VINAYAKA MISSION'S RESEARCH FOUNDATION

(Deemed to be University)

FACULTY OF ARTS & SCIENCE

Curriculum and Syllabus

For

B.Sc. Mathematics

(Regular)

LOCF

(For the Academic Year starting from 2021-2022 onwards)

VINAYAKA MISSION'S RESEARCH FOUNDATION
(Deemed to be University under section 3 of the UGC Act 1956)

FACULTY OF ARTS AND SCIENCE

B.Sc. Mathemaatics- LOCF

PROGRAMME LEARNING OUTCOMES

The Bachelor of Science with Mathematics (B.Sc. Mathematics) program enables students to accomplish, by the time of graduation:

PLO-A. Bachelor's degree in mathematics is the culmination of in-depth knowledge of algebra, calculus, geometry, differential equations and several other branches of mathematics. This also leads to study of related areas like computer science and statistics. Thus, this programme helps learners in building a solid foundation for higher studies in mathematics.

PLO-B. The skills and knowledge gained has intrinsic beauty, which also leads to proficiency in analytical reasoning. This can be utilised in modelling and solving real life problems.

PLO-C. Students undergoing this programme learn to logically question assertions, to recognise patterns and to distinguish between essential and irrelevant aspects of problems. They also share ideas and insights while seeking and benefitting from knowledge and insight of others. This helps them to learn behave responsibly in a rapidly changing interdependent society.

PLO-D. Students completing this programme will be able to present mathematics clearly and precisely, make vague ideas precise by formulating them in the language of mathematics, describe mathematical ideas from multiple perspectives and explain fundamental concepts of mathematics to non-mathematicians.

PLO-E. Completion of this programme will also enable the learners to join teaching profession in primary and secondary schools.

PLO-F. This programme will also help students to enhance their employability for government jobs, jobs in banking, insurance and investment sector

and jobs in various other public and private enterprises.

PLO-G. Demonstrate fundamental systematic knowledge of mathematics and its applications in engineering, science, technology and mathematical sciences. It should also enhance the subject specific knowledge and help in creating jobs in various sectors.

PLO-H. demonstrate educational skills in areas of analysis, geometry, algebra, mechanics, differential equations etc.

PLO-I. Apply knowledge, understanding and skills to identify the difficult/unsolved problems in mathematics and to collect the required information in possible range of sources and try to analyse and evaluate these problems using appropriate methodologies.

PLO-J. Ability to communicate various concepts of mathematics effectively using examples and their geometrical visualizations.

Additional PLOs

The Bachelor of Science in with Mathematics (B.Sc. Mathematics) program enables students to achieve following additional features besides the above-mentioned attributes, by the time of graduation:

PLO-K. Ability to use mathematics as a precise language of communication in other branches of human knowledge.

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PLO-L. Ability to communicate long standing unsolved problems in mathematics.

PLO-M. Ability to show the importance of mathematics as precursor to various scientific developments since the beginning of the civilization.

PLO-N. Ability to explain the development of mathematics in the civilizational context and its role as queen of all sciences.

COURSE WITH CREDITS

Semester	Language Courses (Part - I & Part - II)	Compulsory Core Courses (CC)	Discipline Specific Elective (DSE/Inter Disciplinary/Generic Electives)	Ability Enhancement Compulsory Courses (AECC)	Skill Enhancement Course (SEC)	Total Credits
Sem I	Tamil - I/ Hindi - I (3 Credits) & English - I (3 Credits)	CC - I (1 x 6 credits = 6 credits)	DSE - I (1 x 6 credits = 6 credits)	AEC - I (Environmental Science) 4 Credits	---	22
Sem II	Tamil – II /Hindi - II (3 Credits) & English - II (3 Credits)	CC - II (1 x 6 credits = 6 credits)	DSE - II (1 x 6 credits = 6 credits)	---	SEC – I SEC - II (2 X 4 = 8Credits)	26
Sem III	Tamil - III/ Hindi - III (3 Credits) & English - III (3 Credits)	CC - III & CC - IV (2 x 6 credits = 12 credits)	DSE - III (1 x 6 credits = 6 credits)	---	---	24
Sem IV	Tamil - IV/Hindi - IV (3 Credits)	CC - V & CC - VI (2 x 6 credits = 12 credits)	DSE - IV (1 x 6 credits = 6 credits)	AEC - II (English for Communication) - 4 Credits	---	25
Sem V	---	CC - VII, CC - VIII & CC - IX (3 x 6 credits = 18 credits)	---	---	SEC – III SEC - IV (2 X 4 = 8 Credits)	26
Sem VI	---	CC - X, CC - XI & CC - XII (3 x 6 credits = 18 credits)	DSE – V: Project Work (1 x 6 credits = 6 credits)	---	---	24
Total	21	72	30	8	16	147

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Core course credit	12*6= 72
Tamil/Hindi course credit	4*3 = 12
English as language course credit	3*3 = 9
Discipline specific elective/Generic Elective/ Interdisciplinary Course credit	6*5 = 30
Ability Enhancement compulsory course credit	2*4 = 8
Skill enhancement course credit	4*4 = 16
Total credits	= **147**

Core Courses (CC)

S. No.	Name of the course	Type of course	L	T	P	Credits
CC 1.	Calculus	Core course	5	1	0	**6**
CC 2.	Algebra and Geometry	Core course	5	1	0	**6**
CC 3.	Multivariable Calculus	Core course	5	1	0	**6**
CC 4.	Ordinary Differential Equations	Core course	5	1	0	**6**
CC 5.	Real Analysis	Core course	5	1	0	**6**
CC 6	Group Theory	Core course	5	1	0	**6**
CC 7.	Probability and statistics	Core course	5	1	0	**6**
CC 8.	Mechanics	Core course	5	1	0	**6**
CC 9.	Linear Algebra	Core course	5	1	0	**6**
CC 10	Partial Differential Equations and Calculus of Variations	Core course	5	1	0	**6**
CC 11	Advanced Algebra	Core course	5	1	0	**6**
CC 12.	Complex Analysis	Core course	5	1	0	**6**

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Discipline Specific Elective (DSE) Course

S. No.	Name of the course	Type of course	L	T	P	Credits
1	General Physics-I	Discipline Specific Elective Course	4	0	2	**6**
2	C++ programming for mathematics	Discipline Specific Elective Course	4	0	2	**6**
3	General Physics-II	Discipline Specific Elective Course	4	0	2	**6**
4	Mathematical Logic	Discipline Specific Elective Course	4	0	2	**6**
5	General Chemistry-I	Discipline Specific Elective Course	5	1	0	**6**
6	Linear Programming	Discipline Specific Elective course	5	1	0	**6**
7	General Chemistry-II	Discipline Specific Elective Course	5	1	0	**6**
8	Discrete Mathematics	Discipline Specific Elective Course	5	1	0	**6**
9	Cryptography	Discipline Specific Elective Course	5	1	0	**6**
10	Integral transform and Fourier Analysis	Discipline Specific Elective Course	5	1	0	**6**
11	Information theory and coding	Discipline Specific Elective Course	5	1	0	**6**
12	Graph Theory	Discipline Specific Elective Course	5	1	0	**6**
13	Special Theory and Relativity	Discipline Specific Elective Course	5	1	0	**6**
14	Number Theory	Discipline Specific Elective Course	5	1	0	**6**
15	Mathematical Finance	Discipline Specific Elective Course	5	1	0	**6**
16	Advanced Mechanics	Discipline Specific Elective Course	5	1	0	**6**
17	Project	Discipline Specific Elective Course	5	1	0	**6**

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Ability Enhancement Courses

Sr. No.	Name of the course	Type of course	L	T	P	Credits
1	English for communication	Ability Enhancement Courses	3	1	0	4
2	Environmental Science	Ability Enhancement Courses	3	1	0	4

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Skill Enhancement Courses

Sr. No.	Name of the course	Type of course	L/ P	T	P	Credits
1	Theory of Equations	Skill Enhancement Courses	4	0	0	**4**
2	Matrices	Skill Enhancement Courses	4	0	0	**4**
3	Transportation and Game theory	Skill Enhancement Courses	4	0	0	**4**
4	Integral Calculus	Skill Enhancement Courses	4	0	0	**4**
5	Vector Calculus	Skill Enhancement Courses	4	0	0	**4**
6	Boolean Algebra	Skill Enhancement Courses	4	0	0	**4**
7	Logic and Sets	Skill Enhancement Courses	4	0	0	**4**
8	Mathematical Modeling	Skill Enhancement Courses	4	0	0	**4**
9	Fuzzy set and Fuzzy logic	Skill Enhancement Courses	4	0	0	**4**
10	Computer Graphics	Skill Enhancement Courses	4	0	0	**4**
11	Operating System: Linux	Skill Enhancement Courses	4	0	0	**4**

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LANGUAGE COURSES: All the courses have 3 credits

LANGUAGE COURSES	
PART I	**PART I**
TAMIL-I / HINDI- I	ENGLISH – I
TAMIL-I / HINDI- II	ENGLISH – II
TAMIL-I / HINDI- III	ENGLISH – III
TAMIL-IV / HINDI- IV	-----

value added courses.

S.No.	Course name
1	Women Studies
2	Indian constitutional-Configurable Sturcture
3	Fire Safety (Demonstration)
4	Industrial Safety
5	Campus to Corporate
6	Leadership and Management
7	Computer Networking and Interfacing
8	Basic life support and First aid(Demonstration)
9	Gandhian thought
10	Life Skills

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COURSE LEARNING OUTCOMES

The course learning outcomes are aligned with program learning outcomes but these are specific-to-specific courses offered in a program. The course level learning shall be reflected as program level learning. The core courses shall be the backbone of this framework whereas discipline electives, generic electives and skill enhancement courses would add academic excellence in the subject together with multi-dimensional and multidisciplinary approach.

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YR	SEM	SUB.CODE	TITLE OF PAPER Discipline Specific Core Course: Calculus	L	T	P	C
I	I		B.Sc-Mathematics	5	1	0	6

Objectives;

1. Compute limits, derivatives, and integrals.
2. Analyze functions using limits, derivatives, and integrals
3. Recognize the appropriate tools of calculus to solve applied problems.

Course Learning Outcomes:

This course will enable the students to:

i) Assimilate the notions of limit of a sequence and convergence of a series of real numbers.

ii) Calculate the limit and examine the continuity of a function at a point.

iii) Understand the consequences of various mean value theorems for differentiable functions.

iv) Sketch curves in Cartesian and polar coordinate systems.

v) Apply derivative tests in optimization problems appearing in social sciences, physical sciences, life sciences and a host of other disciplines.

Unit-I:

Real numbers, Sequences of real numbers, Convergence of sequences and series, Bounded and monotonic sequences; Definite integral as a limit of sum, Integration of irrational algebraic functions and transcendental functions, Reduction formulae, Definite integrals.

Unit-II: Limit and Continuity

ε-δ definition of limit of a real valued function, Limit at infinity and infinite limits; Continuity of a real valued function, Properties of continuous functions, Intermediate value theorem, Geometrical interpretation of continuity, Types of discontinuity;

Unit-III: Differentiability

Differentiability of a real valued function, Geometrical interpretation of differentiability, Relation between differentiability and continuity, Differentiability and monotonicity, Chain rule of differentiation; Darboux's theorem, Rolle's theorem, Lagrange's mean value theorem, Cauchy's mean value theorem, Geometrical interpretation of mean value theorems; Successive differentiation, Leibnitz's theorem.

Unit-IV: Expansions of Functions

Maclaurin's and Taylor's theorems for expansion of a function in an infinite series, Taylor's theorem in finite form with Lagrange, Cauchy and Roche–Schlomilch forms of remainder; Maxima and minima.

