Department of Mathematics

ADIKAVI NANNAYA UNIVERSITY

Rajamahendravaram (A.P.) – 533296

M.Sc. Applied Mathematics

Syllabus [w.e.f 2019 Admitted Batch]

COURSE STRUCTURE

Sl.No.	Subject code	Name of the Subject	Number of Periods per Week	Credits
		I-SEMESTER		
1	AM 101(2019)	Real Analysis	6	4
2	AM 102(2019)	Ordinary Differential Equations	6	4
3	AM 103(2019)	Numerical Methods	6	4
4	AM 104(2019)	Algebra	6	4
5	AM 105(2019)	Methods of Applied Mathematics -I	6	4
6	AM 106-LAB(2019)	FORTRAN Lab	6	4
		Total:	36	24
		II-SEMESTER		
7	AM 201(2019)	Complex Analysis	6	4
8	AM 202(2019)	Partial Differential Equations	6	4
9	AM 203(2019)	Classical mechanics	6	4
10	AM 204(2019)	Topology	6	4
11	AM 205(2019)	Methods of Applied Mathematics- II	6	4
12	AM 206(2019)	Comprehensive Viva-voce	---	4
		Total:	30	24
		III-SEMESTER		
13	AM 301(2019)	Advanced Complex Analysis	6	4
14	AM 302(2019)	Operations Research-I	6	4
15	AM 303(2019)	C- Programming	6	4
16	AM 304(2019)	Discrete Mathematical Structures	6	4
17	AM 305(2019)	Elective-I	6	4
18	AM 306-LAB(2019)	Numerical Methods Lab using C	6	4
		Total:	36	24

IV-SEMESTER				
19	AM 401(2019)	Functional Analysis	6	4
20	AM 402(2019)	Operations Research-II	6	4
21	AM 403(2019)	Fluid Dynamics	6	4
22	AM 404(2019)	Probability & Statistics	6	4
23	AM 405(2019)	Elective-II	6	4
24	AM 406-LAB(2019)	MAT Lab	6	4
25	AM 407(2019)	Comprehensive Viva-voce	---	4
		Total:	36	28

Elective-I	Elective-II
1. Numerical Solutions to PDE	1. Finite Element Methods
2. Lebesgue Theory	2. Bio Mechanics
3. Theoretical Computer Science	3. Graph Theory
4. Cryptography	4. Fuzzy Sets & Fuzzy Logic
5. Any Subject Approved by BOS	5. Any Subject Approved by BOS

Department of Mathematics

ADIKAVI NANNAYA UNIVERSITY

Rajamahendravaram (A.P.) – 533296

M.Sc. Applied Mathematics

Syllabus [w.e.f 2019 Admitted Batch]

Instructions for evaluation

1. Each theory subject is evaluated for 100 Marks out of which 75 is allotted to the semester end examination and 25 is allotted to internal assessment. Internal assessment marks shall be included into the result of the subject to the candidate who has secured minimum of 40% marks in the semester end examination. Further, the candidate will be declared pass only on securing 40% marks out of 100. There is no minimum pass mark for internal assessment.
2. Question Paper Pattern is as follows:

Sl. No.	Questions	Units of the Syllabus	Marks
1	Question1 and Question2	Form UNIT-I	15
2	Question3 and Question4	Form UNIT-II	15
3	Question5 and Question6	From UNIT-III	15
4	Question7 and Question8	From UNIT-IV	15
5	Question 9 Short answers from (a) to (e) (Three out of Five should be answered, each question is of 5 Marks)	Covers All Four Units of the Syllabus	3X5=15
		Total:	75

3. Internal assessment for 25 Marks is as follows:
   i) Mid Examinations : 10 Marks
   (Two mid examinations shall be conducted and average of two should be considered as mid examinations marks).
   ii) Assignments / Seminar : 05 Marks
   iii) swachhata activity : 05 Marks
   iv) Attendance : 05 Marks
   (< 66% : 0 Marks
   66%-75% :03 Marks
   76%-80% :04 Marks
   >80% :05 Marks)

4. Each Lab is evaluated for 100 Marks out of which 75 is allotted to the semester end examination and 25 is allotted to internal assessment. Internal assessment marks shall be included into the result of the subject to the candidate who has secured minimum of 50% marks in the semester end examination. Further, the candidate will be declared pass only on securing 50% marks out of 100. There is no minimum pass mark for internal assessment.
5. External assessment for Lab (Semester end examination) is as follows:
   [External Examiner should be invited]
   i. For Computer Program / algorithm : 45 Marks
   ii. Lab Record : 15 Marks
   iii. Viva-Voce : 15 Marks
6. Internal assessment for Lab is as follows:
   [Can be conducted in any of Lab session]
   i) Lab internal exam : 20 Marks
   ii) Continuous evaluation : 5 Marks
7. Comprehensive Viva-Voce at the end of the second and fourth semesters being conducted by all subject teachers of the department together, by giving equal priority to all papers. This is intending to prepare and boost the student interview facing skills and comprehension of subject. The adjudication is for 100 Marks and the pass mark is 50.

*****

AM 101(2019):

REAL ANALYSIS

UNIT-I: Basic Topology: finite, countable and uncountable sets, metric spaces, compact sets, perfect sets, connected sets. And Continuity: limits of functions, continuous functions, continuity and compactness, continuity and connectedness, discontinuities, monotone functions, infinite limits and limits at infinity.
(Chapters 2 and 4 of text book 1)

UNIT-II: The Riemann - Stieltjes integral: linearity properties, integration by parts, change of variable, reduction to a Riemann integral, monotonically increasing integrators, Riemann's condition, comparison theorems, integrators of bounded variation, sufficient conditions for existence of R-S. integrals, necessary conditions for existence of R-S integrals, mean-value theorems for R-S integrals, integral as a function of interval, second fundamental theorem of integral calculus, second mean-value theorem for Riemann integrals.
(Sections: 7.1 to 7.7 and 7.11 to 7.22 of chapter-7 of the text book 2)

UNIT-III: Multivariable Differential Calculus: directional derivative, total derivative, Jacobian matrix, chain rule, mean-value theorem for differentiable functions, sufficient conditions for differentiability and for equality of mixed partial derivatives, Taylor's formula for real valued functions in n real variables.
(Chapter 12 of text book 2)

UNIT-IV:
Sequences and series of functions: uniform convergence, uniform convergence and continuity, uniform convergence and integration, uniform convergence and differentiation. equicontinuous families of functions, the Stone – Weierstrass theorem.
(Chapter 7 of text book 1)

TextBooks:
1.Principles of Mathematical Analysis, Walter Rudin, McGraw Hill Education; Third edition.
2.Mathematical Analysis by Tom. M. Apostol, Narosa Publishing House, India; 2nd edition.

AM 102(2019):

ORDINARY DIFFERENTIAL EQUATIONS

UNIT-I:
Existence and Uniqueness of solutions: Preliminaries – Picard's Successive approximations – Picard‟s theorem – Fixed-point Technique.
[Sections 2.1 to 2.4 and 2.9 0fChapter-2 of the Text Book]

UNIT-II:
Linear Differential Equations of Higher Order: Introduction – Higher Order Equations – A Mathematical model – linear dependence and Wronskian – Basic Theory for linear Equations – Homogeneous Linear equations with constant coefficients – equations with variable coefficients – Method of variation of parameters – some standard methods.
[Sections4.1 to 4.9 of Chapter -4 of theText Book]

UNIT-III:
Systems of Linear Differential Equations: Introduction – Systems of first order equations – Model of arms competitions between two nations – Existence and uniqueness theorem – Fundamental Matrix – Non homogeneous linear systems – Linear systems with constant coefficients – Linear systems withperiodic coefficients.
[Sections5.1 to 5.8 ofChapter-5of theText Book]

UNIT-IV:
Solutions in Power series: Introduction – Second order Linear Equations with Ordinary points – Legendre equations and Legendre Polynomials – Second Order equations with regular singular points – Bessel functions.
[Chapter 6 of the Text Book]

Text Book:
S.G. Deo, V. Lakshmi kantham and V. Raghavendra: Text Book of Ordinary Differential Equations, Third edition, Tata Mc Graw – Hill Publishing company Limited, New Delhi.

Reference Books :
1. An introduction to Ordinary Differential Equations by E.A. Coddington
2. Differential Equations with applications and Historical notes by George F.Simmons.
3. Theory of Ordinary Differential Equations by Samsundaram – Narosa Publications.

AM 103(2019):

NUMERICAL METHODS

UNIT-I:

System Of Linear Algebraic Equation And Eigen Value Problems: Direct methods - Introduction - Gauss Elimination Method- Gauss – Jordan Method - Triangularisation method - Iteration Methods- Jacobi iteration Method - Gauss-Seidel Iteration Method - Eigen values and Eigen vectors:Power method –Jacobi method.
[Above topics are from Chapter-3 of the Text Book 1]

UNIT-II:

Interpolation And Approximation: Introduction - Lagrange Interpolation - Newton Divided Differences - Finite Difference Operators - Interpolating Polynomials using finite differences- Gregory- Newton forward difference interpolation- Backward difference interpolation - Stirling and Bessel interpolation - Hermite interpolation - Spline interpolation - Approximation: Least Square approximation.
[Above topics are from Chapter-4 of the Text Book 1]

UNIT-III:

Numerical Differentiation and Integration: Introduction – Numerical differentiation: Methods based on finite differences- Numerical integration: Composite integration methods - Trapezoidal rule- Simpsons rules – numerical solution of ODEs by picard – Euler - Modified Euler – Runge Kutta methods.
[Above topics are from Chapter-5 and 6 of the Text Book 1]

UNIT-IV:

Numerical solution of Partial differential equations: Introduction - Classification of second order equations – finite difference approximations of derivatives – elliptic equations – solution of Laplace equation- solution of Poisson's equation – parabolic equations – solution of heat equation – Hyperbolic equations – solution of wave equations.
[Above topics are from unit VII inthe text book -2]

Text Book:

1. Numerical Methods for Scientific and Engineering Computation by M. K. Jain, S. R. K. Iyengar,R. K. Jain, New Age International (p) Limited, Publishers, 5 th Edition.
2. Higher Engineering Mathematics by Dr. B. S. Grewal, Khanna publishers.

Reference Book:

1. An Introduction to Numerical Analysis by Kendall E. Atkinson.
2. Computational Methods for Partial Differential Equations by M.K. Jain, S.R.K. Iyengar and R.K. Jain, Wiley Eastern Limited, New Age International Limited, New Delhi.

AM 104(2019):

ALGEBRA

UNIT-I: Normal sub groups: Automorphisms – Conjugacy and G-sets – Normal series solvable groups – Nilpotent groups. [Sections 5.3 and 5.4 of chapter-5, 6.1 to 6.3 chapter-6 of the Text Book]

UNIT-II: Structure theorem of groups: Direct product – Finitely generated abelian groups – Invariants of a finite abelian group – sylow‟s theorems. [Sections 8.1 to 8.4 of chapter-8 of the Text Book]

UNIT-III: Ideals and homomorphisms: Ideals – homomorphisms - Sum and direct sum of ideals - Maximal and prime ideals – Nilpotent and Nil ideals – Zorn‟s lemma. [Sections10.1 to 10.6 of chapter-6 of the Text Book]

UNIT-IV: Unique factorization domains and Euclidean domains: Unique factorization domains - Principal of ideal domains – Euclidean domains – Polynomial rings over UFD – Rings of fractions. [Sections 11.1 to 11.4 of chapter-11 and 12.1of chapter-12 of the Text Book]

Text Book: Basic Abstract Algebra by P.B. Bhattacharya, S.K. Jain and S.R. Nagpal.

Reference Book: Topics in Algebra by I.N.Herstein

AM 105(2019):

METHODS OF APPLIED MATHEMATICS - I

UNIT-I:

Fourier Series: Fourier coefficients- Even and Odd functions- Cosine and Sine series- Fourier series on arbitrary intervals.
[Sections 5.1,5.3 and 5.4 of Chapter-5 of the Text Book-1]

UNIT-II:

The Calculus of variations: Euler's Equation – functions of the form $\int_{x_0}^{x_1} f(x, y_1, y_2, \dots, y_n, y_1', y_2', \dots, y_n')dx$ - functional dependence on higher order derivatives- Variational problems in parametric form and applications.
[Chapter VI of Text Book-2]

UNIT-III:

Difference Equations: Introduction, Definition, Formation of difference equations, Linear difference equations, Rules for finding complementary function, Rules for finding the Particular Integral.
[Above topics are from unit VII inthe text book -3]

UNIT-IV:

Tensor Analysis: N- dimensional space – Covariant and Contravariant vectors – Contraction – Second and higher order tensors – Quotient law –Fundamental tensor – Associate temsor – Angle between the vectors – Principal directions – Christoffel symbols – Covariant and intrinsic derivatives – Geodesics.
[Chapter 1 to 4 of the Text Book 4]

Text Books:

1. Differential Equations Theory, Technique and Practice by George F.Simmons and Steven G.Krantz, Tata McGraw-Hill Edition.
2. Differential Equations by L.Elsgolts, Mir Publishers, Moscow.
3. Higher Engineering Mathematics by B.S.Grewal, Khanna Publishers.
4. Tensor Calculus by Barry Spain.

