to be made on the basis of the parameters to be decided by the concerned faculty in the consultation with the Head of the department.

UNIT - I (15hrs.)

Review of Inner Product spaces, orthonormal systems. Frames in C^n, Frames algorithms, Frames and Bessel sequences in infinite dimensional Hilbert spaces, Frame sequence, the Gram matrix associated with Bessel sequences.

UNIT - II (14hrs.)

Frames and Operators, characterization of frames, dual frames, tight frames, Riesz bases, Frames versus Riesz bases, conditions for a frame being a Riesz basis, frames containing a Riesz basis, Perturbation of frames.

UNIT - III (15hrs.)

Wavelets, Haar Wavelets, basic properties of the Haar scaling function, Haar decomposition and reconstruction algorithms. The Daubechies wavelets, wavelet bases, scaling function. Multiresolution analysis (MRA), Construction of wavelets from MRA.

UNIT - IV **(16hrs.)**

Windowed Fourier Transform (WFT), Continuous Fourier Transform (CFT), Continuous Wavelet Transform (CWT), Comparison between CFT and CWT, Continuous Wavelet Transform as an operator, Inversion formula for Continuous Wavelet Transform.

Books Recommended:

1. O. Christensen, An introduction to frames and Riesz bases, Birkhauser (2003)
2. S. Mallat, a wavelet tour of signal processing, Academic Press (2009).
3. E. Harnendez and G. Weiss, A first course on wavelets, CRC Press (1996).
4. D. Han, K.Kornelson , D. Larson and E. Weber, Frames for undergraduates, Student Math.
   Lib.,(AMS) Vol. 40 (2007). 28
5. Boggess and F.J Narcowich, A first course in Wavelets and Fourier Analysis, Wiley(2009)

FINANCIAL MATHEMATICS

Paper Code: Time Allowed: 3 Hours

Max. Marks: 75 Credits: 5

Note for Examiners and Students:

1. There will be eight questions covering the entire syllabus out of which four are to be attempted by the student selecting one from each section. Q. No. 1 will be compulsory (short answer type five parts are to be attempted out of six) 3X5=15. All questions carry equal marks.
2. Internal evaluation is to be made on the basis of the parameters to be decided by the concerned faculty in the consultation with the Head of the department.

UNIT - I **(14hrs.)**

Fundamentals of probability: probability space and measure, algebras and sigma-algebras, random variables, probability distribution, expectation, variance, covariance, correlation.

UNIT - II **(15hrs.)**

Conditional expectation, conditional probability, dependence and independence, Stochastic processes in discrete time; random walk and the Poisson process.

UNIT - III **(16hrs.)**

Discrete time martingales, sub-martingales, super-martingales, Central Limit Theorem and Brownian motion as a limit of a symmetric random walk, properties of Brownian motion.

UNIT - IV **(15hrs.)**

Informal overview of Ito calculus: stochastic integrals, Ito formula, stochastic differential equations, Applications of calculus in finance: Black-Scholes equation and Black-Scholes formula.

Books Recommended:

1. P. Willmott, Derivatives, Wiley 1997.
2. M. Capinski and T. Zastawniak, Mathematics for Finance: An Introduction to Financial Engineering, Springer 2003.
3. M. Capinski and T. Zastawniak, Probability Through Problems, Springer 2001.
4. Z. Brzezniak and T. Zastawniak, Basic Stochastic Processes, Springer 1999.

COMPUTATIONAL FLUID DYNAMICS

Paper Code: Time Allowed: 3 Hours

Max. Marks: 75 Credits: 5

Note for Examiners and Students:

1. There will be eight questions covering the entire syllabus out of which four are to be attempted by the student selecting one from each section. Q. No. 1 will be compulsory (short answer type five parts are to be attempted out of six) 3X5=15. All questions carry equal marks.
2. Internal evaluation is to be made on the basis of the parameters to be decided by the concerned faculty in the consultation with the Head of the department.

UNIT - I (15hrs.)

Basic equations of Fluid dynamics. Analytic aspects of partial differential equations classification,

Boundary conditions, Maximum principles, Boundary layer theory.

Finite difference and Finite volume discretizations. Vertex-centred discretization. Cell centred

discretization. Upwind discretization. Nonuniform grids in one dimension.

UNIT - II (16hrs.)

Finite volume discretization of the stationary convection-diffusion equation in one dimension. Schemes of positive types. Defect correction. Non-stationary convection diffusion equation. Stability definitions. The discrete maximum principle.

Incompressible Navier-Stokes equations. Boundary conditions. Spatial discretization on collocated and on staggered grids. Temporal discretization on staggered grid and on collocated grid.

