VINAYAKA MISSION'S RESEARCH FOUNDATION

(Deemed to be University)

Curriculum and Syllabus

For

M.Sc. Mathematics

(Regular)

Learning Outcome based Curriculum Framework

(LOCF- 2022)

(For the Academic Year starting from 2022-2023 onwards)

OUTCOME-BASED EDUCATION (OBE)

LEARNING OUTCOME-BASED CURRICULUM FRAMEWORK (LOCF)

OBE is an educational theory that bases each part of an educational system around goals (outcomes). By the end of the educational experience, each student should have achieved the goal. There is no single specified style of teaching or assessment in OBE; instead, classes, opportunities and assessments should all help the students achieve the specific outcomes.

Outcome Based Education, as the name suggests depends on Outcomes and not Inputs. The outcomes in OBE are expected to be measurable. In fact each Educational Institute can state its own outcomes. The ultimate goal is to ensure that there is a correlation between education and employability.

Outcome –Based Education (OBE): is a student-centric teaching and learning methodology in which the course delivery, assessment are planned to achieve, stated objectives and outcomes. It focuses on measuring student performance i.e. outcomes at different levels.

Some important aspects of the Outcome Based Education

Course: is defined as a theory, practical or theory cum practical subject studied in a semester.

Course Outcomes (COs): are statements that describe significant and essential learning that learners have achieved, and can reliably demonstrate at the end of a course. Generally three or more course outcomes may be specified for each course based on its weightage.

Programme: is defined as the specialization or discipline of a Degree.

Programme Outcomes (POs): Programme outcomes are narrower statements that describe what students are expected to be able to do by the time of graduation. POs are expected to be aligned closely with Graduate Attributes.

Programme Specific Outcomes (PSOs):

PSOs are what the students should be able to do at the time of graduation with reference to a specific discipline.

Programme Educational Objectives (PEOs): The PEOs of a programme are the statements that describe the expected achievement of graduates in their career, and also in particular, what the graduates are expected to perform and achieve during the first few years after Graduation.

Some important terminologies repeatedly used in LOCF

Core Courses (CC)

A course, which should compulsorily be studied by a candidate as a core requirement is termed as a Core course. These are the courses which provide basic understanding of their main discipline. In order to maintain a requisite standard certain core courses must be included in an academic program. This helps in providing a universal recognition to the said academic program.

Discipline Specific Elective Courses (DSE) / Generic Elective courses

Elective course may be offered by the main discipline/subject of study is referred to as Discipline Specific Elective (DSE). These courses offer the flexibility of selection of options from a pool of courses. These are considered specialized or advanced to that particular programme and provide extensive exposure in the area chosen; these are also more applied in nature.

Generic Elective Courses

An elective course chosen generally from an unrelated discipline/subject, with an intention to seek exposure is called a Generic Elective.

Generic Elective courses are designed for the students of **other disciplines**. Thus, as per the CBCS policy, the students pursuing particular disciplines would have to opt Generic Elective

courses offered by other disciplines, as per the basket of courses offered by the college. The scope of the Generic Elective (GE) Courses is positively related to the diversity of disciplines in which programmes are being offered by the college.

The Ability Enhancement Courses (AEC)
Two compulsory Ability Enhancement Courses with 4 credits is offered for a PG programme by the Department.

Skill Enhancement Courses (SECs)
These courses focus on developing skills or proficiencies in the student, and aim at providing hands-on training. Skill enhancement courses can be opted by the students of any other discipline, but are highly suitable for students pursuing their academic programme.

M.Sc. MATHEMATICS

PROGRAMME OUTCOMES

PO1: To enhance mathematical and computational strategies in order to solve mathematical problems.

PO2: To construct logical arguments for solving the abstract or applied mathematical problems based on ethical principles.

PO3: To identify mathematical and computational methods in order to solve comprehensive problems.

PO4: To demonstrate various specialised areas of advanced mathematics and its applications using modern tools.

PO5: To know the use of computers both as an aid and as a tool to study problems in Mathematics.

PO6: To present papers in seminars and conferences in order to defend their mathematical skills on various topics in the curriculum.

PO7: To train the students as professional mathematicians either in academia or elsewhere.

PO8: To inculcate the knowledge to the students to learn and apply Mathematics in real life situations aiming at service to the society.

PO9: To prepare the students for eligibility tests affirmed by UGC like CSIR-NET and SET.

M.Sc. MATHEMATICS			
PROGRAMMESTRUCTURE			
Name	**No of Courses**	**No of Credits**	**Total**
Core Course Theory credit (CC (T))	**9**	**6**	**54**
Core Course Practical Credit(CC (P))	**1**	**4**	**04**
Discipline Specific Elective Credit(DSE)	**5**	**4**	**20**
Ability Enhancement Compulsory Course Credit (AEC)	**2**	**4**	**8**
Skill Enhancement Course Credit (SEC)	**2**	**3**	**6**
Project Work	**1**	**8**	**8**
		Total Credits	**100**

Semester	**Compulsory Core Courses (CC) Theory**	**Compulsory Core Courses (CC) Practical**	**Discipline Specific Elective (DSE/Inter Disciplinary/Generic Electives)**	**Ability Enhancement Compulsory Courses (AECC)**	**Skill Enhancement Course (SEC)**	**Total Credits**
Sem I	**CC (I,II,III) (3 x 6 credits =18 credits)**	**-**	**DSE - I (1 x 4 credits =4 credits)**		**SEC - I (1 X 3 = 3 Credits)**	**25**
Sem II	**CC (IV,V) (2 x 6 credits =12 credits)**	**CC(P) (VI) (1 x 4 credits =4 credits)**	**DSE - II (1 x 4 credits =4 credits)**		**SEC - II (1 X 3 = 3 Credits)**	**23**
Sem III	**CC (VII,VIII,IX) (3 x 6 credits =18 credits)**	**-**	**DSE – III (1 x 4 credits =4 credits)**	**AEC – I (1 x 4 credits =4 credits)**	**---**	**26**
Sem IV	**CC (X) (1 x 6 credits =6 credits)** **Project work (1 x 8 credits =8 credits)**		**DSE –IV, V (2 x 4 credits =8 credits)**	**AEC – II (1 x 4 credits =4 credits)**		**26**
Total	**62**	**04**	**20**	**8**	**6**	**100**

M. Sc. MATHEMATICS				
PROGRAMME PATTERN				
Semester	**Component**	**Paper Title**	**Credits**	**Total**
I	CC-I	Algebra	6	25
	CC-II	Real Analysis	6	
	CC-III	Ordinary Differential Equations	6	
	DSE-I	Discipline Specific Elective -I	4	
	SEC - I	Skill Enhancement Course-I	3	
II	CC-IV	Complex Analysis	6	23
	CC-V	Partial Differential Equations	6	
	CC-VI	MATLAB	4	
	DSE-II	Discipline Specific Elective -II	4	
	SEC-II	Skill Enhancement Course-II	3	
III	CC-VII	Linear Algebra	6	26
	CC-VIII	Topology	6	
	CC-IX	Differential Geometry	6	
	DSE-III	Discipline Specific Elective -III	4	
	AEC-1	Human Rights	4	
IV	CC-X	Functional Analysis	6	26
	AEC-II	Problem Solving in Advanced Mathematics	4	
	DSE-IV	Discipline Specific Elective -IV	4	
	DSE-V	Discipline Specific Elective -V	4	
		Project and Dissertation	8	

Course (CC)		
CC-I	Algebra	6 x 09 = 54
CC-II	Real Analysis	
CC-III	Ordinary Differential Equations	
CC-IV	Complex Analysis	
CC-V	Partial Differential Equations	
CC-VII	Linear Algebra	
CC-VIII	Topology	
CC-IX	Differential Geometry	
CC-X	Functional Analysis	

Core Course Practical Credit(CC (P))		
CC(P)-VI	MATLAB	4 x 01 = 06

Discipline Specific Elective (DSE) Choose any 5 Course		
DSE-I	Probability Theory	5x4 = 20
DSE-II	Python Programming for Mathematics	
DSE-III	Numerical Analysis	
DSE-IV	Mathematical Modeling	
DSE-V	Graph Theory	
DSE-VI	Classical Dynamics	
DSE-VII	Difference Equations	
DSE-VIII	Financial Mathematics	
DSE-IX	Mathematical Statistics	
DSE-X	Optimization Techniques	

Skill Enhancement Course (SEC) Choose any 2 Course		
SEC-I	Quantitative Aptitude for Competitive Examination	2x3 = 6
SEC-II	Soft Skills	
SEC-III	Organizational Behaviour	
SEC-IV	Research Methodology	
SEC-V	Essentials of Communication Skills	
SEC-VI	Programming in Java	

Ability Enhancement Course (AEC)		
AEC-I	Human Rights	2x4 = 8
AEC-II	Problem Solving in Advanced Mathematics	

CORE COURSE-I

Programme Title: M.Sc. MATHEMATICS
Course Title: ALGEBRA **Hours / Week: 6**
Semester: I **Credits: 6**

Course Objectives:

1. To introduce the basic concepts of abstract algebra.
2. To make them understand the theory and applications on various algebraic structures.

Course Outcomes (CO):

CO1: Learn the concepts of groups, fields and modules.
CO2: Prove Sylow's theorems on groups, wedderburn's Theorem on finite division rings and theorems on Galois theory.
CO3: Understand in detail about extension fields and roots of polynomials, quotient, free and completely reducible modules.
CO4: Apply the acquired knowledge on Sylow's theorems, extension fields and roots of polynomials to prove the results and solve the problems.
CO5: Interrelate the solvability by radicals of a polynomial with the Galois group and analyse the importance of direct products and Finite abelian groups.

Syllabus

Unit – I **(Hours: 18)**

Group Theory-Another Counting Principle, Sylow's Theorem & Direct Products

Unit – II **(Hours: 18)**

Group Theory - Finite Abelian Groups.Fields -Extension Fields & Roots of Polynomials.

Unit – III **(Hours: 18)**

Fields- More About Roots, The Elements of Galois Theory &Solvability by Radicals.

Unit – IV **(Hours: 18)**

Selected Topics -Finite Fields,Wedderburn's Theorem on Finite Division Rings &A Theorem of Frobenius.

Unit – V **(Hours: 18)**

Modulesand vector spaces- Definitions and examples, Submodules and direct sums, Rhomomorphisms and Quotient modules, completely reducible modules & free modules.

