**DEPARTMENT OF MATHEMATICS**

**Course Structure and Scheme of Examination**

**For Choice based Credit System (CBCS)**

(With effect from June-2010)

- **Course:** M.Sc. (Mathematics)
- **Eligibility for the admission:** B.Sc. (Mathematics)
- **Duration:** Two years

### Semester 1

<table>
<thead>
<tr>
<th>Subject Code</th>
<th>Title of the Course</th>
<th>Course Credits</th>
<th>No. of Hrs. Per Week</th>
<th>Weightage For Internal Examination</th>
<th>Weightage For Semester End Examination</th>
<th>Total Marks</th>
<th>Duration Of Semester end Exam in hrs.</th>
</tr>
</thead>
<tbody>
<tr>
<td>CMT – 1001</td>
<td>Algebra 1</td>
<td>4</td>
<td>4</td>
<td>30</td>
<td>70</td>
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<tr>
<td>CMT – 1002</td>
<td>Real Analysis</td>
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<tr>
<td>CMT – 1003</td>
<td>Topology 1</td>
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<tr>
<td>CMT – 1004</td>
<td>Theory of Ordinary Differential Equations</td>
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<tr>
<td>CMT – 1005</td>
<td>Seminar and Problem Session</td>
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<tr>
<td>EMT – 1001</td>
<td>Classical Mechanics 1</td>
<td>4</td>
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### Semester 2

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<tr>
<th>Subject Code</th>
<th>Title of the Course</th>
<th>Course Credits</th>
<th>No. of Hrs. Per Week</th>
<th>Weightage For Internal Examination</th>
<th>Weightage For Semester End Examination</th>
<th>Total Marks</th>
<th>Duration Of Semester end Exam in hrs.</th>
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<tbody>
<tr>
<td>CMT – 2001</td>
<td>Algebra 2</td>
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<tr>
<td>CMT – 2002</td>
<td>Complex Analysis</td>
<td>4</td>
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<td>CMT – 2003</td>
<td>Topology 2</td>
<td>4</td>
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<td>CMT – 2004</td>
<td>Methods in Partial Differential Equations</td>
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<td>CMT – 2005</td>
<td>Seminar and Problem Session</td>
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<td>EMT – 2001</td>
<td>Classical Mechanics 2</td>
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<td>Subject Code</td>
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<td>Weightage For Internal Examination</td>
<td>Weightage For Semester End Examination</td>
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<td>Duration Of Semester end Exam in hrs.</td>
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<tr>
<td>CMT – 3001</td>
<td>Prog. In C &amp; Numerical Methods</td>
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<td>CMT – 3002</td>
<td>Functional Analysis</td>
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<td>CMT – 3003</td>
<td>Number Theory 1</td>
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<td>CMT – 3004</td>
<td>Discrete Mathematics</td>
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<tr>
<td>EMT – 3011 OR EMT – 3021</td>
<td>Differential Geometry OR Sp. Theory of Relativity and Tensor Analysis</td>
<td>4</td>
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<td>30</td>
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<tr>
<td>PMT – 3001</td>
<td>Practical ( Comp. Applications )</td>
<td>4</td>
<td>8</td>
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# Semester 4

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<th>Title of the Course</th>
<th>Course Credits</th>
<th>No. of Hrs. Per Week</th>
<th>Weightage For Internal Examination</th>
<th>Weightage For Semester End Examination</th>
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<td>CMT – 4001</td>
<td>Commutative Ring Theory</td>
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<td>CMT – 4002</td>
<td>Integration Theory</td>
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<td>CMT – 4003</td>
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<td>Graph Theory</td>
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<td>EMT – 4011</td>
<td>Financial Mathematics</td>
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<tr>
<td>EMT – 4021</td>
<td>General Theory of Relativity &amp; Cosmology</td>
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<tr>
<td>EMT – 4031</td>
<td>Linear Algebra</td>
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<tr>
<td>PMT – 4001</td>
<td>Practical (Numerical Methods with Prog.)</td>
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### M.Sc. (Mathematics) - SEMESTER 1