UNIT - III (15hrs.)

Iterative methods. Stationary methods. Krylov subspace methods. Multigrade methods. Fast Poisson solvers.

Iterative methods for incompressible Navier-Stokes equations.

Shallow-water equations – One and two dimensional cases. Godunov order barrier theorem.

UNIT - IV (14hrs.)

Linear schemes. Scalar conservation laws. Euler equation in one space dimension – analytic aspects. Approximate Riemann solver of Roe.

Osher scheme. Flux splitting scheme. Numerical stability. Jameson – Schmidt – Turkel scheme. Higher order schemes.

Books Recommended:

1. P. Wesseling, Principles of Computational Fluid Dynamics, Springer Verlag, 2000.
2. J.F. Wendt, J.D. Anderson, G. Degrez and E. Dick, Computational Fluid Dynamics: An Introduction, Springer-Verlag, 1996.
3. J.D. Anderson, Computational Fluid Dynamics: The basics with applications, McGraw-Hill, 1995.
4. K. Muralidher, Computational Fluid Flow and Heat Transfer, Narosa Pub. House.
5. T.J. Chung, Computational Fluid Dynamics, Cambridge Uni. Press.
6. J.N. Reddy, An introduction to the Finite Element Methods, McGraw Hill International Edition, 1985.

GENERAL TOPOLOGY

Paper Code: Time Allowed: 3 Hours

Max. Marks: 75 Credits: 5

Note for Examiners and Students:

1. There will be eight questions covering the entire syllabus out of which four are to be attempted by the student selecting one from each section. Q. No. 1 will be compulsory (short answer type five parts are to be attempted out of six) 3X5=15. All questions carry equal marks.)
2. Internal evaluation is to be made on the basis of the parameters to be decided by the concerned faculty in the consultation with the Head of the department.

UNIT - I (16hrs.)

The Tychonoff Theorem, The Stone-Cech Compactification, Local Finiteness, Refinement, Paracompactness, The Smirnov Metrization Theorem, The Nagata-Smirnov Metrization Theorem

UNIT - II (16hrs.)

Complete metric Spaces, Uniform metric, Compactness in Metric Spaces, Point wise and Compact Convergence

UNIT - III (15hrs.)

Topology and convergence of Nets, Hausdorffness and Nets, Filters and their convergence, Ultra-filters, Compactness and Nets, Homotopy of Paths, The Fundamental Group, Covering Space

UNIT - IV (13hrs.)

The Fundamental Group of the Circle, Retractions and Fixed Points, The fundamental Theorem of Algebra, Deformation Retracts and Homotopy Type, The Fundamental Group of S_n.

Books Recommended:

1. Topology, J.R. Munkers, PEARSON
2. Introduction to general topology, K.D. Joshi, NEW ACADEMIC PUBLISHERS

FUZZY SET THEORY

Paper Code: Time Allowed: 3 Hours

Max. Marks: 75 Credits: 5

Note for Examiners and Students:

1. There will be eight questions covering the entire syllabus out of which four are to be attempted by the student selecting one from each section. Q. No. 1 will be compulsory (short answer type five parts are to be attempted out of six) 3X5=15. All questions carry equal marks.
2. Internal evaluation is to be made on the basis of the parameters to be decided by the concerned faculty in the consultation with the Head of the department.

UNIT - I (13hrs.)

Definition of Fuzzy Set, Expanding Concepts of Fuzzy Set, Standard Operations of Fuzzy Set, Fuzzy Complement, Fuzzy Union, Fuzzy Intersection, Other Operations in Fuzzy Set, T-norms and T-conorms.

UNIT - II (16hrs.)

Product Set, Definition of Relation, Characteristics of Relation, Representation Methods of Relations, Operations on Relations, Path and Connectivity in Graph, Fundamental Properties, Equivalence Relation, Compatibility Relation, Pre-order Relation, Order Relation, Definition and Examples of Fuzzy Relation, Fuzzy Matrix, Operations on Fuzzy Relation, Composition of Fuzzy Relation, α - cut of Fuzzy Relation, Projection and Cylindrical Extension, Extension by Relation, Extension Principle, Extension by Fuzzy Relation, Fuzzy distance between Fuzzy Sets.

UNIT - III **(16hrs.)**

Graph and Fuzzy Graph, Fuzzy Graph and Fuzzy Relation, α - cut of Fuzzy Graph, Fuzzy Network, Reflexive Relation, Symmetric Relation, Transitive Relation, Transitive Closure, Fuzzy Equivalence Relation, Fuzzy Compatibility Relation, Fuzzy Pre-order Relation, Fuzzy Order Relation, Fuzzy Ordinal Relation, Dissimilitude Relation, Fuzzy Morphism, Examples of Fuzzy Morphism.