Books for study:

1. I.N.Herstein - Topics in Algebra (Second edition)**,** Vikas publishing house Pvt.Ltd (For Units: I - IV)
   Unit I: Chapter-2-sec: 2.11- 2.13 (Page No: 82 - 108)
   Unit II: Chapter2-Sec:2.14(Page No:109 - 115) Chapter-5-sec:5.1& 5.3(Page No: 207-215,219 -227)
   Unit III: Chapter 5-Sec: 5.5 - 5.7 (Page No: 232 - 256)

Unit IV: Chapter-7-Sec: 7.1 - 7.3(Page No: 355 - 370)

Unit V: Chapter-14-Sec: 1- 5 (Page No: 246 - 268)

2. P.B.Bhattacharya, S.K.Jain and S.R.Nagpaul- Basic Abstract Algebra (Second edition)**,** Cambridge University Press, 1997. (For Unit: V)

Books for Reference:

1. M.Artin - Algebra**,** Prentice Hall of India, 1991.
2. I.S. Luther and I.B.S.Passi - Algebra,Vol.I-Groups, Vol.II Rings, Narosa Publishing House, New Delhi,1999.
3. N.Jacobson - Basic Algebra Vol.I&II**,** Hindustan Publishing Company, New Delhi.

CORE COURSE-II

Programme Title: M.Sc. MATHEMATICS
Course Title: REAL ANALYSIS **Hours / Week: 6**
Semester: I **Credits: 6**

Objectives:

To work comfortably with functions of bounded variation, Riemann - Stieltjes Integration, convergence of infinite series, infinite product and uniform convergence.

Course Outcomes (CO):

CO1: Understand the concepts of functions of bounded variation, Riemann-Stieltjes integral, multi variable derivatives, Implicit functions and extremum problems.
CO2: Examine the properties of monotonic functions,Riemann- Stieltjes integral and the applications of fundamental theorems of integration .
CO3: Assess the importance of functions of bounded variations, Mean value theorems for Riemann-Stieltjes , implicit function and inverse function theorem .
CO4: Recognise the concepts of directional derivative, total derivative, Jacobian matrix, functions with non-zero Jacobian determinant and discuss the related properties.
CO5: Applying the derivatives in chain rule,Mean value theorem of differentiable functions and extrema of real valued functionsof several variables.

Syllabus

UNIT I: Differentiation: **(Hours: 18)**

Differentiation - The derivative of a real function – Mean value Theorems – The continuity of the Derivative – L' Hospital's Rule – Derivatives of Higher order – Taylor'stheorem – Differentiation of Vector–valued functions.

UNIT II: Riemann – Stieltjes Integral: **(Hours: 18)**

The Riemann - Stieltjes Integral – Definition and Existence of the Integral – Propertiesof the Integral – Integration and Differentiation – Integration of Vector–valuedfunctions – Rectifiable curves.

UNIT III: Sequences and Series of Functions: **(Hours: 18)**

Sequences and Series of Functions – Discussion of main problem – UniformConvergence - Uniform Convergence and Continuity - Uniform Convergence andIntegration-Uniform Convergence and Differentiation, Equicontinuous families offunctions – Stone Weierstrass Theorem.

UNIT IV: Some Special Functions: **(Hours: 18)**

Some Special Functions – Power Series – The Exponential and Logarithmic functions –The Trigonometric functions- The algebraic completeness of the complex field –Fourier series - The Gamma function.

UNIT V: **(Hours: 18)**

Linear transformations, Differentiation, the contraction principle, the inverse function theorem, the implicit function theorem.

TEXT BOOK:

Walter Rudin – Principles of Mathematical Analysis, 3rd edition, McGraw Hill BookCo., Kogaskusha, 1976.

Unit I: Chapter 5: Page Number: 103 –119.
Unit II: Chapter 6: Page Number: 120 – 142.
Unit III: Chapter 7: Page Number: 143 – 171.
Unit IV: Chapter 8: Page Number: 172 – 203.
Unit V: Chapter 9.

BOOKS FOR REFERENCE:

1. T.M. Apostol, Mathematical Analysis, Narosa Publ. House, New Delhi, 1985.
2. H.L.Royden, Real Analysis, Macmillian Publn.Co.Inc.4th Edition, New York, 1993
3. V.GanapathyIyer, Mathematical Analysis, Tata McGraw Hill, New Delhi, 1970.

CORE COURSE-III

Programme Title: M.Sc. MATHEMATICS

Course Title: ORDINARY DIFFERENTIAL EQUATIONS **Hours / Week: 6**

Semester: I **Credits: 6**

Objectives:

To develop strong background on finding solutions to linear differential equations with constant and variable coefficients and also with singular points, to study existence and uniqueness of the solutions of first order differential equations.

Course Outcomes (CO):

CO1: Learn the basic concepts and the genesis of ordinary differential equations such as determining roots and Wronskian.

CO2: Discuss the nature of linear dependence and independence of the differential equations and interpret their possible solutions

CO3: Apply the techniques like Annhilator method, Euler equation and Bessel's equation available in Differential Equations for solving problems/society oriented problems.

CO4: Analyse linear second order equations with regular singular points at infinity and boundary value problems of first order equations using Lipschitz condition.

CO5: Justify the existence of a singular point for a Legendre equation, solution for a variable separable equation it's uniqueness and generate the basis and solution for a given differential equation.

Syllabus

UNIT-I: Second Order Linear Equations With Constant Coefficients (Hours: 18)

Second order homogeneous equations-Initial value problems-Linear dependence and independence - Wronskian and a formula for Wronskian -Non-homogeneous equation of order two.

UNIT-II: Linear Equations With Constant Coefficients (Hours: 18)

Homogeneous and non-homogeneous equation of order n - Initial value problems-Annihilator method to solve non-homogeneous equation - Algebra of constant coefficient operators.

UNIT-III : Linear Equation With Variable Coefficients (Hours: 18)

Initial value problems - Existence and uniqueness theorems - Solutions to solve a non-homogeneous equation - Wronskian and linear dependence - reduction of the order of a homogeneous equation - homogeneous equation with analytic coefficients -The Legendre equation.

UNIT-IV: Linear Equation with Regular Singular Points (Hours: 18)

Euler equation - Second order equations with regular singular points -Exceptional cases - Bessel Function.

UNIT-V: **Existence and Uniqueness of Solutions to First Order Equations (Hours: 18)**

Equation with variable separated - Exact equation - method of successive approximations - the Lipschitz condition - convergence of the successive approximations and the existence theorem.

Text Book

1. E.A.Coddington, An introduction to ordinary differential equations (3rd Reprint) Prentice-Hall of India Ltd.,New Delhi, 1987.

   Unit I: Chapter - 2: Sections 1 to 6
   Unit II: Chapter - 2: Sections 7 to 12.
   Unit III: Chapter - 3 Sections 1 to 8 (Omit section 9)
   Unit IV: Chapter 4: Sections 1 to 4 and 6 to 8 (Omit sections 5 and 9)
   Unit V: Chapter 5: Sections 1 to 6 (Omit Sections 7 to 9)

Reference Books

1. Williams E. Boyce and Richard C. DI Prima, Elementary differential equations and boundary value problems, John Wiley and sons, New York, 1967.
2. George F Simmons, Differential equations with applications and historical notes, Tata McGraw Hill, New Delhi, 1974.
3. N.N. Lebedev, Special functions and their applications, Prentice Hall of India, New Delhi, 1965.
4. W.T. Reid. Ordinary Differential Equations, John Wiley and Sons, New York, 1971
5. M.D.Raisinghania, *Advanced Differential Equations*, S.Chand& Company Ltd. New Delhi 2001
6. B.Rai, D.P.Choudary and H.I. Freedman, *A Course in Ordinary Differential Equations*, Narosa Publishing House, New Delhi, 2002.

CORE COURSE-IV

Programme Title: M.Sc. MATHEMATICS

Course Title: Complex Analysis **Hours / Week: 6**

Semester: II **Credits: 6**

Objectives

1. To learn the various intrinsic concepts and the theory of Complex Analysis.
2. To study the concept of Analyticity, Complex Integration and Infinite Products indepth.

Course Outcomes (CO):

CO1: Understand the fundamental concepts of topological spaces, conformality, Cross ratio and Symmetry function

CO2: Enhance the concepts of Cauchy's integral formula, simple connectivity, Rectifiable Arcs and The Index of a Point with Respect to aClosed Curve

CO3: Apply the acquired knowledge and evaluate definite integrals, Removable Singularities, Essential Singularity, Open Mapping Theorem and Maximum Principle.

CO4: Analyze the properties of Cauchy's integral formula, simple connectivity, homology, argument principle and Definite Integrals

CO5: Prove Cauchy's theorem, Schwarz' theorem, Jensen's formula, Harnack'principle, Weierstrass' theorem, Taylor'sseries, Laurent series, Hadamard's theorem, Riemann

Syllabus

UNIT I **(Hours: 18)**

Elementary Point Set Topology: Sets and Elements – Metric Spaces – Connectedness – Compactness – Continuous Functions – Topological Spaces; Conformality: Arcs and Closed Curves – Analytic Functions in Regions – Conformal Mapping – Length and Area; Linear Transformations: The Linear Group – The Cross Ratio – Symmetry

UNIT II **(Hours: 18)**

Fundamental theorems in complex integration: Line Integrals – Rectifiable Arcs – Line Integrals as Functions of Arcs – Cauchy's Theorem for a Rectangle – Cauchy's Theorem in a Disk; Cauchy's Integral Formula: The Index of a Point with Respect to a Closed Curve – The Integral Formula – Higher Derivatives.

UNIT III **(Hours: 18)**

Local Properties of Analytic Functions - Removable Singularities - Taylor's Theorem – Integral representation of the nth term - Zeros and Poles – Algebraic order of f(z) – Essential Singularity - The Local Mapping – The Open Mapping Theorem - The Maximum Principle.

UNIT IV **(Hours: 18)**

The General Form of Cauchy's Theorem: Chains and Cycles – Simple Connectivity – Homology – The General Statement of Cauchy's Theorem – Proof of Cauchy's Theorem – Locally Exact Differentials – Multiply Connected Regions; The Calculus of Residues: The Residue Theorem – The Argument Principle – Evaluation of Definite Integrals

UNIT V **(Hours: 18)**

Harmonic Functions: Definition and Basic Properties – The Mean-value Property –

Poisson's Formula – Schwarz's Theorem – The Reflection Principle; Power series expansions-Weierstrass's Theorem – The Taylor Series – The Laurent Series.

TEXT BOOK

1. Lars V. Ahlfors, Complex Analysis, Third Ed. McGraw-Hill Book Company, Tokyo, 1979.

UNIT – I Chapter 3: 1.1-1.6, 2.1-2.4,3.1-3.3

UNIT – II Chapter 4: 1.1-1.5, 2.1-2.3

UNIT – III Chapter 4: 3.1, 3.2, 3.3,3.4

UNIT – IV Chapter 4: 4.1-4.7, 5.1-5.3

UNIT – V Chapter 4: 6.1-6.5, and Chapter 5: 1.1-1.3

REFERENCES

1. Serge Lang, Complex Analysis, Addison Wesley, 1977.
2. S. Ponnusamy, Foundations of Complex Analysis, Narosa Publishing House, New Delhi, 1997.
3. Karunakaran, Complex Analysis,Alpha Science international Ltd,Second edition,2005.

