IEC UNIVERSITY
THE KNOWLEDGE EXPERTS
BADDI, H.P.

Master of Science /Arts

in

Mathematics

(M.Sc. / M.A. Mathematics)

With Effect from- July 2021-22 onwards

Master of Science/Arts in Mathematics
(M.Sc. / M.A. Mathematics)

Department of External Studies and learning (DESL), IEC University propose to start Master of Science/Arts in Mathematics (M.Sc./ M.A. Mathematics) from the academic session 2020-21. Program Project Report (PPR) is as under:

1. Mission and objectives

Mission: The mission of the program is based on the belief that the demand for mathematics experts has grown exponentially in a number of careers—and so has the interest in these jobs. Mathematics is the study of quantity, structure, space, and change. Mathematicians seek out patterns and formulate new conjectures which resolve the truth or falsity of conjectures by mathematical proofs.

Objective: The main aim of the course is to provide in-depth knowledge to the students in advanced applied mathematics and prepare them for various research activities. M.Sc./M.A. deals with the advanced concepts of Mathematics. It incorporates mathematical thinking in the minds of the students.

2. Relevance of the program with University Mission and Goals: - The University is committed to quality teaching and research through interdisciplinary understanding in areas of social sciences, humanities and management studies. It aims to promote growth in academic endeavours, student - placement and holistic human development with a strong conviction for professionals. The program being offered by the Department of External Studies and learning (DESL)**,** IEC University is relevant and aligned with overall goal of IEC's to foster quality education and raise the credibility of India's education system, improve employability of the products of higher education system, ensure equitable access to education, and ascertain that educational opportunities are available to all segments of the society.

3. Nature of target group of learners: - The program opens new opportunities for aspirants who are separated by time and seeking to upgrade their educational qualification. The target group includes service personnel, academicians, government officials, researchers, home makers, prisoners, people living in rural or remote areas, persons with disabilities, professionals who wish to improve their skills and the persons who were deprived of education in conventional education system.

4. Appropriateness of program to be conducted in External Studies mode to acquire specific skills and competence: - To cater the needs of persons deprived of admission in conventional education system, the Department of External Studies and learning (DESL), IEC University intends to start postgraduation in mathematics in external learning mode. The persons who are in job can also do this course without disturbing their job. M.Sc./M.A. Mathematics offers different career opportunities to the students. After you have completed the course, you may opt for higher studies. Here, we have mentioned some of the most popular fields where M.Sc./M.A. Mathematics students are offered jobs:

- Aerospace companies
- Pharmaceutical companies
- Market research firms
- Research and Development Firms
- Economic Research Firms
- Engineering Firms
- Social Research Institutes

5. Instructional Design:

Instructional Delivery Mechanism: Teaching learning process in the External Studies and learning mode, IEC University involves application of multiple pedagogies such as study material, subject assignments and end-term Examination. Identification of Media-Print: Various print formats are available including textbooks, study material, course scheme and syllabus.

Audio or Video: If required**.**

Online: From the academic session 2020-21, study material will be available on the website of the Universit**y.**

Student Support Service Systems: There are various student support services at the Department of External Studies and learning (DESL), IEC University including publicizing and promoting these programs, pre admission counselling and helpdesk, enquiry-cum-reception centre, registration of students, personal data form, distribution of study material, calendar of academic; activities, library facilities, old question papers and notification of examinations.

6. Admission Procedure: As per University Rules.
Minimum Eligibility: As per University Rules.

7. Requirement of the Library Resources:

The University already has a Centralized Library with all amenities and centrally located within easy reach from all the departments, directorates, hostels and residential areas. To cater the needs of the students, teachers, research scholars and staff, the University Library possesses a very rich collection of books, dissertations, periodicals, reference books, print and back volumes of journals and other reading material on its shelves. The students of the External Studies and learning mode, IEC University are allowed to avail the facilities of Central Library of the University.

Further, for the convenience of the students of External Studies and learning mode, an online library is established with the reference books for various programs being run under the University.

8. Curriculum Design and Detailed Syllabus: -

Duration of the Program: The duration of the course of Master of Science in Mathematics shall be of two academic years.

	M.Sc. MATHEMATICS			
	Basic Structure: Distribution of Courses			
S.No.	Course	Total papers and credits	Maximum marks	Credits
1.	Core Course	12 Papers of 4 &5 Credit Hrs.	12X100= 1200	54
2.	Discipline Specific Elective (DSE)	6 Papers of 4 Credits	100 X 4=400	24
3.	Generic Elective (GE)	1 Papers of 4 Credit Hrs. each (Total Credit Hrs. 2 X4)	100 X 1= 100	04
4	Dissertation	8 credit	100 X 1=	08
Total Credit Hrs			100	90

M.Sc. /M.A. MATHEMATICS

Semester -I				
Subject Code	**Paper**		**L**	**Credits**
MM-701	Real Analysis	Core Discipline	4	4
MM-702	Integral Transform	Core Discipline	4	4
MM-703	Ordinary Differential Equation	Core Discipline	5	5
MM-704	Numerical Analysis	Core Discipline	4	4
MM-705	Discrete Mathematics	Core Discipline	4	4
		TOTAL	21	21
Semester- II				
Subject Code	**Paper**		**L**	**Credits**
MM-801	Complex Analysis	Core Discipline	5	5
MM-802	Abstract Algebra	Core Discipline	5	5
MM-803	Partial Differential Equation	Core Discipline	5	5
MM-804	Integral Equation and Boundary Value Problem	Core Discipline	5	5
MM-805	Operation Research	Core Discipline	5	5
		TOTAL	25	25
Semester -III				
Subject Code	**Paper**		**L**	**Credits**
MM-901	Functional Analysis	Core Discipline	4	4
MM-902	Fixed Point Theory and Its Applications	Core Discipline	4	4
MM-903	Advanced Mathematical Statistics	Core Discipline	4	4
MM-904	Advanced Operation Research	Core Discipline	4	4
MM-905	Programming In Matlab (Elective)	Core Discipline	4	4
		TOTAL	20	20
Semester -IV				
Subject Code	**Paper**		**L**	**Credits**
MM-1001	Advanced Special Function	Core Discipline	4	4
MM-1002	Fluid Mechanics	Core Discipline	4	4
MM-1003	Environmental Studies	Core Discipline	4	4
MM-1004	Advanced Numerical Methods	Core Discipline	4	4
MM-1005	Dissertation	Core Discipline		8
		TOTAL	18	24
(Total Credits 1^{st} + 2^{nd} +3^{rd} +4^{th} Semester)				90

Core papers:12 **DSE: 6/12** **GE: 2/4**

LIST OF DISCIPLINE SPECEFIC ELECTIVE PAPERS (Major) Total 6 out of 13

- DSE 1: Advanced Mathematical Statistics
- DSE 2: Advanced Operation Research
- DSE 3: Advanced Numerical Methods
- DSE 4: Wavelet
- DSE 5: Financial Mathematics
- DSE 6: Mathematical Biology
- DSE 7: Fuzzy Sets and its Applications
- DSE 8: Graph Theory and its Applications
- DSE 9: Fixed Point Theory and Its Applications
- DSE10: Fluid Mechanics
- DSE 11: Environmental Studies
- DSE 12: Quality Management

LIST OF GENERAL ELECTIVE PAPERS (Minor) Total 2 out of 4

- GE1: Programming in C
- GE 2: Programming in C++
- GE 3: Programming in MATLAB
- GE 4: Entrepreneurship Development

MM-701: Real Analysis

Credits: 6 **Max. Marks: 100**

Course Objective: Students will be able to solve functions, limit, continuity and differentiability.