Unit-V: Curvature, Asymptotes and Curve Tracing Curvature;

Asymptotes of general algebraic curves, Parallel asymptotes, Asymptotes parallel to axes; Symmetry, Concavity and convexity, Symmetry, Concavity and convexity, Multiple points, Position and nature of double points; Tracing of Cartesian, polar and parametric curves.

References:

1. Howard Anton, I. Bivens & Stephan Davis (2016). Calculus (10th edition). Wiley India.
2. Gabriel Klambauer (1986). Aspects of Calculus. Springer-Verlag.
3. Wieslaw Krawcewicz & Bindhyachal Rai (2003). Calculus with Maple Labs. Narosa.
4. Gorakh Prasad (2016). Differential Calculus (19th edition). Pothishala Pvt. Ltd.
5. George B. Thomas Jr., Joel Hass, Christopher Heil & Maurice D. Weir (2018). Thomas' Calculus (14th edition). Pearson Education.

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B.Sc. Mathemaatics- LOCF-2020

YR	SEM	SUB.CODE	TITLE OF PAPER Discipline Specific Core Course: Algebra and Geometry	L	T	P	C
I	II		B.Sc-Mathematics	5	1	0	6

Objectives:

In this Course students are exposed to topics like Theory of Equations, Summation of Series, Matrices, Continued Fractions and Elementary Number Theory. The stress is on the development of problem-solving skills.

Course Learning Outcomes:

This course will enable the students to:

i) Understand the importance of roots of real and complex polynomials and learn various methods of obtaining roots.

ii) Familiarize with relations, equivalence relations and partitions.

iii) Employ De Moivre's theorem in a number of applications to solve numerical problems.

iv) Recognize consistent and inconsistent systems of linear equations by the row echelon form of the augmented matrix, using rank.

v) Find eigenvalues and corresponding eigenvectors for a square matrix.

vi) Explain the properties of three-dimensional shapes.

Unit-I: Theory of Equations and Complex Numbers

Elementary theorems on the roots of an equations including Cardan's method, The remainder and factor theorems, Synthetic division, Factored form of a polynomial, The Fundamental theorem of algebra, Relations between the roots and the coefficients of polynomial equations, Imaginary roots, Integral and rational roots; Polar representation of complex numbers, The nth roots of unity, De Moivre's theorem for integer and rational indices and its applications.

Unit-II: Relations and Basic Number Theory

Relations, Equivalence relations, Equivalence classes; Functions, Composition of functions, Inverse of a function; Finite, countable and uncountable sets; The division algorithm, Divisibility and the Euclidean algorithm, The fundamental theorem of arithmetic, Modular arithmetic and basic properties of congruences; Principles of mathematical induction and well ordering.

Unit-III: Row Echelon Form of Matrices and Applications

Systems of linear equations, Row reduction and echelon forms, Linear independence, The rank of a matrix and applications; Introduction to linear transformations, The matrix of a linear transformation, Matrix operations, Determinants, The inverse of a matrix, Characterizations of

invertible matrices; Applications to Computer Graphics; Eigenvalues and eigenvectors, The characteristic equation and the Cayley–Hamilton theorem.

Unit-IV: Planes, Straight Lines and Spheres

Planes: Distance of a point from a plane, Angle between two planes, pair of planes, Bisectors of angles between two planes; Straight lines: Equations of straight lines, Distance of a point from a straight line, Distance between two straight lines, Distance between a straight line and a plane; Spheres: Different forms, Intersection of two spheres, Orthogonal intersection, Tangents and normal, Radical plane, Radical line, Coaxial system of spheres, Pole, Polar and Conjugacy.

Unit-V: Locus, Surfaces, Curves and Conicoids

Space curves, Algebraic curves, Ruled surfaces, Some standard surfaces, Classification of quadric surfaces, Cone, Cylinder, Central conicoids, Tangent plane, Normal, Polar planes, and Polar lines.

References:

1. Titu Andreescu, & Dorin Andrica (2014). Complex Numbers from A to...Z. (2nd edition). Birkhäuser.
2. Robert J. T. Bell (1994). An Elementary Treatise on Coordinate Geometry of Three Dimensions. Macmillan India Ltd.
3. D. Chatterjee (2009). Analytical Geometry: Two and Three Dimensions. Narosa Publishing House.
4. Leonard Eugene Dickson (2009). First Course in the Theory of Equations. The Project Gutenberg EBook (http://www.gutenberg.org/ebooks/29785)
5. Edgar G. Goodaire & Michael M. Parmenter (2015). Discrete Mathematics with Graph Theory (3rd edition). Pearson Education Pvt. Ltd. India.
6. Bernard Kolman & David R. Hill (2003). Introductory Linear Algebra with Applications (7th edition). Pearson Education Pvt. Ltd. India.
7. David C. Lay, Steven R. Lay & Judi J. McDonald (2016). Linear Algebra and its Applications (5th edition). Pearson Education Pvt. Ltd. India.

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YR	SEM	SUB.CODE	TITLE OF PAPER Discipline Specific Core Course: Mulltivariable Calculus	L	T	P	C
			B.Sc-Mathematics	5	1	0	6

Objectives:

This course is aimed at providing a concise introduction to the calculus of the vector valued functions of several variables. It is useful for the students who want to study topics like Differential Geometry, Topology, Analysis, Lie groups, Differential Equations, Theory of relativity, Quantum mechanics, Mathematical Biology, etc. The goal is to get the students acquainted with the basic notions of partial and directional derivatives, multiple integrals, line and surface integrals of functions of several variables.

Course Learning Outcomes:

This course will enable the students to:

i) Learn conceptual variations while advancing from one variable to several variables in calculus.

ii) Apply multivariable calculus in optimization problems.

iii) Inter-relationship amongst the line integral, double and triple integral formulations.

iv) Applications of multivariable calculus tools in physics, economics, optimization, and understanding the architecture of curves and surfaces in plane and space etc.

v) Realize importance of Green, Gauss and Stokes' theorems in other branches of mathematics.

Unit-I: Partial Differentiation

Functions of several variables, Level curves and surfaces, Limits and continuity, Partial differentiation, Tangent planes, Chain rule, Directional derivatives, The gradient, Maximal and normal properties of the gradient, Tangent planes and normal lines.

Unit-II: Differentiation

Higher order partial derivatives, Total differential and differentiability, Jacobians, Change of variables, Euler's theorem for homogeneous functions, Taylor's theorem for functions of two variables and more variables, Envelopes and evolutes.

Unit-III: Extrema of Functions and Vector Field

Extrema of functions of two and more variables, Method of Lagrange multipliers, Constrained optimization problems, Definition of vector field, Divergence, curl, gradient and vector identities

Unit-IV: Double and Triple Integrals

Double integration over rectangular and nonrectangular regions, Double integrals in polar coordinates, Triple integral over a parallelepiped and solid regions, Volume by triple integrals, Triple integration in cylindrical and spherical coordinates, Change of variables in double and triple integrals, Dirichlet integral.

Unit-V: Green's, Stokes' and Gauss Divergence Theorem

Line integrals, Applications of line integrals: Mass and Work, Fundamental theorem for line integrals, Conservative vector fields, Green's theorem, Area as a line integral, Surface integrals, Stokes' theorem, The Gauss divergence theorem.

References:

1. Jerrold Marsden, Anthony J. Tromba & Alan Weinstein (2009). Basic Multivariable Calculus, Springer India Pvt. Limited.

2. James Stewart (2012). Multivariable Calculus (7th edition). Brooks/Cole. Cengage.

3. Monty J. Strauss, Gerald L. Bradley & Karl J. Smith (2011). Calculus (3rd edition). Pearson Education. Dorling Kindersley (India) Pvt. Ltd.

4. George B. Thomas Jr., Joel Hass, Christopher Heil & Maurice D. Weir (2018). Thomas' Calculus (14th edition). Pearson Education.

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B.Sc. Mathemaatics- LOCF-2020

YR	SEM	SUB.CODE	TITLE OF PAPER **Discipline Specific Core Course:** **Ordinary Differential Equations**	L	T	P	C
			B.Sc-Mathematics	5	1	0	6

Objectives:

This course aims to provide logical skills in the formation of differential equations, to expose to different techniques of finding solutions to these equations and in addition stress is laid on the application of these equations in geometrical and physical problems.

Course Learning Outcomes:

The course will enable the students to:

i) Understand the genesis of ordinary differential equations.

ii) Learn various techniques of getting exact solutions of solvable first order differential equations and linear differential equations of higher order.

iii) Know Picard's method of obtaining successive approximations of solutions of first order differential equations, passing through a given point in the plane and Power series method for higher order linear equations, especially in cases when there is no method available to solve such equations.

iv) Grasp the concept of a general solution of a linear differential equation of an arbitrary order and also learn a few methods to obtain the general solution of such equations.

v) Formulate mathematical models in the form of ordinary differential equations to suggest possible solutions of the day to day problems arising in physical, chemical and biological disciplines.

Unit-I: First Order Differential Equations

Basic concepts and genesis of ordinary differential equations, Order and degree of a differential equation, Differential equations of first order and first degree, Equations in which variables are separable, Homogeneous equations, Linear differential equations and equations reducible to linear form, Exact differential equations, Integrating factor, First order higher degree equations solvable for x, y and p. Clairaut's form and singular solutions. Picard's method of successive approximations and the statement of Picard's theorem for the existence and uniqueness of the solutions of the first order differential equations.

Unit-II: Second Order Linear Differential Equations

Statement of existence and uniqueness theorem for linear differential equations, General theory of linear differential equations of second order with variable coefficients, Solutions of homogeneous linear ordinary differential equations of second order with constant coefficients, Transformations of the equation by changing the dependent/independent variable, Method of variation of parameters and method of undetermined coefficients, Reduction of order, Coupled linear differential equations with constant coefficients.

Unit-III: Higher Order Linear Differential Equations

Principle of superposition for a homogeneous linear differential equation, Linearly dependent and linearly independent solutions on an interval, Wronskian and its properties, Concept of a general solution of a linear differential equation, Linear homogeneous and non-homogeneous equations of higher order with constant coefficients, Euler-Cauchy equation, Method of variation of parameters and method of undetermined coefficients, Inverse operator method.

Unit-IV: Series Solutions of Differential Equations

Power series method, Legendre's equation, Legendre polynomials, Rodrigue's formula, Orthogonality of Legendre polynomials, Frobenius method, Bessel's equation, Bessel functions and their properties, Recurrence relations.

Unit-V: Applications

Orthogonal trajectories, Acceleration-velocity model, Minimum velocity of escape from Earth's gravitational field, Growth and decay models, Malthusian and logistic population models, Radioactive decay, Drug assimilation into the blood of a single cold pill; Free and forced mechanical oscillations of a spring suspended vertically carrying a mass at its lowest tip, Phenomena of resonance, LCR circuits, Lotka–Volterra population model.

References:

1. Belinda Barnes & Glenn Robert Fulford (2015). Mathematical Modelling with Case Studies: A Differential Equation Approach Using Maple and MATLAB (2nd edition). Chapman & Hall/CRC Press, Taylor & Francis.

2. H. I. Freedman (1980). Deterministic Mathematical Models in Population Ecology. Marcel Dekker Inc.

3. Erwin Kreyszig (2011). Advanced Engineering Mathematics (10th edition). Wiley.

4. Daniel A. Murray (2003). Introductory Course in Differential Equations, Orient.

5. B. Rai, D. P. Choudhury & H. I. Freedman (2013). A Course in Ordinary Differential Equations (2nd edition). Narosa.

6. Shepley L. Ross (2007). Differential Equations (3rd edition), Wiley India.

7. George F. Simmons (2017). Differential Equations with Applications and Historical Notes (3rd edition). CRC Press. Taylor & Francis.

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YR	SEM	SUB.CODE	TITLE OF PAPER Discipline Specific Core Course: Real Analysis	L	T	P	C
			B.Sc-Mathematics	5	1	0	6

Objectives:

To understand various limiting behavior of sequences and series To explore the various limiting processes viz.continuity, uniform continuity, differentiability and integrability and to enhance the mathematical maturity and to work comfortably with concepts.