UNIT - IV **(15hrs.)**

Interval, Fuzzy Number, Operation of Interval, Operation of α - cut Interval, Examples of Fuzzy Number Operation, Definition of Triangular Fuzzy Number, Operation of Triangular Fuzzy Number, Operation of General Fuzzy Numbers, Approximation of Triangular Fuzzy Number, Operations of Trapezoidal Fuzzy Number, Bell Shape Fuzzy Number.

Books Recommended:

11. Kwang H. Lee, First Course on Fuzzy Theory and Applications, Springer International Edition, 2005.
12. H.J. Zimmerman, Fuzzy Set Theory and its Applications, Allied Publishers Ltd., New Delhi, 1991.
13. John Yen, Reza Langari, Fuzzy Logic - Intelligence, Control and Information, Pearson Education, 1999.

FINITE ELEMENT ANALYSIS

Paper Code: Time Allowed: 3 Hours

Max. Marks: 75 Credits: 5

Note for Examiners and Students:

1. There will be eight questions covering the entire syllabus out of which four are to be attempted by the student selecting one from each section. Q. No. 1 will be compulsory (short answer type five parts are to be attempted out of six) 3X5=15. All questions carry equal marks.
2. Internal evaluation is to be made on the basis of the parameters to be decided by the concerned faculty in the consultation with the Head of the department.

UNIT - I **(15hrs.)**

General theory of finite element methods, Difference between finite element and finite difference,

Review of some integral formulae, Concept of discretization, Different coordinates, one dimensional finite elements, shape functions, stiffness matrix, connectivity, boundary conditions, equilibrium equation, FEM procedure.

UNIT - II **(15hrs.)**

Generalization of the finite element concepts-weighted residual and variational Approaches (Ritz method, Galerkin method, collocation method etc.), Numerical integration, Interpolation formulas and shape functions, Axis symmetric formulations, solving one-dimensional problems.

UNIT - III **(15hrs.)**

Two dimensional finite element methods, Element types: triangular, rectangular, quadrilateral, sector, curved, isoperimetric elements and numerical integration, two dimensional boundary value problems, connectivity and nodal coordinates, theory of elasticity, variational functions, triangular elements and area coordinates, transformations, cylindrical coordinates.

UNIT - IV **(15hrs.)**

Three dimensional finite elements, higher order finite elements, element continuity, plate finite elements, Application of finite element methods to practical elasticity problems, Computer procedures for Finite element analysis.

Books Recommended:

1. D. Braess, Finite Elements: Theory, Fast Solvers, and Applications in Solid Mechanics, Cambridge University Press.
2. C. S. Desai, Introductory Finite Element Method, CRC Press, 2001.
3. G. D. Smith, Numerical solution of Partial Differential Equations: Finite difference methods, Oxford Applied Mathematics and Computing Science Series, 1985.
4. B. Bradie, A friendly introduction to Numerical Analysis, Pearson Education, India, 2007.

CRYPTOGRAPHY

Paper Code: Time Allowed: 3 Hours

Max. Marks: 75 Credits: 5

Note for Examiners and Students:

1. There will be eight questions covering the entire syllabus out of which four are to be attempted by the student selecting one from each section. Q. No. 1 will be compulsory (short answer type five parts are to be attempted out of six) 3X5=15. All questions carry equal marks.
2. Internal evaluation is to be made on the basis of the parameters to be decided by the concerned faculty in the consultation with the Head of the department.

UNIT - I **(16hrs.)**

Modular arithmetic, Congruence, Primitive roots, Cryptography Introduction, Caesar Cipher, Diffie-Hellman RSA public key cryptosystem, Knapsack Cryptosystem, Application of primitive roots to cryptography.

UNIT - II **(15hrs.)**

Applications of Cryptography in Primality testing and Factorization of large composite numbers, Remote coin flipping.

UNIT - III **(15hrs.)**

Perfect numbers, Fermat numbers, Mersenne primes and Amicable numbers, Fibonacci Numbers, Representation of Integers as sum of Squares.

UNIT - IV **(14hrs.)**

Linear and Non-linear Diophantine equations, Fermat's last Theorem, Prime Number Theorem and Zeta function.

Books Recommended:

Text Books: D. M. Burton, Elementary Number Theory, Tata McGraw Hill Publishing House, 2006.