Contents:

Unit 1: Metric spaces

Metric spaces, monotonic functions, limits of functions, continuous functions and uniformly continuous functions defined on metric spaces, Sequence and series of point wise and uniform convergent function, Cauchy Criterion for uniform convergence, Weierstrass M-Test for uniform Convergence of series, Weierstrass approximation theorem.

Unit 2: Compactness and Connectedness

Perfect sets, Compact sets, connected sets, Continuity and compactness, continuity and connectedness.

Unit 3: Riemann-Stieltjes integral

Definition and existence of Riemann-Stieltjes integral, Properties of the integral, Integration and differentiation, Fundamental theorem of calculus, Integration of functions.

Unit 4: Lebesgue measure

Lebesgue outer measure, Measurable sets and properties, Borel set and their measurability, Non-Measurable set, Measurable functions, characteristic function and simple function, Littlewoods's three Principles.

Unit 5: Lebesgue integral

Lebesgue integral of bounded function over a set of finite measure, Integration of Non-negative function, The general Lebesgue integral, Monotonic Convergence Theorem, Lebesgue-Convergence Theorem, Fatou's Lemma.

Text Books:

1. Walter Rudin, Principles of Mathematical Analysis (3rd edition) McGraw-Hill Kogakusha, International Student Edition, 1976.
2. H. L. Roydon, Real Analysis- 4th edition, MacMillan, 1993.

References:

- Mullick & Arora, Mathematical Analysis, New Age International Publishers.
- Jain & Gupta, Lebesgue measure & Integration, New Age International Publishers.

MM-702: Integral Transform

Credits: 6 **Max. Marks: 100**

Course Objective: Students will be able to understand various type of Integral transform

Contents:

Unit 1: Fourier series: Introduction of Fourier series, Fourier series of discontinuous function, Fourier series of even and odd function, Half range Fourier sine and cosine series, Parseval's Identity.

Unit 2: Laplace Transform: Definition and its properties, shifting theorems, Laplace transform of derivative and integral, Laplace transform of various functions.
Inverse Laplace transform: Definition and properties, Convolution theorem.

Unit 3: Solution of ordinary differential equation, Solution of simultaneous differential equation, solution of integral equations.

Unit 4: Fourier transform and its properties, Fourier sine and cosine transform and its properties, Convolution theorem, Inverse Fourier transform and its properties.

Unit 5: Z-Transform: Definition of Z -transform, Z- transform of simple sequences. Properties of Z -transform. Initial and final value theorem, Inverse Z -transform, partial fraction method, convolution theorem, residue method, Application to finite difference equation.

Text Books:

1. B. S. Grewal, Higher Engineering Mathematics, Khanna Publishers.
2. B.V. Ramana, Higher Engineering Mathematics, Tata Mc Graw Hill.

References:

- M. K. Jain, S. R. K. Iyengar and R. K. Jain, Numerical Methods for Scientific and Engineering Computation, New Age International Publishers.
- T. Veerajan and T. Ramachandran, Theory and Problems in Numerical Methods.

MM-703: Ordinary Differential Equation

Credits: 6 **Max. Marks: 100**

Course Objective: Students will be able to solve differential equations by various methods.

Contents:

Unit 1: Preliminaries- initial value problem and the equivalent integral equation, system of first order ordinary differential equation, concepts of local existence, Existence and uniqueness of solution of scalar differential equation, Peano's existence theorem and corollary and scalar case.

Unit 2: System of differential equations, basic Theorems: Ascoli-Arzela theorem, a theorem on convergence of solution of a family of initial value problems, Picard- Lindel of theorem- Peano's existence theorem and corollary for vector.

Unit 3: Differential inequalities and Integral inequalities: Gronwall's Inequality, Maximal and Minimal solutions, differential inequalities lower and upper function.

Unit4: Linear system of differential equation, characteristic polynomials eigen values, eigen vectors linear homogeneous system and their properties, Wronskian, fundamental matrix, Abel-Liouville formula, periodic linear system and Floguet's theorem, Inhomogeneous linear systems and variation of constants formula.

Unit 5: Poincare–Bendixon theory: autonomous system, poincare-Bendixson theorem, Stability of periodic solutions, foci, nodes and saddle Points. Autonomous system of ordinary differential equation, phase plane, critical points stability, critical points and stability of linear systems, stability by Liapunov's direct method, Liapunov function.

Text Book:

1. M. Rama Mohan Rao, Ordinary Differential Equations, East– West press.

References:

- P. Hartman, Ordinary Differential Equations, John Wiley.
- E. A. Coddington and DSN Levinson, Theory of Ordinary Differential Equations, McGraw-Hill.
- G. F. Simmons, Differential Equations with Applications and Historical Note, Tata McGraw-Hill.
- W. T. Reid, Ordinary Differential Equations, John Wiley & Sons.

MM-704: Numerical Analysis

Credits: 6 **Max. Marks: 100**

Course Objective: Students will be able to solve algebraic and transcendental equations, linear system of equations, calculate derivatives and integrals and to solve differential equations by using appropriate numerical methods.

Contents:

Unit 1: Solution of Algebraic & Transcendental Equations: Bisection method, Regula Falsi method, Secant method, Newton-Raphson, Iterative method, Rate of convergence of these methods

Unit 2: Solution of simultaneous linear equations: Gauss Elimination method, Guass-Jordan method, Crout's method, Jacobi's method, Gauss-Seidel methods and Relaxation method and programming in C.

Unit 3: Difference Operators, Interpolation: Newton Forward & Backward, Lagrange's and divided difference formulae, Numerical Differentiation and Numerical Integration: Newton's cotes quadrature formula, Trapezoidal and Simpson's $1/3^{rd}$ rule, Simpson's 3/8 rule and programming in C.

Unit 4: Solution of Ordinary Differential Equations: Picard's method, Taylor's Series method, Euler's Method, Modified Euler's Method, Runge-Kutta Method, Milne's predictor-corrector method and programming in C.

Unit 5: Classification of partial differential equations, Numerical solution of partial differential equations: Elliptic (Laplace Equation), Parabolic (Heat conduction equation and programming in C.

Text Books:

1. S. S. Shastry, "Numerical method", Prentice Hall Inc., India, 1998.
2. M.K. Jain, lyengar and R.K. Jain, "Numerical Methods for Scientific and Engg. Computation" New Age International Publication
3. K. E. *Atkinson*, "An Introduction to Numerical Analysis", John Wiley Pub.

References:

- Grewal, B.S., "Numerical Methods", Khanna Pub., New Delhi, 1998.
- Francis Scheid, "Schaum's Outline of Numerical Analysis" McGraw Hill Professional

MM-705: Discrete Mathematics

Credits: 6 **Max. Marks: 100**

Course Objective: Students will be able to understand set, relation, function and Boolean algebra.