Course Learning Outcomes:

This course will enable the students to:

i) Understand many properties of the real line $\mathbb{R}$ and learn to define sequence in terms of functions from $\mathbb{R}$ to a subset of $\mathbb{R}$.

ii) Recognize bounded, convergent, divergent, Cauchy and monotonic sequences and to calculate their limit superior, limit inferior, and the limit of a bounded sequence.

iii) Apply the ratio, root, alternating series and limit comparison tests for convergence and absolute convergence of an infinite series of real numbers.

iv) Learn some of the properties of Riemann integrable functions, and the applications of the fundamental theorems of integration.

Unit-I: Real Number System

Algebraic and order properties of $\mathbb{R}$, Absolute value of a real number; Bounded above and bounded below sets, Supremum and infimum of a nonempty subset of $\mathbb{R}$,The completeness property of $\mathbb{R}$, Archimedean property, Density of rational numbers in $\mathbb{R}$, Definition and types of intervals, Nested intervals property; Neighborhood of a point in $\mathbb{R}$, Open, closed and perfect sets in $\mathbb{R}$, Connected subsets of $\mathbb{R}$, Cantor set and Cantor function.

Unit-II: Sequences of Real Numbers

Convergent sequence, Limit of a sequence, Bounded sequence, Limit theorems, Monotone sequences, Monotone convergence theorem, Subsequences, Bolzano–Weierstrass theorem for sequences, Limit superior and limit inferior of a sequence of real numbers, Cauchy sequence, Cauchy's convergence criterion.

Unit-III: Infinite Series

Convergence and divergence of infinite series of positive real numbers, Necessary condition for convergence, Cauchy criterion for convergence; Tests for convergence of positive term series; Basic comparison test, Limit comparison test, D'Alembert's ratio test, Cauchy's nth root test, Integral test; Alternating series, Leibniz test, Absolute and conditional convergence, Rearrangement of series and Riemann's theorem.

Unit-IV: Riemann Integration

Riemann integral, Integrability of continuous and monotonic functions, Fundamental theorem of integral calculus, First mean value theorem, Bonnet and Weierstrass forms of second mean value theorems.

Unit-V: Uniform convergence and Improper integral:

Pointwise and uniform convergence of sequence and series of functions, Weierstrass's M-test, Dirichlet test and Abel's test for uniform convergence, Uniform convergence and continuity, Uniform convergence and differentiability, Improper integrals, Dirichlet test and Abel's test for improper integrals.

References:

1. Robert G. Bartle & Donald R. Sherbert (2015). Introduction to Real Analysis (4th edition).Wiley India.

2. Gerald G. Bilodeau, Paul R. Thie & G. E. Keough (2015). An Introduction to Analysis (2nd edition), Jones and Bartlett India Pvt. Ltd.

3. K. A. Ross (2013). Elementary Analysis: The Theory of Calculus (2nd edition). Springer.

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B.Sc. Mathemaatics- LOCF-2020

YR	SEM	SUB.CODE	TITLE OF PAPER Discipline Specific Core Course: Group Theory	L	T	P	C
			B.Sc-Mathematics	5	1	0	6

Objectives:

Group Theory is the mathematical application of symmetry to an object to obtain knowledge of its physical properties. What group theory brings to the table, is how the symmetry of a molecule is related to its physical properties and provides a quick simple method to determine the relevant physical information of the molecule. The symmetry of a molecule provides you with the information of what energy levels the orbitals will be, what the orbitals symmetries are, what transitions can occur between energy levels, even bond order to name a few can be found, all without rigorous calculations. The fact that so many important physical aspects can be derived from symmetry is a very profound statement and this is what makes group theory so powerful.

Course Learning Outcomes:

The course will enable the students to:

i) Recognize the mathematical objects called groups.

ii) Link the fundamental concepts of groups and symmetries of geometrical objects.

iii) Explain the significance of the notions of cosets, normal subgroups, and factor groups.

iv) Analyze consequences of Lagrange's theorem.

v) Learn about structure preserving maps between groups and their consequences.

Unit-I: Groups and its Elementary Properties

Symmetries of a square, Definition and examples of groups including dihedral, permutation and quaternion groups, Elementary properties of groups.

Unit-II: Subgroups and Cyclic

Groups Subgroups and examples of subgroups, Cyclic groups, Properties of cyclic groups, Lagrange's theorem, Euler phi function, Euler's theorem, Fermat's little theorem.

Unit-III: Normal Subgroups

Properties of cosets, Normal subgroups, Simple groups, Factor groups, Cauchy's theorem for finite abelian groups; Centralizer, Normalizer, Center of a group, Product of two subgroups; Classification of subgroups of cyclic groups.

Unit-IV: Permutation Groups

Cycle notation for permutations, Properties of permutations, Even and odd permutations, alternating groups, Cayley's theorem and its applications.

Unit-V: Group Homomorphisms, Rings and Fields

Group homomorphisms, Properties of homomorphisms, Group isomorphisms, Properties of isomorphisms; First, second and third isomorphism theorems for groups; Definitions and elementary properties of rings and fields.

References:

1. Michael Artin (2014). Algebra (2nd edition). Pearson.
2. John B. Fraleigh (2007). A First Course in Abstract Algebra (7th edition). Pearson.
3. Joseph A. Gallian (2017). Contemporary Abstract Algebra (9th edition). Cengage.
4. I. N. Herstein (2006). Topics in Algebra (2nd edition). Wiley India.
5. Nathan Jacobson (2009). Basic Algebra I (2nd edition). Dover Publications.

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FACULTY OF ARTS AND SCIENCE

B.Sc. Mathemaatics- LOCF-2020

YR	SEM	SUB.CODE	TITLE OF PAPER Discipline Specific Core Course: Probabillity and Statistics	L	T	P	C
			B.Sc-Mathematics	5	1	0	6

Objectives:

The main objective of this course is to provide students with the foundations of probabilistic and statistical analysis mostly used in varied applications in engineering and science like disease modeling, climate prediction and computer networks etc.

Course Learning Outcomes:

This course will enable the students to:

i) Understand distributions in the study of the joint behaviour of two random variables.

ii) Establish a formulation helping to predict one variable in terms of the other that is, correlation and linear regression.

iii) Understand central limit theorem, which establish the remarkable fact that the empirical frequencies of so many natural populations, exhibit a bell-shaped curve.

Unit-I: Probability Functions and Moment Generating Function

Basic notions of probability, Conditional probability and independence, Baye's theorem; Random variables - Discrete and continuous, Cumulative distribution function, Probability mass/density functions; Transformations, Mathematical expectation, Moments, Moment generating function, Characteristic function.

Unit-II: Univariate Discrete and Continuous Distributions

Discrete distributions: Uniform, Bernoulli, Binomial, Negative binomial, Geometric and Poisson; Continuous distributions: Uniform, Gamma, Exponential, Chi-square, Beta and normal; Normal approximation to the binomial distribution.

Unit-III: Bivariate Distribution

Joint cumulative distribution function and its properties, Joint probability density function, Marginal distributions, Expectation of function of two random variables, Joint moment generating function, Conditional distributions and expectations.

Unit-IV: Correlation, Regression and Central Limit Theorem

The Correlation coefficient, Covariance, Calculation of covariance from joint moment generating function, Independent random variables, Linear regression for two variables, The method of least squares, Bivariate normal distribution, Chebyshev's theorem, Strong law of large numbers, Central limit theorem and weak law of large numbers.

Unit-V: Modeling Uncertainty

Uncertainty, Information and entropy, Uniform Priors, Polya's urn model and random graphs.

References:

1.Robert V. Hogg, Joseph W. McKean & Allen T. Craig (2013). Introduction to Mathematical Statistics (7th edition), Pearson Education.

2. Irwin Miller &Marylees Miller (2014). John E. Freund's Mathematical Statistics with Applications (8thedition). Pearson. Dorling Kindersley Pvt. Ltd. India.

3. Jim Pitman (1993). Probability, Springer-Verlag.

4. Sheldon M. Ross (2014). Introduction to Probability Models (11th edition). Elsevier

5. A. M. Yaglom and I. M. Yaglom (1983). Probability and Information. D. Reidel Publishing Company. Distributed by Hindustan Publishing Corporation (India) Delhi.

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FACULTY OF ARTS AND SCIENCE

B.Sc. Mathemaatics- LOCF-2020

YR	SEM	SUB.CODE	TITLE OF PAPER Discipline Specific Core Course: Mechanics	L	T	P	C
			B.Sc-Mathematics	5	1	0	6

Objectives:

The primary purpose of the study of engineering mechanics is to develop the capacity to predict the effects of force and motion while carrying out the creative design functions of engineering. This capacity requires more than a mere knowledge of the physical and mathematical principles of mechanics; also required is the ability to visualize physical configurations in terms of real materials, actual constraints ,and the practical limitations which govern the behavior of machines and structures. One of the primary objectives in a mechanics course is to help the student develop this ability to visualize, which is so vital to problem formulation. Indeed, the construction of a meaningful mathematical model is often a more important experience than its solution. Maximum progress is mad e when the principles and heir limitations are learned together within the context of engineering application.

Course Learning Outcomes:

This course will enable the students to:

i) Familiarize with subject matter, which has been the single centre, to which were drawn mathematicians, physicists, astronomers, and engineers together.

ii) Understand necessary conditions for the equilibrium of particles acted upon by various forces and learn the principle of virtual work for a system of coplanar forces acting on a rigid body.

iii) Determine the centre of gravity of some materialistic systems and discuss the equilibrium of a uniform cable hanging freely under its own weight.

iv) Deal with the kinematics and kinetics of the rectilinear and planar motions of a particle including the constrained oscillatory motions of particles.

v) Learn that a particle moving under a central force describes a plane curve and know the Kepler's laws of the planetary motions, which were deduced by him long before the mathematical theory given by Newton.

Unit-I: Statics

Equilibrium of a particle, Equilibrium of a system of particles, Necessary conditions of equilibrium, Moment of a force about a point, Moment of a force about a line, Couples,

Moment of a couple, Equipollent system of forces, Work and potential energy, Principle of virtual work for a system of coplanar forces acting on a particle or at different points of a rigid body, Forces which can be omitted in forming the equations of virtual work.

Unit-II: Centres of Gravity and Common Catenary

Centres of gravity of plane area including a uniform thin straight rod, triangle, circular arc, semicircular area and quadrant of a circle, Centre of gravity of a plane area bounded by a curve, Centre of gravity of a volume of revolution; Flexible strings, Common catenary, Intrinsic and Cartesian equations of the common catenary, Approximations of the catenary.

Unit-III: Rectilinear Motion

Simple harmonic motion (SHM) and its geometrical representation, SHM under elastic forces, Motion under inverse square law, Motion in resisting media, Concept of terminal velocity, Motion of varying mass.

Unit-IV: Motion in a Plane

Kinematics and kinetics of the motion, Expressions for velocity and acceleration in Cartesian, polar and intrinsic coordinates; Motion in a vertical circle, projectiles in a vertical plane and cycloidal motion.

Unit-V: Central Orbits

Equation of motion under a central force, Differential equation of the orbit, (p, r) equation of the orbit, Apses and apsidal distances, Areal velocity, Characteristics of central orbits, Kepler's laws of planetary motion

References:

1. S. L. Loney (2006). An Elementary Treatise on the Dynamics of a Particle and of Rigid Bodies.

2. P. L. Srivatava (1964). Elementary Dynamics. Ram Narin Lal, Beni Prasad Publishers Allahabad. 3. J. L. Synge & B. A. Griffith (1949). Principles of Mechanics. McGraw-Hill.

4. A. S. Ramsey (2009). Statics. Cambridge University Press.

5. A. S. Ramsey (2009). Dynamics. Cambridge University Press. 6. R. S. Varma (1962). A Text Book of Statics. Pothishala Pvt. Ltd.