AM 106-LAB(2019):

FORTRAN LAB

1. Program to solve Quadratic Equaitons
2. Program to reverse a given integer and check it for palindrom
3. Program to generate Prime numbers
4. Program to generate Fibonacci Sequence
5. Sorting of numbers
6. Program to compute Trigonometric functions
7. Program to transpose a matrix
8. Multiplication of two matrices
9. Finding roots of a transcendental equation using N – R
10. Eigen value of a 3 X 3 real symmetric matrix
11. Sorting of numbers using functions in a 2 – D array row wise
12. Program to linear curve fitting
13. Program to declare student result using logical variables.
14. Program to find inverse of a matrix
15. Bisection method
16. False position method
17. Newton Raphson method
18. Secant method
19. Gauss elimination method
20. Gauss seidal method
21. Difference table method
22. Trapezoidal method
23. Simpson 1/3 rule
24. Simpson 2/3 rule2
25. Euler‟s method
26. Thomas method
27. Lagranges method
28. Taylor‟s method
29. Runge-kutta method
30. Modified Euler‟s method

AM 201(2019):

COMPLEX ANALAYSIS

UNIT-I:
Regions in the complex plane – Functions of a complex variable – Mappings by exponential functions – Limits – Continuity – Derivatives – Cauchy-Riemann equations – Sufficient conditions for differentiability – Polar coordinates.
[Section -11 of Chapter-1 and Sections 12 – 23 chapter-2 of the Text Book]

UNIT-II:
Analytic functions – Harmonic functions - Uniquely determined analytic functions - Reflection principle – The exponential function – The logarithmic function – Complex exponents – Trigonometric functions – Hyperbolic functions – Inverse trigonometric and Hyperbolic functions.
[Sections 24 – 28 of Chapter-2and Sections 29 – 36 of Chapter-3 of theText Book]

UNIT-III:
Derivatives of functions w(t) – Definite integrals of functions w(t) – Contours – Contour integrals – some examples - examples with branch cuts - Upper bounds for moduli of contour integrals – Anti derivatives.
[Sections 37 to 45of Chapter-4 of the Text Book]

UNIT-IV:
Cauchy-Goursat theorem and its proof – Simply and multiply connected domains – Cauchy's integral formula –an extension of Cauchy integral formula – some consequences of the extension - Liouville's theorem and fundamental theorem ofalgebra – Maximum modulus principle.
[Sections46 - 54 of Chapter-4 of the Text Book]

Text Book:
Complex Variables and Applications by James Ward Brown, Ruel V.Churchill, McGraw- Hill International Edition(8th edition).

Reference Books:
1. Complex analysis for Mathematics and Engineering by John H.Mathews and Russel.W, Howell, Narosa Pulishing house.
2. Complex Variables by H.S.Kasana, Prentice Hall of India.

AM 202(2019):

PARTIAL DIFFERENTIAL EQUATIONS

UNIT-I:

First Order PDE's: Introduction – Methods of solution of $\frac{dx}{P} = \frac{dy}{Q} = \frac{dz}{R}$ - orthogonal trajectories of a system of curves on a surface- Pfaffian Differential forms and equations – Solutions of Pfaffian Differential Equations in three variables – Cauchy's problem for first order PDE.
[Sections 3 to 6 of Chapter 1 and Sections 1 to 3 of Chapter 2 of the textbook]

UNIT-II:

Linear Equations of the first order – Integral Surfaces – Orthogonal Surfaces – Non-Linear PDE of the first order – Cauchy's method of characteristics – compatible systems of first order equations – Charpit's method – special types of first order equations – Jacobi's method .
[Sections 4 to 13 of Chapter 2 of the text book]

UNIT-III:

Partial differential equations of the second order , their origin, linear partial differential equations with constant and variable coefficients – solutions of linear Hyperbolic equations – Method of separation of variables – Monger's method.
[Sections 1to 5 and sections 8, 9, 11 of Chapter 3 of the text book]

UNIT-IV:

Laplace Equation – elementary solutions families of equipotential surfaces, boundary value problems, method of separation of a variables of solving Laplace equation, problems with axial symmetry, Kelvin's inversion theorem, The wave equation, elementary solution in one dimensional form, Riemann – Volterra solution of one dimensional wave equation.
[Section 1 to 7 of Chapter 4 and Sections 1 to 3 of Chapter 5 of the text book]

[Problematic approach is Preferred]

Text Book:

Elements of partial differential equations by Ian. N. Sneddon, Dover publications(2006).

Reference book:

T. Amarnath, An Elementary Course in Partial differential equations, Second Edition, Narosa Publishing House.

AM203(2019):

CLASSICAL MECHANICS

Unit I:

Lagrangian Formulation: Mechanics of a particle, mechanics of a system of particles, constraints, generalized cordinates generalized velocity, generalized force and potential. D'Alembert's principle and Lagranges equations, simple applications of Lagrangian formulation, Hamilton's principle, derivation of Lagrange's equations from Hamilton's principle, extension of Hamilton's principle to non-holonomic systems, Advantages of variational principle formulation, conservation theorems and symmetry properties
(Section 1.1 to 1.4 and 1.6 of chapter 1 and Section 2.1 to 2.6 of chapter 2 of the Text book 1)

Unit II:

Hamiltonian formulation: Legendre transformations and the Hamilton equations of motion, cyclic coordinates and conservation theorems, derivation of Hamilton's equations from a variational principle, the principle of least action
(Section 8.1, 8.2, 8.5 and 8.6 of chapter 8 of the text book 1)

Unit III:

the equation of canonical transformation, examples of canonical transformation, Poisson and Lagrange brackets and their invariance under canonical transformation. Jacobi's identity; Poisson's theorem, Equations of motion infinitesimal canonical transformation in the Poisson bracket formulation. Hamilton Jacobi Equations for Hamilton's principal function, The harmonic oscillator problem as an example of the Hamilton – Jacobi method
(Section 9.1, 9.2, 9.4, 9.5 of chapter 9 and
Sections 10.1 and 10.2 of chapter 10 of the text book 1)

Unit IV:

New concept of space and Time, postulates of special theory of relativity, Lorentz transformation equations, Lorentz contraction, Time dilation, simultaneity, Relativistic formulae for composition of velocities and accelerations, proper time, Lorentz transformations form a group
(Chapter 1 and Chapter 2 of the text book 2)

Text books:

1. Classical mechanics by H.Goldstein, 2nd edition, Narosa Publishing House.
2. Relevant topics from Special relativity by W.Rindler, Oliver & Boyd, 1960.

AM204(2019):

TOPOLOGY

UNIT-I: Metric Spaces and Topological Spaces: The definition and some examples – Open sets – Closed sets – Convergence, Completeness and Baire‟s Theorem – Topological Spaces - the definition and some examples – Elementary concepts – Open bases and Open subbases.
[Sections 9 -12 of Chapter-2 and Sections 16-18 of Chapter-3 of the Text Book]

UNIT-II: Compactness: Compact spaces – Product spaces – Tychonoff‟s theorem and locally compact spaces – Compactness for Metric spaces – Ascoli‟s Theorem.
[Sections 21-25 of Chapter-4 of the Text Book]

UNIT-III: Separation: T1-Spaces and Hausdorff spaces – Completely regular spaces and normal spaces – Urysohn‟s lemma and the Tietze extension theorem – The Urysohn imbedding theorem.
[Sections 26-29 of Chapter-5 of the Text Book]

UNIT-IV: Connectedness: connected spaces – The components of a space – Totally disconnected spaces – Locally connected spaces.
[Chapter-6 of the Text Book]

Text Book:

Introduction to Topology and Modern Analysis by G.F.Simmons, Tata McGraw-Hill Edition 2004.

Reference Book:

Topology by James R.Munkres, Second Edition, Pearson Education Asia

AM205(2019):

METHODS OF APPLIED MATHEMATICS - II

UNIT- I: Laplace Transforms: Laplace Transform of basic function, Laplace Transform of derivativesintegral –inverse Laplace Transforms of partial fractions- convolution theorem – Solution of Ordinary differential Equations. [Chapter I , II and Sections 3.1 to 3.3 of chapter III of the Text Book 1]

UNIT- II: Fourier Integral formula - Fourier Transform - Inversion Theorem for Complex Fourier transform - Fourier sine transform - Inversion formula for Fourier sine transform - Fourier cosine transform - Inversion formula for Fourier cosine transform - Linearity property of Fourier transform - Change of Scale property - Shifting Property - Modulation theorem – Theorem - Multiple Fourier Transforms – Convolution - The Convolution Theorem - Parseval‟s identity. [Sections6.3 to 6.19 of chapter VI of the Text Book 1]

UNIT- III: Finite Fourier sine transforms - inversion formula for sine transform - Finite Fourier cosine transform - inversion formula for cosine transform - Multiple finite Fourier transforms - Operational properties of finite Fourier sine transforms - Operational properties of finite Fourier cosine transforms - Combined properties of finite Fourier sine and cosine transforms - convolution. [Sections7.1 to 7.9 of chapter VII of the Text Book 1]

UNIT- IV: Integral equation- Solution of non-homogeneous Volterra's integral equation of second kind by the method of successive substitution-Solution of non-homogeneous Volterra‟s integral equation of second kind by the method of successive approximation-Determination of some resolvent kernels-Volterra Integral equations of first kind- Solutions of the Fredholm integral equation by the method of successive substitutions-Iterated kernels-Solution of the Fredholm integral equation by the method of successive approximation.
(Section- 1.1 of chapter 1 and Sections 2.1 to2.7 of chapter 2 of text book 2)

Text Book:

1) Integral Transforms by A.R.Vasihatha and R.K.Gupta, KRISHNA Prakashan Media (P) Ltd.
2) Integral Equations by Santhi Swarup, Krishna prakashan media(p) Ltd.,Merrrut, 13th edition

Reference Books:

1. E.O. Brigham, The Fast Fourier Transforms, Prentice Hall, New Jersy, 1988.
2. Linear integral equations theory and techniques by R.P.Kanwal, Academic Press.

AM301(2019):

ADVANCED COMPLEX ANALYSIS

UNIT-I:
Series: Convergence of sequences and series – Taylor's series – Laurent's series – Absolute and uniform convergence of power series – Continuity of sums of power series – Uniqueness of series representation.
[Sections 55 - 66 of Chapter-5 of the Text Book]

UNIT-II:
Residues and Poles: Isolated singular points - Residues – Cauchy's residue theorem – residue at infinity - the three types of isolated singular points - Residues at poles – Zeros of analytic function – Zeroes and Poles – Behavior of functions near isolated singular points.
[Sections 68 - 77 of Chapter-6 of the Text Book]

UNIT-III:
Applications of Residues: Evaluation ofimproper integrals - Jordan's lemma – Indented paths – an indentation around a branch point –integration along a branch cut - Definite integrals involving sines and cosines – Argument principle – Rouche's theorem.
[Sections 78, 79 andSections 81 - 87 of Chapter-7 of the Text Book]

UNIT-IV:
Linear Transformations: The transformation w=1/z - mappings by w=1/z - Linear fractional transformations –An implicit form – Mapping of the upper half plane – The transformation w=sinz – Mapping by z^2 and branches of $z^{1/2}$– Conformal mapping – Preservation of angles.
[Sections90- 97 of chapter-8 and Section 101 0f chapter-9of the Text Book]

Text Book:

Complex Variables and Applications by James Ward Brown, Ruel V.Churchill, McGraw- Hill International Editions (8th edition)

Reference Books:
1. Complex analysis for Mathematics and Engineering by John H.Mathews and Russel.W, Howell, Narosa Pulishing house.
2. Complex Variables by H.S.Kasana, Prentice Hall of India.

AM302(2019):

OPERATIONS RESEARCH - I

UNIT-I: Overview of operations research: OR models - OR Techniques- LinearProgramming- Introduction - Graphical solution - The standard form of linear programming problems- Basic feasible solutions- Unrestricted variables - Simplex Method.

UNIT-II: Concept of Duality: Artificial variables - Big M and Two phase method- Degeneracy - Alternative optima- Unbounded solutions - infeasible solutions - Dual problems - Relation between primal and dual Problems - Dual simplex method.

UNIT-III: Game theory: Two person Zero sum games- Principle of dominance – Matrix method for mxn games without saddle points - Mixed strategy games.

UNIT-IV: Transportation and Assignment Problems: Transportation model - Basic feasible solutions- North West corner Rule- Lowest cost method- Vogel approximation method- transportation algorithm (MODI -method) - Assignments problem - Hungarian method.