- CMT - 1001 Algebra I
- CMT - 1002 Real Analysis
- CMT - 1003 Topology I
- CMT - 1004 Theory of Ordinary Differential Equations
- CMT - 1005 Seminar and Problem Session
- EMT - 1001 Classical Mechanics I
M.Sc.(Mathematics) - SEMESTER 2
CMT - 2001 Algebra II
CMT - 2002 Complex Analysis
CMT - 2003 Topology II
CMT - 2004 Methods in Partial Differential Equations
CMT - 2005 Seminar and Problem Session
EMT - 2001 Classical Mechanics II

M.Sc.(Mathematics) - SEMESTER 3
CMT - 3001 Prog. In C & Numerical Methods
CMT - 3002 Functional Analysis
CMT - 3003 Number Theory 1
CMT - 3004 Discrete Mathematics
EMT - 3011 Differential Geometry

OR
EMT - 3021 Sp. Theory of Relativity and Tensor Analysis
PMT - 3001 Practical ( Programming in C )
M.Sc. (Mathematics) - SEMESTER 4

CMT - 4001 Commutative Ring Theory
CMT - 4002 Integration Theory
CMT - 4003 Number Theory 2
CMT - 4004 Graph Theory
EMT - 4011 Financial Mathematics

OR

EMT - 4021 General Theory of Relativity & Cosmology

OR

EMT - 4031 Linear Algebra

PMT – 4001 Practical (Computer Oriented Numerical Methods)

* CMT – Core Subject, EMT – Elective Subject, PMT - Practical

♦ Passing Standard is 40% in Internal as well as in external examinations for all the courses.

♦ Student will have to clear internal as well as external examinations. (i.e. internal examination with minimum 40% and external examination with minimum 40% is compulsory) and student can earn credits mentioned against each course.

♦ There will be two internal examinations in each course and average of both the examinations will be considered.
M.Sc. Semester 1

Sub. Code: CMT-1001
Core Sub. 1: Algebra 1

Unit 1
Permutation groups, Isomorphism theorems, Automorphisms, Conjugacy and G-sets, Alternating group $A_n$, Simplicity of $A_n$.

Unit 2
Normal Series, Solvable Groups, Nilpotent Groups.

Unit 3
Direct Products, Finitely Generated Abelian Groups, Invariants of a finite Abelian Groups, Sylow Theorems.

Unit 4
Ideals, Homomorphisms, Sum and Direct Sum of Ideals, Maximal and Prime Ideals, Nilpotent and Nil Ideals.

Unit 5
Euclidean domains, Principal Ideal Domains, Unique Factorization Domains and Polynomial Rings over UFD.


Reference Books:-

Sub. Code: **CMT-1002**  
Core Sub. 2: **Real Analysis**

**Unit 1**  
Algebra and $\sigma$-algebra of sets, Borel sets, Lebesgue outer measure in $\mathbb{R}$, Measurable sets and Lebesgue measure, Measurable functions, A non-measurable set and Littlewood’s three principles.

**Unit 2**  
The Reimann integral, Lebesgue integral of simple functions and bounded functions, Bounded convergence theorem.

**Unit 3**  

**Unit 4**  
Differentiation of Monotone functions, Function of Bounded variation, Differentiation of an integral.

**Unit 5**  
The $L^p$-spaces, The Minkowaski’s inequality, Holder’s inequality, Convergence and completeness.

**Reference Books:**

M . S c . S E M E S T E R 1

Sub. Code: **CMT-1003**
Core Sub. 3: **Topology 1**

**Unit 1**
Relations, Well ordered set, Topological spaces, Basis for a Topology.

**Unit 2**
The Subspace Topology, Order Topology, Product Topology, Closed sets and limit points.

**Unit 3**
Continuous functions, Metric Topology, Quotient Topology.

**Unit 4**
$T_1$- spaces, Hausdorff spaces, Regular spaces and Normal spaces, Urysohan’s Lemma and Tietze extension theorem.

