## DEENBANDHU CHHOTU RAM UNIVERSITY OF SCIENCE & TECHNOLOGY, MURTHAL
### Department of Mathematics
#### Master of Science (M.Sc.) in Mathematics

### Semester I
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
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<tbody>
<tr>
<td>MAT 501B</td>
<td>Algebra</td>
<td>4</td>
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<tr>
<td>MAT 503B</td>
<td>Real Analysis</td>
<td>4</td>
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<tr>
<td>MAT 505B</td>
<td>Mechanics</td>
<td>4</td>
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<tr>
<td>MAT 507B</td>
<td>Ordinary Differential Equations-I</td>
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<tr>
<td>MAT 509B</td>
<td>Programming in C</td>
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<tr>
<td>MAT 511B</td>
<td>Computing Lab</td>
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### Semester II
<table>
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<tr>
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<tr>
<td>MAT 502B</td>
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<td>MAT 504B</td>
<td>Measure &amp; Integration Theory</td>
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<td>MAT 506B</td>
<td>Methods of Applied Mathematics</td>
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<td>Ordinary Differential Equations-II</td>
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<td>MAT 512B</td>
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### Semester III
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<tr>
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<td>MAT 603 B</td>
<td>Partial Differential Equation</td>
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### Electives:
(Students are required to take both the electives from the same Group A or B or C)

#### Group A
- MAT 609B Analytical Number Theory-I
- MAT 611B Abstract Algebra
- MAT 613B Algebraic Coding Theory-I

#### Group B
- MAT 615B Mechanics of Solids-I
- MAT 617B Fluid Mechanics
- MAT 619B Information Theory

#### Group C
- MAT 621B Fuzzy Systems
- MAT 623B Computer Networks
MAT 625 B Data Base Management System

Electives can be offered subject to availability of requisite resources/ faculty in the department

**Semester IV**

<table>
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<td>MAT-604B</td>
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**Electives:**
(Students are required to take both the electives from the same group D or E or F)

**Group D (Prerequisites Group A)**

<table>
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**Group E (Prerequisites Group B)**

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**Group F (Prerequisites Group C)**

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<td>MAT 626B</td>
<td>Software Engineering</td>
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*Note: Electives can be offered subject to availability of requisite resources/ faculty in the department.*
## DEENBANDHU CHHOTU RAM UNIVERSITY OF SCIENCE & TECHNOLOGY
MURTHAL (SONEPAT) HARYANA - 131039
DEPARTMENT OF MATHEMATICS

**SCHEME OF STUDIES & EXAMINATIONS**

**M.Sc. in Mathematics (Two Year Course)**

**Semester – I**

**Effective from Session 2009-2010**

<table>
<thead>
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<th>Paper No.</th>
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<th>Teaching Scheme</th>
<th>Examination Scheme</th>
<th>Duration of Exam.</th>
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### DEENBANDHU CHHOTU RAM UNIVERSITY OF SCIENCE & TECHNOLOGY
**MURTHAL (SONEPAT) HARYANA - 131039**
**DEPARTMENT OF MATHEMATICS**

### SCHEME OF STUDIES & EXAMINATIONS

**M.Sc. in Mathematics**  (Two Year Course)

**Semester – II**

**Effective from Session 2009-2010**

<table>
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DEENBANDHU CHHOTU RAM UNIVERSITY OF SCIENCE & TECHNOLOGY
MURTHAL (SONEPAT) HARYANA - 131039
DEPARTMENT OF MATHEMATICS

SCHEME OF STUDIES & EXAMINATIONS

M.Sc. in Mathematics  (Two Year Course)

Semester – III
Effective from Session 2010-2011

<table>
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Electives:
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**Group-A**
- MAT 609B  Analytical Number Theory-I
- MAT 611B  Abstract Algebra
- MAT 613B  Algebraic Coding Theory-I

**Group B**
- MAT 615B  Mechanics of Solids-I
- MAT 617B  Fluid Mechanics
- MAT 619B  Information Theory

**Group C**
- MAT 621B  Fuzzy Systems
- MAT 623B  Computer Networks
- MAT 625B  Data Base Management System

*Note: Electives can be offered subject to availability of requisite resources/ faculty in the department.*
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MURTHAL (SONEPAT) HARYANA - 131039
DEPARTMENT OF MATHEMATICS

SCHEME OF STUDIES & EXAMINATIONS

M.Sc. in Mathematics (Two Year Course)

Semester – IV
Effective from Session 2010-2011

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Electives:
(Students are required to take both the electives from the same group D or E or F)

Group D (Prerequisites Group A)
MAT 610B    Analytical Number Theory-II
MAT 612 B   Advanced Complex Analyses
MAT 614B    Algebraic Coding Theory -II

Group E (Prerequisites Group B)
MAT 616B    Mechanics of Solids-II
MAT 618B    Optimization Techniques
MAT 620B    Advanced Fluid Mechanics

Group F (Prerequisites Group C)
MAT 622B    Artificial Intelligence
MAT 624B    Computer Graphics
MAT 626 B   Software Engineering

Note: Electives can be offered subject to availability of requisite resources/faculty in the department.
L    T    P    Marks for External Exam    : 100
4     0 - (4 Credits)    Marks for Internal Exam    : 50
Total                                    : 150
Duration of Exam               : 3 Hours

Note: The question paper will consist of four sections. Each section will contain two questions and
the students shall be asked to attempt five questions in all, selecting at least one question
from each section. All questions carry equal marks.

Unit-I
Normal, Subnormal series and Composition Series, Zassenhaus’s lemma, Scheiers theorem,
Jordan-Holder theorem (Abelian and Non-Abelian groups), Commutators and their properties, Hall-
Witt identity, three subgroup lemma of P. Hall.

Unit-II
Nilpotent groups and their class of nilpotency, Upper and lower central series and their properties,
Invariant (normal) and chief series, Solvable groups, Insolvability of Sn(n>4).

Unit-III
Extension Fields, Algebraic and transcendental extensions, algebraically closed field, Prime
fields, Separable and inseparable extensions, Normal extensions, Finite fields and their construction,
Primitive elements.

