

M.Sc., APPLIED MATHEMATICS

SEMESTER-I

S.NO	COURSE	CODE AMA	TITLE OF THE COURSE	H/W	C	SEE	IA	TOTAL MARKS
1	CC	101	1. Methods of Applied Mathematics	4	4	70	30	100
2		102	2(A). Real Analysis 2(B). Viscous Flows	4	3	50	25	75
3		103	3(A).Differential equations 3(B). Integral Equations	4	3	50	25	75
4	P	104	Practical-I (related CC 2&3)	6	2	35	15	50
5	SOC	105	1(A).Numerical Methods 1(B). MATLAB	4	3	50	25	75
6		106	2(A). Discrete Mathematics 2(B).C-Programming Language	4	3	50	25	75
7	P	107	Prcatical- II (related to SOC 1 &2)	6	2	35	15	50
				36	22	340	160	500
8	Audit Course	109	Ancient Indian Mathematics	4	0	0	100	0

SEMESTER-II

S.NO	COURSE	CODE AMA	TITLE OF THE COURSE	H/W	C	SEE	IA	TOTAL MARKS
1	CC	201	4.Mathematical Modeling	4	4	70	30	100
2		202	5(A).Complex Analysis 5(B).Semi group theory	4	3	50	25	75
3		203	6(A).Topology 6(B).Boundary Value Problems	4	3	50	25	75
4	P	204	Practical-III (Related to CC 5&6)	6	2	35	15	50
5	SOC	205	3(A).Mathematical Statistics 3(B).Data Structures and Algorithms	4	3	50	25	75
6		206	4(A). Operations Research For Industry and Community Development (TORA) 4(B). Python	4	3	50	25	75
7	P	207	Prcactical -IV (related to SOC 3 &4)	6	2	35	15	50
8	OOTC-I	208	edX/Swayam/NPTEL/MOOCs	-	2	-	-	100
				36	22	340	260	600
9	Audit Course	209	Vedic Mathematics	4	0	0	100	0

SEMESTER-III: APPLIED MATHEMATICS

S.NO	COURSE	CODE	TITLE OF THE COURSE	H/W	C	SEE	IA	TOTAL MARKS
		AMA						
1	CC	301	7. Classical Mechanics	4	4	70	30	100
2		302	8(A). Advanced Complex Analysis 8(B). Measure and Integration	3	3	50	25	75
3		303	9(A).Differential Geometry 9(B).Functional Analysis	3	3	50	25	75
4	P	304	Practical-I (Related to CC 8 &9)	4	2	35	15	50
5	SOC	305	5(A)Fluid Dynamics 5(B). Finite Element Method	3	3	50	25	75
6		306	6(A).Graph Theory 6(B). Boundary Value Problems	3	3	50	25	75
7	P	307	Practical -II (related to SOC 5 &6)	4	2	35	15	50
8	OOTC-2	308	edX/Swayam/NPTEL/MOOCs	-	2	-	100	100
	OE (Open Elective)		Business Mathematics-I	4	4	70	30	100
Seminar/Tutorials/Remedial classes and Quiz as part of internal Assessment				4	-	-	-	-
			TOTAL	36	22	340	260	600

SEMESTER-IV: APPLIED MATHEMATICS

S.NO	COURSE	CODE MAT	TITLE OF THE COURSE	H/W	C	SEE	IA	TOTAL MARKS
1	OOSDC OR SDC	401	Open online skill Development Courses (SWAYAM/ NPTEL/any equivalent Courses) OR 401-A Continuum Mechanics 401-B Introductory Methods of Numerical Analysis	-	8 4 4	- 70 70	200 30 30	200 100 100
2	Project work	402	Algebra/ Graph Theory / Coding Theory/ Operation Research/ Mathematical Statistics/ Cryptography/ Number theory	-	12	-	300	300
Total					20		300	300

M.Sc., APPLIED MATHEMATICS

SEMESTER-I

AMA101: METHODS OF APPLIED MATHEMATICS

Course Objectives:

1. To familiarize students with a range of mathematical methods that are essential for solving advanced problems in theoretical physics.
2. To study Fourier series and Fourier Transforms.
3. To understand the applications of Sylow's Theorems.
4. To discuss the algebraic structures U.F.D, E.D and polynomial rings.
5. To investigate applications to problems in economics, management and related areas.
6. To develop the understanding of the theoretical concepts behind these methods.

UNIT I:

Fourier Transforms : Dirichlet conditions – Fourier integral formula –The (Complex) Fourier transform – Fourier sine and cosine transforms-Relationship of Fourier and Laplace transforms –Some useful results for direct applications-Linearity property of Fourier transforms –Change of scale property –Shifting property—Modulation theorem –Convolution or Falting-The convolution or Falting theorem for Fourier transforms –Parseval's identity for Fourier transforms Rayleigh's theorem of Plancherel's theorem – Relation between the Fourier transforms of the derivatives of a function –Multiple Fourier transforms-Applications of Fourier transforms to Boundary value problems. (Chapter 4)

UNIT-II

Finite Fourier Transforms: Fourier Series –The finite Fourier sine transform-The finite Fourier cosine transforms –Relation between the finite Fourier transforms of the derivations of a function –Multiple finite Fourier transforms –Applications of finite Fourier transforms to boundary value problems-Special case of boundary value problem (Chapter 5)

Scope and standard as in “ **Integral Transforms**” by Raisinghania, published by S. Chand & Co., New Delhi, 1995 Edition.

ALGEBRA:

UNIT: III

Structure Theorems of Groups : Conjugacy and G-Sets, Normal series, Solvable groups, Simplicity of A_n , Sylow theorems. (Sections 4 of Chapter 5, Sections 1 and 2 of Chapter 6, Section 3 of Chapter 7 and Sections 4 of Chapter 8)

UNIT IV : UNIQUE FACTORIZATION AND EUCLIDEAN DOMAINS:

Unique factorization domains-Principal ideal domains-Euclidean domains-Polynomial rings over UFD(chapter 11)

Scope and standard as in “**Basic Abstract Algebra**” by Bhattacharya , P.B. Jain, S.K. and Nagpul S.R, Cambridge University Press, 1997 Reprint

References: 1. Topics in Algebra – I.N. Herstein

Course outcomes:

1. Understand basic concepts of complex analysis including the important integral theorems.
2. Determine the residues of a complex function and use the residue theorem to compute certain types of integrals.
3. Solve ordinary second order differential equations particularly in the physical sciences; solve physically relevant partial differential equations using standard methods like separation of variables, series expansion (Fourier-type series), and integral transforms.
4. Expand a function in a Fourier series and able to know under what conditions such an expansion is valid.
- 5..Aware of the connection between integral transforms (Fourier and Laplace) and be able to use the latter to solve mathematical problems relevant to the physical sciences.
6. Receive basic training in tensor calculus.

(Common with the paper MAT 102:2(A) of Branch 1(A) Mathematics)

This course covers Riemann-Stieltjes Integral, Sequences and Series of Functions, Functions of Several Variables, Improper Integrals, Fourier series, Maxima and Minima.

Course Objectives:

- 1) Acquire knowledge on Riemann-Stieltjes Integration and Differentiation.
- 2) Discuss Uniform Convergence, Continuity Integration and Differentiation
- 3) Learn comparison Tests
- 4) Understand the concept of functions of several variables.

UNIT – I:

The Riemann –Stieltjes Integral: Definition and Existence of the integral properties of the integral, integration and Differentiation, Integration of vector valued function, Rectifiable curves.

UNIT – II:

Sequence and series of functions: Discussions of main problem, uniform convergence, uniform convergence and continuity, Uniform convergence and Integration, Uniform convergence and Differentiation.

Scope and standard as in Chapters 6, sections 7.1 to 7.18 of chapter 7 of Walter Rudin” Principles of Mathematical Analysis” 3rd edition 1976, Nc. Graw hill International student edition.

UNIT – III:

Improper Integrals: Introduction, Integration of unbounded functions with finite limit of Integration, comparison tests for convergence at a ∞ , infinite Range of Integration.

Fourier series: Trigonometrically series, some preliminary theorems.

UNIT-IV:

Functions of Several Variables : Explicit and Implicit functions, Continuity, Partial derivations, differentiability, partial derivatives of higher order, differentials of higher order, function of functions, change of variables, Taylor’s theorem, Extreme values, Maxima and Minima, functions of several variables.

Scope and standard as in chapters 11, 12 and 15 of **Mathematical Analysis by “S.C. Malik 1994” Wiley Eastern limited**

Reference:

- (1) Mathematical Analysis- A modern Approach to Advanced Calculus Narosa Book Distributors Pvt LTD- New Delhi
- (2) Real Analysis - Golden Math Series By N.P. Bali.
- (3) A course of Mathematical Analysis by Shanti Narayan -K. Mittal , S-Chand & Company LTD-New Delhi

Course Outcomes:

1. Understand the concepts of Riemann Stieltjes integration and Differentiation.
2. Understand Uniform Convergence and continuity.
3. Learn comparison tests at a and infinity.
4. Analyze the concept of functions of several variables.

AMA 102:2B - VISCOUS FLOWS

Course objectives:

1. To introduce and explain fundamentals of Fluid Mechanics, which is used in the applications of Aerodynamics, Hydraulics, Marine Engineering, Gas dynamics etc.
2. To give fundamental knowledge of fluid, its properties and behavior under various conditions of internal and external flows.
3. To determine the losses in a flow system, flow through pipes, boundary layer flow and flow past immersed bodies.

UNIT – I:

General theory of stress and rate of strain –Nature of stresses –Transformation of stress components –Nature of Strain Transformation of rates of strain –Relation between stress and rate of strain.

UNIT – II:

Fundamental equations of the flow of viscous incompressible fluids –The equation of continuity –conservation of momentum –the energy equation – conservation of energy –the equations of state –perfect gases –the fundamental equations in cylindrical coordinate –equation of continuity –equations of motion –the energy equation.

UNIT –III:

Laminar flow of viscous incompressible fluids –similarity of flows –The Reynold's number –Viscosity from the point of view of the kinetic energy –Flow between parallel flat plates –couette flow –plane Poiseuille flow –steady flow through a pipe –the Hagen Poiseuille flow –flow between two co-axial cylinders –Flow between two concentric Rotating cylinders –Applications of the parallel flow theory –The measure of viscosity –Hydro dynamics of bearing Lubrication –Steady flow around a sphere –the theory of very slow motion –unsteady motion on a flat plate

UNIT – IV:

The Laminar Boundary layer –properties of Navier-Stokes equations - Boundary layer concepts –The Boundary layer equations in two dimensional flow –The Boundary layer along a Flat plate –Blasius solution – Shearing stress and boundary layer thickness - Boundary layer as a surface with pressure Gradient –Momentum Integral theorems for the boundary layer –The Von Karman Integral relation.