**Reference Books:-**


M.S c . S E M E S T E R 1

Sub. Code: CMT-1004
Core Sub. 4: Theory of Ordinary Differential Equations

Unit 1: Linear System of Differential Equations
The existence and uniqueness theorem, Linear Homogenous systems, Linear Non-Homogenous systems, Nonlinear system of first order equations.

Unit 2: Linear System with constant coefficients
The exponential of matrix, Eigen values and eigen vectors of matrices, calculation of fundamental matrix, two dimentional linear systems, some population problems, an electric circuit.

Unit 3: Series solutions of Linear Differential Equations
Review of properties of power series, second order linear equations with analytic coefficients, theorem on solutions in power series, singular points of linear differential equations, solutions about a regular singular point, exceptional cases, the Bessel equation and some properties of Bessel functions, singularities at infinity, irregular singular points with an introduction to asymptotic expansions

Unit 4: Existence theory
Existence of solutions, uniqueness of solutions, continuation of solutions, the non linear simple pendulum, existence theory for system of first order equations and higher order equations, linear systems, defendence on initial conditions.
**Unit 5: Laplace Transforms**


This course is covered by “*Ordinary Differential Equations*”, First course by R. Brauer and J. A. Nohel, Second edition, Benjamin Inc.

**Reference Books:-**


M.S.C. SEMESTER 1

Sub. Code: EMT-1001
Elective Sub.1: Classical Mechanics 1

Unit 1: D’Alemberts principle and Lagrange’s Equations
- Conservation theorem for linear momentum and angular momentum for a particle.
- Conservation theorem for linear momentum and angular momentum for a system of particles.
- Classification of dynamical system.
- Constraints.
- Virtual displacement and principle of virtual work.
- Generalized force in holonomic system
- Mathematical expression for principle of virtual work
- D’Almbert’s principle
- Langrange’s equation for holonomic system
- Lagranges’ equation for conservative non-holonomic system
- Problems on above topics

Unit 2: Variational principle and Lagrange’s equations
- Variational principle
- Calculus of variations
- Hamilton’s principle
- Derivation of Hamilton’s principle from Lagrange’s equation
- Derivation of Lagrange’s equations from Hamilton’s principle
• Cyclic co-ordinates
• Conservation theorems
• Problems on above topics

**Unit 3**: Two Body Central force problem

• Reduction to equivalent one body problem
• The equations of motion and first integrals
• The equivalent one dimensional problem and classification of orbits
• The inverse square law of force.

The course is covered by the above topics from the book:

M.S.C. SEMESTER 2

Sub. Code: CMT-2001
Core Sub. 1: Algebra 2

Unit 1
Irreducible Polynomials and Eisenstein Criterion, Adjunction of roots, Algebraic Extensions, Algebraically closed fields.

Unit 2
Splitting fields, Normal extensions, Multiple roots, Finite fields, Separable extensions.

Unit 3
Automorphism groups and fixed fields, Fundamental theorem of Galois theory, Fundamental theorem of Algebra.

Unit 4
Roots of unity and cyclotomic polynomials, Cyclic extensions, Polynomials solvable by radicals, Symmetric functions, Ruler and compass constructions.

Unit 5
Definitions and examples of Modules, Submodules and directsums, R-homomorphisms and quotient modules, Completely reducible modules, Free modules, Noetherian and Artinian modules.

Reference Books:-

Unit 1

The extended complex plane and its spherical representation, analytic functions, bilinear transformations, their properties and classifications, Branches of many valued functions with special reference to \( \text{arg } z \), \( \log z \) and \( z^n \), elementary Riemann surfaces, definition and properties of conformal mapping.

Unit 2

Riemann – Steiltjes integral and its properties, line integral and its properties, fundamental theorem of calculus for line integral, Leibnitz rule, Taylor’s theorem, Cauchy’s integral formula and Cauchy’s theorem for analytic functions on an open disc, winding number of a closed rectifiable curve with respect to a point outside the curve and its properties, Cauchy’s integral formula first version and second version, Cauchy’s theorem first version.

