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SEMESTER III   M. Sc. MATHEMATICS   2016-17

Note- There will be five papers in all.

M3 MAT 01-CT11
TOPOLOGY

L-T-P	3-1-0

TIME: 3 hours

External Assessment 80
Internal Assessment 20

UNIT I

Metric Space: Definition, Examples and properties of a metric space.

Open and closed sphere (ball or neighbourhood), open sets, closed sets and the related results, limit point, continuous mappings, Convergence of a sequence, Cauchy Sequence, Uniform and Pointwise convergence, Complete metric space, compact spaces and compact sets, Baire's category theorem.

UNIT II

Topological Spaces: Definition of Topology, T-open sets, weaker and stronger topology, open sets and closed sets, closure of a set, limit point of a set, derived set, Interior of a set, Boundary of set, Intersection of topological spaces, Kuratowski-space, Kuratowski theorem. Base, sub base, open bases, open sub bases, first countable space, second countable space, separable space, continuous functions in topological spaces, sequentially topological spaces.

UNIT III

Separation Axioms: T_o , T_1 , T_2- space, separation axioms, normal spaces, Regular spaces, completely regular space, tychonoff space, Housdorff space.

Compactness: Cover, open cover, finite sub cover, compact sets, Lindelof space, Locally compact, sequentially compact, Bolzano Weirstrass property and sequentially compactness, compactness for metric spaces, Lindelof theorem, Product spaces.

UNIT IV

Connectedness: Connectedness and continuity, components of a space, product of connected topologic al spaces, Locally connected Spaces.

UNIT V

Approximation: The Weirstrass approximation theorem, function algebra, C(X, R) and C (X, C), the real Stone-Weirstrass theorem, The Complex Stone-Weirstrass theorem.

Books recommended:

1.	George F. Simmons	:	Introduction to Topology and modern analysis, McGraw Hill Book Co.
2.	S.I. Hu	:	Elements of Real Analysis.
3.	H.L. Royden	:	Real analysis.
4.	W.J. Thron	:	Topological structure.
5.	J. Kelley	:	General Topology.
6.	Malik S.C. & Arora, Savita	:	Mathematical Analysis (Third Revised Edition)

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M3 MAT 02-CT12

TENSER ANALYSIS

L-T-P	4-1-0

TIME: 3 hours

External Assessment 80
Internal Assessment 20

UNIT I

Tensors; Transformation of coordinates, Contravariant and covariant vectors, second order tensors, Higher order tensors. Addition, subtraction and multiplication of tensors, Contraction, Quotient Law, symmetric and skew symmetric tensors: Conjugate symmetric tensors of the second order, Fundamental tensor, Associated tensors.

UNIT II

Christoffel symbols, Transformation law of Christoffel symbols, Covariant differentiation of vectors and tensors.

UNIT III

Geodesics, Null Geodesics, Tensor form of gradient, divergence, Laplacian and curl, Intrinsic derivative, Riemannian and Normal Coordinates, Gaussian Coordinates, Parallel transport, Geodesics are auto parallel curves, Parallel propagation.

UNIT IV

Riemannian curvature tensor, Symmetric properties of R^i_{ljk}, Covariant curvature tensor R_{hljk}, Number of independent components of R_{hljk} in a V_n, Ricci tensor, Bianchi indentities, Conformal Curvature tensor, Condition for flat space.

UNIT V

Maxwell's equations in empty space, Transformation of vector and scalar potentials, Transformations of electric and magnetic intensities, Lorentz invariance of Maxwell's equations.

Maxwell's equations in Tensor form, Energy momentum tensor for electromagnetic field, Einstein-Maxwell equation in General Relativity.

Books Recommended:

1. P.G.Bergman   : Introduction to Theory of Relativity.
2. J.L.Synge   : Relativity, The special Theory.
3. B. Spain   : Tensor Calculus.
4. J.L. Bansal   : Tensor Analysis.
5. Roy & Bali   : Theory of Relativity.
6. Raj Bali   : Advanced Tensor Analysis.

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Discipline specific elective (DSE) courses

Any three of the following papers with the permission of the Head of the Department of Mathematics & Statistics.