Course outcomes: From this course students will be able to

1. Employ Bernoulli's equation for real flow and deduce expressions for orifice meter and Venturimeter.
2. Establish Hagen Poiseuille's equation for laminar flow through pipe and parallel plates.
3. The course provides the student with knowledge about: - Formulating and solving problems in fluid mechanics where viscosity and heat conductivity are of importance, in particular at high Reynolds numbers where the boundary layer approximation applies. - Primary focus is on the laminar flow regime. Briefly about stability and transition to turbulence. - Quantitative methods for classical cases, such as Stokes problems, stagnation point flow, Blasius and Falkner-Skan problems, and integral methods for other boundary layers with pressure gradient and possible separation

Standard and treatment as in Articles 4.1 to 4.5 of chapter 4, Articles 5.1 to 5.6, Articles 8.1 to 8.8 of Chapter 8 and Articles 9.1 to 9.5a of chapter 9 of **“FOUNDATIONS OF FLUID MECHANICS” by S.W.Yuvan, Prentice Hall of India Pvt.ltd. New Delhi,1969.**

AMA 103:3A - DIFFERENTIAL EQUATIONS (Common with paper MAT 103:3A of Branch I (A) Mathematics)

This course introduces fundamental knowledge in Differential Equations that is applicable in the engineering aspects. Also it is designed to strengthen the fundamental knowledge of P.D.Es which lead to understand the real world problems.

Course objectives:

1. To find solutions of power series and second order linear equations.
2. To provide knowledge on Special functions -Legendre polynomials and properties of Bessel functions.
3. To find integral surface passing through given surface using P.D.E
4. To explain methods to solve Linear P.D.Es with constant and Variable coefficients

UNIT –I:

Eigen values, Eigen functions –Series solutions of first order equations –Second order linear equations-Ordinary points-Regular singular points.

UNIT – II:

Legendre polynomials – properties of Legendre polynomials –Bessel functions –The gamma function- Properties of Bessel functions

UNIT –III:

Differential Equations in more than two variables: Methods of solutions of $dx/P = dy/Q = dz/R$ -. (Sections 3, of Chapter 1)- Partial Differential Equations of the First order: Partial Differential equations-Origins of first order partial differential equations-Cauchy's problems for first order equations-Linear equations of first order -Charpit's method.(Sections 1,2,3, 4,5,6 and 10 of Chapter 2)

UNIT – IV:

Partial Differential Equations of the Second order: The Origin of second order equations –Linear partial differential with constant coefficients-Equations with variable coefficients. (Sections 1, 4 and 5 of Chapter 3).

Scope and standard as in 1. “**Differential Equations with Applications and Historical notes**” by **George F. Simmons, (1992)** Tata McGraw Hill Publications for Units I & II.

2. “**Elements of Partial Differential Equations**” by **IAN Sneddon** for Units III & IV.

References:

1. Advanced Differential Equations, M.D. Raisinghania , S. Chand Publications
2. Differential Equations” Ross, Shepley L Wiley India Pvt LTD.
3. Engineering Mathematics y Bali NP, SatyanarayanaBhavanari, kelkar, University Science Press, New Delhi 2012.
4. An introduction to O.D.E by Earl.A.Coddington , Prentice Hall of India Private Limited, New Delhi 1991.
5. Theory of ODE by Sam Sundaram, Narosa Publications
6. Ordinary and Partial Differential Equations by M.D. Raisinghania.
7. An elementary course to P.D.E by T.Amarnath, Second Edition, Narosa publishing house.

Course outcomes: From this course students will be able to

1. Find solutions of power series and second order linear equations.
2. Acquire knowledge on Special functions -Legendre polynomials and properties of Bessel functions.
3. Analyze the origin of first order PDEs and Integral surfaces passing through a given Curve
4. Identify linear and nonlinear PDE and solve nonlinear PDE by Charpit's method.

AMA 103:3B - INTEGRAL EQUATIONS

(Common with paper MAT 103:3B of Branch I (A) Mathematics)

Course Objective

1. To study the compact linear operators, which play an important role in the theory of integral equations.
2. Banach fixed point theorem helps us to get the existence of solutions of linear algebraic equations, ordinary differential equations and integral equations.
3. To understand the Banach fixed point theorem and its applications to ordinary differential equations and integral equations.

Unit – 1 : PRELIMINARY CONCEPTS

Introduction; Some Problems which give Rise to Integral Equations; Conversion of Ordinary Differential Equations into Integral Equations; Classification Linear Integral Equations; Integro-differential Equations.

Unit – 2 : FREDHOLM EQUATIONS

Analogies with Matrix Algebra; Degenerate Kernels; Hermitian and Symmetric Kernels; The Hilbert-Schmidt Theorem; Hermitization and Symmetrization of Kernels; Solution of Integral Equations with Green's Function Type Kernels; Miscellaneous.

(Chapter 2 of Text Book).

Unit – 3 : VOLTERRA INTEGRAL EQUATIONS:

Types of Volterra Equations, Resolvent Kernel of Volterra Equation; Convolution Type Kernels; Some Miscellaneous Types of Volterra Integral Equations.

INTEGRAL EQUATIONS AND TRANSFORMATIONS:

Preliminary; Fourier Integral Equations; Laplace Integral Equations; Hilbert Transform; Finite Hilbert Transforms; Miscellaneous Integral Transforms.

Unit – 4 : APPROXIMATE METHODS.:

General; Non-linear Volterra Equations; Non-linear Fredholm Equations; Approximate Methods of Solution for Linear Integral Equations; Approximate Evaluation of Eigenvalues and Eigen functions.

Scope and standard as in Problems and Exercises in Integral Equations, MIR Oybkusgers, Moscow, 1971 by M. Krsnov, A. Kiselev and G. Makarendo.

References:

- 1) Integral Equations and their Applications, WIT press, 25 Bridge Street, Billerica, MA 01821, USA, by M. Rahman.
- 2) Introduction to Integral Equations with Applications, John Wiley & Sons, 1999, by Jerri, A.
- 3) Linear Integral Equation, Theory and Techniques, Academic Press, 2014 by Kanwal R. P.
- 4) A first course in Integral Equations, 2nd edition, World Scientific Publishing Co. 2015 by Wazwaz, A. M.

Course outcomes: From this course students will be able to

1. Apply and analyze the integral equations in ordinary differential equations.
2. Find Hermitian and Symmetric Kernels
3. Gain the knowledge about the types of Volterra equations.
4. Evaluate solutions of Linear Integral Equations.

AMA 104: PRACTICAL-I (Common with paper MAT 104 of Branch I (A) Mathematics)

(Related to CC 2:5A & 3:6A)

Practical for Real Analysis CC 2:5A

1. Write a program to find the largest value in an array of elements.
2. Write a program using pointers to compute the sum of all elements stored in an array
3. Write a program to illustrate error handling in the file operators.
4. Write a program of function power that computes X raised to the power Y for integers X and Y and return double type value.
5. Write a program which would print the alphabet set a to z and A to Z in decimal and character form.
6. Write a program to evaluate the equation $\sum_{i=1}^n \left(\frac{1}{i} \right)$ using a cost

Practicals for Differential Equations: CC 3:6A

1. Evaluate the Eigen Values and Eigen functions for the equation.
2. Explain the Power series solution of the given Differential equation
3. Obtain the solution of the D.E using Recurrence formula

4. Discuss the Legendre polynomial of degree n.
5. Evaluate the D.E $\frac{dx}{P} = \frac{dy}{Q} = \frac{dz}{R}$.
6. Determine the solution of Nonlinear PDE by Charpits Method.
7. Evaluate the solution of second order PDE.

(OR)

AMA 104 : PRACTICAL-I
(Common with paper MAT 104 of Branch I (A) Mathematics)

(Related to CC:2B & 3B)

Practicals for Viscous Flows: CC 2:2(B)

1. Transform the stress components
2. write about relation between stress and rate of Strain.
- 3 Derive the equation of continuity.
4. Deriven the conservation of energy equation.
5. Explain the flow between parallel plates - couette flow
6. Derive momentum integral theorem.

Practicals for Integral equations: CC: 3 (B)

- 1.Convert an ODE to Integral equation
- 2.: Write kernels in finite-sum form and solve related integral equations.
- 3.Determine if kernels are Hermitian or symmetric and study their integral equation solutions.
- 4.: Verify Hilbert-Schmidt conditions and compute eigenvalues and eigenfunctions for kernels.
- 5..Construct and use Green's functions to solve integral equations.
- 6.Solve Volterra integral equations of various types using appropriate methods (resolvent kernels, Laplace transforms).
- 7.Use Fourier transforms to handle convolution-type integral equations.
- 8.Apply Laplace transforms/ Hilbert transforms to solve integral equations with convolution kernels.
9. Apply iterative methods (Picard, Newton-Kantorovich) to solve non-linear Volterra and Fredholm equations.

SKILL ORIENTED COURSE (SOC-I)

AMA 105: SOC- 1 (A) - NUMERICAL METHODS
(Common with paper MAT 105: SOC - 1 (A) - of Branch I (A) Mathematics)

Course objectives:

1. To provide suitable Numerical Methods, for obtaining Roots of algebraic and Transcendental equations
2. To study of different methods of Interpolation.
3. To know the interpolation with unevenly spaced points.
4. To study the various methods of Numerical integration.

UNIT-I:

Solutions of Algebraic and Transcendental Equations: Introduction - Bisection method – Method of False position - Newton Raphson –method solutions of non linear equations – Method of iteration.
[Above topics are from 2.1 to 2.7, 2.12 of Chapter-2 of the Text Book]

UNIT-II:

Interpolation : Introduction - Finite Differences- Newton's formulae for interpolation- Newton's forward difference interpolation- Backward difference interpolation- Central interpolation formulae –Gauss's central difference formulae- Strilling's formula- Bessel's formula.
[Above topics are from 3.1, 3.3, 3.6, 3.7:3.7.1,3.7.2, 3.7.3 of Chapter-3 of the Text Book]

UNIT-III:

Interpolation with unevenly spaced points- Lagrange's Interpolation Formula -Divided Differences and their properties – Newton's general Interpolation Formula-Spline Interpolation [Above topics are from 3.9.1, 3.10.1, 3.13 of Chapter-3 of the Text Book]

UNIT-IV:

Numerical integration: Trapezoidal rule- Simpsons rules – numerical solution of ODEs by Picard – Euler – Modified Euler – Runge-Kutta methods.

[Above topics are from 5.4.1 to 5.4.3 of Chapter- 5 and 7.1 to 7.5 of Chapter- 7of the Text Book]

Text Book:

Scope and standard as 1. “Introductory methods for Numerical Analysis by S.S.Sastry fourth edition”.

Reference Books:

1. An Introduction to Numerical Analysis by Kendall E. Atkinson.
2. Information Technology and Numerical methods fot Atul Kahate
3. Theory and problems in Numerical Methods with programs in C and C++.
4. Numerical Methods and computing by Ward Cheney and David Kincaid
5. Numerical Methods for Scientific and Engineering Computation by M. K. Jain, S.R K. Iyengar, R. K. Jain, New Age International (p) Limited, Publishers, 5th Edition

Course Outcomes:

From this Course Students are able to

1. Solve Algebraic and Transcendental polynomial equations.
2. Understand Interpolation.
3. Study interpolation with unevenly spaced points
4. Analyze and evaluate the accuracy of area, volume by Numerical methods.

AMA 105: SOC 1(B) - MAT-LAB

(Common with paper MAT 105: SOC 1(B) - of Branch I (A) Mathematics)

Course Objectives:

Getting started with MATLAB

To create M-files.

To learn 2D and 3D Plotting Techniques.

To know how to write programs to solve Algebraic Equations

UNIT-I (Basics of MATLAB)

Getting Started with MATLAB- Different windows-Mathematical Operators and Mathematical functions-Creating matrices and arrays- Matrix algebra-Linear algebra concepts

UNIT-II: (MATLAB Programming)

M-files-Script files- Function files-Relational operators-conditional statements

UNIT-III

Graphics: Basic 2-D plots- 3-D plots

UNIT-IV:Algebraic Equations: solving linear system-Gaussian elimination-finding eigen values and eigen vectors.