Unit 3

Cauchy – Goursat theorem, Moreras theorem, Cauchy’s inequality, entire functions, Liouville’s theorem, identity theorem, fundamental theorem of algebra, maximum modulus theorem and minimum modulus theorem.

Unit 4

Schwartz lemma, meromorphic functions, argument principle, Rouche’s theorem, Open Mapping Theorem, Inverse function theorem.

Unit 5

Isolated singularities, classifications of singularities, Laurent’s series, residue theorem, evaluation of integrals.

Reference Books:-


4) Complex Analysis by S. Lang, Addison-Wesley, 1977.


M.S c . S E M E S T E R 2

Sub. Code: **CMT-2003**
Core Sub. 3: **Topology 2**

**Unit 1**
Connected spaces and components, Path components.

**Unit 2**
Nets and Filters, Tychonoff theorem.

**Unit 3**
The product and quotient topologies, Separation properties in products and quotient spaces.

**Unit 4**
Compact spaces, Product and quotient of compact spaces, Limit point and Compactness, Locally compactness.

**Reference Books:**


M.S c . S E M E S T E R 2

Sub. Code: CMT-2004

Core Sub. 4: **Methods in Partial Differential Equations**

**Unit 1**

Surfaces and curves in three dimensions, simultaneous differential equations of the first order and the first degree in three variables, methods of solutions of \[ \frac{dx}{P} = \frac{dy}{Q} = \frac{dz}{R} \] , orthogonal trajectories of a system of curves on a surface.

**Unit 2**

Pfaffian differential forms and equations, solutions of Pfaffian differential equations in three variables, miscellaneous problems.

**Unit 3**

Partial Differential Equations, origins of first order partial differential equations, linear equations of the first order, integral surfaces passing through a given curve, Cauchy problem of the first order, surfaces orthogonal in a given system of surfaces.

**Unit 4**

Non – linear partial differential equations of the first order, Charpit’s method, special types of first order equations, solution satisfying given conditions, Jacobi’s method, applications of first order equations, miscellaneous problems.

**Unit 5**

The origin of second order equations, second order equations in physics, linear partial differential equations with constant coefficients, equations with variable coefficients of the second order.
This course is covered by relevant portions from, “Elements of Partial Differential Equations” by I. Sneddon, Mc Graw Hill.

Reference Books:-


Unit 1: Equations of Motion and Rigid bodies

Independent co-ordinates of rigid bodies, generalized co-ordinates of a rigid bodies, Euler angles, Cayley-Klein parameters and related quantities, components of angular velocity along the body set of axes, Euler’s theorem on the motion of a rigid body, rate of change of a vector, the coriolis force, Euler’s equations of motion for a rigid body, finite rotations, infinitesimal rotations.

Unit 2: The Rigid Body Equations of Motion

Angular momentum and kinetic energy of motion about a point, the inertia tensor and moment of inertia, the heavy symmetrical top with one point fixed.

Unit 3: Hamilton’s equation of Motion

Derivation of Hamilton’s equation of motion, Routh’s procedure, derivation of Hamilton’s equation from Hamilton’s Principle, principle of least action, problem related to above topics.

Unit 4: Canonical transformations and Generating functions

Poisson’s brackets and their properties, Hamilton-Jacobi theory, problem related to above topics.

The course is covered by the above topics from the book:
UNIT 1

Constants, variables, C tokens, keywords, identifiers, declaration of variables, operations and expressions, managing input and output operations and formatted output.

UNIT 2

Decision making and branching statements like – if then else, if then switch, go to and loops, jump in loops

UNIT 3

One or two dimensional array and their initialization, handling of character strings, User defined functions, structure, unions, pointers and file management in C.