CORE COURSE-V

Programme Title: M.SC. MATHEMATICS

Course Title: PARTIAL DIFFERENTIAL EQUATIONS **Hours / Week: 6**

Semester: II **Credits: 6**

Objectives

1. To give an in-depth knowledge of solving partial differential equations and apply Them in scientific and engineering problems.

2. To study the other aspects of PDE

Course Outcomes (CO):

CO1: Understand the basic concepts of second order partial differential equations (PDE's) and different methods of solving PDE's

CO2: Classify PDE's, apply analytic methods, Green's function and interpret the solution

CO3: Formulate and Analyse problems of Laplace, Poisson equations with initial and boundary conditions

CO4: Develop the knowledge of Direc-delta function, D' Alembert's solution, Vibrating string and solve the real world problems

CO5: Analyse the applications of the eigen function method and the method of images and discuss the properties of harmonic functions

Syllabus

Unit – I Fundamental concepts **(Hours: 18)**

Classification of second order partial differential equations - Canonical forms - Adjoint operators - Riemann's Method.

Unit – II Elliptic Differential Equations **(Hours: 18)**

Occurrence of the Laplace and Poisson equations - Boundary Value Problems - Some important Mathematical Tools - Properties of Harmonic functions - Separation of Variables.

Unit – III **(Hours: 18)**

Dirichlet Problem for a Rectangle - The Neumann Problem for a Rectangle - Interior Dirichlet problem for a Circle - Exterior Dirichlet problem for a Circle - Interior Neumann Problem for a Circle - Occurrence of the Diffusion Equation - Boundary conditions - Elementary Solutions of the Diffusion Equation – Dirac Delta Function.

Unit – IV Hyperbolic Differential Equations **(Hours: 18)**

Occurrence of the Wave equation - Derivation of one dimensional Wave equation - Solution of one dimensional Wave equation by Canonical reduction - The Initial Value Problem; D'Alembert's solution - Vibrating string - Variables separable solution - Forced vibrations - Solution of Non-homogeneous Equation.

Unit – V Green's Function **(Hours: 18)**

Introduction - The Methods of Images - The Eigen function Method - Green's Function for the Diffusion Equation.

Book for study:

K. SankaraRao - Introduction to Partial Differential Equations, Prentice Hall of India private Limited, New Delhi (Ninth print – May 2008).

UNIT – I Chapter 1 (Sections 1.2 - 1.5)

UNIT – II Chapter 2 (Sections 2.1 - 2.5).

UNIT – III Chapter 2 (Sections 2.6 - 2.10), Chapter 3 (Section 3.1 - 3.4)

UNIT – IV Chapter 4 (Section 4.1 - 4.6)

UNIT – V Chapter 5 (Section 5.1, 5.3, 5.4 and 5.6)

Books for Reference:

1. S.J. Farlow - Partial Differential Equations for Scientists and Engineers, John Wiley Sons, New York 1982.
2. N. Sneddon - Elements of Partial Differential Equations, McGraw Hill, 1964.

Core Course Practical Credit (CC (P))-VI

Programme Title: M.Sc. MATHEMATICS

Course Title: MATLAB **Hours / Week: 6**

Semester: II **Credits: 4**

Objectives

1. To have a strong foundation of handling the software MATLAB
2. To make use of the software for graphical solutions of mathematical problems.

Course Outcomes (CO):

CO1: Familiar with performing statistical data analysis, data interpolation, polynomial curve fitting and least square curve fitting by Matlab

CO2: Apply Matlab to solve ordinary differential equations and nonlinear system of equations

CO3: Apply Matlab to solve Partial differential equations and nonlinear system of equations

Syllabus

Unit – I: **(Hours: 18)**

Starting with Matlab - Creating arrays - Mathematical operations with arrays.

Unit – II: **(Hours: 18)**

Script files - Functions and function files.

Unit – III: **(Hours: 18)**

Two-dimensional plots - Three-dimensional plots.

Unit - IV **(Hours: 18)**

Programming in MATLAB.

Unit V: **(Hours: 18)**

Polynomials, Curve fitting and interpolation-Applications in numerical analysis.

Text Book: "MATLAB An Introduction with Application" by **A. Gilat,** John Wiley & Sons, Singapore, 2004.

Unit – I: Chapter 1, Chapter 2, Chapter 3.

Unit - II: Chapter 4, Chapter 6.

Unit - III: Chapter 5, Chapter 9.

Unit - IV: Chapter 7.

Unit - V: Chapter 8, Chapter 10.

Reference Books:

1. Getting Started with MATLAB – A Quick Introduction for Scientists and Engineers" by **R. Prata p**, Oxford University Press, New Delhi, 2006.
2. "Introduction to Matlab 7 for Engineers" by **W.J. Palm,** McGraw-Hill Education, New York, 2005.
3. "Introduction to MATLAB 7" by **D. M. Etter, D. C. Kuncicky and H.Moore**, Prentice Hall, New Jersy, 2004.

CORE COURSE-VII

Programme Title: M.Sc. MATHEMATICS
Course Title: LINEAR ALGEBRA **Hours / Week: 6**
Semester: III **Credits: 6**

Objectives:
1. To introduce the basic concepts of Linear Algebra.
2. To make them understand the theory and applications in almost every science and Pseudo science.

Course Outcomes (CO):
CO1: Learn the concepts and properties of vector spaces and linear transformations.
CO2: Relate matrices and linear transformations and compute characteristic roots
CO3: Prove the theorems on linear transformations, polynomials and determinants to solve the problems.
CO4: Use the acquired knowledge to analyse and solve the problems on linear transformations, polynomials and determinants.
CO5: Explain the theorems on canonical forms, hermitian, unitary and normal transformations.

Syllabus

UNIT I: Matrices **(Hours: 18)**

Systems of linear Equations - Matrices and Elementary Row operations -Row-reduced echelon Matrices - Matrix Multiplication - Invertible Matrices -Bases and Dimension. (Only revision of Vector spaces and subspaces).

Unit II: Linear transformations: **(Hours: 18)**

The algebra of linear transformations - Isomorphism of Vector Spaces - Representations of Linear Transformations by Matrices - Linear Functionals – The Double Dual - The Transpose of a Linear Transformation.

Unit III: Algebra of polynomials: **(Hours: 18)**

The algebra of polynomials - Lagrange Interpolation - Polynomial Ideals -The prime factorization of a polynomial - Commutative rings – Determinant functions.

Unit IV: Determinants: **(Hours: 18)**

Permutations and the uniqueness of determinants - Classical Adjoint of a (square) matrix - Inverse of an invertible matrix using determinants -Characteristic values - Annihilating polynomials.

Unit V: Diagonalization: **(Hours: 18)**

Invariant subspaces - Simultaneous triangulation and simultaneous Diagonalization Direct-sum Decompositions - Invariant Direct sums – Primary Decomposition theorem.

TEXTBOOK

1. Kenneth Hoffman and Ray Alden Kunze, Linear Algebra, Second Edition, Prentice all of India Private Limited, New Delhi, 1975.

UNIT - I Chapter 1 & 2 1.2-1.6 and 2.3
UNIT - II Chapter 3
UNIT - III Chapter 4 & 5 4.1 - 4.5 and 5.1 - 5.2
UNIT - IV Chapter 5 & 6 5.3, 5.4 and 6.1 - 6.3
UNIT - V Chapter 6 6.4 - 6.8

REFERENCES

1. S. Kumaresan, Linear Algebra: A Geometric Approach, Prentice-Hall of India Ltd, 2004.
2. V. Krishnamurthy, V.P. Mainra, J.L. Arora, Introduction to Linear Algebra, East West Press Ltd, 1985.
3. A.R. Rao, P. Bhimashankaram, Linear Algebra, Second Edition, Tata McGraw Hill, 2000.
4. Edgar G.Goodaire, Linear Algebra-Pure & Applied World Scientific, Cambridge University Press India Ltd, 2014

CORE COURSE-VIII

Programme Title: M.Sc. MATHEMATICS

Course Title: TOPOLOGY **Hours / Week: 6**

Semester: III **Credits: 6**

Course Objectives:

1. To gain knowledge about various types of topologies and topological spaces.
2. To familiarizes the concepts of connectedness and compactness of topological spaces.
3. To inculcate knowledge about countability and separation axioms.

Course Outcomes (CO):

CO1: Learn the concepts of topological spaces, connected and compact spaces, continuous functions, countability and separation axioms

CO2: Understand the attributes of continuous functions and inspect their applications in connected and compact spaces, countability and separation axioms

CO3: Apply the notions of different topological spaces and solve real world problems

CO4: Interpret various forms of tological spaces and assess their attributes

CO5: Prove extreme value theorem, lebesgue number lemma, uniform continuity theorem, countability and separation, axioms and inspect their applications.

Syllabus

Unit-I: **(Hours: 18)**

Spaces and maps: Topological spaces-Sets in a space-Maps-Subspaces-Sum and product of spaces.

Unit-II: **(Hours: 18)**

Identification and quotient spaces- Homotopy and isotopy.

Unit-III: **(Hours: 18)**

Properties of spaces and maps**:** Separation axioms and compactness.

Unit-IV: **(Hours: 18)**

Connectedness – Pathwise connectedness – Imbedding theorems.

Unit-V **(Hours: 18)**

Extension theorems- Compactification- Hereditary properties.

Text Books:

"Introduction to Topology" by **S.T. Hu**, **Tata** – McGraw-Hill, New Delhi, 1979.

Unit-I: Chapter 2: Sections: 1 - 5.
Unit-II: Chapter 2: Sections: 6 and 7.
Unit-III: Chapter 3: Sections: 1 and 2.
Unit-IV: Chapter 3: Sections: 4-6.
Unit-V: Chapter 3: Sections: 7-9.

References:

1. "Topology" by **J. Dugunj**i, Allyn and Bagon, Boston, 1966.
2. "Topology" by **K. Kuratowski,** Academic Press, New york, 1966
3. "Topology , A First Course " by **J.R. Munkres,** Prentice Hall , Englewood Cliffs, 1975.
4. "General Topology" by **S. Willard,** Addison-Wesley, Reading, 1970 **.**

CORE COURSE-IX

Programme Title: M.Sc. MATHEMATICS

Course Title: DIFFERENTIAL GEOMETRY **Hours / Week: 6**

Semester: IV **Credits: 5**

Course Objectives:

1. To gain knowledge about curves and its characterizations.
2. To get sufficient knowledge on Elementary Theory of surfaces.
3. To make the students to familiarize with space curves and curves on surfaces.