Text Book: Operations Research, Theory and Applications by J.K.SHARMA

Reference Books:

1. Operations Research, An Introduction- Hamdy A.Taha, Seventh Edition.
2. Introduction to Operations Research- Hillier Lieberman, Tata Mc Graw Hill.

AM303(2019):

C- PROGRAMMING

UNIT-I: Over view of C – constants – variables – Data types – operators and expressions.

[Chapters 2,3,4 of the Text Book]

UNIT-II: Managing Input and output operations – Decision making – branching – decision making and looping.

[Chapters 5,6,7 of the Text Book]

UNIT-III: Arrays – Handling of character strings – user defined functions.

[Chapters 8, 9, 10 of the Text Book]

UNIT-IV: Pointers – Structures and Unions.

[Chapter 11 and 12 of the Text Book]

Text Book:

C-Programming and Data Structures – E. Balagurusamy, Fourth Edition Tata McGraw – Hill Publishing company

Reference Books:

1. Programming in C by D. Ravichandran, New Age International, 1998. 2. C and Data Structures by Ashok N. Karthane, Pearson Education.

AM304(2019):

DISCRETE MATHEMATICSL STRUCTURES

UNIT –I: Relations and ordering: Relations- properties of binary relations in a set-Relation matrix and the graph of a relation, partition and covering of a set, equivalence relations, compatability relation, composition of binary relations- partially ordereing- Partially ordered sets - representation and associated terminology.
[Sections 2-3.1 to 2-3.9 of Chapter 2 of the Text Book]

UNIT- II: Lattices: Lattices as partially ordered sets - some properties of Lattices - Lattices as algebraic systems - sub-Lattices - direct product and homomorphism some special Lattices. [Sections4-1.1 to 4-1.5 of Chapter 4 of the Text Book]

UNIT- III: Boolean Algebra: Sub algebra - direct product and Homorphism - Boolean forms and free Boolean Algebras - values of Boolean expressions and Boolean function.
[Sections4-2.1,4-2.2,4-3.1, 4-3.2 of Chapter 4 of the Text Book]

UNIT- IV: Representations and minimization of Boolean Function: Representation of Boolean functions – minimization of Boolean functions- Finite State Machines - Introductory Sequential Circuits - Equivalence of Finite-State Machines.
[Sections4-4.1,4-4.2,4-6.1, 4-6.2 of Chapter 4 of the Text Book]

Text Book:
Discrete Mathematical structures with applications to Computer Science by J.P.Trembly and R. Manohar, Tata McGraw-Hill Edition.

Reference Book:
Discrete Mathematics for Computer Scientists and Mathematicians by J.L.Mott, A.Kandel and T.P. Baker, Prentice-Hall India.

AM305(2019): **Elective-I**

NUMERICAL SOLUTIONS TO PDE

UNIT-I: Partial differential equations: Introduction – Difference methods – Routh Hurwitz criterion – Domain of dependence of hyperbolic equations.
[Sections 1.1 to 1.4 of the Text Book]

UNIT-II: Parabolic equations: Difference methods for parabolic differential equations – introduction – One space dimension – Two space dimension.
[Sections2.1, 2.2, 2.3 of the Text Book]

UNIT-III: Hyperbolic equations: Difference methods for hyperbolic partial differential equations – introduction- One dimension – Two dimension – First order equations.
[Sections3.1 -3.4 of the Text Book]

UNIT-IV: Elliptic equations: Numerical methods for elliptic partial differential equations – introduction- Difference methods for linear boundary value problems – General second order linear equation.
[Sections4.1 -4.3 of the Text Book]

Text book:
Computational Methods for Partial Differential Equations by M.K. Jain, S.R.K. Iyengar and R.K. Jain, Wiley Eastern Limited, New Age International Limited, New Delhi.

Reference Book:
Numerical Solution of Differential Equations by M.K. Jain, Wiley Eastern, New Delhi.

AM305(2019): **Elective-I**

LEBESGUE THEORY

UNIT-I:
Algebra of sets, Lebesgue measure ,Outer measure, Measurable set and Lebesgue measure, a nonmeasurable set measurable function, littlewood‟s Three principles(statements only).
[From Chapter- 3 of Text book]

UNIT-II:
The Riemann integral, the lesbesgue integral of a bounded function over a set of finite measures, the integral of a non-negative function, the general lebesgue integral convergence in measure.
[From Chapter- 4 of Text book]

UNIT-III:
Differentiation of monotonic functions, functions of bounded variation, differentiation of an integral, absolute continuity.
[From Chapter- 5 of Text book]

UNIT-IV:
Lp-Spaces, the Holder‟s and Minkowski inequalities, convergence and completeness.
[From Chapter- 6 of Text book]

Text Book:
Real Analysis by H.L.Royden, Prentice Hall of India, Third Edition.

AM305(2019): **Elective-I**

THEORETICAL COMPUTER SCIENCE

UNIT-I: The Theory of Automata: Definition of an automaton - Description of a Finite Automaton - Transition System - Properties of Transition Functions - Acceptability of a string by a finite Automaton - Non Deterministic finite State Machines - The Equivalence of DFA and NDFA - Mealy and Moore models - Minimization of Finite Automata.
[chapter 3 of the text book]

UNIT-II: Formal Languages: Basic definitions and example - Chomsky classification of Languages - Languages and their relation- Recursive and recursively enumerable sets- operations of languages - Languages and Automaton.
[chapter 4 of the text book]

UNIT-III: Regular sets and Regular Grammars: regular expressions - Finite Automata and regular expressions - Pumping lemma for Regular sets, Application of Pumping lemma - Closure properties of regular sets - Regular sets and Regular grammars - Context free languages- derivation trees – Ambiguity in context -Free Grammars - Simplification of Context-free Grammars - Normal forms for Context-free Grammars.
[chapter 5 and sections 6.1-6.4 of chapter 6 of the text book]

UNIT-IV: Turing Machines: Turing Machine model - Representation of Turing Machines - Languages Acceptability by Turing Machines - Design of Turing Machines.
[sections 9.1 – 9.4 of chapter 9 of the text book]

Text book: Theory of Computer Science (Automata, Languages and Computation) by K.L.P. Mishra, N. Chandrasekharan, PHI, 3rd edition.

AM 306-LAB(2019):

NUMERICAL METHODS LAB USING C

LIST OF PROGRAMS:

1. Bisection method
2. False position method
3. Newton Raphson method
4. Secant method
5. Gauss elimination method
6. Gauss seidal method
7. Difference table method
8. Trapezoidal method
9. Simpson 1/3 rule
10. Simpson 3/8 rule
11. Euler's method
12. Lagranges method
13. Taylor's method
14. Runge – kutta method
15. Modified Euler's method

AM 401(2019):

FUNCTIONAL ANALYSIS

UNIT-I:

Banach Spaces: Normed space – Banach space – Properties of normed spaces – Finite dimensional normed spaces and subspaces – Compactness and finite dimension – Linear operators – Bounded and continuous linear operators – Linear functionals - Linear operators and functional on finite dimensional spaces – Normed spaces of operators – Dual space.
[Sections 2.2 – 2.10 of chapter-2 of the Text Book]

UNIT-II:

Hilbert Space: Inner product space – Hilbert space – Properties of inner product spaces – Orthogonal complements and direct sums – Orthonormal sets and Sequences - Series related to orthonormal sequences and sets.
[Sections3.1-3.5 of chapter-3 of the Text Book]

UNIT-III:

Proper ties of Hilbert Space: Total orthonormal sets and sequences – Representation of functional on Hilbert spaces – Hilbert-Adjoint operator – Self adjoint, unitary and normal operators.
[Sections3.6 and 3.8-3.10 of chapter-3 of the Text Book]

UNIT-IV:

Fundamental Theorems: Hahn Banach theorem for complex vector spaces and normed spaces – Adjoint operator – Reflexive space – Uniform boundedness theorem – Open mapping theorem – Closed graph theorem.
[Sections4.3, 4.5-4.7, 4.12 and 4.13 of chapter-4 of the Text Book]

Text Book:

Introductory Functional Analysis with Applications by Erwin Kreyszig, John Wiley & Sons, 1989.

Reference Book:

1. Introduction to Topology and Modern Analysis by G.F.Simmons, McGraw-Hill Edition.
2. E.Taylor, Introduction to Functional analysis, Wiley International Edition.
3. C.Goffman and G.Pedrick, First Course in Functional analysis, Prentice Hall of India Private Limited, 1991.

AM402(2019):

ORERATIONS RESEARCH - II

UNIT-I: Network Models: Definitions - Net work diagrams – Time estimates - CPM and PERT techniques - Algorithms.

UNIT-II: Deterministic Inventory Models: Static EOQ Models – Cost involved in inventory control - Single items inventory control models without shortages - Model-I: EOQ Model with instant supply - Model-2: Economic production quantity model when Supply (Replenishment) is gradual - Single item inventory control models with shortages - Model-3: EOQ Model with constant rate of demand and variable order cycle time - Model-4: EOQ Model with gradual supply and shortages allowed.

UNIT-III: Queuing Theory: Introduction - Essential features of a queuing system - Performance measures of a queuing system - probability distributions in queuing systems - Classification of queuing singleserver queuing models: Model I: {(M/M/1) : (∞ /FCFS)} Exponential service-Unlimited queue - Model II: {(M/M/1) : (∞ /SIRO)} - Model III: {(M/M/1) : (N/FCFS)} Exponential service-finite.

UNIT-IV: Dynamic Programming: Recursive nature of dynamic programming - Forward and Backward recursion. Sequencing Problem: Introduction -Terminology and Assumptions-Processing n jobs Through Two Machines - Processing n jobs Through Three Machines.

Text Book: Operations Research, Theory & Applications- J.K.Sharma**Reference Books:**
[1] Operations Research, An Introduction by Hamdy A.Taha , Seventh Edition. [2] Introduction to Operations Research by Hillier Lieberman, Tata Mc Graw Hill

AM403(2019):

FLUID DYNAMICS

UNIT-I:

Real Fluids and Ideal Fluids - Velocity of a Fluid at a Point - Streamlines and Pathlines - Steady and Unsteady Flows - The Velocity Potential - The Vorticity Vector - Local and Particle Rates of Change - The Equation of Continuity - Acceleration of a Fluid - Conditions at Rigid Boundary- General Analysis of Fluid Motion
(Chapter 2 of the text book)

UNIT-II:

Euler's Equations of Motion - Bernoulli's Equation- Discussion of the case of steady motion under conservative body forces - Some potential theorems -Some Flows involving axial symmetry - Some Special Two-Dimensional Flows - Impulsive motion - Some further aspects of vortex motion - Kelvin's circulation theorem.
(Sections 3.4 to 3.12 of chapter 3 of the text book)

UNIT-III:

Some Three Dimensional Flows - Introduction - Sources - Sinks and Doublets, Some Two-Dimensional Flows: meaning of Two Dimensional Flows-use of cylindrical Polar coordinates-the stream function-the complex potential for two dimensional, irrotational, incompressible flow- Complex velocity potential for standard Two dimensional flows.
(Sections 4.1 and 4..2 of chapter 4 and Sections 5.1 to 5.6 of chapter 5 of the text book)

UNIT-IV:

Viscous flow: Stress Components in a Real Fluid - Relation between Cartesian Components of Stress - Translational Motion of Fluid Element - The Rate of Strain Quadric and Principal Stresses –Some further properties of the rate of strain quadric - Stress Analysis in Fluid Motion - Relations between Stress and Rate of Strain - The Coefficient of Viscosity and Laminar Flow - The Navier-Stokes Equations of Motion of a Viscous Fluid - Some Solvable Problems in Viscous Flow - Steady Motion between Parallel Planes.
(Sections 8.1 to 8.10.1 of chapter 8 of the text book)

Text Book:

Text Book of Fluid Dynamics by F.Chorlton, CBS Publishers & Distributors (Reprint 2004)

AM 404(2019):

PROBABILITY & STATISTICS

UNIT-I: Distribution functions: Discrete random variable - Continuous random variable – Two - Dimensional Random variables - Mathematical expectation - Moments of a distribution function - Moment generating functions - Characteristic functions and their properties – Chebychev inequality – Probabilitygenerating functions. [Sections 5.2 to 5.5(up to 5.5.5.) of Chapter-5, Chapter 6 except section 6.7 and sections 7.1, 7.2, 7.3, 7.5 and 7.9 of Chapter 7 of the text book]

UNIT-II: Distributions: Discrete Distributions Binomial - Poisson distributions and their properties - Continuous distributions - Normal and Rectangular distributions and their properties. [Sections8.1 to 8.5 of Chapter 8 and 9.1 to 9.3 of Chapter 9 of the text book]

UNIT-III: Correlation and Regression: Correlation - Karl pearson‟s coefficient of correlation - Calculation of correlation coefficient for a bivariate frequency distribution - Spearman‟s rank correlation coefficient - Linear regression- Regression coefficients and their properties - Angle between regression lines. [Sections 10.1 to 10.5 and 10.7.1 of Chapter 10 and Chapter 11 (upto 11.2.3) of the text book]

UNIT-IV: Sampling distribution: Sampling and Large sample tests, Exact sampling distributions χ^2, t and F-distributions. [Chapter-14, Chapter 15 up to 15.6.4 section and Chapter 16 up to 16.6 sections except 16.4 section of the text book]

Text Book: Fundamentals of Mathematical Statistics by S.C.Gupta and V.K.Kapoor , 11th Edition, Sultan Chand & Sons, New Delhi.