UNIT 4


UNIT 5

Solution of simultaneous algebraic equations introduction, Gauss elimination method, ill conditioned equations, refinement of the solution obtained by Gaussian elimination, Gauss-Seidel iterative method, comparison of direct and iterative methods. Interpolation introduction, Lagrange interpolation, difference tables.
Reference Books:-

3) Programming in C, by E. Balagurusami units 2 to 12.
M.Sc. Semester 3

Sub. Code: CMT-3002

Core Sub. 2: Functional Analysis

Unit 1
Normed linear spaces, Banach spaces, Quotient space of a normed linear spaces and its completeness, bounded linear transformations, normed linear spaces of bounded linear transformations, dual spaces with examples.

Unit 2
Weak convergence in normed linear spaces, equivalent norms, Riesz lemma, Basic properties of finite dimensional normed linear spaces and compactness, weak convergence in normed linear spaces, reflexive spaces.

Unit 3
Uniform Boundedness theorem and its consequences, open mapping theorem, closed graph theorem, Hahn-Banach theorem for normed linear spaces, compact operations, solvability of linear equations in Banach spaces, the closed range theorem.

Unit 4
Inner product space, Hilbert space, orthonormal sets, Bessel’s inequality, complete orthonormal sets, Parseval’s identity, structure of Hilbert spaces, projection theorem, Riesz representation theorem for bounded linear functional on Hilbert spaces, reflexivity of Hilbert spaces.
Unit 5


This course is covered by relevant portions from the text “Introductory Functional Analysis with Applications”, John Wiley and Sons, Newyork, 1978.

Reference Books:-

M.Sc. SEMESTER 3

Sub. Code: CMT - 3003

Core Sub. 3: Number Theory - 1

Unit 1
Divisibility, Prime Numbers.

Unit 2
Congruences, Linear Congruences and their solutions, Chinese Remainder Theorem, Degree of a Congruence relation and related theorems.

Unit 3
Primitive rules and related Theorems and Examples, Related Congruences and their solutions.

Unit 4
Largest Integer functions and related results, Arithmetic Functions.

Reference Books:-

1) THE THEORY OF NUMBERS (Authors: Ivan Niven , Herbert S. Zuckerman, Hugh L. Montgomery)
2) NUMBER THEORY (Authors: Z. I. Borevich and I. R. Shafarevich)
3) AN INTRODUCTION TO THE GEOMETRY OF NUMBERS (Authors: J. W. S. Cassels)
4) HISTORY OF THE THEORY OF NUMBERS (Authors: L. E. Dickson)
M.Sc. SEMESTER 3

Sub. Code: **CMT-3004**

Core Sub. 3: **Discrete Mathematics**

**Unit 1**

Semigroups and Monoids, Homomorphism of Semigroups and Monoids, Products and Quotients of semigroups, Fundamental theorem of Homomorphism of Semigroups, Subsemigroups and submonoids. Relations, Transitive Closure and Warshall's Algorithm

**Unit 2**

Lattices as partially ordered sets, Properties of Lattices, Lattices as algebraic systems, Sublattices, Direct product and Homomorphisms of Lattices, Some Special Lattices, Finite Boolean Algebras, Functions on Boolean Algebras, Karnaugh Map Method.

**Unit 3**

Languages and Grammars, Finite State Machines, Semigroups, Machines and Languages, Moore Machines, Simplification of Machines, Moore Machines and Regular Languages, Kleene's Theorem, Pumping Lemma, Nondeterministic Finite State Automata.

**Unit 4**

Propositions and Logical operations, Truth tables, Conditional statements and Logical Equivalence, Quantifiers, Rules of Inference.

**Unit 5**

Elements of Coding Theory, The Hamming Metric, The Parity-Check and Generator Matrices, Group Codes: Decoding with Coset Leaders, Hamming Matrices.
Reference Books:-


M.Sc. SEMESTER 3

Sub. Code: EMT-3011

Elective Sub. 1:
Differential Geometry

Unit 1

Unit 2
Local theory of surfaces – parametric patches on surface. First Fundamental form and arc length.

Unit 3
Normal curvature, Geodesic curvature and Gauss formulae, Shape operator $L^p$ of a surface at a point, vector field a curve.

Unit 4
Second and third fundamental forms of a surface, Weingarten map, principal curvatures, Gaussian curvature, mean and normal curvatures.