Syllabus and treatment as in the Book:

1.Getting Started with MATLAB – A Quick Introduction for Scientists and Engineers, RudraPratap, Oxford

University Press.

References:

- 1.. MATLAB Programming for Engineers. (4th ed.), Stephen J. Chapman, CI Engineering.
2. MATLAB: Demystified -Basic Concepts and Applications, K KSarma, Vikas Publishing House Pvt Lt.
3. Engineering Problem solving with MATLAB, D.M.Etter, Printice-Hall

Course Outcomes:

1. Understand the mathematical operations & functions.
2. Able to write a program to addition & multiplication matrices.
3. Understand the 2-D plotting and 3-D plotting techniques.
4. Able to Solve Algebraic equations.

AMA 106: SOC- 2(A) - DISCRETE MATHEMATICS (Common with paper MAT 106 SOC- 2(A) of Branch I (A) Mathematics)

The aim of the discrete mathematics is the study of mathematical structure that are fundamentally discrete rather than continuous.

Course Objectives:

- 1.To know the connectives & tautology.
- 2.To study the mathematical structure that is countable or distinct and separable.
- 3.To learn sets functions, logic, calculus and analysis.
- 4.To study the Algebraic systems such as Lattices ,Boolean Algebra and Boolean function.

UNIT –I:

Introduction – connectives – well formed formula Tautologies – Equivalence formulas – duality Tautological implications – Formula with distinct truth tables – Functionally complete sets of connectives.
(Sections 1.1 and 1.2 to 2.11 of Chapter 1)

UNIT – II:

Normal Forms-Disjunctive-Conjunctive Principal Disjunctive, Principal Conjunctive Normal Forms –Ordering and Uniqueness of Normal Forms. The theory of Inference for the statement Calculus-Rules of inferences – Consistency of Premises (Sections 1.3 and 1.4 of Chapter 1)

UNIT – III:

The predicate calculus-Inference Theory of the Predicate Calculus (Sections 1.5 and 1.6 of Chapter 1)

UNIT-IV:

Lattices and Boolean Functions: Lattices as partially Ordered sets-Lattices as Algebraic Systems – Minimization.
(Sections 4.1 of Chapter 4)

Scope and Standard as in the book “ **Discrete Mathematical Structures With Applications To Computer Science**” by Tremblay, J.P.&Manohar, R-Published by McGraw-Hill International Edition -1987 Edition

References: 1. Discrete Mathematics & Graph Theory by Bhavanari Satyanarana & Kuncham Syam Prasad, PHI Publications, New Delhi, Second Edition, 2014.

Course Outcomes: From this course students will be able to

1. Use standard notations of propositional logic.
2. Understand the truth tables for expressions involving negation, conjunction, and disjunction
3. Determine if a logical argument is valid or invalid.
4. Understand the Boolean algebraic structures.

**AMA 106 SOC- 2(B) - C-PROGRAMMING LANGUAGE
(COMMON WITH PAPER MAT 106 SOC- 2(B) OF BRANCH I (A) MATHEMATICS)**

UNIT-I:

Constants, Variables, and Data Types: Introduction-Character set-C Tokens-Key words and Identifiers-Constants-Variables-Data types – Declaration of variables-Declaration of storage class – Assigning Values to Variables- Defining Symbolic Constants – Declaring a Variables as Constant- Declaring a Variable as Volatile- Overflow and Underflow of Data.

UNIT-II:

Operators and Expressions : Introduction - Arithmetic operators –Relational operators –Logical operators –Assignment operators-Increment and decrement operators –Conditional operators- Bitwise Operators-Special Operators – Arithmetic Expressions-Evaluation of Expressions-Precedence of Arithmetic Operators – Some Computational Problems-Type Conversions in Expressions – Operator Precedence and Associativity- Mathematical Functions .

UNIT-III:

Decision making and Branching : Introduction – Decision making with if Statement-Simple if Statement-The if...Else Statement – Nesting of if... Else Statements-The Else if Ladder-The Switch Statement – The ?: Operator- The Goto Statement.

UNIT-IV:

Decision Making and Looping: - Introduction-The While Statement – The do Statement-The for Statement-Jumps in Loops-Concise Test Expressions.

Arrays

Introduction - One Dimensional Arrays – Declaration of One-Dimensional Arrays- Initialization of One Dimensional Arrays-Two Dimensional Arrays – Initializing Two –Dimensional Arrays- Multi-Dimensional Arrays- Dynamic Arrays-More about Arrays.

Scope and Standard as in: “ Programming in ANSI C” by E. Balaguruswamy(Sixth edition) Mc. Graw Hill Edition, India. (Sections 2.1 to 2.14 of Chapter 2, 3.1 to 3.16 of Chapter 3, 5.1 to 5.9 of Chapter 5, 6.1 to 6.6, of Chapter 6, 7.1 to 7.9 of Chapter 7)

**AMA 107 : PRACTICAL-II
(Common with paper MAT 107 of Branch I (A) Mathematics)**

(Related to SOC 1A & 2A)

Practical for Numerical Methods: SOC- 1A

1. Bi-section method.
2. False position method.
3. Newton Raphson method.
4. Trapezoidal rule.
5. Simpson's $\frac{3}{8}$ th rule
6. Picard's Method

7. Euler method
8. Modified Euler method
9. Range-Kutta Method

Practicals for DISCRETE MATHEMATICS: SOC 2- 2A

1. Generate truth tables automatically for complex formulas.
 2. Convert logical expressions into their Disjunctive Normal Form (DNF) and Conjunctive Normal Form (CNF).
 3. Construct truth tables for NAND, NOR, and XOR connectives.
 4. Apply Karnaugh maps (K-maps) to minimize Boolean functions.
 5. Draw Hasse diagrams and visually represent lattices. (Use graphing tools or software like Graphviz or Gephi).
 6. Construct examples of modular lattices and distributive lattices and demonstrate their properties.
- (OR)**

AMA 107: PRACTICAL-II (Common with paper MAT 107 of Branch I (A) Mathematics) (Related to SOC 1B & 2B)

Practical for MATLAB: SOC 105 -1B

1. Create any M-file
2. Creating arrays and Matrices
3. Basic 2D-plots
4. Basic 3D-plots
5. Solving system of algebraic equations
6. Find Eigen values and Eigen vectors

Practical for C-PROGRAMMING LANGUAGE: SOC 106 - 2B

1. write a C- program of the given problems.
2. Write a C-program to evaluate the power series.
3. Write a C-program using single subscripted variables.
4. Write a C-program using a two dimensional array.
5. Write a C-program to compute and print a multiplication.
6. Write a C-program for standard deviation.

AMA 108: edX/Swayam/NPTEL/ MOOCS

(Common with paper MAT 108 of Branch I (A) Mathematics)

AMA 109: Ancient Indian Mathematics (Common with paper MAT 109 of Branch I (A) Mathematics)

UNIT – I : (Heralding the Golden Age: Aryabhata I and his Followers):

Introduction – The Mathematics in Aryabhatiya- I and its followers Aryabhatiya –Geometry –series –Algebra – Indeterminate equations.

Unit- II: (Riding the Crest of a Wave: From Brahmagupta to Mahavira- I)

The Mathematics in the Brahmasphuta-siddhanta –arithmetic of calculation –Triangles and Quadrilaterals

Unit-III : (Riding the Crest of a Wave: From Brahmagupta to Mahavira-II)

Geometry of circles –intersecting circles -Shadow Problems –intermediate analysis works of Brahmasphuta-siddhanta –solution of Quadratic equations –volume of sphere – Mahavira –Unit fractions.

Unit-IV: (The 500 Year Climax: Bhaskaracharya and His Legacy)

The Contents of Lilavati – Arithmetic calculation –Method of inversion –Solution of Cubic and biquadratic equations.

Scope and standard as “**Indian Mathematics Engaging with the World from Ancient to Modern Times**” by George Gheverghese Joseph University of Manchester, UK National University of Singapore, Singapore McMaster University, Canada.

Reference:

“**History Of Ancient Indian Mathematics**” by Srinivasiengar .C.N ,The World press Calcutta.

SECOND SEMESTER

AMA 201: MATHEMATICAL MODELLING

Course Objectives:

- 1) Enable students understand how mathematical models for ODE of first order, second order and system of linear differential equations are formulated, solved and interpreted.
- 2) Make students appreciate the power and limitations of mathematics in solving practical real-life problems.
- 3) Equip students with the basic mathematical modeling skills.

UNIT –I

Mathematical modeling through ordinary differential equations of first order.

UNIT-II

Mathematical Modeling through system of ordinary differential equations of first order

UNIT: III

Mathematical Modeling through ordinary differential equations of second order

UNIT IV:

Mathematical Modeling through difference equations: Basic Theory of Linear Difference Equations with constant coefficients- Mathematical Modeling through difference equations in Economics and Finance- Mathematical Modeling through difference Equations in Population Dynamics and Genetics.

Mathematical Modeling Through partial Differential Equations: mass-Balance Equations –Momentum Balance Equations.

Scope and standard as in Chapter 2, Chapter 3, Chapter 4, sections 5.2 to 5.4 Chapters 5 and Sections 6.2 and 6.3 of Chapters 6 in “**Mathematical Modelling**” by J.N. Kapur, Wiley Eastern Limited(1988)

References : 1. Mathematical Modeling –Applications, Issues and analysis – by Vimal K

Mishra, ANE Book Publishers –New Delhi

2. Mathematical Modeling by Meerschaert M. Elsevier India Pvt Ltd.

Course Outcomes:

- 1) Understand what a mathematical model is and explain the series of steps involved in a mathematical modeling process.
- 2) Identify some simple real-life problems that can be solved using mathematical models, model the problem, solve the resulting problem, and interpret the solution.

- 3) Acquire basic mathematical modeling skills that will enable them carry out simple modeling tasks individually or as a group.
- 4) State and explain the different classifications of mathematical models stating examples in each class.
- 5) Analyze the importance of partial differential equations in mathematical modeling.
Frame quantitative problems and model them mathematically

AMA 202:5(A) - COMPLEX ANALYSIS
(Common with paper MAT 202: 5A of Branch I (A) Mathematics)

Complex analysis, traditionally known as the theory of functions of a complex variable, is the branch of mathematical analysis that investigates functions of complex numbers.

Course Objectives:

1. To define analytic functions and derivative rules of complex functions.
2. To introduce Mobius transformations and explain its applications.
3. To evaluate definite integrals using Cauchy integral formula.
4. To understand power series and expansion of analytic function.

UNIT – I :

Differentiation: Analytic Functions: Derivative Rules for Differentiating Complex Functions- The Cauchy-Riemann Equations –Analytic Functions-Geometrical Interpretation of $f^1(z)$ and $|f^1(z)|$ - Conformal Mapping –The Mapping $w = \frac{az+b}{cz+d}$.

UNIT – II:

Mobius Transformations: The Group Property of Mobius Transformations – The Circle –Preserving Property of Mobius Transformations-Fixed points of a Mobius Transformation-Invariance of Cross Ratio-Mapping of a circle onto a Circle – Symmetry Transformations.