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FACULTY OF ARTS AND SCIENCE

B.Sc. Mathemaatics- LOCF-2020

YR	SEM	SUB.CODE	TITLE OF PAPER Discipline Specific Core Course: Linear Alggebra	L	T	P	C
			B.Sc-Mathematics	5	1	0	6

Objectives:

1. To use mathematically correct language and notation for Linear Algebra.
2. To become computational proficiency involving procedures in Linear Algebra.
3. To understand the axiomatic structure of a modern mathematical subject and learn to construct simple proofs.
4. To solve problems that apply Linear Algebra to Chemistry, Economics and Engineering.

Course Learning Outcomes:

This course will enable the students to:

i) Understand the concepts of vector spaces, subspaces, bases, dimension and their properties.

ii) Relate matrices and linear transformations, compute eigen values and eigen vectors of linear transformations.

iii) Learn properties of inner product spaces and determine orthogonality in inner product spaces.

iv) Realize importance of adjoint of a linear transformation and its canonical form.

Unit-I: Vector Spaces

Definition and examples, Subspace, Linear span, Quotient space and direct sum of subspaces, Linearly independent and dependent sets, Bases and dimension.

Unit-II: Linear Transformations

Definition and examples, Algebra of linear transformations, Matrix of a linear transformation, Change of coordinates, Rank and nullity of a linear transformation and rank-nullity theorem.

Unit-III: Further Properties of Linear Transformations

Isomorphism of vector spaces, Isomorphism theorems, Dual and second dual of a vector space, Transpose of a linear transformation, Eigen vectors and eigen values of a linear transformation, Characteristic polynomial and Cayley–Hamilton theorem, Minimal polynomial.

Unit-IV: Inner Product Spaces Inner product spaces and orthogonality, Cauchy–Schwarz inequality, Gram–Schmidt orthogonalisation, Diagonalisation of symmetric matrices.

Unit-V: Adjoint of a Linear Transformation and Canonical Forms

Adjoint of a linear operator; Hermitian, unitary and normal linear transformations; Jordan canonical form, Triangular form, Trace and transpose, Invariant subspaces.

References

1. Stephen H. Friedberg, Arnold J. Insel & Lawrence E. Spence (2003). Linear Algebra (4thedition). Prentice-Hall of India Pvt. Ltd.
2. Kenneth Hoffman & Ray Kunze (2015). Linear Algebra (2nd edition). Prentice-Hall.
3. I. M. Gel'fand (1989). Lectures on Linear Algebra. Dover Publications.
4. Nathan Jacobson (2009). Basic Algebra I & II (2nd edition). Dover Publications.
5. Serge Lang (2005). Introduction to Linear Algebra (2nd edition). Springer India.
6. Vivek Sahai & Vikas Bist (2013). Linear Algebra (2nd Edition). Narosa Publishing House.
7. Gilbert Strang (2014). Linear Algebra and its Applications (2nd edition). Elsevier.

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FACULTY OF ARTS AND SCIENCE

B.Sc. Mathemaatics- LOCF-2020

YR	SEM	SUB.CODE	TITLE OF PAPER **Discipline Specific Core Course:** **Partial Differential Equations and Calculus of Variations**	L	T	P	C
I	I		**B.Sc-Mathematics**	5	1	0	6

Objectives:

1. Variational methods for partial differential equations, linear and nonlinear eigenvalue problems, bifurcation theory
2. Variational problems in differential and complex geometry
3. Variational methods in global analysis and topology
4. Dynamical systems, symplectic geometry, periodic solutions of Hamiltonian systems
5. Variational methods in mathematical physics, nonlinear elasticity, crystals, asymptotic variational problems, homogenization, capillarity phenomena, free boundary problems and phase transitions
6. Monge-Ampère equations and other fully nonlinear partial differential equations related to problems in differential geometry, complex geometry, and physics.

Course Learning Outcomes:

This course will enable the students to:

i) Apply a range of techniques to solve first & second order partial differential equations.

ii) Model physical phenomena using partial differential equations such as the heat and wave equations.

iii). Understand problems, methods and techniques of calculus of variations.

Unit-I: First Order Partial Differential Equations

Order and degree of Partial differential equations (PDE), Concept of linear and non-linear partial differential equations, Partial differential equations of the first order, Lagrange's method, Some special type of equation which can be solved easily by methods other than the general method, Charpit's general method.

Unit-II: Second Order Partial Differential Equations with Constant Coefficients

Classification of linear partial differential equations of second order, Homogeneous and nonhomogeneous equations with constant coefficients.

Unit-III: Second Order Partial Differential Equations with Variable Coefficients

Partial differential equations reducible to equations with constant coefficient, Second order PDE with variable coefficients, Classification of second order PDE, Reduction to canonical or normal

form; Monge's method; Solution of heat and wave equations in one and two dimensions by method of separation of variables.

Unit-IV: Calculus of Variations-Variational Problems with Fixed Boundaries

Euler's equation for functional containing first order and higher order total derivatives, Functionals containing first order partial derivatives, Variational problems in parametric form, Invariance of Euler's equation under coordinates transformation.

Unit-V: Calculus of Variations-Variational Problems with Moving Boundaries

Variational problems with moving boundaries, Functionals dependent on one and two variables, One sided variations. Sufficient conditions for an extremum-Jacobi and Legendre conditions, Second variation.

References:

1. A. S. Gupta (2004). Calculus of Variations with Applications. PHI Learning.
2. Erwin Kreyszig (2011). Advanced Engineering Mathematics (10th edition). Wiley.
3. TynMyint-U & Lokenath Debnath (2013). Linear Partial Differential Equation for Scientists and Engineers (4th edition). Springer India.
4. H. T. H. Piaggio (2004). An Elementary Treatise on Differential Equations and Their Applications. CBS Publishers.
5. S. B. Rao & H. R. Anuradha (1996). Differential Equations with Applications. University Press.
6. Ian N. Sneddon (2006). Elements of Partial Differential Equations. Dover Publications.

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FACULTY OF ARTS AND SCIENCE

B.Sc. Mathematics- LOCF-2020

YR	SEM	SUB.CODE	TITLE OF PAPER **Discipline Specific Core Course:** **Advanced Algebra**	L	T	P	C
			B.Sc-Mathematics	5	1	0	6

Objectives:

(1) Make sense of problems and persevere in solving them
. (2) Reason abstractly and quantitatively.
(3) Construct viable arguments and critique the reasoning of others.
(4) Model with mathematics.
(5) Use appropriate tools strategically.
(6) Attend to precision.
(7) Look for and make use of structure.
(8) Look for and express regularity in repeated reasoning

Course Learning Outcomes:

This course will enable the students to:

i) Understand the basic concepts of group actions and their applications.
ii) Recognize and use the Sylow theorems to characterize certain finite groups.
iii) Know the fundamental concepts in ring theory such as the concepts of ideals, quotient rings, integral domains, and fields.
iv) Learn in detail about polynomial rings, fundamental properties of finite field extensions, and classification of finite fields.

Unit-I: Group Actions

Group actions, Orbits and stabilizers, Conjugacy classes, Orbit-stabilizer theorem, Normalizer of an element of a group, Center of a group, Class equation of a group, Inner and outer automorphisms of a group.

Unit-II: Sylow Theorems

Cauchy's theorem for finite abelian groups, Finite simple groups, Sylow theorems and applications including nonsimplicity tests.

Unit-III: Rings and Fields

Definition, examples and elementary properties of rings, Commutative rings, Integral domain, Division rings and fields, Characteristic of a ring, Ring homomorphisms and isomorphisms, Ideals and quotient rings. Prime, principal and maximal ideals, Relation between integral domain and field, Euclidean rings and their properties, Wilson and Fermat's theorems.

Unit-IV: Polynomial Rings

Polynomial rings over commutative ring and their basic properties, The division algorithm; Polynomial rings over rational field, Gauss lemma and Eisenstein's criterion, Euclidean domain, principal ideal domain, and unique factorization domain.

Unit-V: Field Extensions and Finite Fields

Extension of a field, Algebraic element of a field, Algebraic and transcendental numbers, Perfect field, Classification of finite fields.

References:

1. Michael Artin (2014). Algebra (2nd edition). Pearson.
2. P. B. Bhattacharya, S. K. Jain & S. R. Nagpaul (2003). Basic Abstract Algebra (2nd edition). Cambridge University Press.
3. David S. Dummit & Richard M. Foote (2008). Abstract Algebra (2nd edition). Wiley.
4. John B. Fraleigh (2007). A First Course in Abstract Algebra (7th edition). Pearson.
5. Joseph A. Gallian (2017). Contemporary Abstract Algebra (9th edition). Cengage.
6. N. S. Gopalakrishnan (1986). University Algebra, New Age International Publishers.
7. I. N. Herstein (2006). Topics in Algebra (2nd edition). Wiley India.
8. Thomas W. Hungerford (2004). Algebra (8th edition). Springer.
9. Nathan Jacobson (2009). Basic Algebra I & II (2nd edition). Dover Publications.
10. Serge Lang (2002). Algebra (3rd edition). Springer-Verlag.
11. I. S. Luthar & I. B. S. Passi (2013). Algebra: Volume 1: Groups. Narosa.
12. I. S. Luthar & I. B. S. Passi (2012). Algebra: Volume 2: Rings. Narosa.

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FACULTY OF ARTS AND SCIENCE

B.Sc. Mathemaatics- LOCF-2020

YR	SEM	SUB.CODE	TITLE OF PAPER **Discipline Specific Core Course:** **Complex analysis**	L	T	P	C
			B.Sc-Mathematics	5	1	0	6

Objectives:

1.Extensively understand algebraic and transcendental functions;

2. Describe and parameterize curves and regions in two-dimensional space;

3. Understand and evaluate partial derivatives and integrals of multivariable functions;

4. Understand and find Taylor series and determine their intervals of convergence;

5. Solve boundary value problems.

Course Learning Outcomes:

This course will enable the students to:

i) Visualize complex numbers as points of $\mathbb{R}$ and stereographic projection of complex plane on the Riemann sphere.

ii) Understand the significance of differentiability and analyticity of complex functions leading to the Cauchy Riemann equations.

iii) Learn the role of Cauchy Goursat theorem and Cauchy integral formula in evaluation of contour integrals.

iv) Apply Liouville's theorem in fundamental theorem of algebra.

v) Understand the convergence, term by term integration and differentiation of a power series.

vi) Learn Taylor and Laurent series expansions of analytic functions, classify the nature of singularity, poles and residues and application of Cauchy Residue theorem.

Unit-I: Complex Plane and functions

. Complex numbers and their representation, algebra of complex numbers; Complex plane, Open set, Domain and region in complex plane; Stereographic projection and Riemann sphere; Complex functions and their limits including limit at infinity; Continuity, Linear fractional transformations and their geometrical properties

. Unit-II: Analytic Functions and Cauchy–Riemann Equations

Differentiability of a complex valued function, Cauchy–Riemann equations, Harmonic functions, necessary and sufficient conditions for differentiability, Analytic functions; Analyticity and zeros of exponential, trigonometric and logarithmic functions; Branch cut and branch of multi-valued functions.

Unit-III: Cauchy's Theorems and Fundamental Theorem of Algebra

Line integral, Path independence, Complex integration, Green's theorem, Anti-derivative theorem, Cauchy–Goursat theorem, Cauchy integral formula, Cauchy's inequality, Derivative of analytic function, Liouville's theorem, Fundamental theorem of algebra, Maximum modulus theorem and its consequences.

Unit-IV: Power Series Sequences

series and their convergence, Taylor series and Laurent series of analytic functions, Power series, Radius of convergence, Integration and differentiation of power series, Absolute and uniform convergence of power series.