Reference Books:

1. A handbook of applied cryptography by Alfred J. Menezes, Paul C. Van Oorschot and Scott A. Vanstone, CRC press series on discrete mathematics and its applications

2. A Course In Number Theory And Cryptography by Neal Koblitz , Springer 1987

3. An Introduction To Cryptology by Henk C.A. Van Tilborg, Kluwer Academic Publishers, 1987

4. Contemporary Cryptology : The Science of Information Integrity, by Gustavus J. Simmons (Editor), New York, IEEE Press, 1992

ANALYTICAL NUMBER THEORY

Paper Code: Time Allowed: 3 Hours

Max. Marks: 75 Credits: 5

Note for Examiners and Students:

1. There will be eight questions covering the entire syllabus out of which four are to be attempted by the student selecting one from each section. Q. No. 1 will be compulsory (short answer type five parts are to be attempted out of six) 3X5=15. All questions carry equal marks.
2. Internal evaluation is to be made on the basis of the parameters to be decided by the concerned faculty in the consultation with the Head of the department.

UNIT - I (14hrs.)

Linear Diophantine equation, prime counting function, statement of prime number theorem, Goldbach conjecture, linear congruences, complete set of residues, Chinese remainder theorem, Fermat's little theorem, Wilson's theorem.

UNIT - II (16hrs.)

Number theoretic functions, sum and number of divisors, totally multiplicative functions, definition and properties of the Dirichlet product, the Möbius inversion formula, the greatest integer function, Euler's phi-function, Euler's theorem, reduced set of residues, some properties of Euler's phi-function.

UNIT - III (15hrs.)

Order of an integer modulo n, primitive roots for primes, composite numbers having primitive roots, Euler's criterion, the Legendre symbol and its properties.

UNIT - IV **(15hrs.)**

quadratic reciprocity, quadratic congruences with composite moduli. Public key encryption, RSA encryption and decryption, the equation x2 + y2= z2, Fermat's Last Theorem.

Books Recommended:

1. David M. Burton, Elementary Number Theory (6th Edition), Tata McGraw-Hill Edition, Indian reprint, 2007.
2. Neville Robinns, Beginning Number Theory (2nd Edition), Narosa Publishing House Pvt. Limited, Delhi, 2007.
3. S. Barnard & J.M. Child – *Higher Algebra*(Mac Millan)
4. Burnside & Panton – *Theory of Equations* (S. Chand)
5. Neal H. Mckoy – *Theory of Numbers* (Macmillan)
6. Ivan Niven & N. S. Zuckerman – *An Introduction to Theory of Numbers* (John-Wiley)

SKILL ENHANCEMENT ELECTIVE COURSES

STATISTICS THROUGH SPSS

Paper Code: Time Allowed: 2 Hours

Max. Marks: 50 Credits: 0

Note for Examiners and Students:

1. There will be eight questions covering the entire syllabus out of which four are to be attempted by the student selecting one from each section. Q. No. 1 will be compulsory (short answer type five parts are to be attempted out of six) 2X5=10. All questions carry equal marks.
2. Internal evaluation is to be made on the basis of the parameters to be decided by the concerned faculty in the consultation with the Head of the department.

UNIT - I **(09hrs.)**

Data: Qualitative and quantitative data, Cross-sectional and time series data, Univariate and multivariate data, Scales of measurement of data.

SPSS data file: Opening a data file in SPSS, SPSS Data Editor, Creating a data file, Editing and manipulating data, Missing values, Editing SPSS output, Copying SPSS output, Printing from SPSS, Importing data.

UNIT - II **(07hrs.)**

Descriptive statistics with SPSS: Measures of central tendency, Dispersion, Skewness, Kurtosis.

Charts and graphs with SPSS: Frequencies, Bar charts, Pie charts, Line graphs, Histograms, Box plots.

UNIT - III **(08hrs.)**

Statistical tests using SPSS: Normality tests, t-tests, F-test, One way and Two way ANOVA, Non-parametric tests- Chi Square, Spearman rank, Maan Whitney U and Wilcoxon signed rank test.

UNIT - IV **(08hrs.)**

Correlation and regression using SPSS: Linear correlation and regression, Multiple regression.

Factor analysis using SPSS.

Books Recommended:

1. S.L. Gupta and H. Gupta, SPSS for Researchers, International Book House Pvt. Ltd.

2. A. Field, Discovering Statistics using SPSS, SAGE Publications.

3. V. Gupta, SPSS for Beginners, VJ Books Inc.

4. A. Rajathi and P. Chandran, SPSS for you, MJP Publishers

CORE JAVA

Paper Code: Time Allowed: 2 Hours

Max. Marks: 50 Credits: 0

Note for Examiners and Students:

1. There will be eight questions covering the entire syllabus out of which four are to be attempted by the student selecting one from each section. Q. No. 1 will be compulsory (short answer type five parts are to be attempted out of six) 2X5=10. All questions carry equal marks.
2. Internal evaluation is to be made on the basis of the parameters to be decided by the concerned faculty in the consultation with the Head of the department.