UNIT – III:

Complex Integrals: Cauchy Integral Theorem: Rectifiable Curves-Complex Integrals-The Case of Smooth Curves-Cauchy's Integral Theorem-The Key Lemma proof of Cauchy's Integral Theorem-Application to the Evaluation of Definite Integrals Cauchy's Integral Theorem for a system of Contours. Cauchy's Integral Formula –Morera's Theorem – Cauchy's Inequalities.

UNIT-IV:

Power Series: The Cauchy-Hadamard Theorem – Taylor Series. The Uniqueness Theorem for Power series-Expansion of an Analytic Function in a power series –Liouville's Theorem. The Uniqueness Theorem for Analytic functions-A Points.

Scope and Standard as in Chapters 3,5,7,8 and 10 of **“Introductory Complex Analysis” by Richard A. Silverman Dover Publications, Inc. (1972). New York**

References :

- 1 Complex Variables - Schaum outline series, 2/E by Spiegel
2. An Introduction to Complex Analysis, by C.L. Siegel :North Holland.

Course outcomes:

1. Identify curves and regions in the complex plane defined by simple expressions.
2. Describe basic properties of complex integration and having the ability to compute such integrals.
3. Decide when and where a given function is analytic and be able to find its series development.
4. Describe conformal mappings between various plane regions.
5. Apply the concepts of Complex Analysis in many branches of mathematics, including algebraic geometry, number theory, analytic combinatorics, applied mathematics; as well as in physics, including the branches of hydrodynamics, thermodynamics and particularly quantum mechanics.

AMA 202:5 (B) - SEMIGROUP THEORY
(Common with paper MAT 202:5(B) of Branch I (A) Mathematics)

Course Objectives:

1. Introduce basic definitions and examples of semi groups and semi Lattices.
2. Discuss free semi groups and lattices of equivalences.
3. Explain Ree's theorem & primitive Idempotents.
4. Analyze O-simple semi groups and free semi groups with Illustrations.

UNIT-I

Basic definitions – Homogenic Semigroups – Ordered sets- Semi lattices and lattices – Binary relations- Equivalences- Congruences.

UNIT-II

Free Semi groups Ideals and – Rees Congruences. Lattices of equivalences and congruences – Green's equivalences. The structure of D.Classes – regular semigroups.

UNIT-III

Simple and Q-Simple semi groups. Principle factors, Rees's Theorem, Primitive idempotents.

UNIT-IV

Congruences on completely O-Simple semi groups. The Lattice of Congruences on a completely O-Simple semi groups. Finite Congruences, free semi groups.

Text Book :

An Introduction to Semi group Theory by J.M. Howie (1976), Academic Press, (Content of the Syllabus : Chapters-I, II and III).

Course Out comes:

1. Understand semi groups with the properties.
2. Explain the structure of D.Classes – regular semigroups.
3. Obtain proofs of Rees's Theorem.
4. Know the congruences on completely O-Simple semi groups

AMA 203:6 (A) - TOPOLOGY (Common with paper MAT 203:6(A) of Branch I(A) Mathematics)

Topological concepts play important role in the development of modern mathematics and it has large applications in theoretical physics.

Course Objectives:

1. This course aims to teach the fundamentals of point set topology and constitute an awareness of need for the topology in Mathematics.
2. Introduce the basic definitions and standard examples of topological spaces.
3. Define and illustrate a variety of topological properties such as compactness, connectedness and separation axioms.
4. Explain the idea of topological equivalence and define homeomorphisms.

UNIT –I :

Metric spaces:-open sets-closed sets- convergence-completeness and Baire's theorem-Continuous mappings – Cauchy's Inequality and Minkowski's Inequality.

UNIT – II:

Topological Spaces, definition & examples-open bases and open sub bases- compact spaces

UNIT – III:

Product of spaces-Tychonoff's theorem -compactness for Metric spaces.

UNIT-IV:

Separation – T^1 space and Hausdorff spaces –completely regular spaces and Normal spaces –Urysohn's lemma- Tietze extension theorem-Urysohn's imbedding theorem.

Articles 9 to 14,16,17,18,21, 22, 23, 26-29 and 31 of Chapters II,III,IV,V,andVI of **Introduction to Topology and Modern Analysis** by G.F. Simmons of MC Graw Hill Publishing company, ltd.

Reference:

1. 'Topology' by K.ChandraSekharaRao, Narosa Publications
2. "Topology" by J.P. Chauhan, J.N. Sharma, Krishna Publications
3. "General Topology" by M.G. Murdeshwar, new age International publications

Course Outcomes:

Upon completion of this course, the student will be able to:

1. Understand to construct topological spaces from metric spaces and using general properties of neighbourhoods, open sets, closed sets, basic and sub-basis.
2. Apply the properties of open sets, closed sets, interior points, accumulation points and derived sets in deriving the proofs of various theorems.
3. To understand the concepts of countable spaces and separable spaces.
4. They know what we mean by connectedness, compactness, and hausdorff property and their general characteristics.
5. Understand the Countability axioms, the separation axioms and normal spaces.
6. Understand the classical theorems such as the Uryshon lemma, the Tietze extension theorem.

AMA 203:6B - BOUNDARY VALUE PROBLEMS

Course objectives:

To learn series solution of some well known differential equations, Legendre & Chebysheve polynomials, Fourier &Henkel transforms linear programming problems and basics of probability.

UNIT-I:

Stability of linear and weakly non-linear systems, continuous dependence and stability properties of linear, non-linear and weakly non-linear systems. Two dimensional systems. (chapter III of text book-1)

UNIT-II:

Stability by Liapunov second method, Autonomous systems, quadratic forms, Krasovski'sMethod. Construction of Liapunov functions for linear systems with constant coefficients. Selection of total energy function as a Liapunov Function, Stability based on first approximation (Chapter V of text book-1)

UNIT-III:

Mathematical Models in Population Dynamics: Introduction, single species Models, Two species Lotka volterra Models, Multi species Models. (chapter VI of text book-1)

UNIT-IV:

Analysis and Methods of non-linear differential equations, Existence theorem, extremal solutions, upper and lower solutions. Existence via upper and lower solutions, Monotone iterative Method and Method of quasilinearlization, Bihari's inequality, Application of Bihari's integral inequality. Non-linear variation of parameters formula Alekseev's formula. (Chapter VI of text book-2)

Text Books:

1. M.Rama Mohan Rao, Ordinary Differential equations, Theory methods and applications, Affiliated East-West Press Pvt.Ltd., New Delhi. (1980).
2. V.Lakshmikantam, S.G.Deo and V.Raghavendra, Text book of ordinary differential equations (second edition) Tata Mc Graw Hill, New Delhi. (1997)

Course Outcomes:

After completing this course the students would be able to:

1. Use the knowledge of Legendre and Chebyshev polynomials.
2. Apply Fourier and Hankel transforms in engineering problems.
3. Solve boundary value problems.
4. Understand the probability theory.

AMA 204: PRACTICAL-III
(Common with paper MAT 204 of Branch I (A) Mathematics)

Practicals for Complex Analysis CC 2- 2A

1. Apply the derivative rules (sum, product, quotient, and chain rules) to differentiate several complex functions.
2. Prove that a function is analytic in a given domain by verifying the existence of its derivative and applying the Cauchy-Riemann equations.
3. Evaluate integrals of different analytic functions over smooth curves (like circles or ellipses).
4. Evaluate specific integrals using Cauchy's Integral Formula.
5. Derive the Taylor series expansion for given functions.
6. Derive the Taylor series expansion for given functions.
7. Compute the cross ratio of four distinct points in the complex plane and verify its invariance under a given Möbius transformation.
8. Verify the given transformation is Möbius transformation.

Practical for Topology CC 2- 3A

1. Write a program to evaluate the roots of the equation.
2. Write a program to evaluate the power series
3. Write a program to determine the range of values and the average cost of a personal computer in the market.
4. Write a program to evaluate the series $\left(\frac{1}{1-x}\right)$.
5. Write a program to using single- subscribed variable to evaluate the expression $\text{total} = \sum_{i=1}^{10} (x_i^2)$.
6. Write a program to read a line of text containing a series of words from the terminal.

(or)

AMA 204 CC-5B &6(B): PRACTICAL-I
(Common with paper MAT 204 5B &6(B) of Branch I (A) Mathematics)

Practicals for SEMIGROUP THEORY CC 2 - 3B

1. Construct the Cayley graph of the free semigroup generated by $X=\{a,b\}$ up to length 2.
2. Work with generating sets, ideals, and construct Rees congruences.
3. Explore the lattice structure of equivalences and congruences, and analyze Green's equivalences for given semigroups.
4. Study the structure of D-classes in regular semigroups, construct examples, and explore their properties.
5. Construct examples and identify principal factors, verifying simplicity and Q-simplicity.
6. Apply Rees's Theorem to construct completely 0-simple semigroups and identify primitive idempotents.
7. Explore congruences and the lattice structure of congruences, particularly in Rees matrix semigroups.

Practicals for BOUNDARY VALUE PROBLEMS CC 3 - 4B

1. Derive the stability of linear and weakly non- linear systems.
2. Write about two dimensioned systems.
3. Test the stability by Liapunov second method
4. Explain about Krasovski method,
5. Describe two species Lotka volterra models.
6. State and prove existence theorem

SKILL ORIENTED COURSE (SOC-II)

AMA 205: SOC -3(A) - MATHEMATICAL STATISTICS (Common with the paper MAT 205: SOC -3 (A) of Branch I(A) Mathematics)

Course objectives:

1. To introduce basic concepts of statistics and the probability set functions.
2. To study the Binomial, Poisson, Gamma, chi-square, normal distribution.
3. Explain stochastic convergence
4. To explain the objective of Point estimation-Measures of quality of estimations.

UNIT –I: Probability and Distributions:

Introduction-The probability set function – Conditional probability- Independence-Random variables–The distribution function-Expectations-Some special mathematical expectations – Chebyshev’s inequality. (Section 1.1 to 1.10 of chapter 1)

UNIT- II: Marginal and conditional distributions- Distributions of two variables- conditional distributions and expectations-The Correlation coefficient- Independent of Random variables. (Section 2.1 to 2.4 of chapter 2)

UNIT–III: The Binomial, Poisson, Gamma, chi-square and Normal distribution. Distributions of functions of Random variables – Sampling theory- Transformation of Variables of Discrete type-Transformation of Variables of the continues type. (Section 3.1 to 3.4 of chapter 3, sections 4.1 to 4.3 of chapter 4)

UNIT – IV: The t and F Distributions – Distribution of order statistics –The moment generating function Technique-The Distribution of X and Limiting distribution –Stochastic convergence-Limiting moment generating function-The central limit theorem. (Section 4.4, 4.6 &4.7 of chapter 4, 5.1 to 5.4 of chapter 5)

Scope and Standard as in “ Introduction to Mathematical Statistics” by Robert V. Hogg Allen T. Craig, Macmillan publishing co., Inc., New York -1978

- References:**
1. Mathematical Statistics by J.N. Kapur, H.C. Saxena- S. Chand Publications
 2. Introduction to Mathematical Statistics Robert V Hogg, Allencraig, Joseph W Mekean , Pearson Publishers
 3. Fundamentals of mathematical Statistics by S.C.Gupta and V.K.Kapoor, 11th edition S.Chand and sons, New Delhi
 4. Probability and Statistics for engineers and scientists by Walpole Myers and Keying ye, ninth edition, Pearson Publications

Course outcomes:

1. To learn the fundamental concepts of statistics and techniques required for data analysis.
2. Apply the knowledge of Binomial, Poisson, Gamma, chi-square, normal distribution in solving various problems,
3. To explain stochastic convergence.
4. To discuss measures of quantity of estimations

AMA 205: SOC 3(B) - DATA STRUCTURES AND ALGORITHMS (Common with the paper MAT 205- SOC 3 (B) of Branch I (A) Mathematics)

Course objectives:

1. Learn complexity analysis with examples.
2. Study queues operations and applications of queues.
3. Acquire knowledge on Binary trees and representations.
4. Understand Basic algorithms to sort and to find the shortest paths.