Contents:

Unit 1: Relation, Equivalence relation, partitioning Fundamental theorem on equivalence relation, ordered sets, first and last elements, maximal and minimal elements, upper and lower bounds, similar sets, totally ordered sets, well ordered sets, axioms of choice, Zorn's lemma, well ordering theorem (statements only), inclusion-exclusion principle and pigeon hole principle.

Unit 2: Mathematical logic: propositions and logical operators, contradictions and tautologies, Equivalence and implication, duality NAND and NOR connections, functionally complete sets, two-state devices and statement logic, normal forms, predicate calculus, free and bound variables.

Unit 3: Lattice: definition and examples, distributive lattice, modular lattice, bounded lattice, complemented lattice, Boolean lattice, sub lattice.

Unit 4: Boolean algebra: definition and examples, basic Boolean algebra laws principle of duality, applications of Boolean algebra, Boolean functions, disjunctive and conjunctive normal forms, switching circuits, minimization of switches

Unit 5: Mathematical induction, recursion, recursion and iteration, closed form expression, sequence of integers, recurrence relation, linear recurrence relation, homogeneous recurrence, recurrence relation obtained from solutions, solving linear homogeneous recurrence relation, solving linear non homogeneous recurrence relation, generating function, solution of' recurrence relation using generating function.

Text Books:

1. N. Chandra. S. N. Iyengar, Y. M Chandra Sekharan, K. A. Yenkatesh and P. S. Arunachalam, Discrete Mathematics, Vikas publishing house Pvt. Ltd.
2. Set Theory, Schaum outline series,

References:

- Kenneth. H. Rosen, Discrete Mathematics and its applications, Tata McGraw Hill Pub. Ltd.
- J. K. Truss, Discrete Mathematics for computer scientist, Pearson Education Asia Ltd.
- J. P. Tremblay, R. Manohar, Discrete Mathematical Structure with Applications.

MM-801: Complex Analysis

Credits: 6 **Max. Marks: 100**

Course Objective: Students will be able to understand complex number, analytic function, conformal mapping.

Contents:

Unit 1: Functions of complex variables, Limit and Continuity, Differentiability, Power Series as an analytic function, Exponential and Trigonometric Functions, Complex Logarithms, Zeros of Analytic functions.

Unit 2: Complex integration, Curves in the complex plane, basic properties of complex integrals winding number of a curve, Cauchy-Goursat Theorem, Cauchy's Integral formula, Morera's Theorem, Laurent's series, Maximum Modulus Principle, Schwarz Lemma, Liouville's Theorem.

Unit 3: Isolated Singularities, removable Singularities, Poles and Singularity at infinity calculus of residue at finite point, residue at the point at infinite residue theorem, Number of Zeros, Poles, Rouche's Theorem.

Unit 4: Bilinear transformations, their properties and classifications, Definitions and examples of conformal mappings, spaces of analytic functions, Hurwitz's theorem, Montel's theorem, Riemann mapping theorem.

Unit 5: Hypergeometric series, Generalized hypergeometric functions, Gamma functions and its properties, Riemann Zeta functions, Riemann's functional equation.

Text Book:

1. S. Ponnusamy, Foundation of Complex Analysis, Narosa Publishing House, 1997.

References:

- H. A. Priestly, Introduction to Complex Analysis, Clarendon Press, Oxford, 1990.
- J. B. Conway, Function of one Complex variable, Springer-Verlag, International Student-Edition, Narosa Publishing House, 1980.
- L.V. Ahlfors, Complex Analysis, McGraw-Hill, 1979.
- Walter Rudin, Real and Complex Analysis, McGraw-Hill book Co. 1966.

MM-802: Abstract Algebra

Credits: 6 **Max. Marks: 100**

Course Objective: Students will be able to solve various queries of algebra.

Contents:

Unit 1: Solow's Theorems and Solvable groups

p-Sylows Subgroups, Double Cosets, Conjugate groups, Solow's First, Solow's Second and, Solow's Third Theorems, Normal and Subnormal series, Composition series, Jordan- Holder Theorem, Solvable groups and Commentator subgroups.

Unit 2: Modules Theory

Modules, Cyclic Modules, Simple Modules, Finitely Generated Modules, Fundamental Structure Theorem for Finitely Generated Modules.

Unit 3: Field Theory

Extension fields, Algebraic Extensions, Roots of Polynomials, Simple Extension, Splitting fields and based theorems.

Unit 4: Galois Theory

Elements of Galois Theory, Fixed Fields, Normal Extensions, Group of Automorphisms, Galois Group, Fundamental theorem of Galois Theory.

Unit 5: Transformation

Canonical forms, Similarity of linear transformation, Invariant subspaces, Nilpotent transformation, Reduction to triangular form, Jordan blocks and Jordan normal forms.

Text Books:

1. I. N. Herstein, Topics in Algebra, Wiley Eastern, 1975.
2. P. B. Bhattacharya, S. K. Jain and S. R. Nagpal, Basic Abstract Algebra (2^{nd} Edition), Cambridge University Press, Indian Edit.
3. M. Artin, Algebra, Prentice-Hall of India 1991.

References:

- P. M. Cohn, Algebra, Vols I, II & III, John Wiley & Sons, 1982, 1989, 1991.
- N. Jacobson, W.H. Freeman, Basic Algebra, Vols. I & II, 1980.
- J. P. Escofier, Galois Theory, GTM, Vol. 204, Springer, 2001.
- Y. Lam, Lectures on Modules and Rings, GTM, Vol 189, Springer-Verlag, 1999.

MM-803: Partial Differential Equation

Credits: 6 **Max. Marks: 100**

Course Objective: Students will be able to understand complex number, analytic function, conformal mapping.

Contents:

Unit 1: Classification of Partial Differentials Equations (PDE), Canonical Forms, non-homogeneous Equations, Green's function for Laplace Equations, Mean value Formulas, Properties of Harmonic functions, Spherical mean, Separation of Variables, Dirichlet and Neumann Problems for Rectangle & Circle.

Unit 2: Heat Equations-fundamental solution, Mean Value Formula, Diffusion Equation- Solution by Spherical Means, Non-homogeneous Equations and Separation of Variables Method.

Unit 3: Green's function for Diffusion Equation, Introduction to physiological Heat flow and air pollution equation.

Unit 4: Wave Equation-Solution by Spherical Means, Non-homogeneous Equations, D'Alembert Solution, Separation of Variables, Green's function for Wave Equation.

Unit 5: Legendre Transforms, Potential functions, Laplace's Method and Fourier method for solving Partial Differential Equations.

Text Book:

1. K. Sankara Rao, Introduction to Partial Differentials Equations, McGraw-Hill.

References:

- L. N. Sneddon, Elements of Partial Differentials Equations, McGraw-HilI.
- L. C. Evans, Partial Differential Equations, Graduate studies in Mathematics, Volume 19, AMS,1998.
- L. N. Sneddon, Use of Integral Transforms.

MM-804: Integral Equation and Boundary value problem

Credits: 6 **Max. Marks: 100**

Course Objective: Students will be able to solve integral equations by various methods.

Contents:

Unit 1: Definitions of integral equations and their classification, solution of integral equation, Fredholm integral equations of second kind with separable kernels, solution of Fredholm integral equation with separable kernel, method of successive approximations.