Unit-V: Singularities and Contour Integration

Meromorphic functions, Zeros and poles of meromorphic functions, Nature of singularities, Picard's theorem, Residues, Cauchy's residue theorem, Argument principle, Rouche's theorem, Jordan's lemma, Evaluation of proper and improper integrals.

References:

1. Lars V. Ahlfors (2017). Complex Analysis (3rd edition). McGraw-Hill Education.

2. Joseph Bak & Donald J. Newman (2010). Complex Analysis (3rd edition). Springer.

3. James Ward Brown & Ruel V. Churchill (2009). Complex Variables and Applications (9th edition). McGraw-Hill Education.

4. John B. Conway (1973). Functions of One Complex Variable. Springer-Verlag.

5. E.T. Copson (1970). Introduction to Theory of Functions of Complex Variable. Oxford University Press. 6. Theodore W. Gamelin (2001). Complex Analysis. Springer-Verlag

. 7. George Polya & Gordon Latta (1974). Complex Variables. Wiley.

8. H. A. Priestley (2003). Introduction to Complex Analysis. Oxford University Press

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FACULTY OF ARTS AND SCIENCE

B.Sc. Mathemaatics- LOCF-2020
Interdisciplinary Course/Generic Elective

Category	GENERAL PHYSICS-I + LAB	L	T	P	C
	(TOTAL HOURS: 60)	4	0	2	6

Objectives: To learn concise ideas about basic physics and their applications in day to day life

Unit 1: Properties of Matter **12 Hours**

Elasticity – Hookes Law – Different moduli of Elasticity – Bending of beams - determination of Young's modulus by non-uniform bending (pin and microscope) - Torsional pendulum – Expression for period of oscillation - determination of rigidity modulus without masses.

Viscosity – Streamlined and turbulent flow – Poiseuille's formula for the flow of a liquid through a capillary tube - Determination of coefficient of viscosity of a liquid

Surface Tension: Molecular theory of surface tension-capillary rise-Drop weight method of determining the surface tension of a Liquid – Experiment to determine the interfacial tension.

Unit 2: Mechanics **12 Hours**

Newton's law of gravitation – Mass and mean density of the earth - Kepler's laws - Determination of gravitational constant – Boy's method. Laws of floatation – Meta centre metacentric height of a ship – Rocket motion - Principle –Theory – Velocity of rocket – Rocket propulsion systems – Multistage rockets - Artificial satellites

Unit 3: Thermal Physics **12 Hours**

Thermodynamics: Laws of thermodynamics – Reversible and irreversible process – Heat engine – Carnot's theorem. Radiation: Black body – Stefan's law – Newton's law of cooling–Heat Conduction : Coefficient of Thermal Conductivity – Determination of Thermal Conductivity of a bad Conductor by Lee's disc method.

Unit 4: Electricity & Magnetism **12 Hours**

Coulomb's inverse square law – Principle of a capacitor – Energy stored in a capacitor – Loss of energy due to sharing of charges - Capacitors in series and parallel – Types of capacitors.

Magnetic effects of current: Biot-Savart's law-Magnetic properties of materials: Magnetic intensity, magnetic induction, permeability, magnetic susceptibility- Comparison dia-, para- and ferro-magnetic materials.

Unit 5: Acoustics and Ultrasonics **12 Hours**

Transverse waves – Expression for the velocity of transverse waves in a stretched string – Sonometer - determination of a.c frequency using sonometer - Introduction to ultrasonics – piezoelectric effect – production of ultrasonic waves by piezoelectric method – uses of ultrasonic waves.

Books for Study:

1. Allied Physics, R. Murugeshan S. Chand & Co., (2005)

2. Mechanics and Mathematical Physics, R. Murugeshan, S. Chand & Co., (2013).

3. Thermal Physics, R.Murugeshan and Kiruthiga Sivaprasath, S. Chand & Co, (2004).

4. Electricity and Magnetism, R. Murugeshan, S. Chand & Co., (2013).

Books for Reference:

1. College Physics Volume I and II, A.B. Gupta, Books and Allied (P) Ltd. (2014)

2. Heat and Thermodynamics, Brij Lal and N.Subrahmanyam, S. Chand & Co., (2006).

3. Elements of Properties of Matter, D.S. Mathur, S. Chand & Co. (1999).

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Interdisciplinary Course/Generic Elective

GENERAL PHYSICS-I LAB (Any 6 Experiments)

Objective: To acquire basic understanding of laboratory technique and to educate and motivate the students in the field of Physics.

1. Non-Uniform bending – Pin and Microscope.
2. Surface tension and Interfacial Surface tension by Drop weight Method.
3. Coefficient of viscosity of liquid – Poiseuille's Method.
4. Specific Heat Capacity of a liquid – by Newton's Law of Cooling.
5. Determination of Thermal Conductivity of a bad Conductor by Lee's disc method.
6. Potentiometer – Calibration of Low Range Voltmeter.
7. Determination of m and BH using Deflection Magnetometer in Tan C position and vibration magnetometer.
8. Figure of merit and voltage sensitiveness of table galvanometer.
9. Sonometer – A.C. Frequency using steel wire.
10. Sonometer – Frequency of tuning fork.

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FACULTY OF ARTS AND SCIENCE

B.Sc. Mathemaatics- LOCF-2020

Interdisciplinary Course/Generic Elective

YR	SEM	SUB.CODE	TITLE OF PAPER C++Programming for Mathematics	L	T	P	C
I	I		B.Sc-Mathematics	5	1	0	6

Objectives:

1.Develop a greater understanding of the issues involved in programming language design and implementation
2. Develop an in-depth understanding of functional, logic, and object-oriented programming paradigms
3. Implement several programs in languages other than the one emphasized in the core curriculum (Java/C++)
4. Understand design/implementation issues involved with variable allocation and binding, control flow, types, subroutines, parameter passing
5. Develop an understanding of the compilation process

Course Learning Outcomes:
This course will enable the students to:

i) Understand and apply the programming concepts of C++ which is important for mathematical investigation and problem solving.

ii) Use mathematical libraries for computational objectives.

iii) Represent the outputs of programs visually in terms of well formatted text and plots.

Unit-I: C++ Essentials Fundamentals of programming

Organization of logic flow in stored program model of computation, C++ as a general purpose programming language, Structure of a C++ program, Common compilers and IDE's, Basic data-types, Variables and literals in C++, Operators, Expressions, Evaluation precedence and type compatibility; Outline of program development in C++, Debugging and testing; Applications: Greatest common divisor and random number generation.

Unit-II: Structured Data

Structured data-types in C++, Arrays and manipulating data in arrays; Objects and classes: Information hiding, modularity, constructors and destructors, methods and polymorphism; Applications: Factorization of an integer, Euler's totient, Images in Cartesian geometry using points in two & three dimensions, Pythagorean triples.

Unit-III: Containers and Templates

Containers and Template Libraries: Sets, iterators, multisets, vectors, maps, lists, stacks and queues; Applications: Basic set algebra, modulo arithmetic and congruences, projective plane, permutations, monotone sequences and polynomials.

Unit-IV: Libraries and Packages

Libraries and Packages for arbitrary precision arithmetic and linear algebra; Features of C++ for input/output and visualization: Strings, streams, formatting methods, processing files in a batch, command-line arguments, visualization packages and their uses; Applications: Arbitrary precision arithmetic using GMP, BOOST; Finding nullity, rank, eigen values, eigen vectors, linear transformations, systems of linear equations; Plots.

Unit-V: Odds and Ends

Runtime errors and graceful degradation, Robustness in a program; Exception handling: Trycatch and throw; Defining and deploying suitable exception handlers in programs; Compileroptions; Conditional compilation; Understanding and defining suitable pragmas; Applications: Identification and description of install parameters of mathematical libraries, debugging installation, working with multiple libraries simultaneously and maintaining correctness and consistency of data.

References:

1. Nell Dale & Chip Weems (2013).Programming and Problem Solving with C++ (6th edition). Jones & Bartlett Learning.
2. Peter Gottschling (2016). Discovering Modern C++: An Intensive Course for Scientists, Engineers, and Programmers. Pearson.
3. Nicolai M. Josuttis (2012). The C++ Standard Library: A Tutorial and Reference (2nd edition). Addison-Wesley, Pearson.
4. Donald E. Knuth (1968). The Art of Computer Programming. Addison-Wesley.
5. Edward Scheinerman (2006). C++ for Mathematicians: An Introduction for Students and Professionals. Chapman & Hall/CRC. Taylor & Francis.
6. B. Stroustrup (2013). The C++ Programming Language (4th edition). AddisonWesley.

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FACULTY OF ARTS AND SCIENCE

B.Sc. Mathemaatics- LOCF-2020
GENERAL PHYSICS-II FOR B.Sc (MATHS / CHEMISTRY)

Interdisciplinary Course/Generic Elective

Category	GENERAL PHYSICS-II + LAB	L	T	P	C
	(TOTAL HOURS: 60)	4	0	2	6

Objectives: To learn concise ideas about the Modern Physics and digital Electronics

Unit 1: Optics **12 Hours**

Interference – air wedge – expression for the fringe width – experiment to measure the diameter of a thin wire – Diffraction – determination of wave length of light using transmission grating (normal incidence method) – Polarization – Double refraction – Nicol Prism - Optical activity-Specific rotatory power- Laurent's half shade polarimeter.

Unit 2: Atomic Physics **12 Hours**

Vector Atom model – Quantum numbers associated with vector atom model – Pauli's exclusion principle – statement, explanation. Matter waves - Dual Nature - De Broglie Waves — Davisson and Germer's Experiment. Photoelectric effect – Laws of photoelectric emission – Einstein's photoelectric equation– Millikan's experiment - Photoelectric cells.

Unit 3: Nuclear Physics **12 Hours**

Nuclear fission – Energy released in nuclear fission – Bohr and Wheeler's theory – Chain reaction - Nuclear fusion – Carbon-Nitrogen cycle – Proton-Proton cycle – thermonuclear reactions – hydrogen bomb- Detection Methods – Scintillation counter- Bubble chamber.

Unit 4: Laser Physics **12 Hours**

Principles of laser– population inversion – meta stable state – conditions for laser actions – Nd-Yag Semiconductor Laser – Applications - Holography – Principle – Recording of hologram – Reconstruction of the Image – Properties – Applications. Principle of fiber optics – acceptance angle - numerical aperture - classification of fibers - losses in fibers - Fiber optic communication system (Block diagram only)

Unit 5: Digital Electronics **12 Hours**

Number systems – conversion of binary into decimal – conversion of decimal to binary – binary addition and subtraction – Basic logic gates – NAND and NOR as an universal logic gates – Demorgan's theorems–applications of Demorgans theorems – Half adder and full adder circuits.

Books for Study:

1. Allied Physics, R. Murugesan S. Chand & Co., (2005)
2. Optics and Spectroscopy, R.Murugesan and Kiruthiga Sivaprasath, S. Chand & Co
3. Modern Physics, R.Murugesan and Kiruthiga Sivaprasath, S. Chand & Co, (2012).
4. Principles of Electronics, V.K. Mehta and Rohit Mehta , S. Chand & Co, (2005).

Books for Reference:

1. College Physics Volume I and II, A.B. Gupta, Books and Allied (P) Ltd (2014).
2. A Textbook of Optics Dr. N.Subrahmanyam, Brij Lal and Dr. M.N. Avadhanulu, S. Chand & Co, (2014)
3. Basic Electronics Solid State, B.L. Theraja, S. Chand & Co, (2004)

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FACULTY OF ARTS AND SCIENCE

B.Sc. Mathemaatics- LOCF-2020

Interdisciplinary Course/Generic Elective

GENERAL PHYSICS-II LAB (Any 6 Experiments)

Objective: To acquire basic understanding of laboratory technique and to educate and motivate the students in the field of Physics.