UNIT-I

Performance and Complexity Analysis: Space Complexity, Time Complexity, Asymptotic Notation (Big-Oh), Complexity Analysis Examples.

Stacks: Basic Stack Operations, Representation of a Stack using Static Array and Dynamic Array, Multiple stack implementations using single array

Stack Applications: Reversing list, Factorial Calculation, In fix to post fix Transformation, Evaluating Arithmetic Expressions.

UNIT-II

Queues: Basic Queue Operations, Representation of a Queue using array, Implementation of Queue Operations using Stack

Applications of Queues: Round Robin Algorithm, Circular Queues.

Linked Lists: Introduction, Single Linked List, Representation of a Linked List in Memory, Different Operations on a Single Linked List, Reversing a Single Linked List, Advantages and Disadvantages of Single Linked List, Circular Linked List, Double Linked List and Header Linked List.

UNIT-III

Trees: Definition of Tree, Properties of Tree, Binary Tree, Representation of Binary Trees using Arrays and Linked Lists, Operations on a Binary Tree, Binary Tree Traversals (recursive), Binary Search Tree.

Hashing: Hash Table Representation, Application-Text Compression.

UNIT-IV

Basic Search Algorithms: Linear Search and Binary Search Techniques and their Complexity Analysis.

Basic Sorting Algorithms: Bubble Sort, Insertion Sort, Selection Sort

Divide-and-Conquer Algorithms: merge sort, quick sort

Basic Graph Algorithms: traversals and shortest path.

Scope and Standard as in Data Structures and Algorithms by Alfred V. Aho, John E. Hopcraft and Jeffrey D. Ullman.

References:

1. Data Structures and Algorithms by R.D. Sathiya
2. Data Structures and Algorithms Made Easy" by Narasimha Karumanchi
3. Data Structures and Algorithm Analysis in C++" by Mark Allen Weiss
4. Data Structures and Algorithm Analysis in Java" by Mark Allen Weiss.

AMA 404: SOC-4A: OPERATIONS RESEARCH FOR INDUSTRY AND COMMUNITY DEVELOPMENT

(Common with the paper MAT 404: SOC-4A of Branch 1(A) Mathematics)

Course Objectives:

- 1) To understand Linear Programming Methods
- 2) To solve linear programming problem through Dynamic Programming.
- 3) To introduce game theory.
- 4) To analyze Critical path method and program Evaluation and Review Technique.

UNIT –I :

Linear programming: Graphical Method-Simplex Method-Big M Method-Two phase method -Transportation Problem- (Sections 2.4 and 2.5.1, 2.5.2, 2.5.4 of chapter 2, sections 3.2, 3.3 and 3.4 of chapter 3).

UNIT – II:

Dynamic programming : Introduction –Capital Budgeting problem –Reliability improvement problem –Stage coach problem –Optimal subdividing problem (Chapter 8)

UNIT-III:

Game Theory: Introduction -Game with Pure Strategies-Game with Mixed Strategies –Dominance property-Graphical Methods for 2xn and mx2 Games. (Chapter 12)

UNIT-IV:

Project Management: Guidelines for Network Construction –Critical Path Method (CPM) –Program Evaluation and Review Technique (PERT) (Sections 10.3, 10.4 and 10.6 of Chapter 10)

Scope and standard as “**OPERATIONS RESEARCH**” By pannerselvam, R. published by Prentice Hall of India, New Delhi, 2002 Edition,

References: 1. Introduction to Management Sceicne “Operation Research” by Manmohan . P.K. Gupta, Kantiswarup, Sultan Chand & Sons Publishing house.

2. Operations Research –Theory and Applications by J.K. Sharma- Macmillan Publishers, India.

3. Operations Research –by Gupta, Prem Kumar, Hira S. Chand Publishers

Course Outcomes:

- 1) Formulate some real life problems into Linear Programming Problems.
- 2) Understand Dynamic Programming.
- 3) Solve the problems of Game with pure Strategies and Mixed Strategies.
- 4) Construct Reliable Networks.

AMA 206:SOC-4B: Python

(Common with paper MAT 206: SOC- 4B of Branch I (A) Mathematics)

Course Objectives:

1. To get familiar with Pyhon
2. To learn various operators and conditional statements
3. To create Modules and Strings
4. To understand functions, files and lists

UNIT –I : Basics of Python: Python Installation and Working of it, get familiar with python variables and data types, Operator understanding and its usage, understanding of python blocks

Operators in Python: Arithmetic Operators, Relational Operators, Assignment Operators, Logical Operators, Bitwise Operators, Shift Operators, Ternary Operators, Membership Operators, Identity Operators, Expressions and order of evaluations.

Input and Output statements: input() function, reading multiple values from the keyboard in a single line, print() function, ‘sep’ and ‘end’ attributes, Printing formatted string, replacement operator ({}).

Control flow statements: Conditional statements – if, if-else and if-elif-else statements. Iterative statements – for, while. Transfer statements – break, continue and pass.

UNIT –II:-Functions: Defining Functions, Calling Functions, Types of Arguments - Keyword Arguments, Default Arguments, Variable-length arguments, Anonymous Functions, Function Returning Values, Global and Local Variables.

Modules: Creating modules, import statement, from Import statement.

Strings: Creating and Storing Strings, Basic String Operations, Accessing Characters in String by Index Number, String Slicing and Joining, String Methods, Formatting Strings.

UNIT –III:- Lists: Creation of list objects, Accessing and traversing the elements of list. Important functions of list – len(), count(), index(), append(), insert(), extend(), remove(), pop(), reverse() and sort().

Basic Operations on List: Aliasing and Cloning of List objects, Mathematical Operators for list objects, Comparing list objects, Membership operators on list, Nested Lists, List Comprehensions.

Tuples: Creation of Tuple objects, Accessing elements of tuple, Mathematical operators for tuple, Important functions of Tuple – len(), count(), index(), sorted(), min(), max(), cmp(). Tuple Packing and Unpacking.

Files: Opening files, Text files and lines, Reading and writing files, Searching through a file, Using try, except and open, handling exceptions, debugging.

UNIT –IV:

Scientific and Mathematical Computing Using Python: Numerical Computing using NumPy, Matplotlib, SciPy

Python libraries and modules used in Data Science, AI and ML: Pandas, tensorflow, scikit-learn, pytorch, keras etc...

Scope and Standard as in: Learn Python the right way How to think like a computer scientist, Ritza, 2021-2022

References:

1. Linear Algebra in Data Science, notes by Madhu Babu Pachha (To be prepared)
Suggested Reading:
1. Think Python: How to Think Like a Computer Scientist', 3rd edition, Allen B. Downey, O'Reilly 2024
2. Learning To Program With Python. Richard L. Halterman. Copyright © 2018

Course Outcomes: After completion of this course students are able to

1. Familiar with basic concepts of Python
2. Make use of various operators and conditional statements
3. Create Modules and Strings
4. Understand functions, files and lists

AMA 207: PRACTICAL-II (Common with paper MAT 207 of Branch I (A) Mathematics)

Practicals on Mathematical Statistics –SOC 3A

1. Basic programs to find mean, median and mode
2. Binomial distribution
3. Poisson Distribution
4. Normal Distribution
5. t-distribution
6. F-distribution

Practicals for Operations Research for Industry and Community Development: SOC-4(A):

1. A computer manufacturing company has the following monthly compensation policy to their sales-person:

Minimum base salary: 1500.00

Bonus for every computer sold: 200.00

Commission on the total monthly sales: 2 percent

Since the prices of the computers are changing, the Sales price of each computer program is fixed at the beginning of every month to compute a sales person's gross Salary.

2. The cost of operation of a unit consists of two components C_1 and C_2 which can be expressed as functions of a parameter p as follows:

$C_1 = 430 - 8P$ $C_2 = 10 + p^2$ The parameter ranges from 0 to 10. Determine the Value of P with an accuracy of ± 0.1 where the cost of operation would be minimum.

3. In an organization, the employers are grouped according to their basic pay for the purpose of certain perks. The pay-range and the number of employees in each group are as follows:

Group	Pay-Range	No. of Employees
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1	750-1500	12
2	1501-3000	23
3	3001-4500	35
4	4501-6000	20
5	above 6000	11

Draw a histogram to highlight the group sizes.

- Plot the graphs of the functions of the type $y_1 = \exp(-ax)$, $y_2 = \exp(-ax^2/2)$ for x varying from 0 to 5.0.
- Write a program to calculate the ratio $a/b-c$
- Write a program that selects and prints the largest of the three numbers using nested if... else statement.

(OR)

AMA 207 : PRACTICAL-II
(Common with paper MAT 207 of Branch I (A) Mathematics)

Practicals for Data Structures and Algorithms: SOC-3(B)

- Round Robin Algorithm
- Basic Search Algorithms: Linear Search and Binary Search
- Basic Sorting Algorithms: Bubble Sort, Insertion Sort, Selection Sort
- Divide-and-Conquer Algorithms: merge sort, quick sort
- Basic Graph Algorithms: traversals and shortest path.

Practicals for Python: SOC-4(B)

- Create a 2D array (matrix) and compute the transpose.
- Perform numerical integration
- Solve differential equations
- Solve initial value problem
- Implement a linear regression model to predict house prices.

AMA 208: edX/Swayam/NPTEL/ MOOCS
(Common with paper MAT 208 of Branch I (A) Mathematics)

AMA 209: Vedic Mathematics
(Common with paper MAT 209 of Branch I (A) Mathematics)

Course objectives:

- To inculcate interest on Vedic Mathematics.
- To understand the development of basic concepts
- To know about Vedic Sutras.
- To create awareness on Vedic techniques.

Unit -I:-Actual applications the Vedic Sutras- Arithmetical computations- Factorization

Unit-II:- Simple equations-simultaneous simple equations-quadratic equations- cubic equations

Unit-III:-Partial fractions-integration by partial fractions.

Unit-IV:-Vedic Numerical code -recurring decimals

Standard Text Book:

Vedic Mathematics by Jagadguru Swamisri Bharathi Krisna Thirthaji Maharaja.

Course Outcomes: After the completion of the course students are able to

1. Understand Vedic sutras and Techniques.
2. Solve simple equations using Vedic formulae.
3. Apply techniques to integrate by partial fractions.
4. Write Numerical code.

III Semester: M.Sc., Applied Mathematics

AMA 301: CLASSICAL MECHANICS

(Common with paper MAT 301 of Branch I (A) Mathematics)

Course Objectives:

1. This course is intended to provide a treatment of basic knowledge in mechanics used in deriving a range of important results and problems related to rigid bodies.
2. The objective is to provide the student the classical mechanics approach to solve a mechanical problem.
3. To enable the students to acquire knowledge of Mechanics. Also to understand the concepts of Lagrange's Equation and Hamiltonian Principle.