Unit-IV
Automorphisms of Extensions, Galois Group, Galois extension, Fundamental theorem of
Galois Theory, Solutions of polynomial equations by radicals, Insolvability of the general equation
of degree 5 by radicals, Constructions with ruler and compass.

References
Sons,Inc.USA.
(2009).
7. Rudolf Lidl and Harald Niederreiter, Introduction to Finite Field and their Aplications,
MAT 503B: REAL ANALYSIS

L   T   P
4    0    - (4 Credits)

Marks for External Exam   : 100
Marks for Internal Exam   : 50
Total                      : 150
Duration of Exam          : 3 Hours

Note: The question paper will consist of four sections. Each section will contain two questions and the students shall be asked to attempt five questions in all, selecting at least one question from each section. All questions carry equal marks.

Unit - I
Sequences and series of functions, point-wise and uniform convergence, Cauchy criterion for uniform convergence, Weierstrass M-test, Abel’s and Dirichlet’s tests for uniform convergence, uniform convergence and continuity, uniform convergence and Riemann-Stieltjes integration, uniform convergence and differentiation.

Unit – II
Explicit and Implicit Functions, continuity, differentiability, partial derivatives, of higher orders, and equality, differentials of higher order, functions of functions, Taylor’s theorem.

Unit - III
Definition and existence of Riemann-Stieltjes integral, properties of the integral, integration and differentiation, the fundamental theorem of Calculus, integration of vector-valued functions, rectifiable curves.

Unit - IV
Set functions, intuitive idea of measure, elementary properties of measure, measurable sets and their fundamental properties, Lebesgue measure of sets of real numbers, algebra of measurable sets, Borel sets, equivalent formulation of measurable sets in terms of open, closed $F_s$ and $G_d$ sets, non measurable sets.

References
MAT 505B: MECHANICS

L  T  P  
4 0  - (4 Credits)

Marks for External Exam : 100
Marks for Internal Exam : 50
Total : 150
Duration of Exam : 3 Hours

Note: The question paper will consist of four sections. Each section will contain two questions and the students shall be asked to attempt five questions in all, selecting at least one question from each section. All questions carry equal marks.

Unit-I
Moments and products of Inertia, Theorems of parallel and perpendicular axes, principal axes, The momental ellipsoid, Equimomental systems, Coplanar distributions, Generalized coordinates, Holonomic and Non-holonomic systems, Scleronomic and Rheonomic systems, Lagrange’s equations for a holonomic system, Lagrange’s equations for a conservative and impulsive forces, Kinetic energy as quadratic function of velocities, Generalized potential, Energy equation for conservative fields.

Unit -II
Hamilton’s variables, Donkin’s theorem, Hamilton canonical equations, Cyclic coordinates, Routh’s equations, Poisson’s Bracket, Poisson’s Identity, Jacobi-Poisson equation, Hamilton’s Principle, Principle of least action, Poincare Cartan Integral invariant, Whittaker’s equations.

Unit -III
Jacobi’s equations, Statement of Lee Hwa Chung’s theorem, Hamilton-Jacobi equation, Jacobi’s theorem, Method of separation of variables, Lagrange Brackets, Condition of canonical character of a transformation in terms of Lagrange brackets and Poisson brackets, Invariance of Lagrange brackets and Poisson brackets under canonical transformations.

Unit -IV
Gravitation: Attraction and potential of rod, disc, spherical shells and sphere, Laplace and Poisson equations, Work done by self-attracting systems, Distributions for a given potential, Equipotential surfaces, Surface and solid harmonics, Surface density in terms of surface harmonics.

References
MAT 507B: ORDINARY DIFFERENTIAL EQUATION-I

L T P  Marks for External Exam : 100
4 0 - (4 Credits)  Marks for Internal Exam : 50
                      Total : 150
                      Duration of Exam : 3 Hours

Note: The question paper will consist of four sections. Each section will contain two questions and the students shall be asked to attempt five questions in all, selecting at least one question from each section. All questions carry equal marks.

Unit-I
Uniqueness of solutions, Lipschitz condition, Picard-Lindelof theorem for local existence and uniqueness of solutions, solution of initial-value problems by Picard method,

Unit-II
Total differential Equations: Condition of Integrability, Methods of Solution, Gronwall’s differential inequality, comparison theorems involving differential inequalities, zeros of solutions, Riccati’s Equation, Prüfer transformation, Lagrange’s identity and Green’s Formula for second-order equation

Unit-III
Sturms separation and comparison theorems. Sturm-Liouville boundary-value problems, properties of eigen values and eigen functions. Separation variable method for heat and wave equation (one dimensional ) and Laplace equation in (two dimensional ) in Cartesian system.

Unit-IV
Introduction solution of linear differential equation of second order, complete solution in terms of known integral, Removal of the first derivative, transformation of the equation by changing the independent variable, method of variation of parameters and method of operational factors.

References
MAT 509B: PROGRAMMING IN C

L T P
4 0 - (4 Credits)

Marks for External Exam : 100
Marks for Internal Exam : 50
Total : 150
Duration of Exam : 3 Hours

Note: The question paper will consist of four sections. Each section will contain two questions and the students shall be asked to attempt five questions in all, selecting at least one question from each section. All questions carry equal marks.

Unit -I

Unit -II
The if Statement, Multiple Statements within if, if-else statement, Nested if-else and use of Logical operators, Switch statement.
The while Loop, for loop, Nesting of Loops, The break Statement, The continue Statement, The do-while Loop, Switch statement and goto statement.

Unit -III
Arrays– Declaring an array, Arrays and Memory, Initializing arrays, Multidimensional arrays, Strings and it’s in built functions.
Functions –The basics, declarations and calls, type of functions, Function call by Value and call by Reference, passing Arrays as Function Arguments, Recursion.

Unit -IV

References
2. Gottfried Byrons , Programming in C, Schaum’s Series.
MAT 511B: COMPUTING LAB

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Practical will be based on the Theory paper MAT 509B: Programming in C.
MAT 502B: NUMERICAL ANALYSIS

L  T  P
4  0  -(4 Credits)

Note: The question paper will consist of four sections. Each section will contain two questions and the students shall be asked to attempt five questions in all, selecting at least one question from each section. All questions carry equal marks.