Reference Book: Probability and Statistics for Engineers and Scientists, 9th edition, Walpole Myers, Keying Ye Pearson Publications.

AM405(2019): **Elective-II**

FINITE ELMENT METHODS

UNIT-I: Weighted residual methods: Least square method – Partition method – Galerkin method – Moment Method – Collocation method – Variational methods – Ritz method. (Only One-dimensional) [Sections8.1 to 8.3 of the Text Book]

UNIT-II: Finite Elements: Line segment elements – Triangular element – Rectangular elements with examples. [Section 8.4 of the Text Book]

UNIT-III: Finite Element Methods: Ritz finite element method – Least square finite element method – Galerkin finite element method – Boundary value problem in ordinary differential equations – Assembly of element equations. [Sections 8.5, 8.6 of the Text Book]

UNIT-IV: Boundary value problem in PDE- Linear triangular element – Mixed boundary conditions – Boundary points – Examples. [Section 8.7 of the Text Book]

Text Book:

Numerical Solutions of Differential Equations by M.K.Jain, New Age International (P)Limited, New Delhi.

Reference Book:

Finite Element Methods by J.N.Reddy, McGraw-Hill International Edition.

AM405(2019): **Elective-II**

BIO-MECHANCS

UNIT-I: Mathematical models in pharmacokinetics. Basic Equations and their Solutions for special cases.

UNIT-II: Models for blood flows I: Some basic concepts of fluid dynamics - Basic concepts about blood- Cardiovascular system and blood flow.

UNIT- III: Models for blood flow 2: Steady Non- Newtonian fluid flows in circular tubes - Newtonian Pulsatile flow in Rigid and Elastic tubes - Blood flow through Artery with mild Stenosis.

UNIT- IV: Models of flows for other Bio fluids: Peristaltic flow in tube and channel - Two Dimensional flow in Renal tubule - Lubrication of Human joints. [Section 10.1,10.2 of Chapter 10, section 11.1,11.2,11.3 and 11.5 of Chapter 11 Sections 12.1,12.3,12.4 of Chapter 12 of the Text Book]

Text Book: Mathematical Models In Biology And Medicine by J.N.Kapur, Affiliated East – West press Pvt. Ltd., New Delhi.

Reference Book:1. Y.C. Fung, Bio-Mechanics, Springer – Verlag, New York Inc. 1990.

AM405(2019): **Elective-II**

GRAPH THEORY

UNIT-I: Basic concepts: Isomorphism - Euclidian and Hamilton Graphs – Trees - Properties of Trees - Spanning Trees - Connectivity and Separability. [Chapters 1,2,3 and Sections 4.1 to 4.5 of Chapter 4 of the Text Book]

UNIT-II: Planar graphs: Planar graphs - Kuratowski‟s two graphs - Different representations of planar graphs- Detection of Planarity - Geometric Dual of a graph- Combinatorial Dual. [Sections 5.1 to 5.7 Chapter 5 ofthe Text Book]

UNIT-III: Matrix representation of graphs: Incidence and circuit matrices of a graph - Fundamental Circuit Matrix - Cut set and Path Matrices - Adjacency matrices - Directed Graphs - Incidence and adjacency matrix of a digraph. [Chapter 7 and Sections 9.1, 9.2, 9.8 and 9.9 of Chapter 9 of the Text Book]

UNIT-IV: Coloring - Covering and Partitioning - Chromatic number- Chromatic Partitioning – Chromatic Polynomial – Matchings –Coverings -The four color problem - Applications of graph theory in Operations Research. [Chapter 8 and Sections 14.1 to 14.3 of chapter 14 of the Text Book]

Text Book: Graph Theory with applications to Engineering and Computer Science by Narasingh Deo, Prentice – Hall of India.

Reference Books:1. Discrete Mathematics for Computer Scientists and Mathematicians by J.L.Mott, A.Kandel and T.P. Baker, Prentice-Hall India.2. Graph Theory with applications by Bond JA and Murthy USR, North Holland, New York.

AM405(2019): **Elective-II**

FUZZY SETS & FUZZY LOGIC

UNIT I: Fuzzy sets: Introduction - crisp sets – overview - Fuzzy Sets Basic types - Fuzzy Sets Basic concepts - Characteristics & Significance of the paradigm shift - Additional properties of αcuts - Representation of Fuzzy sets - Extension principle for Fuzzy sets. [Chapters 1 & 2 of the Text Book]

UNIT II: Operations: Types of Operations - Fuzzy compliments - Fuzzy Intersections - Fuzzy Unions - Combinations of Operations - Aggregation Operations. [Chapter 3 of the Text Book]

UNIT III: Fuzzy numbers: Linguistic variables - Arithmetic operations on intervals - Arithmetic operations on Fuzzy numbers - Lattice of Fuzzy numbers - Fuzzy equations. [Chapter 4 of the Text Book]

UNIT IV: Classic logic: Overview - Multivalued Logics - Fuzzy propositions - Fuzzy quantifiers - Linguistic Hedges - Inference from Conditional Fuzzy-Propositions - Inference from Conditional and Qualified Propositions - Inference from Quantified Propositions. [Chapter 8 of the Text Book]

Text Book: Fuzzy Sets and Fuzzy Logic (Theory and Applications) by George J.Klir/Bo Yuan, Prentice Hall, New Jersey.

AM406-LAB(2019):

MAT LAB

(A):1. Solving a first order differential equation analytically

2. Solving a second order differential equation analytically

3. Solving a first order IVP using Euler method

4. Solving a first order IVP using modified Euler method

5. Solving a first order IVP using 4th order RK method

6. Modelling of LR,RC circuits and solving through MATLAB and graphical representations

7. Modelling of free oscillations ,forced oscillations without damping

8. Modelling of free oscillations ,forced oscillations with damping

9. Fourier series expressions of given function, graphical comparison

10. Solving linear system of equations modelling

11. Finding eigen values of a matrix

12. Modelling of electrical circuits formation of linear systems and solving through MATLAB and graphical representation

(OR)

(B):Develop a User friendly Package for Numerical methods

(OR)

(C):

Develop a User friendly Package for Linear Programming/ Operations Research Problems

(OR)

(D):

Write Programs for Linear Programming/ Operations Research Problems

ADIKAVI NANNAYA UNIVERSITY

SEMESTER END EXAMINATIONS

M.Sc. Applied Mathematics

I -SEMESTER

AM101: REAL ANALYSIS

[W.E.F. 2019 A.B]

(MODEL QUESTION PAPER)

Time: 3 Hours   Max . Marks : 75

Answer **ALL** questions. Each question carries 15 marks.   Marks: $5 \times 15 = 75$

1. (a) Let (X,d) be a metric space and Y be a subspace of X and E⊆Y.Then E is open iff E=Y∩G, for some open set G of X.
   (b) A K-cell is a compact subset of $\mathbb{R}^k$

(OR)

2. (a) The image of a compact space under a continuous map is compact.
   (b) State and prove Intermediate value theorem.

3. (a) State and prove First mean value theorem for Riemann-Stieltjes Integrals.
   (b) Let α be bounded variation on [a,b] and assume that $f\epsilon R(\alpha)$ on [a,b] then $f\epsilon R(\alpha)$ on every subinterval [c,d] of [a,b].

(OR)

4. (a) State and prove Integration by parts.
   (b) If f is continuous on [a,b] and α is of bounded variation on [a,b] then $f\epsilon R(\alpha)$ on [a,b].
5. State and prove Mean value theorem for differentiable functions.

(OR)

6. (a) Let S be a subset of $\mathbb{R}^n$, $f: S \to \mathbb{R}^n$. C be a interior point of S and f is differentiable at C.Then f is continuous at C.
   (b) State and prove Taylor's formula.
7. State and prove Stone-Weirstrass theorem

(OR)

8. (a) Prove that there exist a real continuous function on a real line which is no where differentiable
   (b) Suppose *{f_n}* converges to *f* uniformly on a set *E* in a metric space X. Let x be a limit point of E such that $\lim_{t\to x} f_n(t) = A_n, n = 1,2,3, \dots$, then prove that A_n converges and so $\lim_{t\to x} \lim_{n\to\infty} f_n(t) = \lim_{n\to\infty} \lim_{t\to x} f_n(t)$.

9. Answer any **THREE** of the following:
   (a) Every infinite subset of a countable set is countable.
   (b) Every interval [a,b] (a<b) is uncountable.
   (c) For any two partitions P_1 and P_2 of [a,b] then $L(P_1, f, \alpha) \leq U(P_2, f, \alpha)$.
   (d) Every open ball in $\mathbb{R}^k$ is convex.
   (e) Give an example of a sequence of functions that disproves
   $\lim_{t \to x} \lim_{n \to \infty} f_n(t) = \lim_{n \to \infty} \lim_{t \to x} f_n(t)$.

ADIKAVI NANNAYA UNIVERSITY

SEMESTER END EXAMINATIONS

M.Sc. Applied Mathematics

I -SEMESTER

AM 102: ORDINARY DIFFERENTIAL EQUATIONS

[W.E.F. 2019 A.B]

(MODEL QUESTION PAPER)

Time: 3 Hours Max . Marks : 75

Answer **ALL** questions. Each question carries 15 marks. Marks: $5 \times 15 = 75$

1. State and prove Picard's theorem.

(OR)

2. State and prove Contraction Principle.
3. Let the functions $b_1, b_2, \ldots, b_n$ in $L(x) = x^n(t) + b_1(t)x^{(n-1)}(t) + \cdots + b_n(t)x(t)$ be defined and continuous on an interval I. Let $\emptyset_1, \emptyset_2, \ldots, \emptyset_n$ be n linearly independent solutions existing on I containing a point t_0. Prove that
$w(t) = \exp\left[-\int_{t_0}^{t} b_1(s)ds\right] w(t_0)\,;\ t_0, t\epsilon\ I$

(OR)

4. Solve $x^{(4)} + 4x = 0$
5. Let A(t) be an n×n matrix that is continuous in t on a closed and bounded interval I. Also prove that this solution is unique.

(OR)

6. Find the fundamental matrix for the system $x' = Ax$ where
$$A = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ 6 & -11 & 6 \end{bmatrix}$$
7. If $P_n(t)$ and $P_m(t)$ are Legendre polynomials, prove that $\int_{-1}^{1} P_n(t)P_m(t)dt\ \ if\ m \neq n$ and $\int_{-1}^{1} P_n^2(t)dt = \frac{2}{2n+1}$

(OR)

8. Prove that $\frac{d}{dt}[t^p J_p(t) = t^p J_{p-1}(t)$ and $\frac{d}{dt}[t^{-p} J_p(t)] = -t^{-p} J_{p-1}(t)$
9. Answer any **THREE** of the following:
   (a) Solve the IVP $x' = x, x(0) = 1$ by the method of successive approximations.
   (b) Prove that x^4 and $x^3|x|$ are linearly independent function on [-1,1] but they are linearly dependent on [-1,0] and [0,1]
   (c) Solve$6t^2x'' + tx' + x = 0$
   (d) Find the fundamental matrix for the system $x' = Ax$ where
   $$A = \begin{bmatrix} \alpha_1 & 0 & 0 \\ 0 & \alpha_2 & 0 \\ 0 & 0 & \alpha_3 \end{bmatrix};\quad \alpha_1, \alpha_2, \alpha_3 \text{ are scalars.}$$
   (e) Show that $J_{r-1}(t) - J_{r+1}(t) = 2J_r'(t)$

*****

ADIKAVI NANNAYA UNIVERSITY

SEMESTER END EXAMINATIONS

M.Sc. Applied Mathematics

I -SEMESTER

AM 103: NUMERICAL METHODS

[W.E.F. 2019 A.B]

(MODEL QUESTION PAPER)

Time: 3 Hours Max . Marks : 75

Answer **ALL** questions. Each question carries 15 marks. Marks: $5 \times 15 = 75$

1. Find the inverse of the coefficient matrix of the system

$$x_1 + x_2 + x_3 = 1$$
$$4x_1 + 3x_2 - x_3 = 6$$
$$3x_1 + 5x_2 + 3x_3 = 4$$

By using Guass – Jordan method.

(OR)

2. Use Guass – Seidel method to solve the system of linear equations

$$2x_1 - x_2 = 10$$
$$-x_1 + 2x_2 - x_3 = 1$$
$$-x_2 + 2x_3 = 1$$

3. Values of x (in degrees) and *sin x* are given in the following table.

X (in degree)	*sin x*
15	0.2588190
20	0.3420201
25	0.4226183
30	0.5
35	0.5735764
40	0.6427876

Determine the value of *sin* 38^0.