UNIT – I :

D'Alembert's Principle and Lagrange's Equations: Some Definitions-Classification of Dynamical System-Some Examples of Constraints Virtual Displacement-Principle of Virtual Work –Generalised Force in Holonomic System-Mathematical Expression for the principle of Virtual work-D'Alembert's principle-Lagrange's Equations for a Holonomic system-Velocity-dependent potential –Lagrange's Equations of Motion for conservative, Non-holonomic system-physical Significance of λ -Harmonic Oscillator.

UNIT – II:

Variational Principle and Lagrange's Equations: Variational Principle-Calculus of Variations-Hamilton Principle-Derivation of Hamilton's Principle from Lagrange's Equations-Derivation of Lagrange's Equations from Hamilton's Principle –Extension of Hamilton's Principle –Hamilton's Principle for Non-conservative, Non-holonomic System –Generalised Force in Dynamic system-Hamilton Principle for Conservative-Non holonomic System -Lagrange's Equations for Non –conservative –Holonomic System –Cyclic or Ignorable Coordinates –Conservation Theorem-Conservation of Linear Momentum in Lagrangian Formulation-Conservation of Angular Momentum in Lagrangian Formulation –Conservation of Angular Momentum –Conservation of Energy in Lagrangian Formulation.

UNIT – III:

Hamilton's Equations of Motion: Derivation of Hamilton's Equations of Motion (using Lagrange's Equations)-Routh's Procedure-Equations of Motion-Derivation of Hamilton's Equations from Hamilton's Principle –Principle of Least Action-Distinction between Hamilton's Principle and Principle of Least Action.

UNIT-IV:

Canonical Transformations: Canonical Coordinates and Canonical Transformations –The necessary and Sufficient Condition for a Transformation to be Canonical –Examples of Canonical Transformations-Properties of Canonical Transformations- Infinitesimal Contact Transformation-Relation between Infinitesimal Contact Transformation and Poisson's Bracket.

Syllabus and treatment as in the Book “ **Classical Mechanics**” by C.R. MONDAL Prentice Hall of India Private Limited, New Delhi, 110001, 2001, Chapter 1, 2, 4 and Sections 5.1 to 5.4 of Chapter 5.

References:

1. Classical Mechanics by Goldstein Herbert, Charles P Poole, John Safko-

2. Introduction to Classical Mechanics by Takwale R. Puranik P, Mc.GrawHill Education

Course Outcomes:

1. Understand D' Alembert's Principle and simple applications of the Lagrangian Formulation.
2. Derive the Lagrange's Equation from Hamilton's Principle.
3. Study the concept of the Equations of Motion and the Equivalent One-Dimensional Problems.
4. Distinguish the concept of the Hamilton Equations of Motion and the Principle of Least Action.
5. Get familiar with canonical transformations, conditions of cononicity of a transformation in terms of Lagrange and Poisson brackets.

AMA 302: 8(A) ADVANCED COMPLEX ANALYSIS

(Common with paper MAT302:8(A) of Branch I (A) Mathematics)

Course Objectives:

1. To introduce some topics of contemporary advanced complex analysis.
2. To explain Laurent Series, poles and singular points.
3. To understand Residue theorem and its applications.
4. To discuss Laplace's equation, Harmonic functions and Dirichlet problem.
5. To analyse various methods to solve problems in day to day life.

UNIT –I:

Laurent Series-Singular Points: Laurent Series-Laurent's Theorem-Poles and Essential Singular points.

Sections 54,55 and 56 in Chapter 11 of Text book.

UNIT – II:

The Residue Theorem and its Applications: The Residue Theorem-Residues at infinity-Jordan's Lemma-Evaluation of Definite Integrals – The Argument principal-The Theorems of Rouche and Hurwitz.

Sections 59,60 and 61 in Chapter 12 of Text book.

UNIT – III:

Harmonic Functions: Laplace's Equations-Conjugate Harmonic Functions-Poisson's integral. Schwartz's Formula-The Dirichlet problem.

Sections 63,64 and 65 in Chapter 13 of Text book.

UNIT-IV:

Infinite product and Partial Fraction Expansions: Preliminary Results- Infinite Products-Weierstrass' Theorem –Mittage – Leffer's Theorem.

Sections 66,67 and 68 in Chapter 11 of Text book.Scope and Standard as in “**Introductory Complex Analysis**” by **Richard A. Silverman, Dover Publications, Inc. New York (1972)**

Reference:

1. Fundamentals of Complex Analysis- Edward B. Saff, Arthur David Snider, Pearson Education
2. Foundations of Complex Analysis by S. Ponnusamy- Narosa Publications

Course Outcomes:

1. Explain the basic properties of complex integration and compute such integrals.
2. Learn topics of contemporary Advanced complex analysis in particular spaces of holomorphic functions, entire functions, harmonic functions and conformal mapping functions.
3. Apply advanced techniques to evaluate definite integrals and differential equations in applied areas.
4. Explain general principles of conformal mapping.
5. Compute the residue of a function and use the Residue Theory to evaluate a contour integral or an integral over the real line.

AMA 302: 8(B):MEASURE AND INTEGRATION

(Common with paper AMA 302: 8(B) of Branch I(A) Mathematics)

Course Objectives

1. To acquire basic knowledge of measure Theory.
2. To Explain the Contents : Lebesgue integral, general theory of measure spaces .
3. To understand the Riemann integral and lebesgue integral of a bounded function.
4. To analyse the differentiation of monotone functions of bounded variation.

UNIT –I :

Lebesgue Measure: Introduction, Outer measure, Measurable sets and Lebesgue measure, a non measurable set, Measurable functions, Little wood’s three principles

UNIT – II:

The Lebesgue Integral: The Riemann integral, the Lebesgue integral of a bounded function over a set of finite measure, the integral of a non negative function, the general Lebesgue integral , convergence in measure.

UNIT – III:

Differentiation and Integration: Differentiation of Monotone functions –Functions of bounded variations-Differentiation of an integral
– Absolute continuity –Convex functions.

UNIT-IV:

The Classical Banach Spaces: The L^p Spaces, The MinKowski and Holder inequalities, Convergence and completeness, Approximation in L^p , Bounded linear functional on the L^p Spaces.

Syllabus and Scope and Standard as in “ **Real Analysis**” by **H.L. Royden, Prentice Hall of India private limited, New Delhi, 2001-Third edition**. Chapter 3, Chapter 4, Chapter 5, and Chapter 6.

References:

1. Principles of Mathematical Analysis, Third Edition by Walter Rudin.
2. A Real Analysis by H.L.ROYDEN, III ED., Pearson publishers.
3. Measure theory by P.R. HALMOS, 1974. Spingerverlag.
4. Measure theory by V.I.BOGACHVE, 1997, Spingerverlag.

Course Outcomes:

To document insight in modern theory of integration as a tool in advanced analysis and in statistics.

1. Compute Lebesgue measures.
2. Establish the measurability or non-measurability of sets and functions.
3. Approximate measurable functions by simple and step functions.
4. Compute Lebesgue integrals of bounded functions over a set of finite measure.
5. Explain Fourier analysis.
6. Decide under which conditions the fundamental theorem of calculus is applicable in the context of Lebesgue integration.

AMA 303: 9(A): DIFFERENTIAL GEOMETRY

(Common with paper MAT 303 :9(A) of Branch I (A) Mathematics)

The aim of the course is to provide knowledge of the geometry of curves and surfaces. The course integrates concepts from different parts of mathematics, such as linear algebra, calculus and differential equations. It also provides intuitive examples for many concepts in linear algebra, calculus and differential equations. These examples are fundamental to physics and mechanics: they play a role in our understanding of the movements of particles and the theory of relativity.

Course Objectives:

1. Define the equivalence of two curves.

2. Find the derivative map of an isometry.
3. Analyse the equivalence of two curves by applying some theorems.
4. Defines surfaces and their properties
5. Express definition and parametrization of surfaces.
6. Express tangent spaces of surfaces.
7. Explain differential maps between surfaces and find derivatives of such maps.
8. Integrate differential forms on surfaces.

UNIT –I :

The Theory Space Curves: Introductory remarks about space curves –Definitions –Arc length-Tangent, normal, and binormal –Curvature and torsion of a curve given as the intersection of two surfaces –Contact between curves and surfaces-Tangent surface, involutes and evolutes. (Sections 1 to 7 of Chapter 1).

UNIT – II:

The Metric: Local Intrinsic Properties of a Surface: Definitions of a Surface- Curves on a surface-Surfaces of revolution –Helicoids-Metric-Direction Coefficients-Families of curves –Isometric correspondence –Intrinsic properties. (Sections 1 to 9 of Chapter 11).

UNIT – III:

Geodesics-Canonical Geodesic Equations-Normal Property of geodesics –Existence theorems-Geodesic parallels-Geodesic curvature-Gauss-Bonnet theorem –Gaussian curvature-Surfaces of constant curvature –Conformal mapping-Geodesic mapping (Sections 10 to 20 of Chapter 11).

UNIT-IV:

The second Fundamental Form: Local non – intrinsic properties of a surface: The second fundamental form-principal curvatures –Lines of curvature -Developables associated with space curves-Developables associated with curves on surfaces –Minimal surfaces-Ruled surfaces-The fundamental equations of surface theory –Parallel surfaces. (Sections 1 to 10 Chapter III).

Scope and Standard as in Sections and chapters as specified above of the book “ **An Introduction to Differential Geometry**” of T.J Willmore, **Oxford University Press, Thirteenth Impression, 1997.**

References : 1. A first course in Differential Geometry- D. Soma sundaram – Narosa Publications.

Course Outcomes: After completing this course, students should be able to

1. Determine and calculate curvature of curves in different coordinate systems.
2. Parameterize surfaces and use the metric tensor. Calculate isometries.
3. Treat geodesic curves and parallel translation.
4. Calculate and analyse curvature of surfaces in different settings.
5. Know the concept of tensor and recognize tensors that are used in mechanics, image processing and theory of relativity.

AMA 303: 9(B): FUNCTIONAL ANALYSIS

(Common with paper MAT303: 9(B) of Branch I (A) Mathematics)

Functional analysis is one of the primary branches of mathematics mainly dealing with a variety of metrics' and linear operators.

Course Objectives:

1. Define and illustrate several normed spaces.
2. Introduce linear operators and derive their properties.
3. Elaborate basic theorems like open and closed mapping theorem, implicit function theorem and spectral theorem.

UNIT –I : Banach Spaces

The definitions and some examples –continuous –linear transformations-the Hahn-Banach Theorem.

UNIT – II:

Natural imbedding of N in N^{**} -Open mapping theorem –Conjugate of an Operator.

UNIT – III: Hilbert Spaces

Definition and Simple Properties –Orthogonal Complements.

UNIT-IV:

Orthonormal sets –Conjugate spaces –Adjoint of an Operator.

Scope and Standard as in Sections 46 to 51 of Chapter 9, section 52 to 56 of chapter 10 of

“ Introduction to Topological and Modern analysis by G.F. Simmons McGraw Hill Book Company.

References:

1. “Foundations of Functional Analysis” by S. Ponnyusamy-Narosa Publications
2. “Text book of Functional Analysis – A Problem oriented Approach” by V.K. Krishnan-Prentice Halls of India Publishers
3. “Functional Analysis” by B.V. Limaye New age International Publishers

Course Outcomes:

1. They can work with different distance metrics and normed spaces.
2. Understand continuous linear transformations and the Hahn-Banach Theorem.
3. Comprehend the Open mapping theorem and Closed graph theorem.
4. Construct orthonormal sets and conjugate spaces.
5. Understand the relevance of self-adjoint operators, normal, unitary operators and projections.
6. Comprehend the ideas of determinants and the spectrum of an operator.