Unit 2: Method of successive substitutions, Iterative scheme for Fredholm integral equations of the second kind, resolvent kernel and its results, application of iterative scheme to Volterra integral equations of the second kind.

Unit 3: Integral Transform methods, Fourier Transform, Laplace Transform, Convolution Integral, and Application to volterra Integral equations with convolution type kernels. Conversion of initial value problem to volterra integral equation and conversion of boundary value problem to Fredholm integral equation. Conversion of Fredholm integral equation to boundary value problems and conversion of Volterra integral equation to initial value problem.

Unit 4: Orthonormal system of functions, symmetric kernels, and fundamental properties of Eigen values and Eigen functions Green's function, for symmetric kernels, Hilbert Schmidt theory and solutions of Fredholm integral equations with symmetric kernels.

Unit 5: Definition of a boundary value problem for an ordinary differential equation of the second order, Dirac delta function, Green's function, Green's function approach to reduce boundary value problems of a differential equation with homogeneous boundary conditions to integral equations.

Text Books:

1. R. P. Kanwal, Linear Integral Equation Theory and Techniques, Academic Press New York, 1971.
2. S. G. Mikhlin, Linear Integral Equation (translated from Russian), Hindustan Book agency, 1960.

References:

- I. N. Sneddon, Mixed Boundary Value Problems in Potential Theory, North Holland, 1966.
- I. Stakgold, Boundary value Problems of Mathematical Physics, Vol. I, II, MacMillan, 1969.

MM-805: Operation Research

Credits: 6 **Max. Marks: 100**

Course Objective: Students will be able the knowledge of various optimization techniques.

Contents:

Unit 1: Introduction of OR: Nature and meaning of OR; Definitions of OR; Modelling in OR; Future and scope of OR.
Linear Programming Problem: Definitions of LPP; Formulation of LPP; Solution of LPP by Graphical and Simplex method; Duality in LP.

Unit 2: Transportation Problems: Introduction; Transportation model; Basic feasible solution by North-West corner rule, Least cost method and Vogel's approximation method; Optimal solution by MODI method.
Assignment Problems: Introduction; Assignment model; Hungarian method; Variations of the Assignment problems.

Unit 3: Job Sequencing: Processing of *n* jobs through 2 machines, 3 machines and *m* machines; Processing of 2 jobs through *m* machines.
Replacement Problem: Replacement policy for item whose maintenance cost increase with time and money value is constant, money value is changes with constant rate.

Unit 4: Project Management: Introduction; Network diagram representation; Network Scheduling; CPM and PERT techniques.

Unit 5: Queuing Theory: Introduction; Queuing system; Waiting line process; Transient and steady states of the system; Kendall's notation for representing queuing models; Distribution of arrival and departure; Single server queuing model (M/M/1: ∞/FCFS model).

Text Books:

1. H. A. Taha, Operation Research-An introduction, McMillan.
2. J. K. Sharma, Operation Research- Theory and application, Macmillan
3. S. D. Sharma, Operation Research.
4. P. K. Gupta and D. S. Hira, Operation Research, S. Chand

References:

- Kanti Swarup, P.K. Gupta, Man Mohan, Operation Research, S. Chand
- R. K. Gupta, Operation Research.
- F. S. Hiller and G. J. Lieberman, Introduction to Operation Research, McGraw Hill Int., 1995.
- G. H. Hadley, Linear programming, Narosa Pub. House, 1995.

C11: Functional Analysis

Credits: 6 **Max. Marks: 100**

Course Objective: Students will be able to different type of spaces.

Contents:

Unit 1: Normed linear space, banach spaces and examples, quotient spaces of normed linear spaces and its completeness, convex sets and convex functional, lower semi and upper semi continuous functions, equivalent norms.

Unit 2: Riesz lemma, basic properties of finite dimensional normed linear spaces and completeness, normed linear spaces of bounded linear transformations, dual spacers with examples, uniform boundedness theorem and some of its consequences, open mapping and closed graph theorem.

Unit 3: Hahn banach theorem for real linear spaces, complex linear spaces, weak convergence, Reflexive spaces, reflexivity of Hilbert spaces.

Unit 4: Compact operators, inner product spaces, Hilbert spaces, orthonormal sets, Bessel's inequality, complete orthonormal sets and Parseval's identity.

Unit 5: Structure of Hilbert spaces, projection theorem, Riesz representation theorem, adjoint of an operator on a Hilbert space, Self-adjoint operators, positive projection, normal and unitary operators.

Text Books:

1. A. H. Siddique. Functional Analysis with Applications. Tata McGraw Hill. Publishing Company Ltd. New Delhi.
2. Kreyszig, Introductory Functional analysis with applications. John Wiley & sons. New York.

References:

- H. L. Royden, Real Analysis. MacMillan Pub. Co. Inc. New York 4th addition, 1993.
- B.V. Limaye, Functional Analysis. Wiley Eastern Ltd.

C12: Advanced Special Function

Credits: 6 **Max. Marks: 100**

Course Objective: Students will be able to solve various special functions.

Contents:

Unit 1: Hypergeometric and generalized hypergeometric functions: Function ${}_2F_1(a, b, c; z)$ a simple integral form evaluation of ${}_2F_1(a, b, c; z)$, contiguous function relations, hypergeometrical differential equation and its solution, ${}_2F_1(a, b, c; z)$ as function of its parameters, elementary series manipulations, simple transformation, relations between functions of z and 1-z.

Unit 2: Bessel function: Definition of $J_n(x)$, Bessel's differential equation, generating function, recurrence relations, Bessel's integral with index half and an odd integer.

Unit 3: Legendre polynomials: Generating function for Legendre polynomials, Rodrigues formula, Bateman's generating function, additional generating functions, hypergeometric forms of $P_n(x)$, Special properties of $P_n(x)$, some more generating functions, Laplace's first integral form, Orthgonality.

Unit 4: Hermite polynomials: Definition of Hermite polynomials $H_n(x)$, pure recurrence relations, differential recurrence relation, Rodrigues formula, other generating functions, Orthogonality, expansion of polynomials, more generating functions.

Unit 5: Laguerre Polynomials: The Laguerre polynomial $L_n(x)$, generating functions, pure recurrence relations, differential recurrence relation, Rodrigues formula, Orthogonality, expansion of polynomials, special properties, other generating functions.

Text Books:

1. Rainville. E.D., Special Function. The MacMillan Co. New York 1971,
2. Srivastava, H. M. Gupta, K. C. and Goyal, S. P., The H-functions or one and two variables with applications, South Asian Publications, New Delhi.

References:

- N. Saran S. D. Sharma and Trivedi-Special Functions with application. Pragati Prakashan. 1986.
- N. N. Lebdev, Special Functions and Their Applications, Prentice Hall. Englewood Cliffs. New Jersey, USA, 1995.
- E. T. Whittaker and G. N. Watson, Course or Modern Analysis. Cambridge University Press. London,1963

LIST OF DISCIPLINE SPECEFIC ELECTIVE PAPERS (Major) Total 6 out 12

- DSE 1: Advanced Mathematical Statistics
- DSE 2: Advanced Operation Research
- DSE 3: Advanced Numerical Methods
- DSE 4: Wavelet
- DSE 5: Financial Mathematics
- DSE 6: Mathematical Biology
- DSE 7: Fuzzy Sets and its Applications
- DSE 8: Graph Theory and its Applications
- DSE 9: Fixed Point Theory and Its Applications
- DSE10: Fluid Mechanics
- DSE 11: Environmental Studies
- DSE 12: Quality Management

DSE 1: Advanced Mathematical Statistics

Credits: 4 **Max. Marks: 100**

Course Objective: Students will be able to understand the behavior of biological model with various techniques.