(OR)

4. Given the data

X	0	1	2	3
$f(X)$	1	2	33	244

Fit quadratic splines with $M(0) = f''(0) = 0$. Hence, find an estimate of $f(2.5)$.

5. (i) Evaluate $\int_{-2}^{2} \frac{x}{5+2x}\, dx$ by using the the Trapezoidal rule with five ordinates.

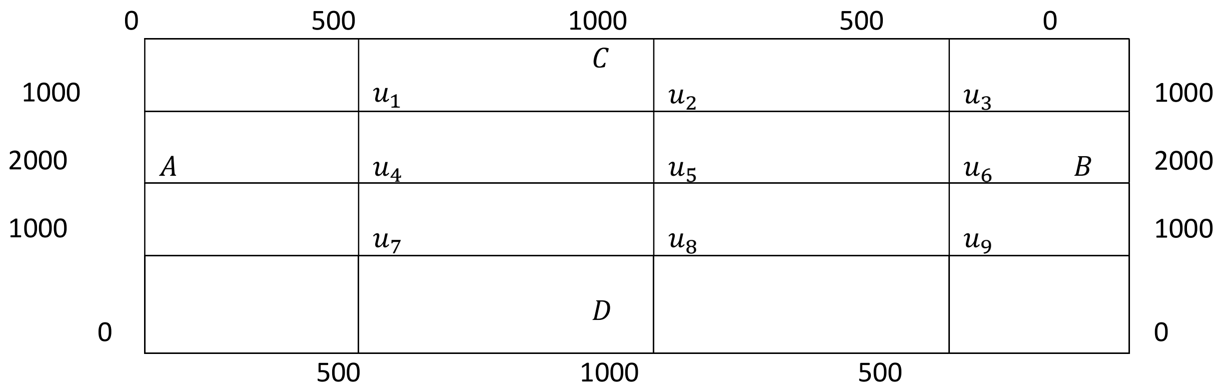
   (ii) Evaluate $\int_{0}^{2} \frac{dx}{x^3+x+1}$ by using the Simpson's rule 1/3 rule with $h = 0.25$.

(OR)

6. Use Runge – Kutta fourth order formula to find y(0.2) and y(0.4) given that

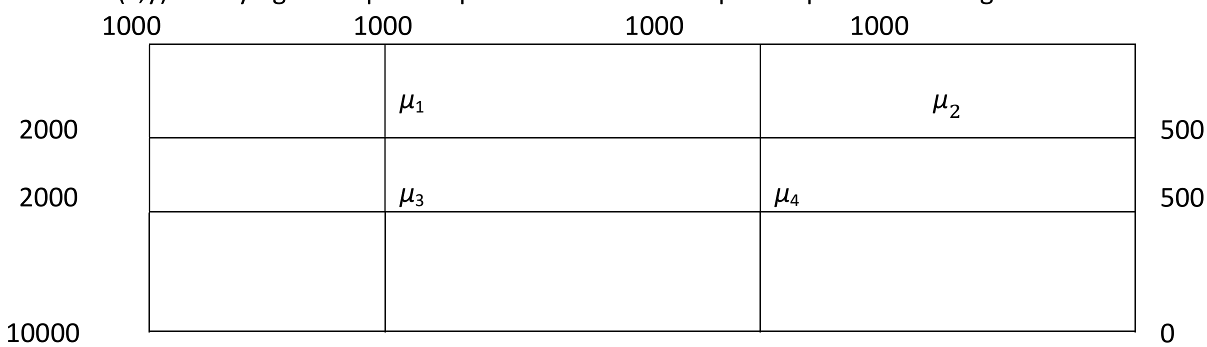
$$y' = \frac{y^2 - x^2}{y^2 + x^2}, y(0) = 1.$$

7. Solve the elliptic equation $u_{xx} + u_{yy} = 0$ for the square mesh of the following figure with boundary values as shown.



(OR)

8. Given the values of u(x,y) on the boundary of the square in the figure evaluate the function u(x,y) satisfying the Laplace equation $\nabla^2 u = 0$ at the pivotal points of the figure



9. Answer any **THREE** of the following:

a) Find the eigen values and eigen vectors of the matrix

$$A = \begin{pmatrix} 1 & 2 & -2 \\ 1 & 1 & 1 \\ 1 & 3 & -1 \end{pmatrix}$$

b) Derive $\mu = \sqrt{1 + \frac{1}{4}\delta^2}$

c) Obtain the least squares straight line fit to the following data

X	0.2	0.4	0.6	0.8	1
$f(X)$	0.447	0.632	0.775	0.894	1

d) $\frac{dy}{dx} = x^2 + y$, using Euler's method with the intital condition $y(0) = 1$, compute $y(0.02)$.

e) Classify the following equation:

$$\frac{\partial^2 u}{\partial x^2} + 4\frac{\partial^2 u}{\partial x \partial y} + 4\frac{\partial^2 u}{\partial y^2} - \frac{\partial u}{\partial x} + 2\frac{\partial u}{\partial y} = 0.$$

ADIKAVI NANNAYA UNIVERSITY

SEMESTER END EXAMINATIONS

M.Sc. Applied Mathematics

I -SEMESTER

AM 104: ALGEBRA

[W.E.F. 2019 A.B]

(MODEL QUESTION PAPER)

Time: 3 Hours | Max . Marks : 75

Answer **ALL** questions. Each question carries 15 marks. Marks: $5 \times 15 = 75$

1. (a) The set Aut(G) of all automorphisms of a group G is a group under composition mappings and G/Z(G)$\cong \mathrm{In}(G)$
   (b) State and prove Cauley's theorem.

(OR)

2. (a) State and prove Jordan-Holder theorem.
   (b) Define Nilpotent group. Prove that a group of order of order p(p prime) is nilpotent.
3. (a) State and prove Cauchy's theorem foe abelian groups.
   (b) State and prove First Sylow theorem.

(OR)

4. State and prove Second & Third Sylow theorems.+
5. (a) State and prove Fundamental theorem of homomorphism.
   (b) If *K* is an idel in a ring *R* then show that each ideal in *R/K* is of the form *A/K* where *A* is an ideal in *R* containing *K*.

(OR)

6. (a) In a non-zero commutative ring with unity, prove that an ideal M is maximal if and only if R/M is a field.
   (b) If R is a commutative ring then prove that an ideal P in R is prime if and only if $ab\epsilon P, a\epsilon R, b\epsilon R \Rightarrow a\epsilon P$ or bϵP.
7. (a) Prove that an irreducible element in a commutative principal ideal domain (PID) is always prime.
   (b) Show that every Euclidian domain is a PID.

(OR)

8. (a) State and prove Gauss lemma.
   (b) Let R be a commutative ring and P is a prime ideal. Then S=R-P is a multiplicative set and R is a local ring with unique maximal ideal P={a/ s\a∈P, s∉P}
9. Answer any **THREE** of the following:
   (a) Define Automorphism of a group. Prove that every group of order p^2 (p prime) is abelian.
   (b) Find the non isomorphic abelian groups of order 360.
   (c) Define Ideal and Maximal ideal. Give two examples each.
   (d) Define nilpotent ideal and give an example.
   (e) Define Euclidean domain and give an example.Define local ring.

ADIKAVI NANNAYA UNIVERSITY

SEMESTER END EXAMINATIONS

M.Sc. Applied Mathematics

I-SEMESTER

AM 105: METHODS OF APPLIED MATHEMATICS - I

[W.E.F. 2019 A.B]

(MODEL QUESTION PAPER)

Time: 3 Hours Max . Marks : 75

Answer **ALL** questions. Each question carries 15 marks. Marks: $5 \times 15 = 75$

1. Find the Fourier series of the function $f(x) = xsinx;\ -\pi \leq x \leq \pi$.

(OR)

2. Find the Fourier series of the function $f(x) = x\sin x;\ \ -\pi \leq x \leq \pi$. Deduce that $\frac{1}{1\cdot 3} - \frac{1}{3\cdot 5} + \frac{1}{5\cdot 7} - \frac{1}{7\cdot 9} + \cdots = \frac{\pi-2}{4}$.
3. (a) Find the curve passing through the points (x_1, y_1) and (x_2, y_2) and when rotated about the X-axis gives a minimum surface area.
   (b) Find the functional depends only on two functions $y(x)$ and $z(x)$, $[v(y(x), z(x)] = \int_{x_0}^{x_1} F(x, y, z, y', z')dx,\ y(x_0) = y_0, z(x_0) = z_0, y(x_1) = y_1,$ $z(x_1) = z_1$.

(OR)

4. Prove that necessary condition for $I = \int_{x_1}^{x_2} f(x, y, y')\, dx$ to have an extremal is $\frac{\partial f}{\partial y} - \frac{d}{dx}\left(\frac{\partial f}{\partial y}\right) = 0$.
5. (a) Solve $y_{n+2} - 4y_{n+1} + 3y_n = 5^n$,
   (b) Solve $y_{n+2} - 2y_{n+1} + y_n = n^2 2^n$.

(OR)

6. (a) Solve the difference equation $u_{n+3} - 2u_{n+2} - 5u_{n+1} + 6u_n = 0$.
   (b) Find the difference equation corresponding to the family of curves $y = ax + bx^2$.

7. (a) Calculate the Christoffel symbols corresponding to the multiplies
   $$ds^2 = (dx')^2 + (x')^2(dx^2)^2 + (x')^2 sin^2 x^2 (dx^3)^{\ 2}.$$
   (b) $ds^2 = (dx')^2 + (G(x', x^2)^2)(dx^2)^2$ where G is a function of x' and x^2.

(OR)

8. (a) If A^{ijk} is skew-symmetric tensor. Then show that $\frac{1}{\sqrt{g}}\frac{\partial}{\partial x^k}(\sqrt{g}A^{ijk})$ is a tensor.
   (b) If $A_{ij} = B_{i,j} - B_{j,i}$. Prove that $A_{ij,k} + A_{jk,i} + A_{ki,j} = 0$.
9. Answer any **THREE** of the following:
   a) Find the Fourier series of the function $f(x, y) = \begin{cases} 0 & if -\pi \leq x \leq 0; \\ x & if\ 0 \leq x \leq \pi \end{cases}$.
   b) Define covariant vector, contravariant vector and invariant.
   c) Find the Fourier sine series of the function $f(x) = \cos x$ on the interval $[0, \pi]$.
   d) Solve the difference equation $y_{n+2} - 5y_{n+1} - 6y_n = 4^n, y_0 = 0, y_1 = 1$.
   e) Find the extremal of the functional $\frac{\sqrt{1+(y')^2}}{y}$.

ADIKAVI NANNAYA UNIVERSITY

SEMESTER END EXAMINATIONS

M.Sc. Applied Mathematics

II-SEMESTER

AM 201: COMPLEX ANALYSIS

[W.E.F. 2019 A.B]

(MODEL QUESTION PAPER)

Time: 3 Hours — Max . Marks : 75

Answer **ALL** questions. Each question carries 15 marks. — Marks: $5 \times 15 = 75$

1. Prove that if $f(z) = u(x, y) + iv(x, y)$ and $f'(z)$ exists at a point $z_0 = x_0 + iy_0$, then the first order partial derivatives of u and v must exist at (x_0, y_0) and they must satisfy Cauchy-Riemann equations.

(OR)

2. Prove that $u(x, y) = y^3 - 3x^2y$ is harmonic and find its harmonic conjugate.

3. Define Logarithmic function and write about its properties.

(OR)

4. Write about Trigonometric functions.

5. Evaluate $\int_c \bar{z}\, dz$, where C is the right-hand half of $z = 2e^{i\theta}$.

(OR)

6. Prove that $\left|\int_{C_R} \frac{z^{1/2}}{z^2+1}\, dz\right| = \frac{\pi/\sqrt{R}}{1-(1/R^2)}$, where C_R is the semicircular path $z = Re^{i\theta}$ $(0 \leq \theta \leq \pi)$.

7. State and prove Cauchy's integral formula.

(OR)

8. Evaluate integral of $g(z)$ around the circle $|z - i| = 2$ in the positive sense when (i) $g(z) = \frac{1}{z^2+4}$ (ii) $g(z) = \frac{1}{(z^2+4)^2}$.

9. Answer any **THREE** of the following:
   a) Define (i) Connected set (ii) Entire function
   b) Write a brief note on the mapping $w = z^2$
   c) Find the principal value of the principal value of $(-i)^i$
   d) State and prove Liouville's theorem
   e) Evaluate $\int_C tanz\, dz$, where C is the circle $|z| = 1$.