AMA 304: Practical-1

(Related to Core Courses 8 & 9)

Skill Oriented Courses

AMA 305:SOC 5(A): FLUID DYNAMICS

Course Objectives:

- 1) Prepare a foundation to understand the motion of fluid and develop concept, models and techniques which enables to solve the problems of fluid flow.
- 2) Help in advanced studies and research in the broad area of fluid motion.

Unit -I: Dynamics of Real Fluid

Introduction, Viscosity and Reynolds number, Influence of Reynolds number, upon flow configuration, the equation of motion for viscous flow, the stress tensor in a viscous fluid, Relationship between stress and rate of strain, the Navier-Stokes equations.

Sections: 5.1.1, 5.1.2, 5.2.1, 5.2.2 of chapter 5 of Textbook

Unit-II: Some exact solutions of Navier -Stoke's equations

Introduction, steady flow through an arbitrary cylinder under pressure, viscous flow through a circular cylinder (Hagen-Poiseuille flow through a circular cylinder), steady Couette flow between cylinders in relative motion, steady flow between two parallel planes under constant pressure gradient (Couette flow).

Sections: 5.3.1, 5.3.2, 5.3.3 of chapter 5 of Textbook

Unit-III: Some solutions for unsteady flows

Unsteady flow of viscous incompressible fluid over a suddenly accelerated flat plate, (flow over a plane wall suddenly set in motion), unsteady flow of viscous incompressible fluid over an oscillatory plate(plane)

The laminar boundary layer in incompressible flow : Introduction, Concept of boundary layer(over flat plate), boundary layer separation, the boundary layer equations, two-dimensional flow along a plane wall.

Sections: 5.3.5 of chapter 5 and 6.1.1, 6.1.2, 6.2.1 of chapter 6 of Textbook

Unit-IV: Some important boundary layer characteristics

Boundary layer thickness, displacement thickness, the kinetic energy thickness, dissipation of energy within a boundary layer due to viscosity, integral equations of boundary layer, Momentum integral equation, kinetic energy integral equation, the Von Mises transformation.

Sections: 6.2.3, 6.2.4, 6.2.5 of chapter 6 of Textbook.

Scope and standard as “ **Modern Fluid Dynamics**” (Volume I, Incompressible Flow) by N. Curle and H.J Davies, D. Van Nostrand Company Ltd., London, 1968.

References: 1. Foundations of Fluid Mechanics by S.W. Yuan – Prentice Hall of India

PVT Ltd, New Delhi.

2. An Introduction to Fluid Dynamics by Batchelor G.K., Cambridge

Mathematical Library.

Course Outcomes:

- 1) Be familiar with continuum model of fluid flow and classify fluid/flows based on physical properties of a fluid/flow along with Eulerian and Lagrangian descriptions of fluid motion.
- 2) Derive and solve equation of continuity, equations of motion, vorticity equation, equation of moving boundary surface, pressure equation and equation of impulsive action for a moving inviscid fluid.
- 3) Calculate velocity fields and forces on bodies for simple steady and unsteady flow including those derived from potentials.
- 4) Know potential theorems, minimum energy theorem and circulation theorem.
- 5) Understand two dimensional motion, circle theorem and Blasius theorem.
- 6) Understand the concept of stress and strain in viscous flow and to derive Navier-Stokes equation of motion and solve some exactly solvable problems.

AMA 305: 5(B) FINITE ELEMENT METHOD

UNIT – I :

Integral formulations and Variational Methods : Need for Weighted-Integral forms- some mathematical concepts and formulae- Boundary, initial and Eigenvalue problems-Integral relations-Functionals-The Variational symbol Weak formulation of Boundary Value problems –Weighted-Integral and Weak formulations- Linear and Bilinear forms and Quadratic Functionals - examples.

UNIT – II:

Variational methods of approximation : The Rayleigh-Ritz Method- The method of Weighted residuals.

UNIT – III:

Finite element analysis of one-dimensional problems : Introduction-Basic steps of Finite element analysis-Model Boundary Value Problem-Discretization of the domain-Derivation of element equations-Connectivity of elements-Imposition of boundary conditions-Solution of equations-Post processing of the solution- Radially Symmetric problems.

UNIT-IV:

Applications of Finite element Analysis –Heat transfer –Fluid Mechanics- Solid Mechanics.

Scope and standard as in Chapters 2 and 3 of “ **INTRODUCTION TO THE FINITE ELEMENT METHOD**” by J. N. Reddy, McGraw-Hill Inc. (Second Edition)

AMA 306: 6(A) GRAPH THEORY

(Common with the paper MAT306: 6(A) of Branch (1A) Mathematics)

Course Objectives:

1. To introduce the fundamental concepts of graph theory
2. To Study the properties of Trees and Connectivity.
3. To explain Eulerian graphs and Hamiltonian graphs
4. To apply graph theory in diversified fields such as Electrical Engineering computers science and communication networks etc

UNIT –I:

Graphs & Subgraphs: Graphs and simple Graphs- Incidence and adjacency Matrices-Sub graphs-Vertex Degrees-Paths and connection –Cycles –Shortest path Problem-Sperner's Lemma.

Sections 1.1,1.3,1.4,1.5,1.6,1.7,1.8,1.9 in chapter 1 of Text book.

UNIT – II:

Trees: Trees-Edges and Bonds –Cut vertices, Cayley's Formula.

Sections 2.1, 2.2, 2.3, 2.4 in chapter 2 of Text book

UNIT – III:

Connectivity: Connectivity –Blocks-Application Construction of Reliable communications Networks.

Sections 3.1, 3.2, 3.3 in Chapter 3 of Txt book.

UNIT-IV:

Euler Tours and Hamiltonian Cycles: Euler Tours – Hamilton cycles

Sections 4.1, 4.2 in chapter 4 of Text book

Scope and standard as in chapters 1 to 4 “ **Graph Theory with application**” **J.A. Bondy and U.S.R. Murthy, M.C. Millan Press**

Rererences:

1. Discrete Mathematics & Graph Theory, by Satyanarayana Bhavanari, K. Syam Prasad, PHI Pvt Ltd, New Delhi Second Edition,2014
2. Mathematical Foundation of Computer Science by SatyanarayanaBhavanari, T. V. Pradeep Kumar, Sk. Mohiddin Shaw, BS Publications, Hyderabad,2016.
3. Graph Theory with applications to Engineering and Computer Science Narsingh Deo
4. First look at Graph Theory- John Clark Derek Allaw Holton.
5. Introduction to Graph Theory- Robin . J. Wilson
6. Introduction to Graph Theory- Douglas B. West
7. Discrete mathematics for computer scientists and Mathematics by J.L.Mott, A.Kandel and T.P.Baker, Prentice Hall of India

Course outcomes:

1. Able to define basic concepts of graphs

2. Understand the properties of trees and use of connectivity
3. Apply Cayley's formula to find number of spanning trees
4. Identify Eulerian and Hamiltonian graphs.
5. Utilize the algorithms to find the shortest path, Optimal tree from a given graph
6. Understand the concepts of practical problems like Chinese postman problem and travelling salesman problem

AMA 306: 6(B): BOUNDARY VALUE PROBLEMS

Course objectives:

To learn series solution of some wellknown differential equations, Legendre & Chebyshev polynomials, Fourier & Hankel transforms, linear programming problems and basics of probability.

UNIT-I:

Stability of linear and weakly non-linear systems, continuous dependence and stability properties of linear, non-linear and weakly non-linear systems. Two dimensional systems. (chapter III of text book-1)

UNIT-II:

Stability by Liapunov second method, Autonomous systems, quadratic forms, Krasovski's Method. Construction of Liapunov functions for linear systems with constant coefficients. Selection of total energy function as a Liapunov Function, Stability based on first approximation (Chapter V of text book-1)

UNIT-III:

Mathematical Models in Population Dynamics: Introduction, single species Models, Two species Lotka volterra Models, Multi species Models. (chapter VI of text book-1)

UNIT-IV:

Analysis and Methods of non-linear differential equations, Existence theorem, extremal solutions, upper and lower solutions. Existence via upper and lower solutions, Monotone iterative Method and Method of quasilinearization, Bihari's inequality, Application of Bihari's integral inequality. Non-linear variation of parameters formula Alekseev's formula. (Chapter VI of text book-2)

Text Books:

1. M.Rama Mohan Rao, Ordinary Differential equations, Theory methods and applications, Affiliated East-West Press Pvt.Ltd., New Delhi. (1980).
2. V.Lakshmikantham, S.G.Deo and V.Raghavendra, Text book of ordinary differential equations (second edition) Tata Mc Graw Hill, New Delhi. (1997)

Course Outcomes:

After completing this course the students would be able to:

1. Use the knowledge of Legendre and Chebyshev polynomials.
2. Apply Fourier and Hankel transforms in engineering problems.

3. Solve boundary value problems.
4. Understand the probability theory.

AMA 307:Practical-II

(Related to SOC-5 &6)

AMA 307-Practical-II

(Related to Skill Oriented Courses 5 &6)

AMA 308

Open Online Transdisciplinary Courses

(SWAYAM/ NPTEL/anyequivalent Courses)

IV SEMESTER: M.Sc., APPLIED MATHEMATICS

AMA 401: SDC-I: CONTINUUM MECHANICS

Course Objectives:

- i. The purpose of the course is to expose the students to the basic elements of continuum mechanics in a sufficiently rigorous manner.
- ii. To provide advanced treatment of the fundamental, unifying concepts of the mechanics of continua such as mechanics of viscous fluids, two dimensional flows.

UNIT I:

Kinematics of Fluids in motion (Chapter 2).

UNIT-II

Equations of motion of a Fluid (Chapter 3)

UNIT: III

Some Three –Dimensional Flows(Chapter 4)

UNIT IV :

Some two–Dimensional Flows. (Sections 5.1 to 5.9 of Chapter 5) Scope and standard as in the book “ **Text Book of Fluid Dynamics**” by F. Chorlton, C.B.S Publishers and Distributors , Delhi, 1985

- References :**
1. D.S. Chandrasekharaiah and L. Debnatha Continuum Mechanics – Academic Press -1994
 2. A.J.M. Speneer : Continuum Mechanics Long Man, 1980
 3. Y. C. Feng, A first Course in Continuum Mechanics – Prentice Hall (2nd Edition) 1997

Course Outcomes:

- i. Be able to describe motion, deformation and forces in a continuum.
- ii. Be able to derive equations of motion and conservation laws for a continuum.
- iii. Understand constitutive models for fluids and viscoelastic solids.
- iv. Formulate and solve specific technical problems of displacement, strain and stress.
- v. Perform experiments with stresses and deformations.
- vi. Numerically model and analyse the stresses and deformations of simple geometries under an arbitrary load in both solids and liquids.


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MAT 402: SDC-II: Introductory Methods of Numerical Analysis
(Common with paper AMA 402: SDC-II of Branch I (B) Applied Mathematics)

Course objectives:

- i. To provide suitable Numerical Methods, for solving ordinary and Partial Differential Equations.
- ii. To study Finite difference Approximations.
- iii. To learn Iterative Methods for the solution of Equations.
- iv. To study the various methods of Approximations..

UNIT-I:

Numerical Solution of Ordinary Differential Equations: Predictor- Corrector Methods-The Cubic Spline Method-Boundary Value Problems.