Course Objectives:

CO1: Learn various properties about tangents, normal, binormal, metric, geodesics, developables and minimal surfaces

CO2: Derive the equations for osculating plane, involutes, geodesics and conjugate direction

CO3: Defend the characteristics of curves and surfaces

CO4: Explain the polar representation for geodesic coordinates, geodesic parallels and the lines of curvature

CO5: Justify isometric correspondence between geodesic surfaces and develop the principal and lines of curvature for curves and surfaces.

Syllabus

Unit I **(Hours: 18)**

Theory of Space Curves**:** Introduction - Representation of space curves – Unique parametric representation of a space curve – Arc length – Tangent and osculating plane – Principal normal and Binomial - Curvature and torsion.

Unit II **(Hours: 18)**

Contact between curves and surface – Osculating circle and osculating sphere – Locus of centers of spherical curvature – Tangent surface, involutes and evolutes - Intrinsic equations of space curves – Fundamental existence theorem – Helices.

Unit III **(Hours: 18)**

Introduction – Definition of surface – Nature of points on a surface – Representation of a surface - Curves on surface – Tangent plane and surface normal – The general surfaces of revolution – Helicoids.

Unit IV **(Hours: 18)**

Families of curves – Orthogonal Trajectories – Double family of curves - isometric correspondence – intrinsic properties – Geodesics and their differential equations – Canonical geodesics equations – Geodesics on surface revolution .

Unit V: **(Hours: 18)**

Normal property of geodesics – Differential equations of geodesics using normal property – Existence theorems – Geodesics parallel – Geodesic curvature – Gauss bonnet theorem – Gaussian curvature.

Text Books:

D. Somasundaram, DIFFERENTIAL GEOMETRY, A first course, Narosa publishing house, Chennai, 2005.

Unit-I: Sec: 1.1 to 1.7

Unit-II: Sec: 1.10 to 1.13 & 1.16 to 1.18

Unit-III: Sec: 2.1 to 2.8

Unit-IV: Sec: 2.11 to 2.15 & Sec: 3.1 to 3.4

Unit-V: Sec: 3.5 to 3.8 & Sec: 3.10 to 3.13

Reference Books:

1. D. J. Struik, CLASSICAL DIFFERENTIAL GEOMETRY, Addison Wesley publishing company INC Massachusetts, 1961.
2. T.J. Wilmore, AN INTRODUCTION OF DIFFERENTIAL GEOMETRY, Oxford, 1959

CORE COURSE-X

Programme Title: M.Sc. MATHEMATICS

Course Title: Functional Analysis **Hours / Week: 6**

Semester: IV **Credits: 6**

Course Objectives:

1. To understand the theory of Hilbert spaces and Banach spaces and their operators.
2. To form a bridge between abstract Mathematics and Applied Mathematics.
3. To generalize many concepts of classical Mathematics.

Course Outcomes:

CO1: Learn the central concepts of Banach Space, Hilbert spaces and spectral theory

CO2: Understand the notions of continuous linear transformations, Natural imbedding, orthogonal complements, various operators, Banach algebra

CO3: Recognize and analyze conjugate of an operator, axiomatic knowledge of the properties of a Hilbert space, including orthogonal complements, orthonormal sets and topological divisors of zero

CO4: Apply the properties of various operators to the resolution of integral equations and Evaluate spectrum of an radius.

CO5: Prove Hahn Banach Theorm, open mapping theorem, properties of Hilbert spaces, the spectral theorem.

Syllabus

UNIT I : Banach Spaces: **(Hours: 18)**

Banach Spaces – Definition and examples – Continuous linear transformations – Hahn Banach theorem.

UNIT II : Banach Spaces and Hilbert Spaces: **(Hours: 18)**

The natural embedding of N in N** - Open mapping theorem – Conjugate of anoperator – Hilbert space – Definition and properties.

UNIT III : Hilbert Spaces: **(Hours: 18)**

Orthogonal complements – Orthonormal sets – Conjugate space H* - Adjoint of an operator

UNIT IV : Operations on Hilbert Spaces: **(Hours: 18)**

Self adjoint operator – Normal and Unitary operators – Projections.

UNIT V: Banach Algebras: **(Hours: 18)**

Banach Algebras – Definition and examples – Regular and simple elements – Topological divisors of zero – Spectrum – The formula for the spectral radius – The radical and semi simplicity.

TEXTBOOKS :

G.F.Simmons, Introduction to Topology and Modern Analysis, McGraw Hill Inter. Book Co, New York, 1963.

Unit-I: (Chapter 9: Sections 46 to 48).

Unit-II: (Chapter 9: Sections 49 to 51, Chapter 10: Sections 52).

Unit-III: (Chapter 10: Sections 53 to 56).

Unit-IV: Chapter 12 : Sections 64 to 69).

Unit-V: (Chapter 10: Sections 57 to 59).

BOOKS FOR REFERENCE :

1. W. Rudin, Functional Analysis, Tata McGraw Hill Publ. Co, New Delhi, 1973.
2. H.C. Goffman and G.Fedrick, First Course in Functional Analysis, Prentice Hall of India , New Delhi, 1987.
3. D. Somasundaram, Functional Analysis S. Viswanathan Pvt.Ltd., Chennai,1994.

Discipline Specific Elective-I

Programme Title: M.Sc. MATHEMATICS

Course Title: Probability Theory **Hours / Week: 6**

Credits: 4

Objectives:

1. To introduce axiomatic approach to probability theory.
2. To study some statistical characteristics, discrete and continuous distribution functions and their properties, characteristic function and basic limit theorems of probability

Course Outcomes:

CO1: To understand the concepts and results related to probability, random events and Distribution.

CO2: To understand various distributions and applications.

CO3: To know the standard results related to probability & distribution.

CO4: To understand characteristic of function and Properties of characteristic function.

CO5: To acquire knowledge about theorem Chebyshev, Lindberg and Kolmogorov.

Syllabus

UNIT-I : Random Events And Random Variables (Hours: 15)

Random events - Probability axioms - Combinatorial formulae - conditional probability - Bayes Theorem - Independent events - Random Variables - Distribution Function - Joint Distribution - Marginal Distribution - Conditional Distribution - Independent random variables - Functions of random variables.

UNIT-II: Parameters of the Distribution (Hours: 15)

Expectation- Moments - The Chebyshev Inequality - Absolute moments - Order parameters - Moments of random vectors - Regression of the first and second types.

UNIT-III: Characteristic Functions (Hours: 15)

Properties of characteristic functions - Characteristic functions and moments - semi-invariants - characteristic function of the sum of the independent random variables - Determination of distribution function by the Characteristic function - Characteristic function of multidimensional random vectors - Probability generating functions.

UNIT-IV : Some Probability Distributions (Hours: 15)

One point , two point , Binomial - Polya - Hypergeometric - Poisson (discrete) distributions - Uniform - normal gamma - Beta - Cauchy and Laplace (continuous) distributions.

UNIT-V: Limit Theorems (Hours: 15)

Stochastic convergence - Bernoulli law of large numbers - Convergence of sequence of distribution functions - Levy-Cramer Theorems - De Moivre-Laplace Theorem - Poisson, Chebyshev, Khintchine Weak law of large numbers - Lindberg Theorem - LyapunovTheroem - Borel-Cantelli Lemma - Kolmogorov Inequality and Kolmogorov Strong Law of large numbers.

Text Book

1. M. Fisz, Probability Theory and Mathematical Statistics, John Wiley and Sons, New York, 1963.

   Unit-I: Chapter 1: Sections 1.1 to 1.7 Chapter 2 : Sections 2.1 to 2.9
   Unit-II: Chapter 3: Sections 3.1 to 3.8
   Unit-III: Chapter 4: Sections 4.1 to 4.7
   Unit-IV: Chapter 5: Section 5.1 to 5.10 (Omit Section 5.11)
   Unit-V: Chapter 6: Sections 6.1 to 6.4, 6.6 to 6.9, 6.11 and 6.12. (Omit Sections 6.5, 6.10, 6.13 to 6.15)

Reference Books

1. R.B. Ash, Real Analysis and Probability, Academic Press, New York, 1972
2. K.L.Chung, A course in Probability, Academic Press, New York, 1974.
3. R.Durrett, Probability : Theory and Examples, (2nd Edition) Duxbury Press, New York, 1996.
4. V.K.RohatgiAn Introduction to Probability Theory and Mathematical Statistics, Wiley Eastern Ltd., New Delhi, 1988(3rd Print).
5. S.I.Resnick, A Probability Path, Birhauser, Berlin,1999.
6. B. R. Bhat, Modern Probability Theory (3rd Edition), New Age International (P)Ltd, New Delhi, 1999

Discipline Specific Elective-II

Programme Title: M.Sc. MATHEMATICS

Course Title: PYTHON PROGRAMMING FOR MATHEMATICS **Hours / Week: 6**
Credits: 4

Objectives:

1. To learn how to use lists, tuples, and dictionaries in Python programs.
2. To learn how to write loops and decision statements in Python.
3. To learn how to identify Python object types.
4. To learn how to use Matplotlib to draw graphs.
5. To work with differential equations and calculus.

Course Outcomes (CO):

CO1: Demonstrate the fundamental concepts of python programming.
CO2: Manipulate object oriented programming concepts in python.
CO3: Demonstrate plotting the graph using Matplotlib.
CO4: Solve equations using the SciPy package.
CO5: Find optimal solutions using Python.

Syllabus

UNIT – I: **(Hours: 15)**

Python Basics: Introduction to Python – Datatypes in Python – Sequences – Sets – Literals – Operators – Mathematical functions – Command Line Window - Input and Output Statements – Command Line Arguments.

UNIT – II: **(Hours: 15)**

Control Statements: if - if…else – if... elif...else – While Loop – for Loop - Infinite Loops - Nested Loops – Break – Continue – Pass – Assert – Return – Arrays in Python – Strings and Characters – Functions.

UNIT – III: **(Hours: 15)**

List – Methods to process Lists – List comprehensions – Basic operations on Tuple – Functions to process Tuples – Dictionaries: Dictionary methods – Introduction to OOPs : Class and Objects – Inheritance and Polymorphism – Exceptions.

UNIT – IV: **(Hours: 15)**

Basic Mathematical functions - Basic plotting with Matplotlib - Changing the plotting style - Adding labels and legends to plots - Adding subplots - Surface and contour plots - Customizing three-dimensional plots, Calculus and Differential Equations : Working with polynomials and calculus - Differentiating and integrating symbolically using SymPy - Integrating functions numerically using SciPy - Solving simple differential equations numerically.