UNIT - I **(08hrs.)**

Object Oriented Methodology-1: Evolution of OO, Basic Concepts of OO Approach, Comparison of Object Oriented and Procedure Oriented Approaches, Benefits of OOPs.

Object Oriented Methodology-2: Classes and Objects, Abstraction and Encapsulation, Inheritance, Method Overriding and Polymorphism.

UNIT - II **(09hrs.)**

Java Language Basics: Introduction To Java, Basic Features, Java Virtual Machine Concepts, Primitive Data Type And Variables, Java Operators, Expressions, Statements and Arrays.

Object Oriented Concepts: Class and Objects-- Class Fundamentals, Creating objects , Assigning object reference variables, Static methods, Constructors , This Keyword , Method overloading, Garbage Collection.

UNIT - III **(08hrs.)**

Inheritance and Polymorphism: Inheritance Basics, Access Control, Multilevel Inheritance, Method Overriding, Abstract Classes, Polymorphism.

Exceptions Handling: Exception, Handling of Exception, Using try-catch, Catching Multiple Exceptions, Types of Exceptions, Throwing Exceptions.

UNIT - IV **(07hrs.)**

Multithreading: Introduction, The Main Thread, Java Thread Model, Thread Priorities, I/O in Java : I/O Basics, Streams and Stream Classes ,The Predefined Streams, Reading from, and Writing to, Console, Reading and Writing Files .

Strings and Characters: Fundamentals of Characters and Strings.

Books Recommended:

1. Programming in Java, E Balagurusamy.
2. The Complete Reference JAVA, TMH Publication.
3. Begining JAVA, Ivor Horton, WROX Public.
4. JAVA 2 UNLEASHED, Tech Media Publications.
5. Patrick Naughton and Herbertz Schildt, "Java-2 The Complete Reference", 1999, TMH.

OPERATING SYSTEM: LINUX

Paper Code: Time Allowed: 2 Hours

Max. Marks: 50 Credits: 0

Note for Examiners and Students:

1. There will be eight questions covering the entire syllabus out of which four are to be attempted by the student selecting one from each section. Q. No. 1 will be compulsory (short answer type five parts are to be attempted out of six) 2X5=10. All questions carry equal marks.
2. Internal evaluation is to be made on the basis of the parameters to be decided by the concerned faculty in the consultation with the Head of the department.

UNIT - I (07hrs.)

Introduction: Introduction to Operating System, Types of Operating Systems: Multitasking, multiprogramming, multi user, Multithreading , Batch operating system, Time-sharing systems, Distributed OS, Network OS, Real Time OS, architecture.

UNIT - II (09hrs.)

Theoretical Concept of Unix/Linux Operating System: Basic features of operating system; Architecture of UNIX/Linux, Study of LINUX Operating System (Linux kernel, shell, basic commands)

Getting Started with Unix/Linux: User names and groups, logging in; Format of Unix/linux commands; Changing your password; Characters with special meaning; Unix documentation; Files and directories

UNIT - III **(08hrs.)**

File Management in UNIX/LINUX: listing files, Hidden files, creating files, Editing files, Displaying contents of file, renaming files, copying contents of a file, Counting words in a file, deleting file.

Directory Management: Current directory, looking at the directory contents, absolute and relative pathnames, listing directories, creating directories.

UNIT - IV **(08hrs.)**

File permissions; basic operation on files; changing permission modes; Standard files, standard output; Standard input, standard error; filters and pipelines; Processes; finding out about processes; Stopping background process; Unix editor vi.

Books Recommended:

1. Arnold Robbins, Linux Programming by Examples The Fundamentals, 2nd Ed., Pearson Education, 2008.
2. Cox K, Red Hat Linux Administrator's Guide, PHI, 2009.
3. R. Stevens, UNIX Network Programming, 3rd Ed., PHI, 2008.
4. Sumitabha Das, Unix Concepts and Applications, 4th Ed., TMH, 2009.
5. Ellen Siever, Stephen Figgins, Robert Love, Arnold Robbins, Linux in a Nutshell, 6th Ed., O'Reilly Media, 2009.
6. Neil Matthew, Richard Stones, Alan Cox, Beginning Linux Programming, 3rd Ed., 2004.