1. Newton's Rings – Radius of Curvature.
2. Air Wedge – Determination of thickness of thin wire.
3. Particle size determination- Semiconductor diode laser system
4. Spectrometer - Grating – Minimum Deviation – Mercury spectrum.
5. Spectrometer – Refractive Index of a liquid – Hollow Prism.
6. Characteristics of a Zener diode-Break down voltage.
7. Basic logic gates – AND, OR and NOT gates using discrete components.
8. Verification of NAND and NOR as Universal gates
9. Verification of De Morgan's theorem
10. Half adder and full adder circuits

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FACULTY OF ARTS AND SCIENCE

B.Sc. Mathematics- LOCF-2020

YR	SEM	SUB.CODE	TITLE OF PAPER **Discipline Specific Elective Course: Mathematical Logic**	L	T	P	C
			B.Sc-Mathematics	5	1	0	6

Objectives:

1. To provide a formal language for mathematical statements that is easily translatable into the natural language and that allows compact and convenient notation.
2. To offer clear and unambiguous interpretation of such statements that is at the same time simple and close to the natural mathematical concepts.

Course Learning Outcomes:

This course will enable the students to:

i) Learn the syntax of first-order logic and semantics of first-order languages.

ii) Understand the propositional logic and basic theorems like compactness theorem, meta theorem and post-tautology theorem.

iii) Assimilate the concept of completeness interpretations and their applications with special emphasis on applications in algebra.

Unit-I: Syntax of First-order Logic

First-order languages, Terms of language, Formulas of language, First order theory.

Unit-II: Semantics of First-order

Languages Structures of first order languages, Truth in a structure, Model of a theory, Embeddings and isomorphism.

Unit-III: Propositional Logics

Syntax of propositional logic, Semantics of propositional logic, Compactness theorem for propositional logic, Proof in propositional logic, Meta theorem in propositional logic, Post tautology theorem.

Unit-IV: Proof and Meta Theorems in First-order Logic

Proof in first-order logic, Meta theorems in first-order logic, Some meta theorem in arithmetic, Consistency and completeness.

Unit-V: Completeness Theorem and Model Theory

Completeness theorem, Interpretation in a theory, Extension by definitions, Compactness theorem and applications, Complete theories, Applications in algebra.

References:

1. Richard E. Hodel (2013). An Introduction to Mathematical Logic. Dover Publications.
2. Yu I. Manin (2010). A Course in Mathematical Logic for Mathematicians (2nd edition). Springer
3. Elliott Mendelson (2015). Introduction to Mathematical Logic (6th edition). Chapman & Hall/CRC.
4. Shashi Mohan Srivastava (2013). A Course on Mathematical Logic (2nd edition). Springer.

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FACULTY OF ARTS AND SCIENCE

B.Sc. Mathemaatics- LOCF-2020

Semester	Sub. Code	Title of the paper	L	T	P	C
		General Chemistry - I	**4**	**1**	**0**	**4**

OBJECTIVES

1. To understand the various theories of coordination chemistry.
2. To study the various concepts of resonance and halogen compounds.
3. To study the properties of aromatic compounds and organic reactions.
4. To learn the concepts of solid state chemistry.

UNIT I COORDINATION CHEMISTRY AND INDUSTRIAL CHEMISTRY

1.1 Coordination Chemistry: Nomenclature – Werner's, sidgwick and Pauling's theories. Chelation - industrial importance of EDTA, Biological role of heamoglobin and Chrophyll.

1.2 Industrial Chemistry: Fuel gases – Water gas, producer gas, LPG gas, Gobar gas and natural gas. Fertilizers – NPK and mixed Fertilizers- soaps and detergents.

UNIT- II ELECTRON DISPLACEMENT EFFECTS AND HALOGEN COMPOUNDS

2.1 Polar effects: Inductive effect – Relative Strength of Aliphatic mono carbocylic acid and aliphatic amines. Resonance – Condition for resonance. Consequences of resonance – resonance of energy. Basic property of aniline and acidic property of phenol. Hyperconjugation – Heat of hydrogenation - Bond length and dipole moment. Steric effect.

2.2 Halogen containing compounds: Important chloro hydrocarbons used as solvents. Pesticides – Dichloromethane, chloroform, carbon tetrachloride, DDT and BHC Types of solvents: - Polar, Nonpolar.

UNIT III AROMATIC COMPOUNDS AND ORGANIC REACTIONS

3.1 Aromatic compounds: Structure, stability resonance and aromaticity of benzene. Substitution reaction: Nitration, Halogenations, Alkylation. Naphthalene – Isolation, properties and uses.

3.2 Organic reaction: Biuret, Decarboxylation, Benzoin, Perkin, Cannizaro, Claisen and

Haloform reactions

3.3 Chemotherapy: Explanation with two examples each for analgesics, antibacterial, anti-inflammatory, antibiotics, antiseptic and disinfectant, anesthetics local and general (Structures not necessary)

UNIT IV SOLID STATE, ENERGETICS AND PHASE RULE

4.1 Solid state: Typical crystal lattices - unit cell, elements of symmetry, Bragg's equation, Weiss Indices, Miller indices, simple body centered and face centered lattices.

4.2 Energetics: First law of thermodynamics – state and path function – need for the second law – carnots cycle and thermo- dynamic scale of temperature, spontaneous and Non – spontaneous processes – entropy – Gibbs free energy.

4.3 Phase rule: Phase, component, degree of Freedom, phase rule definitions - one component system– water system.

UNIT V: CHEMICAL EQUILIBRIUM AND CHEMICAL KINETICS

5.1 Chemical equilibrium: Criteria of homogeneous and heterogeneous equilibria, - decomposition of HI, N_2O_4, $CaCO_3$ and PCl_5.

5.2 Chemical Kinetics: Order of reaction and their determinations - activation energy, effects of temperature on reaction rate.

REFERENCES

1. Gopalan R, Text Book of Inorganic Chemistry, 2nd Edition, Hyderabad, Universities Press, (India),2012.
2. Morrison R.T. and Boyd R.N., Bhattacharjee S. K. Organic Chemistry (7th edition), Pearson India,(2011)
3. Puri B.R., Sharma L.R. and Pathania M.S. (2013), Principles of Physical Chemistry, (35th edition), New Delhi: Shoban Lal Nagin Chand and Co.

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FACULTY OF ARTS AND SCIENCE

B.Sc. Mathemaatics- LOCF-2020

Semester	Sub. Code	Title of the paper	L	T	P	C
		Chemistry Lab - I	**0**	**0**	**3**	**2**

VOLUMETRIC ANALYSIS

1. Acidimetry and alkalimetry

(a) Strong acid VS strong base (b) Weak acid VS strong base (c) Determination of hardness of water.

2. Permanganometry

(a) Estimation of ferrous sulphate (b) Estimation of oxalic acid

3. Iodometry

(a) Estimation of potassium dichromate (b) Estimation of potassium permanganate

REFERENCES

1. R. Gopalan, Elements of analytical chemistry, S. Chand, New Delhi,2000.
2. N. S. Gnanapragasam and G. Ramamurthy, Organic Chemistry labmanual, S. Viswanathan and Co. Pvt. Ltd. Chennai-1998

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B.Sc. Mathemaatics- LOCF-2020

YR	SEM	SUB.CODE	TITLE OF PAPER **Linear programming**	L	T	P	C
			B.Sc-Mathematics	5	1	0	6

Objectives:

maximize or to minimize some numerical value. This value may be the expected net present value of a project or a forest property; or it may be the cost of a project; it could also be the amount of wood produced, the expected number of visitor-days at a park, the number of endangered species that will be saved, or the amount of a particular type of habitat to be maintained."

Course Learning Outcomes:

This course will enable the students to:

i) Analyze and solve linear programming models of real life situations.

ii) Provide graphical solutions of linear programming problems with two variables, and illustrate the concept of convex set and extreme points.

iii) Understand the theory of the simplex method.

iv) Know about the relationships between the primal and dual problems, and to understand sensitivity analysis.

v) Learn about the applications to transportation, assignment and two-person zero-sum game problems.

Unit-I: Linear Programming Problem

Convexity and Basic Feasible Solutions Formulation, Canonical and standard forms, Graphical method; Convex and polyhedral sets, Hyperplanes, Extreme points; Basic solutions, Basic Feasible Solutions, Reduction of feasible solution to basic feasible solution, Correspondence between basic feasible solutions and extreme points.

Unit-II: Simplex Method

Optimality criterion, Improving a basic feasible solution, Unboundedness, Unique and alternate optimal solutions; Simplex algorithm and its tableau format; Artificial variables, Two-phase method, Big-M method.

Unit-III: Duality

Formulation of the dual problem, Duality theorems, Complimentary slackness theorem, Economic interpretation of the dual, Dual-simplex method.

Unit-IV: Sensitivity

Analysis Changes in the cost vector, right-hand side vector and the constraint matrix of the linear programming problem.

Unit-V: Applications Transportation Problem:

Definition and formulation, Methods of finding initial basic feasible solutions: Northwest-corner rule, Least- cost method, Vogel approximation method; Algorithm for obtaining optimal solution. Assignment Problem: Mathematical formulation and Hungarian method.

Game Theory: Formulation and solution of two-person zero-sum games, Games with mixed strategies, Linear programming method for solving a game.

References:

1.Mokhtar S. Bazaraa, John J. Jarvis & Hanif D. Sherali (2010). Linear Programming and Network Flows (4th edition). John Wiley & Sons

2.. G. Hadley (2002). Linear Programming. Narosa Publishing House.

3. Frederick S. Hillier & Gerald J. Lieberman (2015). Introduction to Operations Research (10th edition). McGraw-Hill Education.

4. Hamdy A. Taha (2017). Operations Research: An Introduction (10th edition). Pearson.

5. Paul R. Thie & Gerard E. Keough (2014). An Introduction to Linear Programming and Game Theory (3rd edition). Wiley India Pvt. Ltd.

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FACULTY OF ARTS AND SCIENCE

B.Sc. Mathemaatics- LOCF-2020

Semester	Sub. Code	Title of the paper	L	T	P	C
		General Chemistry - II	**4**	**1**	**0**	**4**

OBJECTIVES

- To learn the basics of nuclear chemistry and metallic bond.
- To understand the properties and applications of carbohydrates, amino acids and proteins.
- To study the basic concepts of polymers, heterocyclic compounds and stereoisomerism.

UNIT I : NUCLEAR CHEMISTRY AND METALLIC BOND

1.1 Nuclear Chemistry : Fundamental particles of nucleus- isotopes, isobars, isotones and isomers – differences between chemical reactions and nuclear reactions, nuclear fusion and fission- radioactive series.

1.2 Metallic bond: Electron gas, Pauling and band theories, semi conductiors – intrinsic, extrinsic n-type and p-type semiconductors.

1.3 Compounds of sulphur and sodium thiosulphate

UNIT II: CARBOHYDRATES, AMINOACIDS AND PROTEINS

2.1 Carbohydrates: classification – glucose and fructose – preparation and properties –structure of glucose – Fischer and Haworth cyclic structures.

2.2 Amino acids and proteins: Amino acids – Classification based on structure. Essential and non – essentials amino acids – preparation, properties and uses – peptides (elementary treatment only) – proteins – Classification based on physical properties and biological functions. Structure of proteins – primary and secondary (elementary treatment).

UNIT III: POLYMERS, HETEROCYCLICCOMPOUND AND STEREOISOMERISM

1.1. Synthetic polymers: preparation, properties and uses of teflon, epoxy resins, polyester resin.

3.2 Heterocyclic compounds: Furan, pyrrole and pyridine – preparation, properties and uses – basic properties of pyridine and pyrrole.

3.3 Stereoisomerism: Optical isomerism – Lactic and tartaric acid – racemic mixture and resolution. Geometrical isomerism – maleic and fumaric acids.

UNIT IV: SURFACE AND PHOTO CHEMISTRY

4.1 Surface Chemistry: Emulsions, gels – preparation, properties - Electrophoresis and applications, chromatography – Column, paper and thin layer Chromatography.