Unit -I

Unit -II
Forward, backward & central differences, Factorial notation, averaging operator, shift operator and relationship between various type of operators, Newton’s forward & backward interpolation formula, Central difference interpolation formula, interpolation formula for unequal intervals, Hermite interpolation and cubic Spline interpolation.

Unit -III
Numerical differentiation using forward, backward and central difference formulas. Numerical integration, Newton’s Cotes formula, Trapezoidal and Simpson’s rules, Romberg integration, Gaussian quadrature, Richardson Extrapolation.

Unit -IV

References

5. E Balagurusamy, Numerical Methods, TMH.
MAT 504B: MEASURE AND INTEGRATION THEORY

L  T  P  Marks for External Exam     : 100
4  0  -      (4 Credits)          Marks for Internal Exam : 50
          Total                    : 150
          Duration of Exam       : 3 Hours

Note: The question paper will consist of four sections. Each section will contain two questions and the students shall be asked to attempt five questions in all, selecting at least one question from each section. All questions carry equal marks.

Unit – I
Measurable functions and their equivalent formulations, Properties of measurable functions. Approximation of measurable functions by sequences of simple functions, Measurable functions as nearly continuous functions, Egoroffs theorem, Lusin’s theorem, Convergence in measure and F. Riesz theorem for convergence in measure, Almost uniform convergence.

Unit – II
Shortcomings of Riemann Integral. Lebesgue Integral of a bounded function over a set of finite measure and its properties, Lebesgue integral as a generalization of Riemann integral, Bounded convergence theorem, Lebesgue theorem regarding points of discontinuities of Riemann integrable functions.

Unit – III
Integral of non-negative functions, Fatou’s Lemma, Monotone convergence theorem, General Lebesgue Integral, Lebesgue convergences theorem. Vitali’s covering Lemma, Differentiation of monotonic functions,

Unit – IV
Functions of bounded variation and its representation as difference of monotonic functions. Differentiation of indefinite integral. Fundamental Theorem of Calculus. Absolutely continuous functions and their properties.

References
3. P.K. Jain and V.P. Gupta, Lebesgue Measure and Integration, New Age International (P) Limited Published, New Delhi, 1986 (Reprint 2000)
MAT 506B: METHODS OF APPLIED MATHEMATICS

L T P Marks for External Exam : 100
4 0 - (4 Credits) Marks for Internal Exam : 50

Total : 150 Duration of Exam : 3 Hours

Note: The question paper will consist of four sections. Each section will contain two questions and the students shall be asked to attempt five questions in all, selecting at least one question from each section. All questions carry equal marks.

Unit -I
Fourier Transforms – Definition and properties, Fourier transform of some elementary functions, convolution theorem, Application of Fourier transforms to solve ordinary & partial differential equations.

Unit -II
Curvilinear Co-ordinates: Co-ordinate transformation, Orthogonal Co-ordinates, Cartesian, Cylindrical and Spherical Co-ordinates, expressions for velocity and accelerations, $ds$, $dv$ and $ds^2$ in orthogonal co-ordinates, Areas, Volumes and Surface areas in Cartesian, Cylindrical & Spherical co-ordinates in a few simple cases, Grad, Div, Curl, Laplacian in Orthogonal Co-ordinates, Contravariant and Co-variant components of a vector.

Unit -III
Sample spaces, random variables, Distribution and density distribution function, Marginal and conditional distribution, probability generating function, Characteristic function, Mathematics expectation, Moments, moment generating function, Binomial & Poisson distributions as the discrete distributions, Uniform, Exponential, Normal as the continuous distributions.

Unit -IV
Correlation, Karl Pearson coefficient of correlation, Rank correlation, Tied rank, limit for rank correlation coefficient, Regression, lines of regression, regression curves, regression coefficients and its properties, angle between two lines of regression, correlation coefficient between observed and estimated value, weak law of large numbers, central limit theorem, t, f, and Chi-square as sampling distribution.

References
MAT 508B: ORDINARY DIFFERENTIAL EQUATION-II

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Note: The question paper will consist of four sections. Each section will contain two questions and the students shall be asked to attempt five questions in all, selecting at least one question from each section. All questions carry equal marks.

**Unit -I**

Linear systems, fundamental set and fundamental matrix of a homogeneous system, Wronskian of a system. Method of variation of constants for a non-homogeneous system, reduction of the order of a homogeneous system, systems with constant coefficients, adjoint systems, periodic solutions, Floquet theory for periodic systems (Relevant topics from the book by Coddington and Levinson).

**Unit -II**

Nonlinear differential equations, plane autonomous systems and their critical points, classification of critical points-rotation points, foci, nodes, saddle points. Stability, asymptotical stability and unstability of critical points, almost linear systems, Perturbations, Simple Critical points, dependence on a parameter.

**Unit -III**

Liapunov function, Liapunov’s method to determine stability for nonlinear systems, limit cycles, Bendixson non-existence theorem, Statement of Poincare-Bendixson theorem, index of a critical point (Relevant topics from the books of Birkhoff & Rota, and by Ross).

**Unit -IV**


**References**

MAT 510B: COMPLEX ANALYSIS

L  T  P  
5  0  -  (5 Credits)  

Marks for External Exam : 100
Marks for Internal Exam : 50
Total : 150
Duration of Exam : 3 Hours

Note: The question paper will consist of four sections. Each section will contain two questions and the students shall be asked to attempt five questions in all, selecting at least one question from each section. All questions carry equal marks.

Unit -I

Cauchy Riemann equations, Necessary and sufficient conditions for a function to be analytic, Polar form of Cauchy Riemann equations, Harmonic function, Construction of analytical function, Power series, Radius of convergence of power series, Sum function of power series, Cauchy Hadamard theorem.

Unit -II

Complex Integration, Antiderivatives, Cauchy-Goursat Theorem, Simply and Multiply connected domains, Cauchy’s Integral formula, Cauchy’s Integral formula for higher Order derivatives, Morera’s theorem, Cauchy’s inequality, Liouville’s theorem, The fundamental theorem of Algebra, Maximum Modulus Principle, Minimum Modulus Principle, Schwarz Lemma, Poisson’s integral formula.