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M3 MAT 01–DSE 01

NUMERICAL ANALYSIS-I

| L-T-P | 4-1-0 |

TIME: 3 hours

External Assessment 80
Internal Assessment 20

UNIT I

Theory of Iteration: Simple iteration, Rate of Convergence, Acceleration a convergence, method for multiple and complex roots, Convergence of iteration process in the case of several unknowns.

UNIT II

Real and complex roots, solution of transcendental and polynomial equations by using besection method, secant method, Regula-Falsi method, Newton Ruphson method, Chebyshev method and Muller method.

UNIT III

Concept of synthetic division, the Birge – vita, Bairstow and Graeffe's root squaring method. System of Simultaneous equations(Linear): Direct method of determinant, Gauss–Elimination.

UNIT IV

Gauss-Jordan Cholesky, Partition method of Successive approximation, Conjugate Gradient, Gaurs or Jacobi iteration, Gauss-Seidel and Relaxation methods.

UNIT V

Eigen value problems: Basic properties of Eigen values and Eigen vector power methods, Method for finding all Eigen pairs of a matrix, Complex Eigen values.

Books Recommended:

1. Jain, Iyenger and Jain   :   Numerical Analysis.

2. Jain, M. K.   :   Numerical solutions of differential equation.

3. Chouhan D.S., Vyas P. & Soni. V. :   Studies in Numerical Analysis

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M3 MAT 02 –DSEP 02

COMPUTER PROGRAMMING IN-C

(Practical Oriented)

| L-T-P | 2-0-3 |

TIME: 3 hours

External Assessment 80
Internal Assessment 20

UNIT I

Definition and properties of algorithm, flow chart, conversion of flow chart to language, examples of algorithms and flow charts, introduction to program design, errors, syntax error, logical error, runtime error.

UNIT II

Character set of C, constants and variables in C, arithmetic expressions in C, assignment and multiple assignment and mode of statements in C, built in functions and libraries in C, input and output statements in C, data types, structure of C program, elementary programs in C

UNIT III

Logical if statements in C: if- else, nested if, switch, break, continue, GOTO statements in C
 For , while and do-while loops in C, nested loops

UNIT IV

Functions: Defining and accessing a function, passing arguments to a function, specifying arguments data types, function prototypes, Scope rules of functions, call by value, call by reference

UNIT V

Array : introduction of array, Classification of arrays, functions with arrays, Pointers in C, pointers and arrays, File input/output: create, open, write, delete, close.

Books Recommended:

1.   Introduction Information Technology : Satish jain, BPB Publication, New Delhi.

2.   Fundamentals of computers : P. K. Sinha

3.   The C-Programming Language : B.W. Kernyharn & D.M. Ritche - PHI Ltd.

4.   Computer Programming in C : Y Kanetkar-B.P.B. Publication, New Delhi.

5.   Programming In ANSI C : E Balagurusamy**.**

Note: Two theory lectures per week are required for this paper.

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M3 MAT 03 –DSE 03

DISCRETE MATHEMATICS-I

| L-T-P | 4-1-0 |

TIME: 3 hours

External Assessment 80
Internal Assessment 20

UNIT I

Formal logic– Statement, Symbolic Representation and Tautologies, Quantifiers, Predicate validity, Propositional logic. Semi groups and monoids, Relations and ordering. Functions definitions and examples of semi groups and monoids (including those pertaining to concatenation operation).

UNIT II

Homomorphism of semi groups and monoids. Quotient subgroups, sub semigroups and sub monoids. Direct products. Basic Homomorphism theorem.

UNIT III

Lattices: - Lattices as partially ordered sets. Their properties. Lattices as Algebraic systems. Sub lattices, direct products and Homomorphism complete, Complemented and distributive lattices.

UNIT IV

Boolean Algebras:- Boolean Algebras as lattices. Various Boolean identities. The switching Algebras examples. Sub Algebras. Direct products and Homeomorphisms, Join- irreducible elements, Atoms and minterms.

UNIT V

Boolean forms and their equivalence. Minterms, Boolean forms. Minimization of Boolean functions. Application of Boolean Algebras to switching theory (OR and not gates).The Karnaugh map method.