UNIT – V: **(Hours: 15)**

Finding Optimal Solutions : Minimizing a simple linear function - Minimizing a non-linear function – Using gradient descent methods in optimization - Using least squares to fit a curve to data - Analyzing simple two-player games

REFERENCE BOOKS:

1. NageswaraRao R., “Core Python Programming”, 2nd Edition, Dreamtech Press, New Delhi, 2018. [UNIT – I to UNIT – III]
2. Kenneth A. Lambert, “Fundamentals of Python – First Programs”, 2nd Edition, Cengage Publication, New Delhi, 2019.
3. Paul Barry, “Head First Python”, 2nd Edition, O’Reilly Media, Beijing, 2016.
4. Sam Morley, “Applying Math with Python” Packt Publishing Ltd., UK, 2020.

[UNIT – IV and UNIT –V]
5. Peter Farrell, “Math Adventures With Python”, No Starch Press, Inc., San Francisco, 2019.

DISCIPLINE SPECIFIC ELECTIVE-III

Programme Title: M.Sc. MATHEMATICS

Course Title: Numerical Analysis **Hours / Week: 6**

Credits: 4

Course Objectives:

1. To acquire knowledge about the methods of obtaining numerical solutions to Various types of equations.
2. To develop problem solving skill applying different numerical methods.

Course Outcomes (CO):

CO1: Understand and discuss efficient numerical methods for solving algebraic and transcendental equations, linear systems of equations, ordinary and partial differential equations, boundary and eigen value problems

CO2: Analyse the methods of finding solutions using differentiation and integration methods, Taylor's series, Euler's methods, Runge kutta methods

CO3: Apply Newton – Raphson method, Romberg integration method, differentiation and integration methods, direct and iterative methods to obtain solutions of linear systems,ordinary and partial differential equations

CO4: Determine the solutions of initial and boundary value problems, laplace equations, parabolic equations and hyperbolic equations

CO5: Derive various rules, formulae and interpret their applications

Syllabus

Unit – I **(Hours: 15)**

Solution of algebraic and transcendental equations: Newton - Raphson method, LIN - Bairstow's method. Numerical differentiation and integration: Numerical differentiation, Trapezoidal rule, Simpson's 1/3 rule, Simpson's 3/8 rule, Romberg integration.

Unit – II **(Hours: 15)**

Solution of linear systems : Gauss elimination method, Gauss - Jordan method, Lu decomposition, Lu decomposition from Gauss elimination, Iterative methods.

Unit – III **(Hours: 15)**

Numerical solution of ordinary differential equations : Solution by Taylor's series, Euler's method, Modified Euler's methods, Runge-Kutta methods, Predictor - corrector methods, Adams – Moulton method, Milne's method.

Unit – IV **(Hours: 15)**

Boundary - value problems :Finite difference method, The shooting method, The cubic spline method. The Eigen value problem: Eigen values of a symmetric tridiagonal matrix, House holder's method.

Unit – V **(Hours: 15)**

Numerical solution of partial differential equations : Finite - difference approximataion to derivatives, Laplace's equations, Jacobi's method, Gauss -Seidel method, Successive over - relaxation, Parabolic equations, Iterative methods for the solution of equations, Hyperbolic equations.

Book for study:

S.S.Sastry - Introductory methodsof Numerical Analysis, Fourth Edition, Prentice -

Hall of India, New Delhi.

Unit-I: Chapter 2 (2.5, 2.10) Chapter 5 (5.2, omitting 5.2.2 only, 5.4.1, 5.4.2, 5.4.3 and 5.4.6)

Unit-II: Chapter 6 (6.3.2, 6.3.3, 6.3.6, 6.3.7 and 6.4)

Unit-III: Chapter 7 (7.2, 7.4 (Omitting 7.4.1 only), 7.5, 7.6).

Unit-IV: Chapter 7 (7.10, 7.10.1, 7.10.2 and 7.10.3)
Chapter 6 (6.5, 6.5.1, 6.5.2)

Unit-V: Chapter 8 (8.2, 8.3, 8.3.1, 8.3.2, 8.3.3, 8.4, 8.5 and 8.6)

Books for Reference:

1. Devi Prasad - Introduction to Numerical Analysis, Second Edition**,** Narosa Publishing House.
2. Rama B.Bhat, S.Chakravarthy - Numerical Analysis in Engineering, Narosa Publishing House.

DISCIPLINE SPECIFIC ELECTIVE-IV

Programme Title: M.Sc. MATHEMATICS

Course Title: MATHEMATICAL MODELING **Hours / Week: 6**

Credits: 4

Objectives:

1. To study the different mathematical models in ODE and Difference equations.
2. To study graph theoretical models.

Course outcomes:

CO1: Learn the importance of differential equations in solving mathematical models.

CO2: Understand the Occurrence, classification and characteristics of Mathematical Models.

CO3: Apply problem solving techniques in Mathematical Modeling to bring solutions to various real life situations.

CO4: Examine the principles governing the motion of satellites through notions of Mathematical Modeling and interpret the techniques in Mathematical Models to analyse the motion of fluids.

CO5: Construct suitable models for population dynamics, medicine and reducing various forms of Pollution.

Syllabus

UNIT I - Mathematical Modelling through Ordinary Differential Equations of First order : (Hours: 15)

Linear Growth and Decay Models – Non-Linear Growth and Decay Models – Compartment Models – Dynamics problems – Geometrical problems.

UNIT II - Mathematical Modelling through Systems of Ordinary Differential Equations of First Order: (Hours: 15)

Population Dynamics – Epidemics – Compartment Models – Economics –Medicine, Arms Race, Battles and International Trade – Dynamics.

UNIT III - Mathematical Modelling through Ordinary Differential Equations of Second Order: (Hours: 15)

Planetary Motions – Circular Motion and Motion of Satellites – Mathematical Modelling through Linear Differential Equations of Second Order –Miscellaneous Mathematical Models.

UNIT IV - Mathematical Modelling through Difference Equations : **(Hours: 15)**

Simple Models – Basic Theory of Linear Difference Equations with Constant Coefficients – Economics and Finance – Population Dynamics and Genetics –Probability Theory.

UNIT V - Mathematical Modelling through Graphs : **(Hours: 15)**

Solutions that can be Modelled through Graphs – Mathematical Modelling in Terms of Directed Graphs, Signed Graphs, Weighted Digraphs and Unoriented Graphs.

TEXT BOOK

1. J.N. Kapur, Mathematical Modelling, Wiley Eastern Limited, New Delhi, 1988.

REFERENCES

1. J. N. Kapur, Mathematical Models in Biology and Medicine, Affiliated East – West Press Pvt Limited, New Delhi, 19

DISCIPLINE SPECIFIC ELECTIVE-V

Programme Title: M.Sc. MATHEMATICS

Course Title: GRAPH THEORY **Hours / Week: 6**

Credits: 4

Objectives:

- To give a comprehensive idea about the basic knowledge of graphs.
- To find the applications in various graph theoretic problems.

COURSE OUTCOMES:

CO1: Acquire in depth knowledge on vital concepts in graph.

CO2: Understand the graphs, its types and on the theory of connectivity, colorings and planarity

CO3: Apply the imbibed knowledge on the concepts to categorize graphs.

CO4: Analyze and infer properties of graphs and its associated concepts.

CO5: Evaluate connectivity, chromatic number etc., and construct graphs with specific properties.

Syllabus

Unit I **(Hours: 15)**

Graphs and sub graphs: Introduction – Definition and examples – Degrees – Subgraphs – Isomorphism – Independent set and covering – Intersection of graphs and line graphs – Matrices - Operations of Graphs.

Unit II **(Hours: 15)**

Connectedness: Introduction – Wallks, Trails and paths –Connectedness and components – Blocks – Connectivity. Elurien and Hamiltonian graph : Introduction – Elurien Graphs – Hamiltonian Graphs.

Unit III **(Hours: 15)**

Trees; Introduction – Characterization of Tree – Centre of a Tree .Directed graphs: Introduction – Definition and Basic properties – Paths and connections –Digraphs and Matrices – Tournaments.

UNIT-IV: **(Hours: 15)**

Matchings - Matchings and Coverings in Bipartite Graphs - Edge Chromatic Number - Vizing's Theorem, Independent sets - Ramsey's Theorem - Chromatic Number - Brooks' Theorem - Chromatic Polynomials.

UNIT V: **(Hours: 15)**

Kruskal's algorithm – Dijkstra's shortest path algorithm, Prim's algorithm – Transport-Networks.

Text Book

1 .Dr.S.Arumugam, S.Ramachandran, INVITATION TO GRAPH THEORY, Scitech Publishers, 2001

2.J.A.Bondy and U.S.R. Murthy, Graph Theory and Applications, Macmillan, London, 1976.

Reference Book

1. S.Kumaravelu, and SuseelaKumaravelu, GRAPH THEORY, S.K.V Printer, 1996
2. A.Chandran A FIRST COURSE IN GRAPH THEORY, Macmillan Publishers, Chennai,1997.
3. R.J. Wilson, Introduction to Graph Theory, Pearson Education, 4th Edition, 2004, Indian Print.
4. S.A.Choudum, A First Course in Graph Theory, MacMillan India Ltd.1987.

DISCIPLINE SPECIFIC ELECTIVE-VI

Programme Title: M.Sc. MATHEMATICS

Course Title: Classical Dynamics **Hours / Week: 6**

Credits: 4

Objectives

1. To study mechanical systems under generalized coordinate systems, virtual work, energy and momentum.
2. To study mechanics developed by Newton, Langrange, Hamilton Jacobi and Theory of Relativity due to Einstein.

Course Outcomes:

CO1: Use knowledge of mechanical system in classical mechanics.

CO2: Understand formulate physical problems as classical mechanics using Lagrange's equation.

CO3: Interpret solutions in physical context, Hamiltonian equations, variational principle.

CO4: Classify classical mechanics, apply Hamiltonian Jacobians, descriptions.

CO5: Formulate, understand analogies between canonical transformations.

Syllabus

UNIT I **(Hours: 15)**

Introductory concepts: The mechanical system - Generalised Coordinates - constraints - virtual work - Energy and momentum.

UNIT II **(Hours: 15)**

Lagrange's equation: Derivation and examples - Integrals of the Motion – Small oscillations.

UNIT III **(Hours: 15)**

Special Applications of Lagrange's Equations: Rayleigh's dissipation function - impulsive motion - Gyroscopic systems - velocity dependent potentials.

UNIT IV **(Hours: 15)**

Hamilton's equations: Hamilton's principle - Hamilton's equations – Other variational principles - phase space.

UNIT V **(Hours: 15)**

Hamilton - Jacobi Theory: Hamilton's Principal Function – The Hamilton - Jacobi equation - Separability.