ADIKAVI NANNAYA UNIVERSITY

SEMESTER END EXAMINATIONS

M.Sc. Applied Mathematics

II-SEMESTER

AM 202: PARTIAL DIFFERENTIAL EQUATIONS

[W.E.F. 2019 A.B]

(MODEL QUESTION PAPER)

Time: 3 Hours Max . Marks : 75

Answer **ALL** questions. Each question carries 15 marks. Marks: $5 \times 15 = 75$

1. a) Find the integral curves of the equations $\frac{dx}{xz-y} = \frac{dy}{yz-x} = \frac{dz}{1-z^2}$
   b) Prove that a necessary and sufficient condition that the Pfaffin differential equation $X.dr = 0$ should be integrable is that $X \cdot curl\, X = 0$.

(OR)

2. a) Find the surface which intersects the surfaces of the system $z(x+y) = c(3z+1)$ orthogonally and which passes through the circle $x^2 + y^2 = 1, z = 1$.
   b) Verify that the equation $2y(a-x)dx + [z - y^2 + (a-x)^2]dy - ydz = 0$ is integrable and find its primitive.

3. Find the surfaces which is orthogonal to the one-parameter system $z = cxy(x^2 + y^2)$ and which passes through the hyperbola $x^2 - y^2 = a^2, z = 0$

(OR)

4. Find a complete integral of the partial differential equation $(p^2 + q^2)x = pz$ and deduce the solution which passes through the curve $x = 0, z^3 = 4y$.

5. Reduce the equation $y^2 \frac{\partial^2 z}{\partial x^2} - 2xy \frac{\partial^2 z}{\partial x \partial y} + x^2 \frac{\partial^2 z}{\partial y^2} = \frac{y^2}{x}\frac{\partial z}{\partial x} + \frac{x^2}{y}\frac{\partial z}{\partial y}$ to canonical form and hence solve it.

(OR)

6. Solve the equation $rq^2 - 2pqs + tp^2 = pt - qs$.
7. State and prove Kelvin's Inversion theorem.

(OR)

8. Derive d' Alembert's solution of the one-dimensional wave equation.

9. Answer any **THREE** of the following:
   a) Eliminate the arbitrary function f from the equation from the equation
   $$z = xy + f(x^2 + y^2)$$
   b) Show that the equations $xp = yq, z(xp + yq) = 2xy$ are compatible and find their solution.
   c) Find the complete integral of the equation $(p^2 + q^2)y = qz$
   d) Find the particular integral of the equation $(D^2 - D)z = 2y - x^2$
   e) Show that the surfaces $(x^2 + y^2)^2 - 2a^2(x^2 - y^2) + a^4 = c$ can form a family equipotential surfaces.

ADIKAVI NANNAYA UNIVERSITY

SEMESTER END EXAMINATIONS

M.Sc. Applied Mathematics

II-SEMESTER

AM 203: CLASSICAL MECHANICS

[W.E.F. 2019 A.B]

(MODEL QUESTION PAPER)

Time: 3 Hours Max . Marks : 75

Answer **ALL** questions. Each question carries 15 marks. Marks: $5 \times 15 = 75$

1) a) State and obtain conservation theorems for
   (i) The linear momentum and
   (ii) Total angular momentum of a system of particles.

   b) Formulate Lagrange's equations of motion for a simple pendulum.

(**OR**)

2) a) State Hamilton's principle. Derive Lagrange's equations of motion from Hamilton's principle, for a conservative holonomic dynamical system.

   b) Prove with the usual notation that the curve that gives the shortest distance between two points in space is a straight line.

3) a) With the usual notation, obtain Hamiton's equations of motion from a variational principle.

   b) Using Hamiton's canonical equations of motion, obtain the equations of motion for one dimensional harmonic oscillator.

(**OR**)

4) a) State and obtain the principle of least action.

   b) Obtain Jacobi's form of the least action principle with the usual notation.

5) a) State and prove Poisson's theorem.

   b) Show that the transformations defined by $q = \sqrt{2p}\ \sin Q\,; p = \sqrt{2p}\ \cos Q$ is canonical.

(**OR**)

6) a) State and prove Bilinear invariant condition.

   b) Show that the geodesics of a spherical surface are great circles.

7) State Lorentz transformations . Obtain with the usual notation the relativistic law of composition of velocities in special theory of relativity.

(**OR**)

8) Explain the concepts: i) Lorentz – Fitzgerlad contraction, and ii) time dilation.

9) Answer any **THREE** of the following:
   a) State and obtain the Nielsen form of the Lagrange equations for a holonomic dynamical system.
   b) Explain Constrained motion and Constrained Equations.
   c) Show that $\frac{\partial M}{\partial t} = \frac{dM}{dt} = 0$ if t doesnot occour in Lagrangian.
   d) State and obtain Jacobi's identity for Poisson brackets.
   e) Show that $ds^2 = c^2dt^2 - dx^2 - dy^2 - dz^2$ is invariant under Lorentz transformation.

ADIKAVI NANNAYA UNIVERSITY

SEMESTER END EXAMINATIONS

M.Sc. Applied Mathematics

III-SEMESTER

AM204: TOPOLOGY

[W.E.F. 2019 A.B]

(MODEL QUESTION PAPER)

Time: 3 Hours Max . Marks : 75

Answer **ALL** questions. Each question carries 15 marks. Marks: $5 \times 15 = 75$

1. (a) State and prove Cantor's Intersection Theorem

   (b) Let X be a metric space. Then, prove that any finite intersection of open set is open.

(OR)

2. (a) State and Prove Lindelöf's theorem

   (b) In any metric space X , each closed sphere is a closed set.

3. State and Prove Ascoli's Theorem.

(OR)

4. State and Prove Tychonoff's Theorem.

5. State and Prove Urysohn's Imbedding Theorem.

(OR)

6. State and Prove Tietze Extension Theorem.

7. (a) Prove that the Product of any non-empty class of connected space is connected

   (b) Let X be a Hausdorff space. If X has an open base whose sets are also closed, Then show that X is totally disconnected.

(OR)

8. Let X be a locally connected space. If Y is an open subspace of X, then each component of Y is open in X. In particular, each component of X is open.

9. Answer any **THREE** questions of the following.

   (a) The components of a totally disconnected space are its points.

   (a) Let T_1 and T_2 be two topologies on a non-empty set X. Show that $T_1 \cap T_2$ is also a topology on X.

   (b) Show that every sequentially compact metric space is compact.

   (c) Define Cantor set and show that the cantor set is compact.

   (d) Every compact Hausdorff space is normal.

ADIKAVI NANNAYA UNIVERSITY

SEMESTER END EXAMINATIONS

M.Sc. Applied Mathematics

II-SEMESTER

AM 205: METHODS OF APPLIED MATHEMATICS - II

[W.E.F. 2019 A.B]

(MODEL QUESTION PAPER)

Time: 3 Hours Max . Marks : 75

Answer **ALL** questions. Each question carries 15 marks. Marks: $5 \times 15 = 75$

1. Prove the following Hypothesis:
   If F(t) is continuous for all $t \geq 0$ and be of exponential order a as $t \to \infty$ and if $F'(t)$ is of class A, then the Laplace transformation of the derivative $F'(t)$ eist when $p > a$ and $L[F'(t)] = pL[F(t)] - F(0)$

(OR)

2. Find the inverse Laplace Transformation of the following functions
   a) $\frac{2p+1}{(p+2)^2(p-1)^2}$ (b) $\frac{e^{-4p}}{(p-3)^4}$

3. Find the Fourier transform of F(t) defined by
   $F(x) = \begin{matrix} 1 \text{ for } |x| < a \\ 0 \text{ for } |x| > a \end{matrix}$ and hence evaluate the following
   Asd (a) $\int_{-\infty}^{\infty} \frac{sinPa\ cosPx}{P} dp$ (b) $\int_0^{\infty} \frac{sinP}{P} dp$

(OR)

4. Find Fourier Sine and Cosine transform of e^{-x} and using the inversion formulae recover the original functions, in both the cases.

5. (a) Find the Fourier Sine and Cosine Transform of *f(x)=x*
   (b) When *f(x) = sin mx*, where *m* is a positive integer show that $\widetilde{f}_s(p) = 0$ if $p \neq m$ and show that $\widetilde{f}_s(p) = \frac{\pi}{2}$ if $p = m$

(OR)

6. Find the finite sine transform of *f(x),* if
   (e) *f(x)= cos kx* (b) $f(x) = x^3$ and (c) $f(x) = e^{cx}$

7. Show that $\emptyset(x) = F(x) + \lambda \int_0^x R(x, \xi; \lambda)\, F(\xi) d\xi$, where the resolvent kernel $R(x, \xi; \lambda) = K(x, \xi) + \sum_{v=1}^{\infty} \lambda^v\, K_v(x, \xi)$ is the solution of a non-homogeneous Volterra's integral equation of second kind $\emptyset(x) = F(x) + \lambda \int_0^x K(x, \xi)\, \emptyset(\xi) d\xi$.

(OR)

8. Find the solution of the Volterra's integral equation
   $\emptyset(x) = (1 - 2x - 4x^2) + \int_0^x [3 + 6(x - \xi) - 4(x - \xi)^2](x, \xi; \lambda)\, \emptyset(\xi) d\xi.$

9. Answer any **THREE** from the following:

(a) Find the $L\{e^{3t}(3sin2t - 2cos2t)\}$

(b) Find Inverse Laplace Transformation of $\frac{3}{(p-4)(p+5)}$ using Convolution Theorem

(c) Define Fourier Transform and Complex Fourier Transform

(d) Define Finite Fourier Sine Transformation

(e) Solve the Volterra integral equation $\emptyset(x) = (1 + x) - \int_0^x \emptyset(x)\, d\xi \ with \ \emptyset_0(x) = 1$ by the successive approximations method.

ADIKAVI NANNAYA UNIVERSITY

SEMESTER END EXAMINATIONS

M.Sc. Applied Mathematics

III-SEMESTER

AM301: ADVANCED COMPLEX ANALYSIS

[W.E.F. 2019 A.B]

(MODEL QUESTION PAPER)

Time: 3 Hours Max . Marks : 75

Answer **ALL** questions. Each question carries 15 marks. Marks: $5 \times 15 = 75$

1.State and prove Taylor's theorem

(OR)

2. Represent the function $f(z) = \frac{-1}{(z-1)(z-2)}$ by it's Laurent series in the domain
   (i) $|Z| < 1$ (ii) $1 < |Z| < 2$

3. State and Prove Cauchy's Residue theorem

(OR)

4. Evaluate the integral $\int_C \frac{dz}{z(z-2)^4}$,where C is the positively oriented circle $|z-2| = 1$

5. State and Prove Rouche's Theorem

(OR)

6. Show that $\int_0^{2\pi} \frac{d\theta}{1+asi} = \frac{2\pi}{\sqrt{1-a^2}}$, -1 < a < 1

7. Find the linear fractional transformation that maps the points Z_1 =-1, Z_2=0, Z_3= 1 onto the points W_1 = -i, W_2= 1, W_3 = i

(OR)

8. Write about the transformation w=sinz

9.Answer any **THREE** of the following:

(a) Expand the function $f(z) = \frac{1+2z^2}{z^3+z^5}$ into a series involving powers of z when 0<$|Z|$ < 1

(b) Evaluate the integral $\int_C \frac{5z-2}{z(z-1)} dz$ where C is the circle $|Z| = 2$ described counterclock wise

(c) Evaluate the Improper integral $\int_0^\infty \frac{x^2 dx}{x^6+1}$

(d) Determine the number of roots of the equation $z^7 - 4z^3 + z - 1 = 0$ inside the circle $|z| = 1$

(e) Write a short note on the transformation w= $\frac{1}{z}$

ADIKAVI NANNAYA UNIVERSITY

SEMESTER END EXAMINATIONS

M.Sc. Applied Mathematics

III-SEMESTER

AM302: OPERATIONS RESEARCH - I

[W.E.F. 2019 A.B]

(MODEL QUESTION PAPER)

Time: 3 Hours Max . Marks : 75

Answer **ALL** questions. Each question carries 15 marks. Marks: $5 \times 15 = 75$

1. Use the graphical method to solve the following LP problem.
   Maximize $Z = 15x_1 + 10x_2$
   Subject to the constraints
   $$4x_1 + 6x_2 \leq 360$$
   $$3x_1 + 0x_2 \leq 180$$
   $$0x_1 + 5x_2 \leq 200$$
   and $x_1, x_2 \geq 0$

(OR)

2. Use the simplex method to solve the following LP problem.
   Maximize $Z = 3x_1 + 5x_2 + 4x_3$
   Subject to the constraints
   $$2x_1 + 3x_2 \leq 8$$
   $$2x_2 + 5x_3 \leq 10$$
   $$3x_1 + 2x_2 + 4x_3 \leq 15$$
   and $x_1, x_2, x_3 \geq 0$
3. Use Big-M method to solve the following LP problem.
   Maximize $Z = x_1 + 2x_2 + 3x_3 - x_4$
   Subject to the constraints
   $$x_1 + 2x_2 + 3x_3 = 15$$
   $$2x_1 + x_2 + 5x_3 = 20$$
   $$x_1 + 2x_2 + x_3 + x_4 = 10$$
   And $x_1, x_2, x_3 \geq 0$

(OR)

4. Use Dual simplex method to solve the given LPP
   Maximize $Z = 3x_1 + 4x_2 + x_3$
   Subject to the constraints
   $$x_1 + 2x_2 + 3x_3 \leq 90$$
   $$2x_1 + x_2 + x_3 \leq 60$$
   $$3x_1 + x_2 + 2x_3 \leq 80$$
   and $x_1, x_2, x_3 \geq 0$

5. For the game with payoff matrix

Player B

Player A	B_1	B_2	B_3
A_1	-1	2	-2
A_2	6	4	-6

Determine the optional strategies for player A and B. Also determine the value of the game.