Unit 5
Riemannian curvatures, Gauss theorem of Egregium, isometry groups and fundamental existence theorem for surfaces.

Reference Books:-
M.S.C. SEMESTER 3

Sub. Code: EMT-3021

Elective Sub. 2: Special Theory of Relativity and Tensor Analysis

Unit 1
- Newtonian Relativity (Galilean Transformation)
- Lorentz transformation
- Michelson – Morley experiment

Unit 2
- Length Contraction
- Time dilation
- Relativistic law of addition of velocities
- Equivalence of mass and energy
- Problems related to above topic

Unit 3
- Tensor Algebra
- Vector field in affine and Riemann space

Unit 4
- Christoffel Symbols
- Tensor Analysis

Books:–
1) Related topics of Unit 1 and Unit 2 will be covered from the book “Special Relativity” by W. Rindler. Pub.: Oliver and Bosed.
2) Related topics of Unit 3 and Unit 4 will be covered from the book “Introduction to General Relativity” by R.
Reference Books:-
M.Sc. Semester 4

Subject Code: CMT-4001

Core Sub. 7: Commutative Ring Theory

Unit 1
Rings and ring homomorphisms, Ideals, Quotient rings, Zero-divisors, Nilpotent elements, Units, Prime ideals and Maximal ideals, Nilradical and Jacobson radical, Operations on ideals, Extension and contraction.

Unit 2
Modules and module homomorphisms, Submodules and quotient modules, Operation on submodules, Direct sum and product, Finitely generated modules, Exact sequences, Rings and modules of fractions, Local properties, Extended and contracted ideals in rings of fractions.

Unit 3

Unit 4
Noetherian modules, Artinian modules, Composition series of a module, Noetherian rings, Hilbert's basis theorem, Primary decomposition in Noetherian rings.

Unit 5
Artin rings, Structure theorem for Artin rings, Discrete Valuation rings, Dedekind domains, fractional ideals.
The contents of the syllabus of this course is covered by the first nine chapters of the book--- Introduction to Commutative Algebra by M.F.Atiyah and I.G.Macdonald, Addison-Wesley Publishing Company, 1969.
**Reference Books:-**


M.Sc. SEMESTER 4

Sub. Code: CMT-4002

Core Sub. 2: Integration Theory

Unit 1

Measures spaces, Measurable functions, integration, general convergence theorems.

Unit 2

Signed measures, Positive sets, negative sets, null sets and their properties, Hahn- Decomposition Theorem, mutually singular measures, Jordan-Decomposition for a signed measure.

Unit 3

Measure absolutely continuous with respect to another measure, Radon-Nikodym theorem for measure and for signed measure, Lebesgue decomposition theorem, outer measure on a set, algebra of sets, Caratheodary extension theorem.

Unit 4

Product measure, structure of measurable sets in the product measure space, Fubini’s theorem, Fonelli’s theorem, $L^p(k)$ and Riesz Representation theorem for bounded linear functional on $L^p(k)$, Baire measure on the real line, Lebesegue Stieltjes integral of Borel measurable function with respect to monotonically increasing function.

Unit 5
Locally compact Hausdorff spaces, Baire and Borel measures, continuous functions with compact support, regularity of measures on locally compact Hausdorff spaces, integration of continuous functions with compact support, Riesz Markov-theorem.

Reference Books:-

2) G. de Barre, Measure Theory and Integration, Wiley Eastern Limited, 1981.

M.Sc. SEMESTER 4

Sub. Code: CMT-4003
Core Sub. 3: Number Theory - 2

Unit 1
Farey Fractions, Irrational numbers, Farey Fractions and Approximation of Irrationals by Rationals

Unit 2
Continued Fractions (Finite and Infinite), Approximations of Irrationals by Rationals, Hurwitz’s Theorem.

Unit 3
Periodic Continued Fractions, Pell’s Equations.

Unit 4
Diophantine Equations, Pythagorean Triples, Some other Examples.