Text Books

1. Donald T. Greenwood,Classical Dynamics, PHI Pvt. Ltd., New Delhi-1985.

UNIT – I Chapter 1: Sections 1.1 to 1.5

UNIT – II Chapter 2: Sections 2.1 to 2.4

UNIT – III Chapter 3 : Sections 3.1 to 3.4

UNIT – IV Chapter 4: Sections 4.1 to 4.4

UNIT – V Chapter 5: Sections 5.1 to 5.3

References

1. H. Goldstein, Classical Mechanics, (2nd Edition), Narosa Publishing House, New Delhi.

2. Narayan Chandra Rana & Promod Sharad Chandra Joag, Classical Mechanics, Tata McGrawHill, 1991.

DISCIPLINE SPECIFIC ELECTIVE-VII

Programme Title: M.Sc. MATHEMATICS

Course Title: DIFFERENCE EQUATIONS **Hours / Week: 6**

Credits: 4

Objectives:

1. To acquire the knowledge in linear difference equations, stability theory and asymptotic methods.
2. To understand the fundamentals of the difference calculus, basic theory for linear difference equations.
3. To analyse stability results for linear and non-linear systems.

Course Outcomes:

CO1: Recall the basic concepts in the theory of difference operators

CO2: Interpret the notion of solving linear difference equations of first order

CO3: Perceive the idea of converting nonlinear equations into linear equations and their applications on z-transform

CO4: Examine various initial value problems for linear systems

CO5: Appraise the methods of Asymptotic analysis and non-linear equations

Syllabus

UNIT I : Difference Calculus: (Hours: 15)

Difference operator – Summation – Generating function – Approximate summation.

UNIT II: Linear Difference Equations: (Hours: 15)

First order equations – General results for linear equations.

UNIT III: Linear Difference Equations(Contd.): (Hours: 15)

Equations with constant coefficients – Equations with variable coefficients – z – transform.

UNIT IV: (Hours: 15)

Initial value problems for linear systems – Stability of linear systems.

UNIT V: (Hours: 15)

Asymptotic analysis of sums – Linear equations.

Text Book:

1. W.G.Kelley and A.C.Peterson, Difference Equations, Academic press, New York,1991.

UNIT – I (Chapter 2 Sections 2.1 to 2.3).

UNIT – II (Chapter 3 Sections 3.1 to 3.2).

UNIT – III (Chapter 3 Sections 3.3,3.5 AND 3.7).

UNIT – IV (Chapter 4 Sections 4.1 to 4.3).

UNIT – V (Chapter 5 Sections 5.1 to 5.3).

Books for Reference:

1. S.N.Elaydi, An Introduction to Difference Equations, Springer – Verleg, NewYork,1990

2. R.Mickens, Difference Equations, Van Nostrand Reinhold, New York, 1990.

3. R.P.Agarwal, Difference Equations and Inequalities Marcel Dekker, New York,1992.

DISCIPLINE SPECIFIC ELECTIVE-VIII

Programme Title: M.Sc. MATHEMATICS

Course Title: Financial Mathematics **Hours / Week: 6**

Credits: 4

Objectives:

1. Provide the students with knowledge of a range of mathematical and computational techniques that are required for a wide range of quantitative positions in the financial sector and to develop student appreciation of the major issues involved in rigorous advances in the area of financial mathematics.

Course Outcomes:

CO1: Understand the mathematical foundations of quantitative finance

CO2: Appreciation of emerging theory and techniques in the area of financial mathematics.

CO3: Create and evaluate potential models for the price of shares.

CO4: Use the internet to write reports about basic Financial Mathematics principles.

CO5: Apply knowledge gained during the course using computer applications

Syllabus

Unit I: Basic Financial Calculations (Hours: 15)

Introduction: financial securities- zero coupon bond, fixed interest, index linked securities etc.; the time value of money; nominal Vs. real interest, deflationary conditions; accumulating factors, force of interest, compound interest functions.

Unit II: Annuities and Equation of Value (Hours: 15)

Discounting and Accumulation: discrete and continuous cash flows; level annuities, deferred and increasing/decreasing annuities, equation of value and yield on transaction, probability of cash flows, higher discount, loan schedules; consumer credit: flat rate and APRs.

Unit III: Capital Budgeting Techniques and Compound Interest Problems (Hours: 15)

Introduction to financial statement, assessing financial performance, net present value, internal rate of return, payback period; projects with different lives; money and time weighed rate of return; fixed interest securities, uncertain income securities, equities, valuing a loan with allowance for capital gains and indexation.

Unit IV: Arbitrage, Forward Contracts, and Term Structure of Interest (Hours: 15)

Rationale for no arbitrage assumption; forward contracts, calculating the forward price for a security with known dividend yield; hedging, fixed cash income; Discrete time and continuous time rates; continuous time spot rates and forward rates; instantaneous forward rates; theories of time; term structure of interest rates; yield curve; yields to maturity; convexity and immunization; interest rate risk.

Unit V: Stochastic Interest Models and Investments (Hours: 15)

Simple stochastic interest rate models, fixed and varying interest model, log normal distribution; fixed interest government borrowings, government bonds, tax, security, marketability and return; government bills: corporate debt, debentures, unsecured loan stocks, eurobonds, certificates of deposit, convertibles, property, derivatives, future, range of futures, clearing house, margin, bond futures, short interest futures, stock index futures etc.,

Books for Study

1. Ross, S.M., (1999):An Introduction to Mathematical Finance, Cambridge University Press, Norton, London.
2. Martin, P.G. and Michael B., (1991): Applied Financial Mathematics, Prentice Hall.

Books for Reference

1. Baxter, M. and A. L. Rennie, (1 9 9 6) : Financial Calculus, Cambridge University Press.
2. Karatzas, L. and Shreve S.E., (1998): Methods of Mathematical Finance , Springer.
3. Watsham,T.J .and Perramore. K . ,(1997): Quantitative Methods in Finance, International Thomson Business Press.

DISCIPLINE SPECIFIC ELECTIVE-IX

Programme Title: M.Sc. MATHEMATICS

Course Title: MATHEMATICAL STATISTICS **Hours / Week: 6**

Credits: 4

Course Objectives:

1. To know the brief and proper introduction to modern probability theory and Mathematical Statistics.
2. To gain knowledge about the possible applications of these theories, accompanied by descriptive concrete examples.
3. To discussing the stochastic convergence in various theorems.

Course Outcomes:

CO1: Learn the concepts of Probability theory and Mathematical Statistics.

CO2: Understand the notions and properties of Random variables Moments, Characteristic function, Binomial distribution, Poisson distribution, Normal distribution, and Stochastic Convergence.

CO3: Solve today's complex world problems by applying the concepts obtained in the course.

CO4: Evaluate mean, variance, moments for various distributions using Characteristic function, Probability Generating function, One point distribution and Two point distribution

CO5: Derive various distributions and prove the theorems on Stochastic Convergence

Syllabus

UNIT I: **(Hours: 15)**

Collection, classification and tabulation of data, graphical and diagrammatic representation – Bar diagrams, Pie diagram, Histogram, Frequency polygon, frequency curve and Ogives.

UNIT II: **(Hours: 15)**

Measures of central tendency – Mean, Median and Mode in series of individual observations, Discrete series, Continuous series (inclusive), More than frequency, Less than frequency, Mid-value and open-end class.

UNIT III: **(Hours: 15)**

Measures of dispersion – Range, Quartile deviation, Mean deviation about an average, Standard deviation and co-efficient of variation for individual, discrete and continuous type data.

UNIT IV: **(Hours: 15)**

Correlation – Different types of correlation – Positive, Negative, Simple, Partial Multiple, Linear and non-Linear correlation. Methods of correlation – Karl-Pearson's coefficient of correlation- Spearman's rank correlations and Concurrent deviation.

UNIT V: **(Hours: 15)**

Regression types and method of analysis, Regression line, Regression equations, Deviation taken from arithmetic mean of X and Y, Deviation taken from assumed mean, Partial and multiple regression coefficients – Applications.

TEXT BOOK:

S.C.Gupta and V.K. Kapoor, Fundamentals of Mathematical Statistics, Sultan Chand and Sons, New Delhi, 1994.

BOOKS FOR REFERENCE:

1. Freund J.E. (2001); Mathematical Statistics, Prentice Hall of India.

2. Goon, A.M., Gupta M.K., Dos Gupta, B, (1991), Fundamentals of Statistics, Vol. I, World Press, Calcutta.

DISCIPLINE SPECIFIC ELECTIVE-X

Programme Title: M.Sc. MATHEMATICS

Course Title: OPTIMIZATION TECHNIQUES **Hours / Week: 6**

Semester: II **Credits: 4**

Objectives:

This course aims to introduce decision theory, PERT, CPM, deterministic and probabilistic inventory systems, queues, replacement and maintenance problems.

COURSE OUTCOMES:

CO1: Learn the notions of network models, deterministic dynamic programming, inventory models, decision analysis and queuing models

CO2: Understand minimal spanning tree, maximal flow, shortest-route algorithms, forward and backward recursive approaches and solve real world problems

CO3: Analyse the criterions for different decision making environments, pure birth and death models, specialized poisson queues, single and multiple – server models and solve related problems

CO4: Determine the minimal spanning tree, most economical cable network, replacement policy, maximal flow, optimal inventory policy, solutions of cargo – loading and LP problems using dynamic programming

CO5: Discuss Dijkstra's algorithm, Floyd's algorithm, Knapsack model, the procedure of determining optimum inventory policy in various EOQ models.

Syllabus

UNIT-I: DECISION THEORY (Hours: 15)

Steps in Decision theory Approach - Types of Decision-Making Environments - Decision Making Under Uncertainty - Decision Making under Risk - Posterior Probabilities and Bayesian Analysis - Decision Tree Analysis - Decision Making with Utilities.

UNIT-II: PROJECT MANAGEMENT : PERT AND CPM (Hours: 15)

Basic Differences between PERT and CPM - Steps in PERT/CPM Techniques - PERT/CPM Network Components and Precedence Relationships - Critical Path Analysis - Probability in PERT Analysis - Project time-cost Trade Off - Updating the Project.

UNIT-III: DETERMINISTIC INVENTORY CONTROL MODELS (Hours: 15)

Meaning of Inventory Control - Functional Classification - Advantage of Carrying Inventory - Features of Inventory System - Inventory Model building - Deterministic Inventory Models with no shortage - Deterministic Inventory with Shortages

UNIT-IV: QUEUEING THEORY (Hours: 15)

Essential Features of Queueing System - Operating Characteristic of Queueing System - Probabilistic Distribution in Queueing Systems - Classification of Queueing Models - Solution of Queueing Models - Probability Distribution of Arrivals and Departures.

UNIT-V: REPLACEMENT AND MAINTENANCE MODELS (Hours: 15)

Failure Mechanism of items - Replacement of Items Deteriorates with Time - Replacement of items that fail completely - other Replacement Problems.