(OR)

6. Solve the game whose payoff matrix is given below

Player B

Player A	B_1	B_2	B_3	B_4
A_1	3	2	4	0
A_2	3	4	2	4
A_3	4	2	4	0
A_4	0	4	0	8

7. A company has three production facilities S_1, S_2, S_3 with production capacity of 7, 9,18 units (in 100;s) per week of a product, respectively. These units are to be shipped to the warehouses D_1, D_2, D_3 , and D_4 with requirement of 5, 6, 7 and 14 units (in 100;s) per week of a product, respectively. Tge transportation costs (in rupees) per unit between factories to warehouses are given in the table below:

	D_1	D_2	D_3	D_4	Demand
S_1	19	30	50	10	7
S_2	70	30	40	60	9
S_3	40	8	70	20	18
Capacity	5	8	7	14	34

Obtain an optimum solution.

(OR)

8. A department has five employees with five jobs to be performed. The time (in hours) each men will take to perform each job is given in the effectiveness matrix:

Employees

		I	II	III	IV	V
Jobs	A	10	5	13	15	16
	B	3	9	18	13	6
	C	10	7	2	2	2
	D	7	11	9	7	12
	E	7	9	10	4	12

How should the jobs be allocated, one per employee, so as to minimize the total man-hours?

9. Answer any **THREE** questions of the following

(a) Write a brief note on LPP and non –LPP

(b) Write about slack and surplus variables

(c) Write the dual to the following LP problem.

Maximize $Z = x_1 - x_2 + 3x_3$

Subject to the constraint:

$$x_1 + x_2 + x_3 \leq 10$$
$$2x_1 - x_2 - x_3 \leq 2$$
$$2x_1 - 2x_2 - 3x_3 \leq 6$$

and $$x_1, x_2, x_3 \geq 0$$

(d) Solve the following game by using maxmin (minimax)principle whose payoff matrix is

Player B

Player A	B_1	B_2	B_3
A_1	-2	15	-2
A_2	-5	-6	-4
A_3	-5	20	-8

(e) Determine an initial basic feasible solution to the following transportation problem by north-west corner rule

Destination

		D_1	D_2	D_3	D_4	Supply
Source	S_1	21	16	15	3	7
	S_2	17	18	14	23	13
	S_3	32	27	18	41	19
	Demand	6	10	12	15	

****

ADIKAVI NANNAYA UNIVERSITY

SEMESTER END EXAMINATIONS

M.Sc. Applied Mathematics

II-SEMESTER

AM 303: C PROGRAMMING

[W.E.F. 2019 A.B]

(MODEL QUESTION PAPER)

Time: 3 Hours Max . Marks : 75

Answer **ALL** questions. Each question carries 15 marks. Marks: $5 \times 15 = 75$

1. Explain Data types in C with examples.

(OR)

2. Describe different categories of operators in C with examples.
3. Explain conditional control structures in C.

(OR)

4. (a)Write a program to generate Prime numbers up to N.

   (b) Explain GO TO statement with suitable example.

5. (a) What is recursion in functions? Write a program to find the factorial of given number using recursion.

   (b) Write a C program to multiply two given matrices.

(OR)

6. Discuss in detail about storage classes in C.
7. What is pointer? Explain the advantages of pointer with suitable examples.

(OR)

8. Write a C program to process student data in generating results using array of structures.
9. Answer any **THREE** of the following:
   (a) Discuss in brief about structure of a C program.
   (b) What are the input output statements in C?Explain?
   (c) Write a program to print the following output

```
1 2 3 4 5
1 2 3 4
1 2 3
1 2
1
```

   (d) Explain string handling functions.
   (e) Explain Call by value and Call by reference.

*****

ADIKAVI NANNAYA UNIVERSITY

SEMESTER END EXAMINATIONS

M.Sc. Applied Mathematics

III-SEMESTER

AM304: DISCRETE MATHEMATICAL STRUCTURES

[W.E.F. 2019 A.B]

(MODEL QUESTION PAPER)

Time: 3 Hours Max . Marks : 75

Answer **ALL** questions. Each question carries 15 marks. Marks: $5 \times 15 = 75$

1) Let $X = \{1, 2, 3\}$ if $R = \{(x, y)/\ x \in X \wedge y \in X \wedge ((x - y)$ is an integral non-zero multiple of $2)\}$, $S = \{(x, y)/\ x \in X \wedge y \in X \wedge ((x - y)$ is an integral non-zero multiple of $3)\}$
(a) Find $R \cup S$ and $R \cap S$ (b) If $X = \{1, 2, 3, \ldots.\}$, What is $R \cap S$ for R and S as defined in (a)

(OR)

2) Let A be a given finite set and $\rho(A)$ its power set. Let $\subseteq$ be the inclusion relation on the elements of $\rho(A)$. Draw Hasse diagrams of $(\rho(A), \subseteq)$ for (a) A= {a}; (b) A={a, b}; (c) A= {a, b, c} (d) A= {a, b, c, d}

3) Let (L, $\leq$) be a lattice . For any a, b, c $\in$ L show that the following holds:
$a \leq c \Leftrightarrow a \oplus (b * c) \leq (a \oplus b) * c$

(OR)

4) Show that in a lattice (L,$\leq$), for any a , b, c$\in L$, the distributive inequalities hold:

$$a \oplus (b * c) \leq (a \oplus b) * (a \oplus c)$$
$$a * (b \oplus c) \geq (a * b) \oplus (a * c)$$

5) Write the following Boolean expression in an equivalent sum of products canonical form in three variables x_1 , x_2 and x_3 (a) $x_1 * x_2$ (b) $x_1 \oplus x_2$ (c) $(x_1 \oplus x_2)' * x_3$

(OR)

6) Obtain the values of the Boolean forms $x_1 * (x_1' \oplus x_2)$, $x_1 * x_2$and $x_1 \oplus (x_1 * x_2)$ over the ordered pairs of the two-element Boolean algebra.

7) Prove that if for some integer k , $p_{k+1} = p_k$, then $p_k = p$ and conversely.

(OR)

8) Draw the karnaugh map for one variable, two variables, 3-variable, 4-variable

9) Answer any **THREE** of the following:

a) Draw Hasse diagram of the set x = {2, 3, 6, 12, 24, 36} and the relation $\leq$ be such that $x \leq y$ if x divides y

b) Write some properties of lattices

c) Define subalgebra, Direct product and Homomorphism.

d) Obtain the product of sums canonical forms of the Boolean expression $x_1 * x_2$

(e) Write about finite state machines.

ADIKAVI NANNAYA UNIVERSITY

SEMESTER END EXAMINATIONS

M.Sc. Applied Mathematics

III-SEMESTER

AM305.3: THEORITICAL COMPUTER SCIENCE

[W.E.F. 2019 A.B]

(MODEL QUESTION PAPER)

Time: 3 Hours　　　　Max . Marks : 75

Answer **ALL** questions. Each question carries 15 marks.　　　　Marks: $5 \times 15 = 75$

1.(a)Find a deterministic acceptor equivalent to M = (({q_0, q_1,q_2}, {a,b},δ, q_o, {q_2}) where $'\delta\,'$ is given by

States/$\sum$	a	b
$\rightarrow q_0$	q_0, q_1	q_2
q_1	q_0	q_1
q_2		q_0, q_1

(b) Cosider the Mealy machine described by the following transition table. Construct a Moore machine which is equivalent to Mealy machine

Present state	Next state			
	Input a=0		Input a=1	
	state	Output	state	Output
$\rightarrow q_1$	q_3	0	q_2	0
q_2	q_1	1	q_4	0
q_3	q_2	1	q_1	1
q_4	q_4	1	q_3	0

(OR)

2.Construct a minimum state automation equivalent to the finite automation with the transition Table

States/$\sum$	**0**	**1**
$\rightarrow q_0$	q_1	q_5
q_1	q_6	q_2
q_2	q_0	q_2

q_3	q_2	q_6
q_4	q_7	q_5
q_5	q_2	q_6
q_6	q_6	q_4
q_7	q_6	q_2

3(a) Let L be the set of all palindromes over {a. b}. Construct a grammar G generating L.

(b).Construct a grammar G generating $\{a^n\, b^n\, c^n \,/\, n \geq 1\}$

(OR)

4. Prove that **A context-sensitive language is recursive.**

5 (a)State and prove Arden's theorem

(b) Construct a finite automaton equivalent to the regular expression $(0 + 1)^*(00 + 11)(0 + 1)^*$

OR

6. Reduce the following grammar G to CNF, G is $S \rightarrow aAD, A \rightarrow aB/bAB$, $B \rightarrow b$, $D \rightarrow d$

7.Define a Turing machine and explain its functioning through ID and moves.

(OR)

8.Consider the Turing machine M described by the transition table given in the following table. Describe the processing of (a) 011 (b) 0011, (c) 001 using IDs. Which of the above strings are accepted by M?

Present state	Tape symbol				
	0	1	x	y	b
$\rightarrow q_0$	xRq_2				bRq_5
q_2	$0Rq_2$	yLq_3		yLq_2	
q_3	$0Lq_4$		xRq_5	yLq_3	
q_4	$0Lq_4$		xRq_1		
q_5				$yxRq_5$	bRq_6
q_6					

9. Answer any **THREE** of the following:

(a)Prove that $(1+00^*)+(1+00^*1)(0+10^*1)(0+10^*1) = 0^*1(0+10^*1)^*$

(b) If $G = (\{S\},\{0,1\},\{S\rightarrow 0S1, S \rightarrow \Lambda\},S)$. Find L(G)

(c) Show that $L = \{0^i\, 1^i \,/\, i \geq 1\}$ is not regular.

(d) Write application of Pumping lemma

(e) Design a Turing machine to recognize all strings consisting of an even number of 1's.

ADIKAVI NANNAYA UNIVERSITY

SEMESTER END EXAMINATIONS

M.Sc. Applied Mathematics

IV-SEMESTER

AM401: FUNCTIONAL ANALYSIS

[W.E.F. 2019 A.B]

(MODEL QUESTION PAPER)

Time: 3 Hours Max . Marks : 75

Answer **ALL** questions. Each question carries 15 marks. Marks: $5 \times 15 = 75$

1. a) Show that every finite dimensional subspace Y of a normal space X is complete.
   In particular, every finite dimensional normed space is complete.
   b) Prove that finite dimensional vector space is algebraically reflexive.

(OR)

2. a) If Y is a Banach space then, prove that (the set of all bound linear operators from X into Y) B(X, Y) is a Banach space.
   b) If T be a linear operator, then, prove that the range, R(T) is a vector space.

3. State and prove Bessell Inequality.

(OR)

4. State and prove Minimizing vector Theorem.

5. State and prove Riesz-Representation Theorem.

(OR)

6. a) Let H1, H2 be Hilbert spaces, $S: H_1 \to H_2$ and $T: H_1 \to H_2$ be bounded linear operators and α any scalar. Then prove the following: i)$\langle T^* y, x\rangle = \langle y, Tx\rangle$ ii) $(\alpha T)^* = \bar{\alpha} T^*$ iii)$(T^*)^* = T$.
   b) Let the Operators $U: H \to H$ and $V: H \to H$ be unitary and His Hilbert space. Then, prove that a bounded linear operator T on a complete Hilbert space H is unitary if and only if T is isomeric and surjective.

7. State and prove Generalized Hahn-Banach Theorem.

(OR)

8. State and prove Open Mapping Theorem.

9. Answer any **THREE** questions of the following.
   a) State and prove Schwarz inequality and Triangle Inequality.
   b) Define inner product space, orthogonality, Hilbert space and Banach space.
   c) State and prove Baire's Category Theorem in Complete metric space.
   d) Show that the dual space R^n is R^n.
   e) Show that an orthonormal set is linearly independent.