Contents:

Unit 1: Definitions of central tendencies, Measure of dispersions with variance in detail, least square for curve fitting, correlation & regression.

Unit 2: Theory of probability & distributions: various definitions, additive & multiplicative law, Bayes' theorem. Continuous variable, Mathematical expectation, Binomial, Poisson, Normal distribution, Rectangular distribution, Exponential distribution, Moment generation function, marginal & conditional probability distributions & conditional expectation.

Unit 3: Theory of estimators: Unbiasedness, consistency, efficiency, sufficiency, maximum likelihood estimators, Cramer-Rao inequality and its applications confidence intervals with respect to normal distributions.

Unit 4: Exact sampling distributions & Chi-square, t, F, Z distributions & tests, Non-parametric tests: Sign test, Wilcoxon's signed rank sum test, Medial test, Mann Whitney, U-test and run test for randomness.

Unit 5: Analysis of variance: one way & two-way classifications. Basic principles of design: Replication, randomization, local control, lay out and analysis of completely randomized, randomized block & latin square design, missing plot techniques in randomized block & latin square design, Basic knowledge of Sps software

Text Books:

1. Mathematical Statistics by C.E. Weatherburn.
2. Fundamentals of Mathematical Statistics by S C Gupta & V K Kapoor- S. Chand & Sons, New Delhi.
3. Fundamentals of Applied Statistics by S C Gupta & V K Kapoor, S Chand & Sons, New Delhi.

References:

- An outline of Statistical Theory by Goon, Gupta & Das gupta.
- Fundamentals of Statistics by Goon, Gupta Das gupta.

DSE 2: Advanced Operation Research

Credits: 4 **Max. Marks: 100**

Course Objective: Students will be able the knowledge of various advanced optimization techniques.

Contents:

Unit 1: Advanced Topics in Linear Programming: Duality in LP; Dual Simplex, method; Revised Simplex method; Sensitivity Analysis; Integer Programming.

Unit 2: Dynamic Programming: Introduction; Distinguish characteristics of Dynamic programming; Dynamic programming approach; Formulation of Dynamic programming problem; Solution of LPP by Dynamic programming.

Unit 3: Decision Theory: Steps in Decision theory approach; Decision making environments; Decision making under conditions of certainty, uncertainty and risk.

Game Theory: Introduction; Competitive situations; Characteristics of Competitive Games; Maximin and minimax principal; Two persons zero sum games: Saddle point; Pure and mixed strategies; Dominance Method.

Unit 4: Inventory Models: Introduction; Necessity for maintaining inventory; Inventory costs; Classification of fixed order quantity inventory models; Inventory models with deterministic demand.

Unit 5: Non-Linear Programming: Introduction; Problem formulation examples; Concave and Convex functions; Types of non-linear programming problems; Quadratic programming problem; Kuhn-Tucker conditions; Wolf 's modified simplex method

Text Books:

1. H. A. Taha, Operation Research-An introduction, McMillan.
2. J. K. Sharma, Operation Research- Theory and application, Macmillan
3. S. D. Sharma, Operation Research.
4. P. K. Gupta and D. S. Hira, Operation Research, S. Chand

References:

- Kanti Swarup, P.K. Gupta, Man Mohan, Operation Research, S. Chand
- R. K. Gupta, Operation Research.
- F. S. Hiller and G. J. Lieberman, Introduction to Operation Research, McGraw Hill Int., 1995.

DSE 3: Advanced Numerical Methods

Credits: 4 **Max. Marks: 100**

Course Objective: Students will be able to solve successive differentiation, partial differentiation, integration.

Contents:

Unit 1: Difference equations, formation of difference equations, linear difference equations. First order equations, general results for linear equations, equations with constant coefficients, equations with variable coefficients.

Unit 2: Interpolations and approximations, Hermite interpolations, piecewise quadratic interpolations, piecewise cubic interpolations, Spline interpolations, quadratic Spline interpolations, cubic Spline interpolations.

Unit 3: Numerical solution of partial differential equations, classification of second order equations, Elliptic Equation, Numerical solutions of Laplace and Poisson equations, solution to elliptic equations by relaxation method, solution by Laplace equation by Alternating Direction Implicit (ADI) method.

Unit 4: Parabolic equations, Numerical solution of one-dimensional diffusion & heat equations, hyperbolic equations, one dimensional wave equation, Numerical solutions of one-dimensional wave equation, Numerical solutions of one-dimensional wave equation by difference schemes, central-difference schemes, D' Alembert solution.

Unit 5: Variational finite element method with application to one dimensional problem solution of time dependent problems in one dimension and two dimension, and steady state problems using Ritz method.

Text Books:

1. Walter G. Kelley and Allan C. Peterson, Difference Equation- An Introduction with applications, Academic Press Inc., Harcourt Brace Joranovich Publishers, 1991.
2. M. K. Jain, Numerical solutions of Differential equations, New Age International (P) Limited, Publishers.

References:

- I. Gerald & Wheatley, Applied Numerical Analysis, Pearson Education.

DSE 4: Wavelet

Credits: 4 **Max. Marks: 100**

Course Objective: Students will be able to apply the concept on many of the engineering problems.

Contents:

Unit 1: Haar's simple wavelets, Haar wavelet transforms, Inverse Haar wavelet transforms, Multi-dimensional wavelets, Two-dimensional Haar wavelets.

Unit 2: Application of wavelets, Noise reduction data compression, Edge detection, Daubechies wavelet (DW), approximation of samples with D' wavelets, Fast DW transform and its inverse.

Unit 3: Inner products and orthogonal projection, Applications of orthogonal projection computer graphics, Computation of functions and wavelets, Discrete and fast Fourier transform with inverse and applications.

Unit 4: Fourier series for periodic functions, its convergence and inversion, uniform convergence of Fourier series, Bessel's inequality, Parsevals inequality.

Unit 5: The Fourier Transform, Convolution and inversion of Fourier transform, weight function, approximate identities.

Text Books:

1. Wavelets Made Easy by Y. Nievergelt.
2. A first Course on Wavelets by E. Hernandez and G. Weiss.

References:

- An Introduction to Wavelets by Chui, Academic Press.

DSE 5: Financial Mathematics

Credits: 4 **Max. Marks: 100**

Course Objective: Students will be able to study behaviour economy strategy.

Contents:

Unit 1: Elements of Theory of Interest, Cash Flow Valuation, annuities, Amortization and Sinking funds, Brief Review of Probability Theory.

Unit 2: Survival Distributions, Life Tables, Valuing Contingent Payments, Life Insurance, Life Annuities, Net Premiums, insurance Models including expenses.

Unit 3: A brief introduction to financial markets, basics of securities, stocks, bonds and Financial derivatives, viz. Forwards, futures, options and swaps.