Text Book

1. J. K. Sharma, *Operations Research* Theory and Applications, Third Edition (2007), Macmillan India Ltd.
   UNIT – I Chapter-1 1: 11.1 - 11.8
   UNIT – II Chapter-13: 13.1 - 13.7
   UNIT – III Chapter-14: 14.1 - 14.8
   UNIT – IV Chapter-16: 16.1 - 16.8; Appendix 16.A (PP 774-781)
   UNIT – V Chapter-17: 17.1 - 17.5

Reference Books

1. F.S. Hillier and J.Lieberman -,*Introduction to Operations Research* (8th Edition), Tata McGraw Hill Publishing Company, New Delhi, 2006.
2. Beightler. C, D.Phillips, B. Wilde, *Foundations of Optimization* (2nd Edition) Prentice Hall Pvt Ltd., New York, 1979
3. Bazaraa, M.S; J.J.Jarvis, H.D.Sharall, *Linear Programming and Network flow,* John Wiley and sons, New York 1990.
4. Gross, D and C.M.Harris, *Fundamentals of Queueing Theory*, (3rd Edition), Wiley and Sons, New York, 1998.
5. Hamdy A. Taha ,*Operations Research* (sixth edition), Prentice - Hall of India Private Limited, New Delhi.

SKILL ENHANCEMENT COURSE-I

Programme Title: M.Sc. MATHEMATICS

Course Title: Quantitative Aptitude for Competitive Examinations **Hours / Week: 6**
Credits: 3

Course Objectives:

1. To acquire the knowledge of basic Mathematics.
2. To understand the basic concepts of numbers, logarithms, permutations and combinations and probability.
3. To promote the problem solving ability using short-cut methods.

Course Outcomes (CO):

CO1: Recognise the basic notions on Numbers,Profit and Loss,Partnership, Permutation and combination, Probability, Height and Distances and Odd man out

CO2: Understand and acquire knowledge on the concepts required to improve their quantitative aptitude

CO3: Apply the concepts obtained in the course to solve the problems/society connect problems

CO4: Relate ideas and concepts of H.C.F and L.C.M of numbers, Square roots and Cube roots, Ratio and Proportion,Chain rule, Logarithms and Probability

CO5: Determine the speed of objects including train and boats and evaluate the height of a building tower etc by using trigonometric formulas

Syllabus

Unit – I **(Hours :12)**

Numbers – HCF and LCM of Numbers – Decimal Fractions – Square Roots and Cube Roots.

Unit – II **(Hours :12)**

Average – Problems on Numbers – Problems on Ages-Surds and indices

Unit – III **(Hours : 12)**

Profit and Loss – Ratio and Proportion – Partnership – Chain Rule.

Unit – IV **(Hours : 12)**

Time and Distance – Problems on Trains – Boats and Streams – Logarithms

Unit – V **(Hours :12)**

Permutations and Combinations – Probability – Heights and Distances – Odd Man Out and Series.

Book for Study:

R.S.Aggarwal, Quantitative Aptitude for Competitive Examinations (Fully Solved) – S.Chand and company Ltd.,

UNIT – I Section 1 (1, 2, 3, 5)
UNIT – II Section 1 (6 - 9)
UNIT – III Section 1 (11 - 14)
UNIT – IV Section 1 (17, 18, 19, 23)
UNIT – V Section 1 (30, 31, 34, 35)

Books for Reference:

bhijitGuha, Quantitative Aptitude for All Competitive Examinations, McGraw Hill Education; Sixth edition.

SKILL ENHANCEMENT COURSE-II

Programme Title: M.Sc. MATHEMATICS

Course Title: Soft Skills **Hours / Week: 6**

Credits: 3

Course Outcomes (CO):

CO1: Be exposed and trained in various nuances of SoftSkills in a Professional manner responding to the requirements of national and international market

CO2: Be able to synthesize the knowledge and practical skills learnt to be personal effective in any managerial positions

CO3: Be equipped to construct plans and strategies to work for better human society

CO4: Be able to illustrate the problems at work and home and design solutions and Maintain a balance of work and home

CO5: Be able to connect on a continuum and maintain growth and sustainability and creativity in employment that increases in productivity, profit for individuals and the society.

Syllabus

Unit – I Effective Communication (Hours :12)

Definition of communication, Process of Communication, Barriers of Communication, Non-verbal Communication. JOHARI Window as a tool of effective communication

Unit – II Resume Writing Interview Skills (Hours :12)

Meaning and Purpose. Resume Formats. Types of Resume. Functional and Mixed Resume**,** Steps in preparation of Resume, Model resumes for an IT professional Chronological, Types of interviews, Creative resumes using online platforms

Common interview questions, Dos and Don'ts for an interview, Attitude, Emotions, Measurement, Body Language, Facial expressions, Different types of interviews, Telephonic interviews, Behavioral interviews and Mock interviews(Centralized).

Unit – III Group Discussion (Hours :12)

Group Discussion Basics, GD as the first criterion for selecting software testers, Essentials of GD, Factors that matter in GD, GD parameters for evaluation, Points for GD Topics, GD Topics for Practice, Tips for GD participation. Video shooting of GD presentation & Evaluation(Centralized)

Unit – IV Personal Effectiveness (Hours :12)

Self Discovery: Personality, Characteristics of personality, kinds of self, Personality inventory table, measuring personality, intelligence and Exercises

Unit – V Test of Reasoning (Hours :12)

Number series, letter series, coding and decoding, logical sequence of words, Assertion and Reasoning, Data Sufficiency, Analogy, Kinds of relationships.

Series**,** Classification, analogical, Pattern comparison, Deduction of figures out of series, Mirror Reflection Pattern, Hidden figures, Rotation pattern, Pattern completion and comparison, Sense of direction, Blood relations

References

1. Aggarwal, R.S.*QuantitativeAptitude, S.Chand& Sons*
2. Aggarwal,R.S. (2010). *A Modern Approach toVerbal and Non Verbal Reasoning*. S.Chand &C0,RevisedEdition.
3. Covey, Stephen. (2004). *7 Habits of Highly effectivepeople,*FreePress.
4. Egan,Gerard.(1994).*TheSkilledHelper*(5thEd).PacificGrove,Brooks/Cole.
4. Khera,Shiv(2003).*You Can Win.* Macmillan Books, Revised Edition

SKILL ENHANCEMENT COURSE-III

Programme Title: M.Sc. MATHEMATICS

Course Title: ORGANISATIONAL BEHAVIOUR **Hours / Week: 6**

Credits: 3

Course Objective:

1. To impart knowledge on factors influencing Individual and group behavior in the organizational context.
2. To make the students understand various styles of leadership

Course Outcomes (CO):

CO1: Know the importance of understanding behavior in the organizational context

CO2: Be familiar with the factors affecting behaviour

CO3: Know the formation and role of Groups in organisation

CO4: Be able to differentiate and apply various leadership styles.

Syllabus

Unit-I: **(Hours :12)**

Organizational Behaviour- Meaning - Importance – Evolution -Disciplines contributing to Organizational Behaviour- Models of Organizational Behaviour-relevance of OB in modern management.

Unit – II: **(Hours :12)**

Individual behavior: Factors affecting individual behavior – personal – biography-environmental – socio-cultural – political - organizational factors. Personality – Meaning - Determinants of personality - Theories of Personality -Type theory, Trait theory, Psychoanalytical theory, social learning theory, self theory.

Unit III: **(Hours :12)**

Perception – Importance – Perceptual - Process selectivity – Developing perceptual skills Attitude and Behaviour - Factors in Attitude Formation – Relevant for Organisation – Effects of Employee Attitude – Developing positive attitude.

Unit IV: **(Hours :12)**

Group- meaning – types – stages in group formation-group norms - group cohesiveness-factors affecting cohesiveness- group decision making – advantages – disadvantages. Conflict – Types of conflict – Conflict Resolution.

Unit V: **(Hours :12)**

Leadership – Meaning, Functions and Qualities of a leader - Leader vs Manager - Leadership styles. Organizational change- meaning-reasons- types of change - managing planned change – planning, assessing and implementing the change-causes of resistance to change- overcoming resistance to change.

Text Book

1. Organizational behavior – L.M.Prasad S.Chand& company Ltd
2. Organizational behavior – S.S.Khanka, S.Chand & company Ltd

REFERENCE BOOKS

1. Fred Luthans, OrganisationalBehaviour, McGraw Hill.
2. ShashiK.Gupta& Rosy Joshi, OrganisationalBehaviour –Kalyani Publishers.
3. K. Aswathappa, Organisational behavior, Texts and cases –Himalaya Publishing company
4. Keith Devis, John W.Newstrom, OB –Human Behaviour at work, TMH
5. M.L Blum, Industrial Psychology and its Social foundations.
6. J Jayasankar, Organizational Behaviour, Margham Publications Chennai.
7. P Subba Roa, Management and Organizational Behaviour – HPH.
8. Robbins Stephen P Organizational Behaviour, Prentice Hall, New Delhi

SKILL ENHANCEMENT COURSE-IV

Programme Title: M.Sc. MATHEMATICS

Course Title: RESEARCH METHODOLOGY **Hours / Week: 6**

Credits: 3

COURSE OBJECTIVES:

To make the students

1. To understand the basic framework of research and research process and its important in business decision.
2. To develop an understanding of various research designs and sampling techniques and its application.

COURSE OUTCOMES:

CO1: Assess the best suitable research type and formulate there search objective for the business problem.

CO2: Formulate the suitable research designs and select appropriate sampling techniques for there search.

CO3: Select the appropriate data collection method for solving the business issue and decide the appropriate measurement scale for designing the instrument for data collection.

CO4: Apply appropriate analytical tools for the data collected and formulate a suitable suggestion for the business problem.

CO5: Demonstrate capabilities of team work, problem-solving, critical thinking, and communication skills and design a suitable research report based on the ethical norms of research.

UNIT-I **(Hours :12)**

Research - Introduction to Research: Meaning – Purpose – Types of Research – Significance– Qualities of a good research – Steps in Research - Identification, Selection and Formulation of Research Problem. Research Design: Components of Research Design – Methods of Research Design - Ethics in Research.

UNIT-II **(Hours :12)**

Sampling Design – Census and Sample Survey–Characteristics of a Good Sample Plan–Steps in Sampling – Types of Sampling – Advantages and Limitations of Sampling. Data Collection: Primary Data - Meaning – Significance – Methods of Collecting Data: Observation – Interview Schedule – Questionnaire. Secondary Data – Meaning - Sources of Secondary Data – Precautions while using Secondary Data.

UNIT-III **(Hours :12)**

Scaling Techniques and Report Writing: Meaning of Scale–Measurement of Scale – Important Scaling Techniques – Processing of Data – Editing – Purpose–Analysis and Interpretation of Data - Meaning–Need for Interpretation – Techniques of Interpretation.- Report Writing: Types of Resarch Reports - Layout of the Report – Steps in Writing the Report – Contents of Research Reports – Ethics in Publication – Plagiarism check – Publication Misconduct.