[Sections 7.1, 7.7 & 7.10 of Chapter-7 of the Text Book]

UNIT-II:

Numerical Solution of Partial Differential Equations: Introduction-Finite Difference Approximations to Derivatives-Laplace's equation.

[Sections 8.1, 8.2, 8.3 of Chapter-8 of the Text Book]

UNIT-III:

Numerical Solution of Partial Differential Equations (Continued):Parabolic Equations-Iterative Methods for the Solution of Equations-Hyperbolic Equations-Software for Partial Differential Equations.

[Sections 8.4, 8.5, 8.6 & 8.7 of Chapter-8 of the Text Book]

UNIT-IV:

The Finite Element Method: Introduction-Methods of Approximation-Application to Two-dimensional problems.

[Sections 10.1,10.2 &10.3 of Chapter-10 of the Text Book]

Text Book:

Scope and standard as "Introductory methods for Numerical Analysis by S.S.Sastry fourth edition".

Reference Book:

1. An Introduction to Numerical Analysis by Kendall E. Atkinson.
2. Theory and problems in Numerical Methods with programs in C and C++.
3. Numerical Methods and computing by Ward Cheney and David Kincaid
4. Numerical Methods for Scientific and Engineering Computation by M. K. Jain, S.R K. Iyengar, R. K. Jain, New Age International (p) Limited, Publishers, 5th Edition

Course Outcomes: From this Course Students are able to

- i. Solve ordinary and Partial Differential equations using numerical Methods.
- ii. Understand Laplace's Equation.
- iii. Study Parabolic and Hyperbolic equations.
- iv. Learn Methods of Approximation.


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B- 236-03-08

**M.Sc DEGREE EXAMINATION
THIRD SEMESTER
BRANCH:-MATHEMATICS
308: Open Elective: Business Mathematics-I
(Regular/Supplementary)**

Time: 3 hours

Marks: 70

Answer any FOUR questions.

All questions carry equal marks.

(Marks : $4 \times 5 = 20$)

1. If $47.2506 = 4A + \frac{7}{B} + 2C + \frac{5}{D} + 6E$, then find the value of $5A + 3B + 6C + D + 8E$.
2. What is the unit digit in $(3157)^{734}$?
3. Evaluate 45% of 280 + 28% of 450.
4. If $abc = 1$ then $\frac{1}{1+a+b^{-1}} + \frac{1}{1+b+c^{-1}} + \frac{1}{1+c+a^{-1}} = 1$.
5. If $4a = 5b$ and $8b = 9c$, then find $a : b : c$.
6. Two numbers are in the ratio of 3 : 5. If each number is increased by 10, the ratio becomes 5 : 7, then find the numbers.
7. Convert the decimal number 44_{10} into octal.
8. Conversion 14_{10} of decimal into binary.

PART - B

Answer ALL questions.

Each question carries 12.5 marks.

(Marks: $4 \times 12.5 = 60$)

UNIT - I

9. (a) Find the H.C.F and L.C.M of 1.5, 3, 0.6.
(b) Find the L.C.M of 15, 18, 24, 27, 56.

Or

[P.T.O.]

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M.Sc DEGREE EXAMINATION
FOURTH SEMESTER
BRANCH:- Applied Mathematics
AMA 401: SDC-I: CONTINUUM MECHANICS

Marks: 70

Time: 3 hours

SECTION - A

Answer any FOUR questions. All questions carry equal marks.

(Marks : $4 \times 5 = 20$)

1. Define stream lines. Determine the equation of stream lines if $\vec{q} = x\vec{i} - y\vec{j}$.
2. For an incompressible fluid $q = (wy, wx, 0)$ Discuss the Nature of the flow.
3. Derive the condition at a boundary of two inviscid immiscible Fluids?
4. Explain pitot tube.
5. Explain Stoke's Stream function.
6. Obtain stream function ψ for a uniform line source along $\overline{oz}$.
7. Discuss the flow due to a uniform line doublet at 'o' of strength μ per unit length Its axis being along $\overline{ox}$.
8. Discuss the uniform flow past a fixed infinite circular cylinder.

SECTION - B

Answer ALL questions. All questions carry equal marks.

(Marks: $4 \times 12.5 = 60$)

9. (a) Derive the equation of Continuity.
(b) 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. Find the velocity potential and the equations of the streamlines.

Or

10. (a) Explain the conditions at rigid boundary.
(b) Discuss general analysis of fluid motions.

[P.T.O.]

11. (a) Prove that the pressure at 'p' in moving inviscid fluid is independent of the orientation of ' δA '.
(b) Discuss Bernoulli's equation.

Or

12. (a) Discuss the case of steady motion under conservation body forces
(b) Explain ventury tube?
13. (a) If $r^n S_n(\theta, \psi)$ is a Harmonic function, then prove that $r^{-(n+1)} S_n(\theta, \psi)$ is also Harmonic function.
(b) Discuss doublet is a uniform stream.

Or

14. State and prove Weiss's sphere theorem.
15. (a) Discuss the flow for which $W = z^2$.
(b) State and prove the Milne - Thomson circle theorem.

Or

16. State and prove Blasius theorem.


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M.Sc. DEGREE, EXAMINATIONS

FOURTH SEMESTER

BRANCH:-MATHEMATICS

MAT 402: SDC- II: INTRODUCTORY METHODS OF NUMERICAL ANALYSIS

Max. Marks: 70

Time: 3 Hours

SECTION-A

Answer any **FOUR** questions. All questions carry equal marks.

4X5=20

1. What is the importance of Predictor-Corrector Methods?
2. Explain boundary -value problems
3. Classify the P.D.Es and what type of problems arise in the study of P.D.Es?
4. Explain SOR method
5. Solve $\frac{\partial u}{\partial t} = \frac{\partial^2 u}{\partial x^2}$ subject to the initial condition $u = \sin \pi x$ at $t=0$ for $0 \leq x \leq 1$ and the boundary conditions $u=0$ at $x=0$ at $x=1$ for $t>0$. Take $h=0.2$, $\lambda = 1$ and compute the values of u at the internal mesh point up to two time steps.
6. Explain Crank – Nicolson method
7. Find the functions for the boundary- value problem defined by $\frac{d^2 y}{dx^2} = f(x)$ and $y(a)=y(b)=0$
8. Discuss two Methods of approximation.

SECTION- B

Answer All questions. Each question carries 12.5 Marks.

4X12.5=50

UNIT-I

9. Given $\frac{dy}{dx} = 1 + y^2$, where $y = 0$, when $x = 0$, compute $y(0.8)$

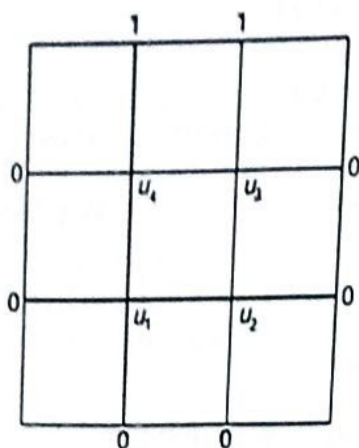
(OR)

10. Given the Boundary Value problem $x^2 y'' + xy' - y = 0$, $y(1) = 1$, $y(2) = 0.5$. Determine the value of $y(1.5)$ by applying cubic spline method.

UNIT-II

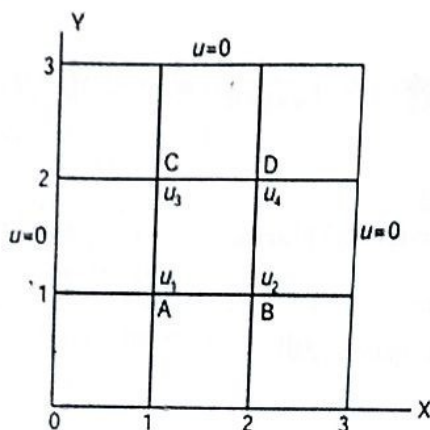
11. Solve the equation $u_{xx} + u_{yy} = 0$ in the domain of following figure by
- a) Jacobi's Method
 - b) Gauss- Seidel Method


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(OR)

12. Solve the Poisson equation $u_{xx} + u_{yy} = -10(x^2 + y^2 + 10)$ in the domain of following figure



UNIT-III

13. Use the Bender-Schmidt recurrence relation to solve the equation $\frac{\partial^2 u}{\partial x^2} = 2 \frac{\partial u}{\partial t}$ with conditions $u(x, 0) = 4x - x^2$, $u(0, t) = u(4, t) = 0$

(OR)

14. Solve the Heat equation $\frac{\partial u}{\partial t} = \frac{\partial^2 u}{\partial x^2}$ subject to conditions $u(x, 0) = 0$, $u(0, t) = 0$, $u(1, t) = t$

UNIT-IV

15. Find the functional for the boundary-value problem defined by $\frac{\partial^2 y}{\partial x^2} = f(x)$ and $y(a) = y(b) = 0$

(OR)

16. Solve the boundary-value problem defined by $y'' + y = -x$, $0 < x < 1$, with $y(0) = y(1) = 0$


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**M.Sc DEGREE EXAMINATION
FOURTH SEMESTER
BRANCH:- Applied Mathematics
AMA 401: SDC-I: CONTINUM MECHANICS**

Marks: 70

Time: 3 hours

SECTION - A

Answer any FOUR questions. All questions carry equal marks.

(Marks : $4 \times 5 = 20$)

1. Define stream lines. Determine the equation of stream lines if $\vec{q} = x\vec{i} - y\vec{j}$.
2. For an incompressible fluid $q = (wy, wx, 0)$ Discuss the Nature of the flow.
3. Derive the condition at a boundary of two inviscid immiscible Fluids?
4. Explain pitot tube.
5. Explain Stoke's Stream function.
6. Obtain stream function ψ for a uniform line source along $\vec{oz}$.
7. Discuss the flow due to a uniform line doublet at 'o' of strength μ per unit length Its axis being along $\vec{ox}$.
8. Discuss the uniform flow past a fixed infinite circular cylinder.

SECTION - B

Answer ALL questions. All questions carry equal marks.

(Marks: $4 \times 12.5 = 60$)

9. (a) Derive the equation of Continuity.
(b) 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. Find the velocity potential and the equations of the streamlines.

Or

10. (a) Explain the conditions at rigid boundary.
(b) Discuss general analysis of fluid motions.

[P.T.O.]

10. Evaluate

(R) $869 \times 738 + 869 \times 262$

(b) What is the unit digit in $3^{57} \times 6^{41} \times 7^{63}$.

UNIT - II

11. By selling 100 pens a shopkeeper gains the selling price of 20 pens. Find his gain percent.

Or

12. Rs. 395 are divided among A, B and C in such a manner that B gets 25% more than A and 20% more than C. Find the share of A?

UNIT - III

13. Solve $\frac{3x-y+1}{9} = \frac{2x+y+2}{5} = \frac{3x+2y+1}{6}$.

Or

14. (a) If $a : b = 1 : 3$, $b : c = 5 : 7$ and $c : d = 9 : 8$. Find $a : b : c : d$.

(b) On dividing a sum of Rs. 832 between A and B in the ratio $\frac{1}{3} : \frac{1}{5}$, then find their shares.

UNIT - IV

15. (a) Convert $(190)_{10}$ into hexa decimal.

(b) Covert $(B5)_{16}$ into decimal.

Or

16. (a) How to convert of decimal into binary with examples.

(b) Add $111100_2 + 011111_2$.

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