Unit - III

Transformation: Jacobian Transformation, Conformal Transformation, Some general transformations, Bilinear transformations and their properties and classification.

Unit - IV

Taylor’s Series, Laurent’s Series, Signularities, Meromorphic functions, Argument principle, Rouche’s theorem, Calculus of residues, Cauchy’s residue theorem, Evaluation of Integrals, Mittag Leffler’s expansion theorem.

References
MAT 512B: Numerical Computational Lab

L  T  P
-  -  4 (4 Credits)

Marks for External Exam : 25
Marks for Internal Exam  : 25
Total                   : 50
Duration of Exam        : 2 Hours

Practical will be based on the Theory paper MAT 512B : Numerical Analysis
MAT 601B: TOPOLOGY

L T P Marks for External Exam : 100
4 0 - (4 Credits) Marks for Internal Exam : 50

Total : 150 Duration of Exam : 3 Hours

Note: The question paper will consist of four sections. Each section will contain two questions and the students shall be asked to attempt five questions in all, selecting at least one question from each section. All questions carry equal marks.

Unit-I
Definition and examples of topological spaces, Comparison of topologies on a set, Intersection and union of topologies on a set, Neighborhoods, Interior point and interior of a set, Closed set as a complement of an open set, Adherent point and limit point of a set, Closure of a set, Derived set, Properties of Closure operator, Boundary of a set, Dense subsets, Interior, Exterior and boundary operators.

Base and subbase for a topology, Neighborhood system of a point and its properties, Base for Neighbourhood system Relative(Induced) topology, Alternative methods of defining a topology in terms of neighbourhood system and Kuratowski closure operator.

Continuous functions, Open and closed functions, Homeomorphism, Connectedness and its characterization.

Unit-II
Connected subsets and their properties, Continuity and connectedness, Connectedness spaces, Components, Locally connected spaces, Locally connected and product spaces, First and Second Countable spaces and their hereditary and topological property, Lindelof’s theorem, Separable spaces, Countability of a collection of disjoint open sets in separable and second countable spaces.

Unit- III
Separation axioms: T₀, T₁ and T₂ spaces their characterization and basic properties, Regular and normal spaces, Urysohn’s Lemma and Tietze Extension theorem, T₃ and T₄ spaces, Complete regularity and Complete normality, T₃½ and T₅ spaces.

Unit - IV
Compact spaces and subsets, Compactness in terms of finite intersection property, Basic properties of compactness, Closedness of compact subset and a continuous map from a compact space into a Hausdorff space and its consequence. Sequentially and countably compact sets, Local compactness, Compactness and product space.

References
5. J. Dugundji, Topology, Allyn and Bacon, 1966 (Reprinted in India by Prentice Hall Of India Pvt. Ltd.).
MAT 603B: PARTIAL DIFFERENTIAL EQUATION

L T P  
40 – (4 credits)

Marks for external exam  :100
Marks for internal exam  :50
Total  :150
Duration of exam  : 3hours

Note: The question paper will consist of four sections. Each section will contain two questions and the students shall be asked to attempt five questions in all, selecting at least one question from each section. All questions carry equal marks.

Unit -I

Unit -II

Unit -III

Unit -IV
Separation of variables, Similarity solutions (Plain & Traveling waves solutions, Similarity under scaling), Fourier transform- Plancherel’s theorem, Laplace transform, Legendere transform, Potential functions.

References
2. I.N. Sneddon, Elements of Partial Differential Equations, McGraw Hill international
3. An Introduction to Partial Differential Equation Yehuda Pinchover and Jacob Rubinstein,Cambridge University press 2005
MAT 605B: DISCRETE MATHEMATICS

L.T.P.  
4 0 – (4 credits)  

Marks for external exam : 100  
Marks for internal exam : 50  
Total : 150  
Duration of exam : 3 hours

Note: The question paper will consist of four sections. Each section will contain two questions and the students shall be asked to attempt five questions in all, selecting at least one question from each section. All questions carry equal marks.

Unit – I
Recurrence Relations, Explicit Formula for a Sequence, Solution of Recurrence Relations Homogeneous Recurrence Relations with Constant Coefficients, Particular Solution of a Difference Equation, Recursive Functions, Generating Functions, Convolution of Numeric Functions, Solution of Recurrence Relations by the Method of Generating Function.

Unit – II

Unit – III
Definitions and Basic Properties of Boolean Algebra, Representation Theorem, Boolean Expressions, Logic Gates and Circuits, Boolean Function, Method to find Truth Table of a Boolean Function, Karanugh map, Expressing Boolean Functions as Boolean Polynomials, Addition of Binary Digits, Half – Adder, Full Adder.

Unit – IV
Graphs: Basic concepts and types of Graphs, Paths and Circuits, Eulerian Circuits, Hamiltonian Circuits, Matrix Representation of Graphs, Planar Graphs, Trees: Definition, and Characterization of Trees Representation of Algebraic Expressions by Binary Trees, Spanning Tree of a Graph, Shortest Path Problem, Minimal Spanning Tree, Tree Searching.

References
MAT 607B: SEMINAR

L  T  P
-  -  2(2 Credits)

Marks for External Exam : -
Marks for Internal Exam : 50
Total : 50
Duration of Exam : -
MAT 609B: ANALYTICAL NUMBER THEORY –I

L  T  P Marks for External Exam : 100
5  0 - (5 Credits)

Marks for Internal Exam : 50
Total : 150
Duration of Exam : 3 Hours

Note: The question paper will consist of four sections. Each section will contain two questions and
the students shall be asked to attempt five questions in all, selecting at least one question
from each section. All questions carry equal marks.

Unit –I
Distribution of primes. Fermat’s and Mersenne numbers, Congruences, Complete
Residue System, Reduced Residue System and related results, Fermat Theorem, Wilson. Theorem
(Relevant portions from the Books Recommended at Sr. No. 1 and 4).

Unit -II
Farey series and some results concerning Farey series. Approximation of irrational
numbers by rationals, Hurwitz’s theorem. Irrationality of e and p. Diophantine equations ax + by
= c. x²+y² = z² and x⁴+y⁴ = z⁴. Simultaneous linear and non-linear congruences. Chinese
Remainder Theorem and its extension. (Relevant portions from the Books Recommended at Sr.
No. 1 and 4).