UNIT-IV **(Hours :12)**

Hypothesis: Characteristics of a good Hypothesis – Formulation of Hypothesis – Procedure for Testing of Hypothesis – T test, F test and Chi Square Test, Analysis of Variance - Business Forecasting – Exponential Smoothing

UNIT-V **(Hours :12)**

Descriptive Statistics - Measures of Central Tendency: - Mean, Median and Mode - Standard deviation – Karl Pearson Correlation – Spearman Rank Correlation - Regression Analysis – Inferential Statistics – Multivariate Analysis - Factor Analysis – Kruskal WallisTest

SUGGESTED READINGS:

1. Uma Sekaran, Roger Bougie (2018), *Research Methods for Business: A Skill-Building Approach*, 7th edition, Wiley, New Delhi.
2. C.R. Kothari , Gaurav Garg (2018), *Research Methodology*, Fourth Edition, New Age International Publishers, New Delhi.
3. Donald Cooper and Pamela Schindler (2017), *Business Research Methods*, 11th edition, McGraw Hill education, New Delhi.
4. Zikmund William G. et.al (2016*), Business Research Methods*, Cengage India ,New Delhi.
5. MarkN.K.Saunders,PhilipLewis,AdrianThornhill(2015),*ResearchMethodsforBusiness Students*, 7th edition, Pearson Education, New Delhi.
6. https://swayam.gov.in/nd2_arp19_ap72/preview
7. https://swayam.gov.in/nd2_cec20_hs17/preview

SKILL ENHANCEMENT COURSE-V

Programme Title: M.Sc. MATHEMATICS

Course Title: ESSENTIALS OF COMMUNICATION SKILLS **Hours / Week: 6**
Credits: 3

Objectives:

1. To understand the basics of grammar and its usage.
2. To understand the basics of communication skills.
3. To learn the different skills in communication.

Unit I Grammar I **(Hours :12)**

Parts of Speech - Active and Passive Voice

Unit II Grammar II **(Hours :12)**

Tense Forms - Simple, Compound and Complex Sentence

Unit III **(Hours :12)**

Introduction to Communication – LSRW

Unit IV **(Hours :12)**

Group Discussion

Unit V **(Hours :12)**

Interview Skills

SKILL ENHANCEMENT COURSE-VI

Programme Title: M.Sc. MATHEMATICS

Course Title PROGRAMMING IN JAVA **Hours / Week: 6**

Credits: 3

Objective:

1. Programming in the Java programming language
2. Knowledge of object-oriented paradigm in the Java programming language
3. The use of Java in a variety of technologies and on different platforms.

COURSE OUTCOMES:

CO1: An ability to apply knowledge of computing and mathematics appropriate to the discipline

CO2: An ability to analyze a problem, and identify and define the computing requirements appropriate to its solution

CO3: An ability to design, implement, and evaluate a computer-based system, process, component, or program to meet desired needs

Syllabus

Unit I: **(Hours :12)**

Java Token – Java Statements – Constants – Variables – Data Types

Unit II: **(Hours :12)**

Operators – Expressions – Decision making and branching.

Unit III: **(Hours :12)**

Classes – Objects – Methods –Arrays – Strings – Vectors – Multiple inheritance.

Unit IV: **(Hours :12)**

Multithreaded Programming – Managing errors and Exceptions.

Unit IV: **(Hours :12)**

Applet Programming

Reference Books:

1. E. Balagurusamy, Programming with Java – A primer , Tata McGraw Hill Publishing Company Limited, New Delhi, 1998.
2. Mitchell Waite and Robert Lafore, Data Structures and Algorithms in Java, Techmedia(Indian Edition), New Delhi, 1998
3. Adam Drozdek, Data structures and Algorithms in Java, (Brown/Cole), Vikas Publishing House, New Delhi, 1999.

UNIT – I Chapters 3 & 4
UNIT – II Chapters 5, 6 & 7
UNIT – III Chapters 8, 9 & 10
UNIT – IV Chapters 12 & 13
UNIT – V Chapters 14

ABILITY ENHANCEMENT COURSE-I

Programme Title: M.Sc. MATHEMATICS
Course Title: HUMAN RIGHTS **Hours / Week: 6**
Credits: 4

COURSE OUTCOME	Human rights' as an emblem of modernity, good governance, and globalization. Its universal nature with reference to the dignity of every human being brings forward dreams of freedom as well as worries about foreign influence. It refers to actually existing international law and associated legal and political mechanisms as well as processes of far-reaching social and cultural change. This programme offers courses in human rights in both theory and practice from legal, historical, philosophical, political and social science-based perspectives.

SYLLABUS

UNIT-I : Introduction To Human Rights **12 HOURS**

Human rights: Meaning-origin and growth of human rights in the world- Need and Types of human rights- UNHRC (United Nations Human Rights Commission) – Human Rights in India

UNIT-II: Classification of human rights **12 HOURS**

Rights to liberty – Rights to life – Rights to equality-Rights to Dignity- Right against Exploitation- Educational Rights- Cultural rights – Economical Rights –Political Rights-Social Rights.

UNIT-III: Rights of Women and Children **12 HOURS**

Rights of Women- Female feticide and infanticide and selective abortion- Physical assault and sexual harassment-Domestic violence-violence at work place- Remedial measures.

Rights of children-Protection right- survival Rights – Participation Rights-Development Rights-Role of UN on convention on Rights of children.

UNIT –IV Multi – Dimensional aspects of human Rights **12 HOURS**

Labor Rights –Bonded Labour- Child Labour- Contract labour- Migrant Labour- Domestic Women labour-Gender equity –Rights ethic refugees- Problems and Remedies- Role of trade union in protecting the unorganized labour.

UNIT –V Grievances and Redressal Mechanism **12 HOURS**

Redressal Mechanisms at national and international levels-structure and function of National and state level human rights commission- Constitutional remedies and directive principles of state policy.

REFERENCES BOOKS:

1. Baradot Sergio and Swarojali Ghosh Teaching of human Rights: Dominant Publishers and Distributors New Delhi,2009.

2. Roy A.N Human Rights Achievement and challenges: vista imitational Publishing house, Delhi, 2005.

3. Asish Kumar das and PeasantKumar Mohanty: Human Rights in India: Sarup and sons New Delhi, 2007.

4. Velan, G . Human Rights and Development issues: The associated Publishers Ambalacannt, 2008.

ABILITY ENHANCEMENT COURSE-II

Programme Title: M.Sc. MATHEMATICS
Course Title: Problem Solving In Advanced Mathematics **Hours / Week: 6**
Credits: 4

Course Outcomes (CO):

CO1: Acquire knowledge of fundamental concepts on Analysis, Algebra, and differential Equations and Logical reasoning.

CO2: Understand the nuances of problem-solving approach in Real Analysis Complex **a**nalysis and Algebra and Quantitative aptitude.

CO3: Identify and apply the relevant techniques to solve problems in pure mathematics, quantitative aptitude and logical reasoning.

CO4: Analyze and evaluate the efficiency of a specific technique when solving a problem.

CO5: Develop new problem-solving methodology to tackle problems in Advanced mathematics and quantitative aptitude.

Syllabus

Unit-I **(12 Hours)**

Sets-open-closed-compact-connected-Sequences and series – Sequences and series of functions Continuity, uniform continuity, differentiability, mean value theorems. Analytic functions, Cauchy-Riemann equations., Harmonic functions, Complex integration, Cauchy's theorem, Cauchy's integral formula, Liouville's theorem, Maximum modulus principle, Schwarz lemma, classification of singularities and calculation of residues.

Unit-II **(12 Hours)**

Groups, subgroups, normal subgroups, quotient groups, homomorphisms, cyclic groups, permutation groups, Cayley's theorem, class equations, Sylow theorems. Rings, ideals, prime and maximal ideals, quotient rings, Vector spaces, subspaces, linear dependence, basis, dimension.

Unit-III **(12 Hours)**

Linear Transformations, Rank and nullity, Rank and determinant of matrices, systems of linear equations. Eigen values and eigen vectors, Cayley-Hamilton theorem. Matrix representation of linear transformations. Linear Differential Equations, Wronskian, singular and regular solutions Existence and uniqueness of solutions of initial value problems for first order ODE's.

Unit IV **(12 Hours)**

Problem Solving on Profit and Loss-Ages- Time and Work-Time and Distance-Trains-Area, Volume Surface- Problem Solving on Permutations and Combinations-Probability.

Unit V **(12 Hours)**

Logical Reasoning - Deductions- Statements- Assumptions- Conclusions.

Books for Study

1. A.P. Singh,Info Study's Real Analysis, Info study Publications 2017.
   Unit I Chapter 1(Sec 1.24-1.40), Chapter 2 (Sec 2.1-2.3) and Chapter 3(Sec 3.1-3.4)
2. A.P. Singh, Info Study's Complex Analysis, Info Study Publications 2017
   Unit- I Chapter 2 (Sec 2.5-2.8) Chapter 3 (Sec3.1-3.6) and Chapter 5(5.1-5.5)
3. A.P.Singh Info Study's Modern Algebra, Info study Publications 2017.
   Unit-II Chapter 1 (Sec 1.1-1.7,1.9,1.10,1.11) and Chapter 2 (Sec 2.1-2.7)
4. A.P.Singh Info Study's Linear AlgebraInfo study Publications 2017.

Unit-II Chapter 1 (1.1-1.6) and Chapter 2 (Sec 2.1-2.7)

Unit -III Chapter 3 (Sec 3.1-3.13, 3.16) and Chapter 4 (Sec 4.1-4.18)

5. A.P.Singh Info Study's Differential EquationInfo study Publications 2017.

Unit -III Chapter 2(Sec 2.1-2.10,2.12, 2.13- Omit 2.11) and Chapter 3 (Sec 3.1)

6. R. S. Agarwal Quantitative Aptitude S. Chand & Co. 2017.

Unit- IV Chapters8, 12, 17, 18, 20, 24, 25, 30, 31

7. R.S Agarwal,A Modern Approach to Verbal &Non Verbal ReasoningRevised Edition. S. Chand & Co. 2009.

Unit -V Part I Section II Chapters 1, 3, 5.

Books for Reference

1. Walter Rudin, Principles of Mathematical Analysis, Third Edition, Mc Graw-Hill International Book Company, New York, 1976
2. John B.Conway, Functions of one Complex Variable, Second Edition, Springer Graduate Texts in Mathematics, New York, 1978
3. Seymour Lipschutz and Marc Lipson, Schaum's Outlines Linear Algebra Third Edition
4. Earl A.Coddington,An Introduction to Ordinary Differential Equations, Prentice-Hall of India, New Delhi,1992