----------*----------

ADIKAVI NANNAYA UNIVERSITY

SEMESTER END EXAMINATIONS

M.Sc. Applied Mathematics

IV-SEMESTER

AM402: OPERATIONS RESEARCH - II

[W.E.F. 2019 A.B]

(MODEL QUESTION PAPER)

Time: 3 Hours | Max . Marks : 75

Answer **ALL** questions. Each question carries 15 marks. Marks: $5 \times 15 = 75$

1. An insurance company has decided to modernize and refit one of its branch offices. Some of the existing office equipments will be disposed of but the remaining will be returned to the branch of completion of the renovation work. Tenders are invited from a number of selected contractors. The contractors will be responsible for all the activities in connection with the renovation work expecting the prior removal of the old equipment and its subsequent replacement.

The major elements of the project have been identified as follows along with their durations and immediately preceding elements.

Activity	Description	Duration (weeks)	Immediate Predecessors
B.	Design new premises	14	-
C.	Obtain tendors from the contractors	4	A
D.	Select the contractor	2	B
E.	Arrange details with selected contactor	1	C
F.	Decide which equipment to be used	2	A
G.	Arrange storage of Equipment	3	E
H.	Arrange disposal of other equipment	2	E
I.	Order new equipment	4	E
J.	Take delivery of new equipment	3	H, L
K.	Renovations take place	12	K
L.	Remove old equipment for storage Or disposal	4	D, F, G
M.	Cleaning after the contactor has finished	2	J
N.	Return old equipment for storage	2	H, L

a) Draw the network diagram showing the interrelations between the various activities of the project

b) Calculate the minimum time that the renovation can take from the design stage

c) Find the effect on the overall duration of the project if the estimates or tenders can be obtained in two weeks from the contractors by reducing their numbers.

d) Calculate the 'independent float' that is associated with the non-critical activities in the network diagram

(OR)

2. A small project is composed of 7 activities whose time estimates are listed in the table below. Activities are identified by their beginning (i) and ending (j) node numbers.

Activity	Estimated Duration (weeks)		
(i- j)	Optimistic	Most Likely	Pessimistic
1-2	1	1	7
1-3	1	4	7
1-4	2	2	8
2-5	1	1	1
3-5	2	5	14
4-6	2	5	8
5-6	3	6	15

a) Draw the network diagram of activities in the project.
b) Find the expected duration and variance for each activity. What is the expected project length?
c) Calculate the variance and standard deviation of the project length. What is probability that the project will be completed?
   (i) Atleast 4 weeks earlier than expected time.
   (ii) No more than 4 weeks later than expected time.

d) If the project due date is 19 weeks, what is the probability of not meeting the due date.

Given:					
Z :	0.50	0.67	1.00	1.33	2.00
Probability :	0.3085	0.2514	0.1587	0.0918	0.0228

3. Derive an EOQ Model with Constant Rate of Demand

(OR)

4. A shop produces three items in lots. The demand rate for each item is constant and can be assumed to be deterministic. No back orders are to be allowed. The pertinent data for the items is given in the following table.

Item	I	II	III
Carrying cost (Rs per unit per year)	20	20	20
Set-up cost (Rs per set-up)	50	40	60
Cost per unit (Rs)	6	7	5
Yearly demand (units)	10,000	12,000	7,500

Determine approximately the economic order quantities for three items subject to the condition that the total value of average inventory levels of these items does not exceed Rs 1,000.

5. Write about the performance measures for Model 1 {(M/M/1) : $(\infty/FCFS)$}

(OR)

6. Arrivals at telephone booth are considered to be Poisson with an average time of 10 minutes between one arrival and the next. The length of phone call is assumed to be distributed exponentially, with mean 3 minutes.
    a. What is the probability that a person arriving at the booth will have to wait?
    b. The telephone department will install a second booth when convicted that an arrival would expect waiting for atleast 3 minutes for a phone call. By how much should the flow of arrivals increase in order to justify a second booth?
    c. What is the average length of the queue that forms from time to time?
    d. What is the probability that it will take him more than 10 minutes altogether to wait for the phone and complete his call?

7. Use Dynamic programming to show that

$$\sum_{i=1}^{n} p_i \log p_i$$

Subject to the constraint

$$\sum_{i=1}^{n} p_i = 1$$

and $p_i \geq 0$, for all i

is minimum when $p_1 = p_2 \dots \dots = p_n = \frac{1}{n}$

(OR)

8. Find the sequence that minimizes the total time required in performing the following jobs on three machines in the order ABC. Processing times (in hours) are given in the following table:

Job	1	2	3	4	5
Machine A	8	10	6	7	11
Machine B	5	6	2	3	4
Machine C	4	9	8	6	5

9. Answer any **THREE** questions of the following

    a. Explain Looping, Dangling and Dummy activity.
    b. Write the difference between PERT and CPM.
    c. Write a brief note on COST'S involved in inventory matrix.
    d. Derive Expected number of customers waiting in the queue.
    e. Write about Bell-man's principle in Dynamic programming.

ADIKAVI NANNAYA UNIVERSITY

SEMESTER END EXAMINATIONS

M.Sc. Applied Mathematics

IV-SEMESTER

AM403: FLUID DYNAMICS

[W.E.F. 2019 A.B]

(MODEL QUESTION PAPER)

Time: 3 Hours Max . Marks : 75

Answer **ALL** questions. Each question carries 15 marks. Marks: $5 \times 15 = 75$

1. Derive equation of continuity for incompressible fluids.

(OR)

2. Test whether the motion specified by $\bar{q} = \frac{k^2(x\bar{j}-y\bar{i})}{x^2+y^2}$ (k =constant) is a possible motion for an incompressible fluid. If so, determine the equations of the streamlines. Also test whether the motion is of the potential kind and if so determine the velocity potential.

3. Derive Euler's equation of motion.

(OR)

4. Derive Kelvin's circulation theorem

5. Doublets of strengths μ_1, μ_2 are situated at points A_1, A_2 whose Cartesian co-ordinates are $(0,0,C_1)$, $(0,0,C_2)$ their axes being directed towards and away from the origin respectively. Find the condition that there is no transport of fluid over the surface of the sphere $x^2 + y^2 + z^2 = C_1C_2$.

(OR)

6. Write about the complex potential for Two-Dimensional, Irrotational, Incompressible flow.

7. Derive the relations between stress and Rate of strain.

(OR)

8. Derive the Navier's Stokes Equations of Motion of a viscous Fluid

9. Answer any **THREE** of the following:
   a) At the point in an incompressible fluid having spherical polar co-ordinates (r, θ, Ψ) the velocity components are $[2Mr^{-3}\cos\theta, Mr^{-3}\sin\theta, 0]$ where M is a constant. Show that the velocity is of the potential kind.
   b) Write about acceleration of a fluid
   c) Write about the working principle of the instrument Pitot tube
   d) Discuss the flow for which $w = z^2$
   e) Write about the coefficient of viscosity and laminar flow.

ADIKAVI NANNAYA UNIVERSITY

SEMESTER END EXAMINATIONS

M.Sc. Applied Mathematics

IV-SEMESTER

AM404: PROBABILITY & STATISTICS

[W.E.F. 2019 A.B]

(MODEL QUESTION PAPER)

Time: 3 Hours Max . Marks : 75

Answer **ALL** questions. Each question carries 15 marks. Marks: $5 \times 15 = 75$

1. From a lot of 10 items containing 3 defective , a sample of 4 items is drawn at random. Let a random variable X denote the number of defective items in a sample. Find the probability distribution of X when the sample is drawn without replacement and also find Expectation and Variance.

(OR)

2. If t is any positive real number, show that the function defined by $P(x) = e^{-t}(1 - e^{-t})^{x-t}$ can represent a probability function of a random variable X assuming the values 1,2,3,,… Find E(X) and Var(X) of the distribution.
3. Fit a poisson distribution to the following data:

Number of mistakes per page:	0	1	2	3	4	Total
Number of pages :	109	65	22	3	1	200

(OR)

4. In a distribution exactly normal, 10.03% of the items are under 25 kilogram weight and 89.97% of the items are under 70 kilogram weight. What are the mean and standard deviation of the distribution?
5. Calculate the correlation coefficient for the following heights (in inches) of fathers(X) and their sons(Y):

X :	65	66	67	67	68	69	70	72
Y :	67	68	65	68	72	72	69	71

(OR)

6. Ten competitors in a musical test were ranked by the three judges A, B and C in the following order:

Ranks by A:	1	6	5	10	3	2	4	9	7	8
Ranks by B:	3	5	8	4	7	10	2	1	6	9
Ranks by C:	6	4	9	8	1	2	3	10	5	7

Using rank correlation method discuss which pair of judges has the nearest approach to common likings in music

7. A survey of 800 families with four children each revealed the following distribution:

No. of boys	:	0	1	2	3	4
No.of girls	:	4	3	2	1	0
No. of families	:	32	178	290	236	64

Is this result consistent with the hypothesis that male and female births are equally probable?

(OR)

8. A random sample of 10 boys has the following I.Q.'s 70, 120, 110, 101, 88, 95, 98, 107, 100. Do these data support the assumption of a population mean I.Q. of 100? Find a reasonable range in which most of the mean I.Q. values of samples of 10 boys lie.

9. Answer any **Three** of the following:

(a) If a random variable has the probability density *f(x) as*

$$f(x) = \begin{cases} 2e^{-2x}, for\ x > 0 \\ 0 \quad\ , for\ x \leq 0 \end{cases}$$

, find the probabilities that it will take on a value (i) Between 1 and 3 (ii) greater than 0.5

(b) A die is thrown 6 times , if getting an even number is a success, find the probabilities of

(i) At least one success

(ii) $\leq$ 3 success

(iii) 4 success

(c) Write chief characterstics of the normal distribution.

(d) If θ is a angle between two regression lines and S.D. of Y is twise the S.D. of X and r=0.25,find tanθ.

(e) A random sample of 500 apples was taken from a large consignment and 60 were found to be bad. Obtain the 98% confidence limits for the percentage of bad apples in the consignment.

ADIKAVI NANNAYA UNIVERSITY

SEMESTER END EXAMINATIONS

M.Sc. Applied Mathematics

IV-SEMESTER

AM405.3: GRAPH THEORY

[W.E.F. 2019 A.B]

(MODEL QUESTION PAPER)

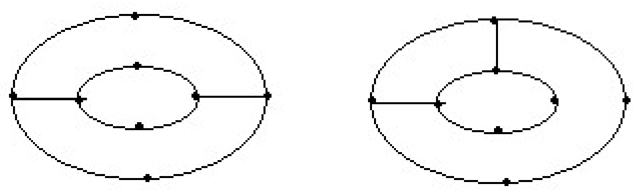
Time: 3 Hours Max . Marks : 75

Answer **ALL** questions. Each question carries 15 marks. Marks: $5 \times 15 = 75$

1. (a) Prove that “The number of vertices of odd degree in a graph is even”
   (b) Explain the Konig’s berg Bridge problem

(OR)

2. Test whether the following graphs are isomorphic or not

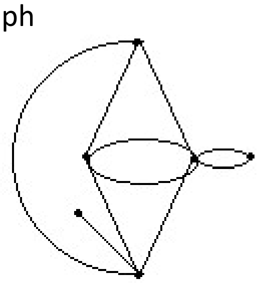


(a) (b)

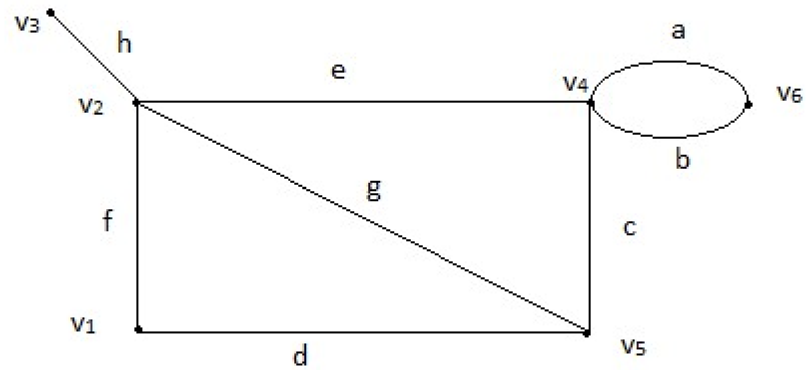
3. Prove that the complete graph of five vertices is non-planner v_5

(OR)

4. Obtain the Dual of the following graph



5. Let *A* and *B* be the respective circuit matrix and the incidence matrix (of a self loop free graph) whose columns are arranged using the same order of edges. Then every row of *B* is orthogonal to every row *A*. i.e $A.B^T = B.A^T = 0$ (Mod 2)
   Verify the result for the following graph



(OR)

6. If A*(G*) is an incidence matrix of a connected graph *G* with *n* vertices, then show that the rank of A(G) is n-1.

7. Show that the vertices of every planar graph can be properly colored with five colors

(OR)

8. State and prove Max-flow-min-cut theorem.

9. Answer any **THREE** of the following
   (a) Define Incidence Matrix and Path Matrix
   (b) Define Tree, Binary Tree with examples
   (c) Show that Kuratowski second graph is non planar
   (d) Show that every tree with two or more vertices is two chromatic number
   (e) Obtain the adjacency matrix of the following graph