Unit -III
The representation of number by two or four squares. Four square theorem, Waring’s
problem, the numbers g(k) & G(k). Lower bounds for g(k) & G(k). (Relevant portions from the
Books Recommended at Sr. No. 1 and 4).

Quadratic residues and non-residues. Legendre’s Symbol. Gauss Lemma and its
applications. Quadratic Law of Reciprocity. Jacobi’s Symbol. (Scope as in Chapters 4,6 and 7 of
Recommended Book at Sr. No.5).

Unit – IV
The arithmetic in Zₙ. The group Uₙ. Congruences with prime power modulus, primitive
roots and their existence. The group Uₚⁿ (p-odd) and U₂ⁿ. The group quadratic residues Qₙ,
quadratic residues for prime power moduli and arbitrary moduli. The algebraic structure of Uₙ and
Qₙ (Scope as in Chapters 4,6 and 7 of Recommended Book at Sr. No.5).

References
MAT 611B: ABSTRACT ALGEBRA

L  T  P  
5  0  - (5 Credits)  
Marks for External Exam : 100  
Marks for Internal Exam :  50  
Total : 150  
Duration of Exam : 3 Hours

Note: The question paper will consist of four sections. Each section will contain two questions and the students shall be asked to attempt five questions in all, selecting at least one question from each section. All questions carry equal marks.

Unit-I
Simple classification of Abelian Groups, and structure of torsion groups, Prüfer groups, Steinitz Exchange Theorem, Finite Abelian groups, Fundamental structure theorem for finitely generated Abelian groups and its application to finitely generated Abelian groups. Divisible groups, Main theorem on p-Prüfer groups, Decomposition theorem for divisible groups.

Unit-II
Roots of unity and cyclotomic polynomials, nth cyclotomic field, composite and simple extensions with Galois Extensions, cyclotomic extensions and Abelian extensions over Q, Kronecker-Weber theorem, Galois groups of polynomials upto degree 5.

Unit-III

Unit-IV

References
MAT 613B: ALGEBRAIC CODING THEORY-I

L T P
5 0 - (5 Credits)

Marks for External Exam : 100
Marks for Internal Exam : 50
Total : 150
Duration of Exam : 3 Hours

Note: The question paper will consist of four sections. Each section will contain two questions and the students shall be asked to attempt five questions in all, selecting at least one question from each section. All questions carry equal marks.

Unit-I
The communication channel. The Coding Problem. Types of Codes. Block Codes. Types of Codes such as Repetition codes, Parity Check Codes and their error-detection and correction capabilities. Hamming metric, Relationship of Error detection/correction with hamming distance, Maximum likelyhood decoding procedure, Decoding by Syndrome decoding and Coset Leaders, Standard Array.

Unit-II
Linear Codes(Binary and non binary), Minimum Distance , Dimension, Modular representation of linear codes. Description of Linear Codes by Matrices, Polynomial Codes, Generator and Parity Check Polynomials and Matrices.

Unit-III
Dual Codes, Self duality, Weight Distribution of dual of binary linear codes, Macwilliam Identity( binary case) Extending , Expurgating and Augmenting a code. Lee Metric, Convolutional codes, Description using Matrices and Polynomials, Encoding using (4, 3,2) encoder.

Unit-IV

References
MAT 615B: MECHANICS OF SOLIDS-I

L  T  P  Marks for External Exam : 100
5  0 - (5 Credits)  Marks for Internal Exam : 50
                             Total : 150
                             Duration of Exam : 3 Hours

Note: The question paper will consist of four sections. Each section will contain two questions and
the students shall be asked to attempt five questions in all, selecting at least one question
from each section. All questions carry equal marks.

UNIT-I
Cartesian Tensor : Coordinate transformation, Cartesian Tensor of different order, Sum, difference
and product of two tensors, Contraction theorem, Quotient law, Symmetric & Skewsymmetric
tensors, Kronecker tensor, alternate tensor and relation between them, Scalar invariant of second
order tensor, Eigen values & vectors of a symmetric second order tensor, Gradient, divergence &
curl of a tensor field.

UNIT-II
Analysis of Strain : Affine transformations, Infinitesimal affine deformation, Geometrical
interpretation of the components of strain, Strain quadric of Cauchy, Principal strains and
invariants, General infinitesimal deformation, Saint-Venant’s equations of Compatibility.

UNIT-III
Analysis of Stress : Stress tensor. Equations of equilibrium, Transformation of coordinates, Stress
quadric of Cauchy, Principal stress and invariants, Maximum normal and shear stresses.

UNIT-IV
Equations of Elasticity : Generalised Hooke’s law, Homogeneous isotropic media, Elastic moduli
for isotropic media, Equilibrium and dynamic equations for an isotropic elastic solid, Strain energy
function and its connection with Hooke’s law, Beltrami-Michell compatibility equations, Saint-
Venant’s principal.

References
   Company Ltd., New Delhi, 1977.
3. S. Timoshenko and N. Goodier, Theory of Elasticity, Mc Graw Hill, New York,
   1970.
MAT617B: FLUID MECHANICS

L T P
5 0 - (5 Credits)

Marks for External Exam : 100
Marks for Internal Exam : 50
Total : 150
Duration of Exam : 3 Hours

Note: The question paper will consist of four sections. Each section will contain two questions and the students shall be asked to attempt five questions in all, selecting at least one question from each section. All questions carry equal marks.

UNIT-I
Kinematics of fluid- Lagrangian and Eulerian methods, Stream lines, Path lines, Streak lines, Velocity potential, Irrotational and rotational motions, Vortex lines, Equation of Continuity, Lagrangian and Eulerian approach, Euler’s equation of motion, Bernoulli’s theorem.

UNIT-II
Kelvin circulation theorem, Vorticity equation, Energy equation for an incompressible flow, Boundary conditions, Kinetic energy of liquid, Axially symmetric flows, Motion of a sphere through a liquid at rest at infinity, Liquid streaming past a fixed sphere, Equation of motion of a sphere.