Reference Books:-

THE THEORY OF NUMBERS (Authors: Ivan Niven, Herbert S. Zuckerman, Hugh L. Montgomery)
1) NUMBER THEORY (Authors: Z. I. Borevich and I. R. Shafarevich)
2) AN INTRODUCTION TO THE GEOMETRY OF NUMBERS (Authors: J. W. S. Cassels)
3) HISTORY OF THE THEORY OF NUMBERS (Authors: L. E. Dickson)
M.Sc. Semester

Subject Code: CMT-4004

Core Sub. 4: Graph Theory

Unit 1
A quick review of the following concepts, Graph, degree of a vertex, path, circuit, connected and disconnected graphs, components, Euler circuits, Euler graph, Hamiltonian Paths and circuits.

Unit 2
Trees and Fundamental circuits

Unit 3
Cut-Sets and Cut-Vertices

Unit 4
Planar Graphs, Kuratowski’s two graphs, Different representation of planarity, Detection of Planarity.

Unit 5
Coloring of graphs, chromatic number, chromatic polynomial, the four color problem matching

Unit 6
Graph theory in OR: transport networks, extension of Max-Flow, Min-Cut theorem, minimal cost flows.

The syllabus is a covered by chapters 1 & 2 (for quick review), Chapter 3 (3.1 to 3.6), 4 (4.1 to 4.6), 5 (5.1 to 5.5), 8 (8.1 to 8.4) and 14(14.1 to 14.3) from “Graph theory with application to Engineering & computer science” by Narsingh Deo, Prentics- Hall of India New Delhi.
Reference Books:–
1) Graph theory by F. Harary – Addison – Wesley 1969
2) Introduction to Graph theory by R. J. Wilson, Peterson
E’du asia (Low price).
3) R. J. Willson & J. J. Walkms: Graphs: An introductory
M.Sc. SEMESTER

Sub. Code: EMT - 4011

Elective Sub. I: Financial Mathematics

Unit 1
Basic option theory, Types of options, interest rates and present value, Asset price

Unit 2
Random walk, Ito’s lemma, Black-Sholes model, arbitrage theorem, option values

Unit 3
The Black – Sholes formulae, hedging the practice, partial differential equations and Black – Sholes formulae.

Unit 4
Variations in Black – Sholes model to include dividends as well as forward and future contracts, American Options.

Reference Books:-
Unit 1: The Gravitational Field Equation in Empty Space
• Criteria for the field equations.
• The Riemann curvature tensor and its properties.
• The Bianchi identities.

Unit 2: The Schwarzschild solution and its consequences, experimental tests of General Relativity
• The Schwarzschild solution
• The Schwarzschild solution in isotropic co-ordinates
• The General Relativistic Kepler problem and the perihilc shift of Mercury.
• The trajectory of light ray in Schwarzschild field.
• The Schwarzschild radius, Kruskal co-ordinates and the Black hole.

Unit 3: The Kerr Solution
• The Schwarzschild and Kerr solution
• The Kerr solution and Rotation.

Relevant topics will be covered from “Introduction to General Relativity”. – By R Adees, M. Bazin, M. Schiffer.

Reference Books:-
1) Essential Relativity – W. Rindler. Pub.: Springer Verlag
M.Sc. SEMESTER 4

Sub. Code: **EMT-4031**
Elective Sub. 3: **Linear Algebra**

**Unit 1**
The Algebra of linear transformations, Characteristic roots, Matrices.

**Unit 2**
Canonical Forms: Triangular Form, Nilpotent linear transformations, Invariants of a nilpotent linear transformation.

**Unit 3**
Canonical Forms: The primary decomposition theorem, Jordan Form, Rational canonical Form.

**Unit 4**
Trace and Transpose, Determinants, Cramer's rule, Cayley-Hamilton theorem, A quick review of inner product spaces, Hermitian, Unitary and Normal transformations.

**Unit 5**
Real Quadratic Forms, Sylvester's law of inertia, Bilinear Forms, Symmetric Bilinear Forms, Skew-Symmetric Bilinear Forms, Groups preserving Bilinear Forms.

Reference Books:-