4.2 Photochemistry: Laws of photochemistry and applications.

UNIT V: ELECTROCHEMISTRY, pH AND BUFFER

5.1 Electrochemistry: Specific and equivalent conductivity –their determination – effect of dilution on conductivity. Ostwald's Dilution law, Kohlrausch law, conductivity measurements, and conductometric titrations.

5.2 pH and buffer: Importance of pH and buffers – pH determination by colorimetric and electrometric methods.

REFERENCES

1. B.R. Puri, L.R. Sharma, K.C. Kalia, 'Principles of Inorganic Chemistry', 21st edition, Vallabh Publications,2004-2005.
2. Bahl, B.S. and Bahl, A., Organic Chemistry, (12th edition), New Delhi, Sultan Chand & Co.,(2010)
3. PuriB.R.,SharmaL.R. and PathaniaM.S.(2013), Principles of Physical Chemistry, (35th edition),New Delhi: Shoban Lal Nagin Chand andCo.

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FACULTY OF ARTS AND SCIENCE

B.Sc. Mathematics- LOCF-2020

Semester	Sub. Code	Title of the paper	L	T	P	C
		Chemistry Lab - II	**0**	**0**	**3**	**2**

OrganicAnalysis

Analyse the following organic Compounds.

1. Carbohydrate, 2. Amide, 3. Aldehyde, 4. Ketone, 5. Acid & 6.Amine

The students may be trained to perform the specific reactions like tests for elements (nitrogen only), aliphatic or aromatic, saturated or unsaturated and functional group present and record their observations.

REFERENCES

1. R. Gopalan, Elements of analytical chemistry, S. Chand, New Delhi,2000.
2. N. S. Gnanapragasam and G. Ramamurthy, Organic Chemistry lab manual, S. Viswanathan and Co. Pvt. Ltd. Chennai-1998

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FACULTY OF ARTS AND SCIENCE

B.Sc. Mathematics- LOCF-2020

YR	SEM	SUB.CODE	TITLE OF PAPER Discipline Specific Elective Course: Discrete Mathematics	L	T	P	C
I	I		B.Sc-Mathematics	5	1	0	6

Objectives:

Use mathematically correct terminology and notation.
Construct correct direct and indirect proofs.
Use division into cases in a proof.
Use counterexamples
. Apply logical reasoning to solve a variety of problems.

Course Learning Outcomes:

This course will enable the students to:

i) Learn about partially ordered sets, lattices and their types.

ii) Understand Boolean algebra and Boolean functions, logic gates,switching circuitsand their applications.

iii) Solve real-life problems using finite-state and Turing machines.

iv) Assimilate various graph theoretic concepts and familiarize with their applications.

Unit-I: Partially Ordered Sets

Definitions, examples and basic properties of partially ordered sets (poset), Order isomorphism, Hasse diagrams, Dual of a poset, Duality principle, Maximal and minimal elements, Least upper bound and greatest upper bound, Building new poset, Maps between posets.

Unit-II: Lattices

Lattices as posets, Lattices as algebraic structures, Sublattices, Products and homomorphisms; Definitions, examples and properties of modular and distributive lattices; Complemented, relatively complemented and sectionally complemented lattices.

Unit-III:Boolean Algebras and Switching Circuits

Boolean algebras, De Morgan's laws, Boolean homomorphism, Representation theorem; Boolean polynomials, Boolean polynomial functions, Disjunctive and conjunctive normal forms, Minimal forms

of Boolean polynomials, Quine–McCluskey method, Karnaugh diagrams, Switching circuits and applications.

Unit-IV: Finite-State and Turing Machines

Finite-state machines with outputs, and with no output; Deterministic and nodeterministic finite-state automaton; Turing machines: Definition, examples, and computations.

Unit-V: Graphs

Definition, examples and basic properties of graphs, Königsberg bridge problem; Subgraphs, Pseudographs, Complete graphs, Bipartite graphs, Isomorphism of graphs, Paths and circuits, Eulerian circuits, Hamiltonian cycles, Adjacency matrix, Weighted graph, Travellingsalesman problem, Shortest path and Dijkstra's algorithm.

References:

1. B. A. Davey & H. A. Priestley (2002). Introduction to Lattices and Order (2nd edition). Cambridge University Press.
2. Edgar G. Goodaire & Michael M. Parmenter (2018). Discrete Mathematics with Graph Theory (3rd edition). Pearson Education.
3. Rudolf Lidl & Günter Pilz (1998). Applied Abstract Algebra (2nd edition). Springer.
4. Kenneth H. Rosen (2012). Discrete Mathematics and its Applications: With Combinatorics and Graph Theory (7th edition). McGraw-Hill.
5. C. L. Liu (1985). Elements of Discrete Mathematics (2nd edition). McGraw-Hill.

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FACULTY OF ARTS AND SCIENCE

B.Sc. Mathematics- LOCF-2020

YR	SEM	SUB.CODE	TITLE OF PAPER **Discipline Specific Elective Course: Cryptography**	L	T	P	C
			B.Sc-Mathematics	5	1	0	6

Objectives;

It is also referred to as the privacy or secrecy of information. It maintains information and keeps it safe from unauthorized people. This can be attained through various means, such as by physical methods or through mathematical algorithms. Confidentiality in cryptography can be achieved by using scrambled text, cipher text, or encrypted text.

Course Learning Outcomes:

This course will enable the students to:

i) Understand the difference between classical and modern cryptography.

ii) Learn the fundamentals of cryptography, including Data and Advanced Encryption Standards (DES & AES) and RSA.

iii) Encrypt and decrypt messages using block ciphers, sign and verify messages using well-known signature generation and verification algorithms.

iv) Know about the aspects of number theory which are relevant to cryptography.

Unit I: **Introduction to Cryptography and Classical Cryptography**

Cryptosystems and basic cryptographic tools: Secret-key cryptosystems, Public-key cryptosystems, Block and stream ciphers, Hybrid cryptography, Message integrity: Message authentication codes, Signature schemes, Nonrepudiation, Certificates, Hash functions, Cryptographic protocols, Security; Hybrid cryptography: Message integrity, Cryptographic protocols, Security, Some simple cryptosystems, Shift cipher, Substitution cipher, Affine cipher, Vigenère cipher, Hill cipher, Permutation cipher, Stream ciphers, Cryptanalysis of affine, substitution, Vigenère, Hill and LFSR stream ciphers.

Unit-II: Cryptographic Security, Pseudo Randomness and Symmetric Key Ciphers

Shannon's theory, Perfect secrecy, Entropy, Spurious keys and unicity distance; Bit generators, Security of pseudorandom bit generators. Substitution-permutation networks, Data encryption standard (DES), Description and analysis of DES; Advanced encryption standard (AES), Description and analysis of AES; Stream ciphers, Trivium.

Unit-III: Basics of Number Theory and Public-Key Cryptography

Basics of number theory; Introduction to public-key cryptography, RSA cryptosystem, Implementing RSA; Primality testing, Legendre and Jacobi symbols, Solovay–Strassen algorithm, Miller–Rabin

algorithm; Square roots modulo n, Factoring algorithms, Pollard p − 1 algorithm, Pollard rho algorithm, Dixon's random squares algorithm, Factoring algorithms in practice; Rabin cryptosystem and its security.

Unit-IV: More on Public-Key Cryptography

Basics of finite fields; ElGamal cryptosystem, Algorithms for the discrete logarithm problem, Shanks' algorithm, Pollard rho discrete logarithm algorithm, Pohlig–Hellman algorithm; Discrete logarithm algorithms in practice, Security of ElGamal systems, Bit security of discrete logarithms.

Unit-V: Hash Functions and Signature Schemes

Hash functions and data integrity, SHA-3; RSA signature scheme, Security requirements for signature schemes, Signatures and Hash functions, ElGamal signature scheme, Security of ElGamal signature scheme, Certificates.

References:

1. Jeffrey Hoffstein, Jill Pipher & Joseph H. Silverman (2014). An Introduction to Mathematical Cryptography (2nd edition). Springer.
2. Neal Koblitz (1994). A Course in Number Theory and Cryptography (2nd edition). Springer-Verlag.
3. Christof Paar & Jan Pelzl (2014). Understanding Cryptography. Springer.
4. Simon Rubinstein-Salzedo (2018). Cryptography. Springer
5. Douglas R. Stinson & Maura B. Paterson (2019). Cryptography Theory and Practice (4th edition). Chapman & Hall/CRC Press, Taylor & Francis.

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FACULTY OF ARTS AND SCIENCE

B.Sc. Mathematics- LOCF-2020

YR	SEM	SUB.CODE	TITLE OF PAPER Discipline Specific Elective Course: Integral Transform and Fourier Analysis	L	T	P	C
I	I		B.Sc-Mathematics	5	1	0	6

Objectives:

The course is aimed at exposing the students to learn the Laplace transforms and Fourier transforms. To equip with the methods of finding Laplace transform and Fourier Transforms of different functions. To make them familiar with the methods of solving differential equations, partial differential equations, IVP and BVP using Laplace transforms and Fourier transforms

Course Learning Outcomes:

This course will enable the students to:

i) Know about piecewise continuous functions, Dirac delta function, Laplace transforms and its properties.

ii) Solve ordinary differential equations using Laplace transforms.

iii) Familiarise with Fourier transforms of functions belonging to class, relation between Laplace and Fourier transforms.

iv) Explain Parseval's identity, Plancherel's theorem and applications of Fourier transforms to boundary value problems.

v) Learn Fourier series, Bessel's inequality, term by term differentiation and integration of Fourier series.

vi) Apply the concepts of the course in real life problems.

Unit-I: Laplace Transforms

Laplace transform, Linearity, Existence theorem, Laplace transforms of derivatives and integrals, Shifting theorems, Change of scale property, Laplace transforms of periodic functions, Dirac's delta function.

Unit-II: Further Properties of Laplace Transforms and Applications

Differentiation and integration of transforms, Convolution theorem, Integral equations, Inverse Laplace transform, Lerch's theorem, Linearity property of inverse Laplace transform, Translations theorems of inverse Laplace transform, Inverse transform of derivatives, Applications of Laplace transform in obtaining solutions of ordinary differential equations and integral equations.

Unit-III: Fourier Transforms

Fourier and inverse Fourier transforms, Fourier sine and cosine transforms, Inverse Fourier sine and cosine transforms, Linearity property, Change of scale property, Shifting property, Modulation theorem, Relation between Fourier and Laplace transforms

Unit-IV: Solution of Equations by Fourier Transforms

Solution of integral equation by Fourier sine and cosine transforms, Convolution theorem for Fourier transform, Parseval's identity for Fourier transform, Plancherel's theorem, Fourier transform of derivatives, Applications of infinite Fourier transforms to boundary value problems, Finite Fourier transform, Inversion formula for finite Fourier transforms.

Unit-V: Fourier Series

Fourier cosine and sine series, Fourier series, Differentiation and integration of Fourier series, Absolute and uniform convergence of Fourier series, Bessel's inequality, The complex form of Fourier series.

References:

1. James Ward Brown & Ruel V. Churchill (2011). Fourier Series and Boundary Value Problems. McGraw-Hill Education.
2. Charles K. Chui (1992). An Introduction to Wavelets. Academic Press.
3. Erwin Kreyszig (2011). Advanced Engineering Mathematics (10th edition). Wiley.
4. Walter Rudin (2017). Fourier Analysis on Groups. Dover Publications
. 5. A. Zygmund (2002).Trigonometric Series (3rd edition). Cambridge University Press.