UNIT-III
Sources, Sinks and doublets, Images in a rigid impermeable infinite plane and in impermeable spherical surfaces, Two-dimentional irrotational motion produced by motion of circular, co-axial and elliptic cylinders in an infinite mass of liquid.

UNIT- IV
Stream functions, Stokes stream functions, Complex velocity potential, Conformal mapping, Milne-Thomson Circle theorem, Blasius theorem, Vortex Motion and its elementary properties, Kelvin’s proof of permanence, Motion due to rectilinear vortices.

References
MAT-619B: INFORMATION THEORY

L T P Marks for External Exam : 100
5 0 - (5 Credits) Marks for Internal Exam : 50

Total : 150 Duration of Exam : 3 Hours

Note: The question paper will consist of four sections. Each section will contain two questions and the students shall be asked to attempt five questions in all, selecting at least one question from each section. All questions carry equal marks.

Unit-I


Unit-II


Unit-III

Discrete Memoryless Channel – Classification of channels. Information processed by a channel. Calculation of channel capacity. Decoding schemes. The ideal observer. The fundamental theorem of Information Theory and its strong and weak converses.

Unit-IV

Some intuitive properties of a measure of entropy – Symmetry, normalization, expansibility, boundedness, recursivity, maximality, stability, additivity, subadditivity, nonnegativity, continuity, branching, etc. and interconnections among them. Axiomatic characterization of the Shannon entropy due to Shannon and Fadeev.

References
**MAT 621B: FUZZY SYSTEMS**

L T P Marks for External Exam : 100
5 0 - (5 Credits) Marks for Internal Exam : 50
Total : 150 Duration of Exam : 3 Hours

**Note:** The question paper will consist of four sections. Each section will contain two questions and the students shall be asked to attempt five questions in all, selecting at least one question from each section. All questions carry equal marks.

**Unit-I**

**Unit-II**

**Unit-III**

**Unit-IV**

**Reference**
1. George J. Klir and Bo Yuan, Fuzzy Sets and Fuzzy Logic, PHI
2. Witold Pedrvcz and Femando Gomide, An Introduction to Fuzzy Sets, PHI
MAT 623B: COMPUTER NETWORKS

L L T P  
5 0 - (5 Credits)  
Marks for External Exam : 100  
Marks for Internal Exam : 50  
Total : 150  
Duration of Exam : 3 Hours

Note: The question paper will consist of four sections. Each section will contain two questions and the students shall be asked to attempt five questions in all, selecting at least one question from each section. All questions carry equal marks.

Unit-I

Unit-II

Unit –III

Unit IV
Application Layer: Application Layer: File Transfer, Access and Management, Electronic mail, Virtual Terminals, Other application, Example Networks - Internet and Public Networks.

References
MAT 625B: DATA BASE MANAGEMENT SYSTEM

L  T  P  Marks for External Exam  : 100
5  0  - (5 Credits)  Marks for Internal Exam  :  50
Total                                   : 150
Duration of Exam               :  3 Hours

Note: The question paper will consist of four sections. Each section will contain two questions and the students shall be asked to attempt five questions in all, selecting at least one question from each section. All questions carry equal marks.

Unit-I

Introduction: An overview of database management system, database system Vs file system, Database system concepts and architecture, data models schema and instances, data independence and data base language and interfaces, Data definitions language, DML, Overall Database Structure.

Unit-II

Data Modeling using the Entity Relationship Model: ER model concepts, notation for ER diagram, mapping constraints, keys, Concepts of Super Key, candidate key, primary key, Generalization, aggregation, reduction of an ER diagrams to tables, extended ER model, relationships of higher degree.

Unit-III

Relational data Model and Language: Relational data model concepts, integrity constraints: entity integrity, referential integrity, Keys constraints, Domain constraints, relational algebra.

Unit-IV

Data Base Design & Normalization: Functional dependencies, normal forms, first, second, third normal forms, BCNF, inclusion Dependences.
Concurreny Control Techniques: Concurrency control, locking Techniques for concurrency control, Time stamping protocols for concurrency control, validation based protocol, multiple granularity, Multi version schemes, Recovery with concurrent transaction.

References

1. C. J. Date, An Introduction To Database System, Addision Wesley.
6. Majumdar & Bhattacharya, Database Management System, TMH.
MAT 602B: FUNCTIONAL ANALYSIS

L    T    P
4 0 - (4 Credits)

Marks for External Exam : 100
Marks for Internal Exam : 50
Total : 150
Duration of Exam : 3 Hours

Note: The question paper will consist of four sections. Each section will contain two questions and the students shall be asked to attempt five questions in all, selecting at least one question from each section. All questions carry equal marks.

**Unit-I**

Normed linear spaces, metric on normed linear spaces, Holder’s and Minkowski’s inequality, completeness of quotient spaces of normed linear spaces, Completeness of \( L^p, L^q, R^n, C^n \) and \( C[a,b] \). Bounded linear transformation, Equivalent formulation of continuity, Spaces of bounded linear transformation, Continuous linear functional, conjugate spaces.

**Unit-II**

Fundamental Theorems, Hahn Banach extension theorem (Real and Complex form) Riesz representation theorem for bounded linear functional on \( L^p \) and \( C[a,b] \) and their consequences, Second Conjugate spaces, Reflexive spaces, uniform boundedness principle and its consequence, open mapping theorem and its application, projections, closed graph theorem Equivalent norms.

**Unit-III**

Compact operators and its relation with continuous operators, compactness of linear transformation on a finite dimensional space, properties of compact operators, compactness of the limit of the sequence of compact operators, Fixed point, Banach Contraction Principle and its application to solve Matrix equation, Differential Equations, Picard’s Theorem and Picard-Lindeloff Theorem.

**Unit-IV**


**References:**

MAT-604B: DATA STRUCTURES

L  T  P
4  0  - (4 Credits)

Marks for External Exam : 100
Marks for Internal Exam : 50
Total : 150
Duration of Exam : 3 Hours

Note: The question paper will consist of four sections. Each section will contain two questions and the students shall be asked to attempt five questions in all, selecting at least one question from each section. All questions carry equal marks.