Unit 4: An introduction to Stochastic calculus, Stochastic Process, Geometric Brownian motion, Stochastic Integration and Ito's lemma.

Unit 5: Option pricing models- Binomial Model and Blank Scholes Option Pricing Model for European Options, Black Scholes Formula and Computation of Greeks.

Text Books:

1. John. C. Hull, Options, Futures and other Derivatives, Prentice-hall of India Pvt, Ltd.
2. Sheldon M. Ross, An Introduction to Mathematics of Financial Derivatives, Cambridge University Press.

References:

- Salih N. Neftci, An Introduction to Mathematics of Financial Derivatives, Academic Press, Inc.
- Robert J. Elliot & P. E. Kopp, Mathematics of Financial Markets, Springer Verlag, New York, Inc.

DSE 6: Mathematical Biology

Credits: 4 **Max. Marks: 100**

Course Objective: Students will be able to solve different biological model with the help of mathematical tools.

Contents:

Unit 1: Continuous growth models, delay models, linear analysis of delay population models, Harvesting a single natural population, population model with age structure.

Unit 2: Fishery management model, predator-prey models, lotka-Volterra systems, competition models, principle of competitive exclusion, mutualism or symbiosis, stability analysis of predator prey models.

Unit 3: Stability analysis of competition models, epidemic models and the dynamic of infectious diseases, simple epidemic model, SIS, SIR and SIRS epidemic models.

Unit 4: Modelling venereal diseases, multi group model for Gonorrhoea, AIDS: Modelling and transmission dynamics of HIV

Unit 5: Introduction of compartment models, discrete and continuous transfers, discrete population models for a single species, discrete logistic model, discrete delay model for single species, solution by eigen value analysis.

Text Books:

1. J. D. Murray, Mathematical Biology (Biomathematics, Volume 19). Springer Verlag.
2. M. R. Cullen. Linear Models in Biology, Ellis Horwood Ltd.

References:

- J. N. Kapur, Mathematical Models in Biology and Medicines.
- S. I. Rubinow, Introduction to Mathematical Biology. John Wiley & Sons, 1975.

DSE 7: Fuzzy Sets and its Applications

Credits: 4 **Max. Marks: 100**

Course Objective: Students will be able to solve successive differentiation, partial differentiation, integration.

Contents:

Unit 1: Fuzzy sets- Basic definitions, α-level sets, convex fuzzy sets, Basic operations on fuzzy sets, Types of fuzzy sets, Cartesian products, Algebraic product Bounded sum and difference, t-Norm and t-Conorms.

Unit 2: The Extension Principle: The Zadeh's extension principle, Image and inverse image or fuzzy sets, Fuzzy numbers, Elements of fuzzy arithmetic.

Unit 3: Fuzzy relation and fuzzy graphs fuzzy relation on fuzzy sets, Composition of fuzzy relations, Min-Max composition and its properties, Fuzzy equivalence relation.

Unit 4: Fuzzy compatibility relations, Fuzzy relation equations, Fuzzy graphs, Similarity relation, Fuzzy Logic: An overview of Classical logic Multi valued logics, Fuzzy Propositions.

Unit 5: Fuzzy quantifiers, Linguistic variables and hedges Inference from conditional fuzzy propositions, The compositional rule of inference.

Text Books:

1. H. J. Zimmermann, Fuzzy Set Theory and its Applications, Allied Pub. Ltd. New Delhi, 1991.
2. G. J. Klir and B. Yuan, Fuzzy sets and fuzzy Logic. Prentice-Hall of India, New Delhi, 1995.

References:

- G.J. Klir, Tina A. Folger, Fuzzy Sets, Uncertainty and Information, Prentice-Hall of India

DSE 8: Graph Theory and its Applications

Credits: 4 **Max. Marks: 100**

Course Objective: Students will be able to apply graph theory and its applications in computer science.

Contents:

Unit 1: Revision of graph theoretic preliminaries, Operations on graphs, Graph Isomorphism disconnected graph and their Components, Traveling salesman problem, round table problem, Konisberg Bridge problem, Eulerian and Hamiltonian Paths and circuits.

Unit 2: Properties of trees, Distance, centre, radius, diameter eccentricity and related theorems, Graph as a metric space, Rooted and binary trees, Labelled graph and trees spanning tree, weighted spanning tree, Shortest path, Fundamental circuits, Rank and nullity, cutsets and cut vertices, Fundamental cutsets.

Unit 3: Connectivity and separability in graphs, Abstract graphs, geometric graphs, planar graphs, kurtowski two graphs, Embedding and regions of a planar graphs, Detection of planarity, Geometric dual and combinational dual.

Unit 4: Coloring and covering of graphs, Chromatic. Polynomial, chromatic partitioning, Dimmer problem, Dominating sets, Independent sets, Four colour conjecture.

Unit 5: Digraph and types of digraphs, Digraph and binary relation, Equivalence relation in a graph, directed path, walk, circuit and connectedness, Eulerian digraph, arborescence matrices A, B and C of digraph, Adjacency metric of a digraph, Algorithms, Kruskal algorithm, Prism algorithm, Dijkastra algorithm.

Text Book:

1. Graph Theory with Applications to Engineering and Computer Science by Narsingh. Deo.

References:

- Graph Theory by Harary.

DSE 9: Fixed Point Theory and Its Applications

Credits: 4 **Max. Marks: 100**

Course Objective: Students will be able to study the various concept related to fixed point theory.

Contents:

Unit 1: Fixed Point Spaces, Banach Contraction principle, Elementary Domain invariance, Continuation Method for Contractive and Non expensive Maps, Extensions of the Banach Theorem.

Unit 2: KKM-Maps and the Geometric KKM-Principle, Brouwer-Schauder fixed point theorems, Ky Fan Best Approximation Theorem.

Unit 3: Fixed Points of Affine Maps, Markoff Kakutani Theorem, Non expansive Maps in Hilbert Space, Applications of the Banach Principle to Integral and Differential Equations, Applications of the Elementary Domain invariance.

Unit 4: Theorems of Mazur-Orlicz and Hahn-Banach, Brouwer's Theorem, Topological KKM-principle, Compact and Completely Continuous Operators, Schauder Projection and Approximation Theorem.

Unit 5: Extension of the Brouwer and Borsuk Theorems, Simple Application of Game Theory and Mathematical Economics.

Text Books:

1. R. P. Agrawal, Maria Meehan and Donal o' Regan, Fixed Point Theory and Applications, Cambridge University Press.
2. Andrzej Granas, James Dugundgji, Fixed ,Foint Theory, Springer.

References:

- M. A. Khamsi and W. A. Kirk, An introduction to Metric Spaces and Fixed-Point Theory, Wiley-Inter Sci. (2001).
- Kim C. Border, Fixed point theorems with applications to economics and game theory, Cambridge University Press. 1985.

DSE 10: Fluid Mechanics

Credits: 4 **Max. Marks: 100**

Course Objective: Students will be able to study the flow of fluid by various methods.

Contents:

Unit 1: Langrangian and Eulerian method. Equation of continuity types of flow lines, Velocity, potential. Stream function, irrotational motions, vertex lines Lagrange and Euler equation of motion.

Unit 2: Bernoullis theorem, irrotational motion in two dimensions, complex velocity potential. Sources. Sinks conformal mapping. Theorem of Blasius.