Books recommended:

1. J.P. Tremblay & R. Manohar   : Discrete Mathematical structure with applications to computer science.

2. J.L. Gerstling   : Mathematical Structures for Computer Science, (3rd edition).

3. N. Arsing Deo   : Graph theory with applications to Engineering and Computer Science.

4.	K.D. Joshi	:	Foundation of Discrete Mathematics.
5.	S. Wiitala	:	Discrete mathematics – A Unified Approach.
6.	C. L. Liu	:	Elements of Discrete Mathematics.
7.	Gokhroo & Gokhroo	:	Advanced Discrete Mathematics(Navkar Publications)

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M3 MAT 04 –DSE 04

OPTIMIZATION TECHNIQUES-I

| L-T-P | 4-1-0 |

TIME: 3 hours

External Assessment 80
Internal Assessment 20

UNIT I
Dual simplex method, Bounded value algorithm, Parametric linear Programming.

UNIT II
Sensitivity Analysis: (i) Changes in the coefficients of the objective function, (ii) Changes in the components of vector b, (iii) Changes on the component (a_{ij}) of the matrix A.

UNIT III
Addition of the new variable, Addition of a new constraint. Deletion of a variable, Deletion of constraint.

UNIT IV
Integer programming: Importance of interger programming problems, Gomory's cutting plane methods, δ Fractional cut and λ-cut, Branch and bound method.

UNIT V
Project Management by PERT and CPM, cost time, trade off, Resource leveling.

Books Recommended:

1.	Kanti swaroop, Mak-Mohan, P.K. Gupta.	:	Operation Research
2.	Hamdy A. Taha	:	Operation Research
3.	S.D. Sharma	:	Operation Research
4.	S.I. Gass	:	Linear-Programming
5.	K.V. Mittal	:	Optimization Methods in Operations Research and systems analysis

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M3 MAT 05–DSE 05
MATHEMATICAL THEORY OF STATISTICS-I

| L-T-P | 4-1-0 |

TIME: 3 hours

External Assessment 80
Internal Assessment 20

UNIT I

Elements of theory of probability; sample space, various definitions of probability, addition and multiplication laws of probability, conditional probability and statistical independence of events. Baye's theorem and its applications.

UNIT II

Mathematical expectations, conditional expectations, Moments and cumulates. Moments generating and characteristic functions. Inversion theorem, Chebyshev's inequality, Central limit theorem for i.i.d. random variables.

UNIT III

Binomial, Negative -binomial, Poisson and Hyper geometric distributions.

UNIT IV

Rectangular, Normal, Cauchy, Gamma and Beta distributions Elementary idea of Exponential and Laplace distributions.

UNIT V

Curve fitting and principle of least squares, Scatter diagram, linear regression and correlation.

Note: Candidates who have offered Mathematical Statistics / Statistics / Applied Statistics as an optional subject in their B.A. /B.Sc. examination will not be permitted to offer this course.

Books recommended:

1. Gupta and Kapoor   : Fundamentals of Mathematical Statistics.

2. Kapur and Sexena   : Mathematical Statistics.

3. Goon and Others   : Outline of Statistical Theory, Vol. I, II.

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M3 MAT 06 –DSE 06

VISCOUS FLUID DYNAMICS-I

| L-T-P | 4-1-0 |

TIME: 3 hours

External Assessment 80
Internal Assessment 20

UNIT I

Viscosity, Analysis of stress, Relation between stress and rate of strain, Navier-stokes equations and equation of energy in cartesian system of coordinates.

UNIT II

vorticity and circulation. Reynolds law of similarity, Physical importance of non-dimentional parameters, Reynolds number Froude numbers, Mach number, Prandtl number, Eckert number.

UNIT III

Some exact solutions of Navier-stokes equations-steady, motion between parallel plates, Hagen poiseuille flow a circular pipe, flow between coaxial circular pipes, flow between two concentric rotating cylinders.

UNIT IV

Pulsatile flow between parallel surfaces, flow in convergent and divergent channels (Jaffery-Hamel flow), flow in the vicinity of stagnation point.

UNIT V

Unsteady motion of a plate. Theory of very slow motion of a sphere in viscous fluid Osceen's improvement of stoke's theory.