Unit - I
Introduction, Elementary data organization, data structure, data structure operations, time-space tradeoff, complexity of algorithms, Arrays: introduction, linear arrays, representation of linear arrays in memory, traversing linear arrays, inserting and deleting, sorting (bubble sort), searching (linear search).

Unit- II
Linked lists: Definition, representation of linked lists in memory, traversing and searching a linked list, memory allocation (garbage collection), insertion into & deletion from a linked list, Stacks: definition, array and linked representation of stacks, Polish notation, quicksort as an application of stacks.

Unit- III
Trees: Definition, binary trees, complete binary trees, representing binary trees in memory(linked & sequential representation of binary trees), traversing binary trees, traversal algorithms using stack(preorder, inorder, postorder), binary search trees, searching and inseraching in binary search trees, heap, heapsort.

Unit- IV
Graphs: Graph theory terminology, sequential representation of graphs (adjacency matrix, path matrix), Warshall’s algorithm (shortest paths), linked representation of a graph, operation on graphs(searching, insertion, deletion ), traversing a graph(breadth first search, depth first search).

References
3. Fundamentals of computer algorithms by Horowitz Sahni and Rajasekaran.
MAT 606B: DIFFERENTIAL GEOMETRY

L T P
4 0 - (4 Credits)

Marks for External Exam : 100
Marks for Internal Exam : 50
Total : 150
Duration of Exam : 3 Hours

Note: The question paper will consist of four sections. Each section will contain two questions and the students shall be asked to attempt five questions in all, selecting at least one question from each section. All questions carry equal marks.

UNIT-I
Curves With Torsion: Tangent, Osculating Plane, Rectifying Plane, Curvature, Principal Normal, Binormal, Torsion, Serret Frenet Formula, Locus of Center of Spherical Curvature.

UNIT-II
Envelopes: Surfaces, Tangent Plane, Envelope, Characteristics, Edge of Regression (Section1-6, 13-16 of Weatherburn’s Book).

UNIT-III
Curvilinear co-ordinates: First order magnitude, Directions on a surface, Second order magnitude, Derivative of unit normal, Principal directions and curvature.

UNIT-IV
Geodesics: Geodesic Property, Equation of Geodesics, Torsion of a Geodesic (Section22-27, 29-30, 46, 47 and 49 of Weatherburn’s Book).

References
2. Discrete Differential-Geometry Operators for Triangulated 2-Manifolds Meyer et al., ’02
### MAT 608B: SEMINAR

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MAT 610B: ANALYTICAL NUMBER THEORY-II

L T P Marks for External Exam : 100
5 0  - (5 Credits)

Marks for External Exam : 50
Total : 150
Duration of Exam : 3 Hours

Note: The question paper will consist of four sections. Each section will contain two questions and the students shall be asked to attempt five questions in all, selecting at least one question from each section. All questions carry equal marks.

Unit-I

Riemann Zeta Function \( \zeta(s) \) and its convergence. Application to prime numbers. \( \zeta(s) \) as Euler’s product. Evaluation of \( \zeta(2) \) and \( \zeta(2k) \). Dirichlet series with simple properties. Euler’s products and Dirichlet products, Introduction to modular forms (Scope as in Chapters 8 and 9 of Recommended Book at Sr. No. 5).

Unit-II

Algebraic numbers and Integers : Gaussian integers and their properties. Primes and fundamental theorem in the ring of Gaussian integers. Integers and fundamental theorem in \( \mathbb{Q} (\omega) \) where \( \omega^3 = 1 \). Algebraic fields. Primitive polynomials.

Unit-III

The general quadratic field \( \mathbb{Q}(\sqrt{m}) \), Units of \( \mathbb{Q}(\sqrt{2}) \). Fields in which fundamental theorem is false. Real and complex Euclidean fields. “Fermat’s theorem”, \( i^{th} \) ring of Gaussian integers. Primes of \( \mathbb{Q}(\sqrt{2}) \) and \( \mathbb{Q}(\sqrt{5}) \). Series of Fibonacci and Lucas. Luca” test for the primality of the mersenne primes. (Relevant sections of Recommended Book at Sr. No. 1).

Unit-IV

Arithmetic functions \( \phi(n) \), \( \tau(n) \), \( s(n) \) and \( s_k (n) \), \( u(n) \), \( N(n) \), \( I(n) \). Definition and examples and simple properties. Perfect numbers the Mobius inversion formula. The Mobius function \( \mu(n) \), the order and average order of the function \( \phi(n) \), \( \tau(n) \), \( s (n) \). The functions \( \Lambda(n) \), \( \psi(n) \) and \( s(n) \) Bertrand Postulate, Merten’s theorem, Selberg’s theorem and Prime number theorem (Scope as in Chapter 8 of Recommended Book at Sr. No. 5 and recommended Books at Sr. No.1 and 4).

References

4. I.Niven and H.S. Zuckermann, An Introduction to the Theory of Numbers
MAT-612 B: Advanced Complex Analysis

L T P Marks for External Exam : 100
5 0 - (5 Credits) Marks for Internal Exam : 50

Total : 150 Duration of Exam : 3 Hours

Note: The question paper will consist of four sections. Each section will contain two questions and the students shall be asked to attempt five questions in all, selecting at least one question from each section. All questions carry equal marks.

Unit -1


Unit -II


Unit -III


Unit - IV

The range of an analytic function. Bloch’s theorem. The little Picard theorem. Schottky’s theorem. Montel Caratheodory and the Great Picard theorem. Univalent functions. Bieberbach’s conjecture (Statement only) and the “¼ theorem” (Statement only).

References
MAT 614B: ALGEBRAIC CODING THEORY-II

L    T    P
4    1    - (5 Credits)

Marks for External Exam : 100
Marks for External Exam : 50
Total : 150
Duration of Exam : 3 Hours

Note: The question paper will consists of four sections. Each section will contain two questions and the students shall be asked to attempt five questions in all, selecting at least one question from each section. All questions carry equal marks.

Unit-I
Cyclic codes. Cyclic Codes as ideals. Description of Cyclic Codes by Matrices and Polynomials. Hamming and Golay Codes as Cyclic Codes. Error Detection with Cyclic Codes. Error-Correction procedure for Cyclic Codes. Pseudo Cyclic Codes.