Unit 3: Motion of a sphere through a liquid at rest as infinity, Equation of motion of a sphere, Stress components in a real fluid. Relations between rectangular components of stress convection between stresses and gradients of velocity.

Unit 4: Plane Poiceuille and Coquette flows between two parallel plates, Flow through tubes or uniform, Annulus under constant pressure gradient, Dynamical similarity, Reynolds number, Prandtls boundary layer.

Unit 5: Boundary layer equations in two dimensions, Blasius solution, Boundary layer thickness, displacement thickness, Karman integral conditions, separation of boundary layer flow.

Text Books:

1. R. K. Rajput, A Text book of fluid Mechanics by SI Units.
2. R. K. Rathy, An Introduction to fluid Dynamics, Oxford and IBH Published Co.

References:

- Joseph. H Spurk, Fluid-Mechanics (Springer)
- Irfan. A. Khan (H.R.W), Fluid Mechanics.
- G. K. Batchelor, An Introduction to fluid Mechanics. Foundation Books, New Delhi, 1994.

DSE 11: Environmental Studies

Credits: 4 **Max. Marks: 100**

Course Objective: The Environmental Studies prepares students for careers as leaders in understanding and addressing complex environmental issues from a problem-oriented, interdisciplinary perspective. Furthermore, methods from ecological and physical sciences and their application are used in environmental problem solving.

Contents:

Unit 1: Study of Environment and Ecology

(a) Environment – Definition and Its segments (Atmosphere, Lithosphere, Hydrosphere and Biosphere).
(b) Environmental education- Definition, scope, importance, Need for Public Awareness & multidisciplinary nature of Environmental Science.
(c) Elements of ecology
(d) Ecosystem- Concepts, components, structure & function, energy flow, food chain, food web, ecological pyramids and types.

Unit 2: Environmental Pollution and Population

(a) Air, water, noise, soil and nuclear pollution- definition, causes, effect and prevention of pollution.
(b) Environmental issues
(c) Population growth, disparities between countries.
(d) Population explosion, family welfare program.
(e) Environment and human health.
(f) Cleanliness and disposal of domestic waste.

Unit 3: Natural resources, Problems and Conservation

(a) Natural resource- Definition and classification
(b) Water resources, Forest resources, Land resources, Food resources and its management
(c) Energy resources- Classification and alternatives of conventional energy resources (Solar energy, geothermal energy, wind energy, nuclear energy, biomass and biogas energy)

Unit 4:

Bio-diversity and its Protection

(a) Introduction- Genetic, species and ecosystem diversity.
(b) Value of bio-diversity- Consumable use: Productive use, Social, Moral and Aesthetic uses.
(c) India as a nation of mega bio-diversity center, bio-diversity at national and local levels.
(d) Threats to bio-diversity – Loss of habitat, poaching of wildlife, man and wildlife conflicts.

Unit 5: Disaster Management and Environmental Laws

(a) Concepts of hazard, Vulnerability, Risks, Natural disasters (earthquake, cyclone, floods, volcanoes), and manmade disaster (Armed conflicts and civil strip, Technological disasters, Human settlement, Slow disasters (famine, draught, epidemics) and Rapid onset disasters (Air crash, tidal waves, Tsunami)

(b) Disaster Management: Prevention, Preparedness and Mitigation

(c) Environmental legislations in India: Air conservation act, water conservation act, wildlife conservation act, environment protection act.

(d) Role of information technology in protecting environment and health.

Text Books:

1. Environmental Science by B. S. Chauhan
2. Environmental Science by Cuningham and Cuningham
3. Environmental Engineering by S. K. Dhameja
4. Environmental Science by Richards T. Wright
5. Environment and Ecology by P. D. Sharma

References:

- Environmental Engineering by Howard S. Peavy, Donald R. Rowe, T. Georg
- Environmental Science and Engineering by Gilbert M. Master
- Environmental Chemistry by Stanley
- Kapur, Anu & others, 2005: Disasters in India Studies of grim reality, Rawat Publishers, Jaipur
- Kapur Anu 2010: Vulnerable India: A Geographical Study of Disasters, lIAS and Sage Publishers, New Delhi.
- Coppola P Damon, 2007. Introduction to International Disaster Management, Carter, Nick 1991.

DSE 12: Quality Management

Credits: 4 **Max. Marks: 100**

Course Objective: Students will be able to solve various special differential equations.

Contents:

Unit 1: Quality Concepts: Evolution of Quality Control, concept change, TQM Modern concept, Quality concept in design, Review of design, Evolution of proto type. Control on Purchased Product: Procurement of various products, evaluation of supplies, capacity verification, Development of sources, procurement procedure. Manufacturing Quality: Methods and techniques for manufacture, inspection and control of product, quality in sales and services, guarantee, analysis of claims.

Unit 2: Quality Management: Organization structure and design, quality function, decentralization, designing and fitting, organization for different type products and company, economics of quality value and contribution, quality cost, optimizing quality cost, seduction program. Human Factor in quality Attitude of top management, cooperation of groups, operators' attitude, responsibility, causes of apparatus error and corrective methods.

Unit 3: Control Charts, Theory of control charts, measurement range, construction and analysis of R charts, process capability study, use of control charts. Attributes of Control Chart, Defects, construction and analysis of charts, improvement by control chart, variable sample size, construction and analysis of C charts.

Unit 4:

Defects diagnosis and prevention defect study, identification and analysis of defects, correcting measure, factors affecting reliability, MTTF, calculation of reliability, building reliability in the product, evaluation of reliability, interpretation of test results, reliability control, maintainability, zero defects, quality circle.

Unit 5: ISO-9000 and its concept of Quality Management, ISO 9000 series, Taguchi method, JIT in some details.

References:

- Lt. Gen. H. Lal, "Total Quality Management", Eastern Limited, 1990.
- Greg Bounds, "Beyond Total Quality Management", McGraw Hill, 1994.
- Menon, H.G, "TQM in New Product manufacturing", McGraw Hill 1992.

DSE 13 : Solid Mechanics

Credits: 4 **Max. Marks: 100**

UNIT-I

Analysis of Strain – Affine transformation, Infinitesimal Affine deformations, Geometrical interpretation of the components of Strain. Strain Quadric of Cauchy, Principal Strains. Invariants. General Infinitesimal Deformation. Equation of compatibility. Finite deformation.

Analysis of Stress – Stress Tensor. Equations of Equilibrium. Transformation of coordinates. Stress Quadric of Cauchy. Principal stress and Invariants. Maximum normal and shear stresses, Mohr's circle Diagram.

UNIT-II

Equations of Elasticity – Generalized Hooke's law. Stress – Strain relations for a medium having one plane elastic symmetry, three orthogonal planes symmetry and for homogeneous isotropic media. Elastic-moduli for isotropic media. Equilibrium and Dynamic equations for an isotropic solids. Strain energy function and its connection with Hooke's law. Unique solution of Boundary value problem. Derivation of Navier's equations and Beltrami-Michal compatibility equations.

UNIT-III

Statement of problem. Extension of beams by longitudinal forces. Beam stretched by its own weight. Bending of beams by terminal couples. Torsion of a circular shaft. Plane stress Plane strain.