Book& Recommended:

1. G. Schfichting   : Boundary Layer Theory.

2. S.I. Pai   : Viscous Flow Theory, Vol.I, Laminar flow.

3. J.L. Bansal   : Viscous Fluid Dynamics.

4. M. D. Raisinghania   : Fluid Dynamics.

5. Shanti Swarup   : Fluid Dynamics.

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M3 MAT 07–DSE 07

INTEGRAL EQUATIONS

L-T-P | 4-1-0

TIME: 3 hours

External Assessment 80
Internal Assessment 20

UNIT I

Linear Integral equations: Definition and classification, Conversion of initial and boundary value problem to an integral equation, Eigen values and Eigen functions.

UNIT II

Solution of fredholm integral equations of second kind with seperable kernels. Reduction to a system of Algebraic equations.

UNIT III

Solution of Fredholm and Voltera integral equations of second kind by method successive substitution and successive approximations. Resolvenlt Kernal and its applications.

UNIT IV

Condition of uniform convergence and uniqueness of series solutions. Integral Equation with symmetric kernels: Complex Hilbert space, Orthogonal system of functions. Fundamental Properties of Eigen values and Eigen functions for symmetric Kernels, Expansion in Eigen-functions and Bilinear form.

UNIT V

Hilbert–Schmidt theorem, Solution of Fredholm integral equations of second kind with symmetric Kernels. Classical–Fredholm theory, Fredholm theorems, Solution of volterra integral equations with convolution type Kernels and Librated Kernels.

Books Recommended:

1. Ranville, E.D.   : Laplace and Fourier Transforms.
2. Sneddon, I.N.   : The use of Integral Transforms.
3. Ze manian, A.H.   : Generalized Integral transforms.
4. Lowit   : Linear Integral equations.

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M3 MAT 08–DSE 08

ASTRONOMY-I

| L-T-P | 4-1-0 |

TIME: 3 hours

External Assessment 80
Internal Assessment 20

UNIT I

Spherical Trigonometry- Great and small circular spherical triangles and their properties, various spherical trigonometrically formula-Cosine, sine, supplemental cosine, sine cosine, contingent, half of an angle and side Napier's analogies.

UNIT II

Delambe's analogies, their identities formulae for, right angled triangles and their solutions.

UNIT III

Celestial sphere, diurnal motion, Hour angle rising and setting of stars motion of sun, Zenith distance and Azimuth, Twilight.

UNIT IV

Refraction: Laws, effect of refraction on sun rise and sun set, Simpson's Hypothesis, effect of refraction in right ascension and declination etc. Time: Equation of time, seasons and their lengths, precession and Nutation and their effects on right ascension and declination, planetary precession double stars.

UNIT V

Aberration and its effect of longitude, latitude, right ascension and declination, position of apex, diurnal aberration and its effect in declination, right ascension and hour angle.

Books Recommended:

1. Astronomy by Gorakh Prasad.
2. Astronomy by Smart.

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M3 MAT 09–DSE 09

NUMBER THEORY-I

| L-T-P | 4-1-0 |

TIME: 3 hours

External Assessment 80
Internal Assessment 20

UNIT I

Divisibility: Gcd and Lcm of two or more integers, Euclidean, algorithm, the linear diophantine equation ax + by = c. Prime Numbers, composite numbers, infinitude of primes, fundamental theorem of arithmetic.

UNIT II

Congruences: Basic properties, divisibility tests, linear Congruences. Application of Congruences: Fermat's little theorem, Euler's generalization, Wilsons's theorem Chinese remainder theorem.

UNIT III

Number Theoretic functions: T.J, and, Multiplicative functions, Mobius inversion formula, the greatest integer function. Primitive Roots and Indices, Primitive roots, characterization of natural numbers having primitive roots, theory of indices, solution of certain congruence, through indices.

UNIT IV

Quadratic Residues: Quadratic residues and quadratic non residues of an integer in general and of a prime in particular, Gauss Lemma and its applications, the quadratic reciprocity law.

UNIT V

Special Numbers: Fibonacci numbers, Fermat's numbers, Perfect numbers. Diophantine Equations: Representation of integers as sums of 2, 3 and 4 squares.

Books Recommended:

1. Donald M. Burton   : Elementary Number Theory, Allyn and Bacon Inc.
2. Niven & H.S. Zuckerman : An Introduction to the Theory of Numbers,
                             Willey eastern India Ltd.
3. Lang, S.   : Algebraic Number theory, GTM Vol. 110,
                             Springer-Verlag 194.