Unit-II
Quadratic residue codes of prime length. Distance Properties. Relationship of these codes with their duals. Extended Quadratic Residue codes (binary case only). Code Symmetry and Invariance under transitive group of permutations. Hadamard Matrices and non-linear Codes derived from them. Introduction to Product codes and Concatenated codes.

Unit-III

Unit-IV

References
MAT 616B: MECHANICS OF SOLIDS-II

L  T  P
5  0  - (5 Credits)

Marks for External Exam : 100
Marks for Internal Exam : 50
Total : 150
Duration of Exam : 3 Hours

Note: The question paper will consist of four sections. Each section will contain two questions and the students shall be asked to attempt five questions in all, selecting at least one question from each section. All questions carry equal marks.

UNIT-I
Two-dimensional Problems: Plane stress, Generalized plane stress, Airy stress function, General Solution of Biharmonic equation, Stresses and displacements in terms of complex potentials, The structure of functions of $\phi(z)$ and $\psi(z)$, First and second boundary value problems in plane elasticity, Thick-walled tube under external and internal pressures.

UNIT-II
Visoelasticity: Spring & Dashpot, Maxwell and Kelvin Models, three parameter solid, Correspondence principle & its application to the Deformation of a viscoelastic Thick-walled tube in Plane strain.

UNIT-III
Torsion: Torsion of cylindrical bars, Torsional rigidity, Torsion and stress functions, Lines of Shearing stress, Simple problems related to circle, ellipse and equilateral triangle.
Waves: Propagation of waves in an isotropic elastic solid medium, Waves of dilatation and distortion, Plane waves, Elastic surface waves such as Reyleigh and Love waves.

UNIT-IV
Variational methods : Theorem of minimum potential energy, Theorems of minimum complementary energy, Reciprocal theorem of Betti and Rayleigh, Deflection of elastic string, central line of a beam and elastic membrane, Solution of Euler’s equation by Ritz, Galerkin and Kantorovich methods.

References
**MAT 618B : OPERATIONS RESEARCH**

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**Unit-I**

Linear programming problems:- Problem formulation graphical method, simplex method. For maximization and minimization, penalty method, degeneracy in LPP, other special cases (Infeasible, unbounded & multiple optimum solution), Dual Simplex method & Sensitivity analysis (Vairtion in price vector, requirement vector & element as of coeff matrin).

**Unit-II**

Transportation & Assignment Problem:- Concept of transportation problem, mathematical formulation, various methods of finding initial basic feasible solution, Testing the optimality by MODI method, some special cases of transportation problem, concept of assignment problem, mathematical formulation, Hungarian method, minimum & maximum cases, unbalanced problem, Traveling salesman problem.

**Unit-III**

Inventory control:- Introduction to inventory problem, reasons for carrying inventory, deterministic models. The classical EOQ (Economic order quantity) model, inventory control models with shortage.

Queuing Theory:- Introduction, basic queuing process, important definitions, various queuing models are (M/M/I): (8/FcFs), (M/M/I) : (N/FcFs), General erlang queuing model.

**Unit-IV**


Non-Linear Programming:- NLPP, Mathematical formulation and solution with equally constrained, Kuhn-Tucker necessary and sufficient conditions for the optimality of objective function in a GNLP problem.

**References**

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**Unit-I**
Stress components in a real fluid, Relations between rectangular components of stress, Connection between stresses and gradients of velocity, Navier-Stock’s equations of motion, Exact Solution of Navier-Stoke’s equations of motion – Couette flows and generalized Couette flow between two parallel plates, Plane Poiseuille flow, Hagen Poiseuille flow,

**Unit -II**
Flow through tubes of uniform cross section in form of circle, annulus, ellipse and equilateral triangle under constant pressure gradient, Unsteady flow over a flat plate, Dynamical similarity: Buckingham p-theorem, Reynolds number, Eckert Number, Froude Number, Application of pi-theorem to viscous and compressible fluid.

**Unit -III**
Boundry Layer Flow: Prandtl’s boundary layer, Boundary layer equations in two-dimensions, Blasius solution, Boundary layer thickness, Displacement thickness, Karman integral equations, Separation of boundary layer flow.

**Unit -IV**

**References**

MAT 622B: ARTIFICIAL INTELLIGENCE
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**Unit –I**
Introduction: Introduction to Artificial Intelligence, Simulation of sophisticated & Intelligent Behavior in different area problem solving in games, natural language, automated reasoning, visual perception, heuristic algorithm versus solution guaranteed algorithms.

**Unit –II**
Understanding Natural Languages: Parsing techniques, context free and transformational grammars, transition nets, augmented transition nets, Fillmore's grammars, Shanks Conceptual Dependency, grammar free analyzers, sentence generation, and translation.

**Unit –III**

**Unit –IV**
Expert System: Existing Systems (DENDRAL, MYCIN) domain exploration Meta Knowledge, Expertise Transfer, Self Explaining System

**References**
1. E. Charnick, Introduction to Artificial Intelligence, Addision Wesley
3. Winston, “LISP”, Addison Wesley
MAT 624 B: COMPUTER GRAPHICS

L  T  P
5  0  - (5 Credits)

Marks for External Exam : 100
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Unit –I


Unit –II

Polygon: Polygon Representation, Entering polygons, Filling polygons. Segments: Segments table, creating deleting and renaming segments, visibility, image transformations.

Unit –III

Transformations: Matrices transformation, transformation routines, displays procedure. Windowing and Clipping: Viewing transformation and clipping, generalize clipping, multiple windowing. Three Dimension: 3-D geometry primitives, transformations, projection clipping.

Unit –IV


References

MAT 626B: SOFTWARE ENGINEERING

L T P    Marks for External Exam : 100
5 0 - (5 Credits)    Marks for Internal Exam : 50
5 0 - Total : 150
Duration of Exam : 3 Hour

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Unit –I


Unit –II


Unit –III


Unit –IV

Software Maintenance: Software as an Evolutionary Entity, Need for Maintenance, Categories of Maintenance: Preventive, Corrective and Perfective Maintenance, Cost of Maintenance, Software Re-Engineering, Reverse Engineering, Software Configuration Management Activities, Change Control Process, Software Version Control,

References