Text Book

1. Sokolnikoff, I. S.: Mathematical Theory of Elasticity, McGraw hill, New York.

Reference Books

1. Love, A. E. H: A Treatise on the Mathematical Theory of Elasticity.
2. Godfrey, D. E.: Theoretical of Elasticity and Plasticity for Engineers.
3. Muskelishvill, N. I.: Some Basic problems of the Mathematical Theory of Elasticity.
4. Timoshenko. S. & Goddler, I. N.: Theory of Elasticity.

LIST OF GENERAL ELECTIVE PAPERS (Minor) Total 2 out of 4

- GE1: Programming in C
- GE 2: Programming in C++
- GE 3: Programming in MATLAB
- GE 4: Entrepreneurship Development

GE 1: Programming in C

Credits: 4 **Max. Marks: 100**

Course Objective: Upon successful completion of this course, the students will learn various concepts and techniques for problem solving and will implement those ideas using C programs.

Contents:

Unit 1: Introduction to C, Character Set, Keywords and Identifier, Data Types, Variables, Constants, Symbolic Constants, Declaration of Variables.

Unit 2: Operators and expressions, Operator precedence and associativity, Complier control directives, Input and Output Operations, formatted input and output, Control Structure input and output.

Unit 3: Control Structures (Decision Making and branching, if, if……. else, Switch Statement, goto Statement, Looping, for, while and do statement).

Unit 4: Arrays, one and multidimensional array, Handling of Character Strings, String handling function, Pointer and their application.

Unit 5: User defined function, calling a function by reference, arguments, Calling a function by value, Recursion, Library function.

Text Books:

1. Programming in ANSI C by E. Balaguruswamy, Tata-McGraw, New Delhi.
2. Schaum's outline series.

References:

- Let's us C by Y. Kanetkar.

GE 2: Programming in C++

Credits: 4 **Max. Marks: 100**

Course Objective: Upon successful completion of this course, the students will learn various concepts and techniques for problem solving and will implement those ideas using C++ programs.

Contents:

Unit 1: Concepts of object oriented programming, Need of Object Oriented Programming, Characteristics of OOP: Classes & Objects, Inheritance, Data Hiding, Encapsulation, Polymorphism, Overloading, Classes and Structures, Classes and Unions Overview of C++, Compiling & Debugging C++ Program, Basics : Preprocessor Directives, Header files, Input and Output Streams, Cout, Cin, Comments, Type Casting, Loops & Decisions : for loop, do loop, while loop, if statement, if….else, switch, Logical Operators, break, continue, goto.

Unit 2: C++ streams, Formatted I/O: Formatting using the ios members, Setting and clearing the format flags, using manipulators to format I/O, Creating your own manipulators. Creating Class, Introduction to Constructor, Parameterized constructor, Multiple constructors, Default arguments constructor, Copy constructor, Destructor. Friend function, Friend classes, Inline function, Scope resolution operator, Static class members: Static data member, Static member function, passing objects to function, Returning objects, Object assignment.

Unit 3: Function overloading, Overloading constructor function, finding the address of an overloaded function Operator Overloading: Overloading Unary Operators, Operator Keyword, Operator Arguments, Overloading Binary Operators: Arithmetic Operators, Concatenating Strings, Comparison Operators, Assignment Operators, Overloading Using friend function, Overloading Special Operators: New, Delete, [ ], ( ), -, comma operator, <<.

Unit 4: Inheritance: Base & Derived class, Accessing Base Class Member, Specifying Derived Class, Protected Specifier, Overriding Member Function, Abstract base class, Public and Private Inheritance, Levels of Inheritance, Containership: Classes within Classes.

Unit 5: Pointers: Address of Operator &, Pointer variable, Pointers and Arrays, Pointers and Functions: Passing variables, Arrays, Pointer and Strings, Memory Mgt using new and delete, pointers to Objects: reference to members Virtual Functions, Pure Virtual Functions, Virtual Base Class, Late Binding, this pointer, Accessing Member data with this pointer. Command Line Arguments.

References:

- C++ The complete reference - Herbert Schildt, - TMH Publication

- Object Oriented Programming C++ - R. Lafore
- Object Oriented Programming with C++ - R. Subburaj, Vikas Publishing House, New Delhi.
- C++- E. Balguruswamy, TMH Publication

GE 3: Programming in MATLAB

Credits: 4 **Max. Marks: 100**

Course Objective: Students will be able to understand set, relation, function and Boolean algebra.

Contents:

Unit 1: MATLAB basics: The MATLAB environment, Basic computer programming, Variables and constants, operators and simple calculations, Formulas and functions, MATLAB toolboxes.

Unit 2: Matrices and vectors: Matrix and linear algebra review, Vectors and matrices in MATLAB, Matrix operations and functions in MATLAB.

Unit 3: Computer programming: Algorithms and structures, MATLAB scripts and functions (mfiles), Simple sequential algorithms, Control structures (if…then, loops).

Unit 4: MATLAB programming: Reading and writing data, file handling, Personalized functions, Toolbox structure, MATLAB graphic functions.

Unit 5: Graph plotting, Numerical solution of ODEs and PDEs, Numerical simulation

Text Books:

1. Getting started with MATLAB, Rudra Pratap, 2010, Oxford University Press.2. Set Theory, Schaum outline series.
2. Simulation of ODE/PDE Models with MATLAB®, OCTAVE and SCILAB: Scientific and Engineering Applications: A. Vande Wouwer, P. Saucez, C. V. Fernández. 2014 Springer ISBN: 978-3319067896.

References:

- A Guide to MATLAB, B.R. Hunt, R.L. Lipsman, J.M. Rosenberg, 2014, 3rd Edn., Cambridge University Press.
- Applied Numerical Methods with MATLAB for Engineers and Scientists, Steven C Chapra, 2010, Tata McGraw Hill.

GE4: Entrepreneurship Development

Credits: 4 **Max. Marks: 100**

Course Objective: Upon completion of this course, students will be able to complete the following key tasks:

- To prepare a ground where the students view Entrepreneurship as a desirable and feasible career option.
- To develop students' ability to assess the need for innovation, initiate the process and run innovations in organizations.
- To Develop skills in successfully initiating, expanding and diversifying a business enterprise in new, up-coming areas.

Contents:

Unit 1: Entrepreneurship Development: Concept, importance and function of Enterpriser, Goal determination– Problems Challenges and Solutions.

Unit 2: Project Proposal: Need and Objects: Nature of organization, Production Management, Financial Management, Marketing Management, Consumer Management.

Unit 3: Role of regulatory Institutions, Role of development Organizations, and self-employment-oriented schemes, various growths

Unit 4: Financial Management for Project, Financial institution and their role, capital estimation and arrangement, cost and price determination, according management

Unit 5: Problem of entrepreneur– Problem Relating Capital, Problem Relating Registration, Administration Problem and how to overcome from above problems

References:

- Entrepreneurship: A South Asian Perspective, Donald. F Kuratko& T.V Rao, Cengage Learning Publications, 2012
- Family Business, Ernesto J. Poza, 3rd ed., 2010
- Entrepreneurship and Small Business Management, C.B Gupta and S.S Khanka, Sultan Chand Publications, 2014
- Entrepreneur Development, Taneja& Gupta, Galgotia Publishing Company, 2nd ed., 2012