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FACULTY OF ARTS AND SCIENCE

Interdisciplinary Course/Generic Elective

B.Sc. Mathematics- LOCF-2020

YR	SEM	SUB.CODE	TITLE OF PAPER Information Theory and Coding	L	T	P	C
			B.Sc-Mathematics	5	1	0	6

Objectives:

1. Introduce the principles and applications of information theory.
2. To teach study how information is measured in terms of probability and entropy, and the relationships among conditional and joint entropies.
3. To teach coding schemes, including error correcting codes.
4. Explain how this quantitative measure of information may be used in order to build efficient solutions to multitudinous engineering problems.

Course Learning Outcomes:

This course will enable the students to:

i) Study simple ideal statistical communication models.

ii) Understand the development of codes for transmission and detection of information.

iii) Learn about the input and output of a signal via transmission channel.

iv) Study detection and correction of errors during transmission.

v) Represent a linear code by matrices - encoding and decoding.

Unit-I: Concepts of Information Theory

Communication processes, A model of communication system, A quantitative measure of information, Binary unit of information, A measure of uncertainty, H function as a measure of uncertainty, Sources and binary sources, Measure of information for two-dimensional discrete finite probability schemes.

Unit-II: Entropy Function

A sketch of communication network, Entropy, Basic relationship among different entropies, A measure of mutual information, Interpretation of Shannon's fundamental inequalities; Redundancy, efficiency, and channel capacity; Binary symmetric channel, Binary erasure channel, Uniqueness of the entropy function, Joint entropy and conditional entropy, Relative entropy and mutual information, Chain rules for entropy, Conditional relative entropy and conditional mutual information, Jensen's inequality and its characterizations, The log sum inequality and its applications.

Unit-III: Concepts of Coding

Block codes, Hamming distance, Maximum likelihood decoding, Levels of error handling, Error correction, Error detection, Erasure correction, Construction of finite fields, Linear codes, Matrix representation of linear codes, Hamming codes

Unit-IV: Bounds of Codes

Orthogonality relation, Encoding and decoding of linear codes, The singleton bound and maximum distance separable codes, The sphere-packing bound and perfect codes, The Gilbert–Varshamov bound, MacWilliams' identities.

Unit-V: Cyclic Codes

Definition and examples of cyclic codes, Generator polynomial and check polynomial, Generator matrix and check matrix, Bose–Chaudhuri–Hocquenghem (BCH) code as a cyclic code.

References:

1. Robert B. Ash, (2014). Information Theory. Dover Publications.
2. Thomas M. Cover & Joy A. Thomas (2013). Elements of Information Theory (2nd edition). Wiley India Pvt. Ltd.
3. Joseph A. Gallian (2017). Contemporary Abstract Algebra (9th edition), Cengage.
4. Fazlollah M. Reza, (2003). An Introduction to Information Theory. Dover Publications.
5. Ron M. Roth (2007). Introduction to Coding Theory. Cambridge University Press.
6. Claude E. Shannon & Warren Weaver (1969). The Mathematical Theory of Communication. The University of Illinios Press.

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FACULTY OF ARTS AND SCIENCE

B.Sc. Mathematics- LOCF-2020

YR	SEM	SUB.CODE	TITLE OF PAPER Discipline Specific Elective Course: Graph Theory	L	T	P	C
			B.Sc-Mathematics	5	1	0	6

Objectives:

1. To understand and apply the fundamental concepts in graph theory
2. To apply graph theory, based tools in solving practical problems
3. To improve the proof writing skills.

Course Learning Outcomes:

This course will enable the students to:

i) Appreciate the definition and basics of graphs along with types and their examples.

ii) Understand the definition of a tree and learn its applications to fundamental circuits.

iii) Know the applications of graph theory to network flows.

iv) Understand the notion of planarity and coloring of a graph.

v) Relate the graph theory to the real-world problems.

Unit-I: Paths, Circuits and Graph Isomorphisms

Definition and examples of a graph, Subgraph, Walks, Paths and circuits; Connected graphs, disconnected graphs and components of a graph; Euler and Hamiltonian graphs, Graph isomorphisms, Adjacency matrix and incidence matrix of a graph, Directed graphs and their elementary properties.

Unit-II: Trees and Fundamental Circuits

Definition and properties of trees, Rooted and binary trees, Cayley's theorem on a counting tree, Spanning tree, Fundamental circuits, Minimal spanning trees in a connected graph.

Unit-III: Cut-Sets and Cut-Vertices

Cut-set of a graph and its properties, Fundamental circuits and cut-sets, Cut-vertices, Connectivity and separability, Network flows, 1- isomorphism and 2- isomorphism.

Unit-IV: Planar Graphs

Planar graph, Euler theorem for a planar graph, Various representations of a planar graph, Dual of a planar graph, Detection of planarity, Kuratowski's theorem.

Unit-V: Graph Coloring

Chromatic number of a graph, Chromatic partition, Chromatic polynomial, Matching and coverings, Four color problem.

References:

1. R. Balakrishnan & K. Ranganathan (2012). A Textbook of Graph Theory. Springer.

2. Narsingh Deo (2016). Graph Theory with Applications to Engineering and Computer Science. Dover Publications.
3. Reinhard Diestel (2017). Graph Theory (5th edition). Springer.
4. Edgar G. Goodaire & Michael M. Parmenter (2018). Discrete Mathematics with Graph Theory (3rd edition). Pearson.
5. Douglas West (2017). Introduction to Graph Theory (2nd edition). Pearson.

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FACULTY OF ARTS AND SCIENCE

B.Sc. Mathematics- LOCF-2020

YR	SEM	SUB.CODE	TITLE OF PAPER **Discipline Specific Elective Course:** **Special Theory of Relativity**	L	T	P	C
			B.Sc-Mathematics	5	1	0	6

Objectives:

Relativity has profoundly changed the whole physics. By the analysis of the fundamental concepts of space and time, of mass and of force, it has given a new orientation not only to science but also to our approach to philosophical problems in general. It is the theory which says that concepts like space, time, mass, simultaneity, motion etc., are not absolute but relative; absolute to frame of reference.

Course Learning Outcomes:

This course will enable the students to:

i) Understand the basic elements of Newtonian mechanics including Michelson Morley experiment and geometrical interpretations of Lorentz transformation equations.

ii) Learn about length contraction, time dilation and Lorentz contraction factor.

iii) Study 4-dimensional Minkowskian space-time and its consequences.

iv) Understand equations of motion as a part of relativistic mechanics.

v) Imbibe connections between relativistic mechanics and electromagnetism.

Unit-I: Newtonian Mechanics

Inertial frames, Speed of light and Gallilean relativity, Michelson–Morley experiment, Lorentz–Fitzgerold contraction hypothesis, Relative character of space and time, Postulates of special theory of relativity, Lorentz transformation equations and its geometrical interpretation, Group properties of Lorentz transformations.

Unit-II: Relativistic Kinematics

Composition of parallel velocities, Length contraction, Time dilation, Transformation equations for components of velocity and acceleration of a particle and Lorentz contraction factor.

Unit-III: Geometrical representation of space-time

Four dimensional Minkowskian space-time of special relativity, Time-like, light-like and space-like intervals, Null cone, Proper time, World line of a particle, Four vectors and tensors in Minkowiskian space-time.

Unit-IV: Relativistic Mechanics

Variation of mass with velocity. Equivalence of mass and energy. Transformation equations for mass momentum and energy. Energy-momentum four vector. Relativistic force and Transformation equations for its components. Relativistic equations of motion of a particle.

Unit-V: Electromagnetism

Transformation equations for the densities of electric charge and current. Transformation equations for electric and magnetic field strengths. The Field of a Uniformly Moving Point charge. Forces and fields near a current carrying wire. Forces between moving charges. The invariance of Maxwell`s equations.

References:

1. James L. Anderson (1973). Principles of Relativity Physics. Academic Press.
2. Peter Gabriel Bergmann (1976). Introduction to the Theory of Relativity. Dover Publications.

3. C. Moller (1972). The Theory of Relativity (2nd edition). Oxford University Press.
4. Robert Resnick (2007). Introduction to Special Relativity. Wiley.
5. Wolfgang Rindler (1977). Essential Relativity: Special, General, and Cosmological. Springer-Verlag.
6. V. A. Ugarov (1979). Special Theory of Relativity. Mir Publishers, Moscow.

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FACULTY OF ARTS AND SCIENCE

B.Sc. Mathematics- LOCF-2020

YR	SEM	SUB.CODE	TITLE OF PAPER **Discipline Specific Elective Course: Number Theory**	L	T	P	C
			B.Sc-Mathematics	5	1	0	6

Objectives:

1. Identify and apply various properties of and relating to the integers including the Well-Ordering Principle, primes, unique factorization, the division algorithm, and greatest common divisors.
2. Identify certain number theoretic functions and their properties.
3. Understand the concept of a congruence and use various results related to congruences including the Chinese Remainder Theorem.
4. Solve certain types of Diophantine equations.
5. Identify how number theory is related to and used in cryptography.

Course Learning Outcomes:

This course will enable the students to:

i) Learn about some important results in the theory of numbers including the prime number theorem, Chinese remainder theorem, Wilson's theorem and their consequences.

ii) Learn about number theoretic functions, modular arithmetic and their applications.

iii) Familiarise with modular arithmetic and find primitive roots of prime and composite numbers.

iv) Know about open problems in number theory, namely, the Goldbach conjecture and twin-prime conjecture.

v) Apply public crypto systems, in particular, RSA.

Unit-I: Distribution of Primes and Theory of Congruencies

Linear Diophantine equation, Prime counting function, Prime number theorem, Goldbach conjecture, Twin-prime conjecture, Odd perfect numbers conjecture, Fermat and Mersenne primes, Congruence relation and its properties, Linear congruence and Chinese remainder theorem, Fermat's little theorem, Wilson's theorem.

Unit-II: Number Theoretic Functions

Number theoretic functions for sum and number of divisors, Multiplicative function, The Möbius inversion formula, Greatest integer function, Euler's phi-function and properties, Euler's theorem.

Unit-III: Primitive Roots

Order of an integer modulo n, Primitive roots for primes, Composite numbers having primitive roots; Definition of quadratic residue of an odd prime, Euler's criterion.

Unit-IV: Quadratic Reciprocity Law

The Legendre symbol and its properties, Quadratic reciprocity, Quadratic congruencies with composite moduli.

Unit-V: Applications

Public key encryption, RSA encryption and decryption with applications in security systems.

References:

1.David M. Burton (2007). Elementary Number Theory (7th edition). McGraw-Hill.
2.Gareth A. Jones & J. Mary Jones (2005). Elementary Number Theory. Springer.
3. Neville Robbins (2007). Beginning Number Theory (2nd edition). Narosa.
4.I.Niven (2012). An Introduction to the Theory of Numbers (5th edition). John Wiley & Sons.
5. Neal Koblitz (1994). A Course in Number Theory and Cryptography (2nd edition). Springer-Verlag.

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FACULTY OF ARTS AND SCIENCE

Interdisciplinary Course/Generic Elective

B.Sc. Mathematics- LOCF-2020

YR	SEM	SUB.CODE	TITLE OF PAPER Mathematical Finance	L	T	P	C
I	I		B.Sc-Mathematics	5	1	0	6

Objectives;

Interest rates, annuities and mortgages, bonds and bond market structure.

Course Learning Outcomes:

This course will enable the students to:

i) Understand financial markets and derivatives including options and futures.

ii) Appreciate pricing and hedging of options, interest rate swaps and no-arbitrage pricing concepts.

iii) Learn stochastic analysis, Ito's formula, Ito integral and the Black–Scholes model.

iv) Study and use Hedging parameters, trading strategies and currency swaps.

Unit-I: Basic Theory of Interest and Fixed-Income Securities

Principal and interest: simple, compound and continuous; Present and future value of cash flow streams; Net present value, Internal rates of return and their comparison; Inflation, Annuities; Bonds, Bond prices and yields, Macaulay duration and modified duration.

Unit-II: Term Structure of Interest Rates, Bonds and Derivatives

Spot rates, forward rates and explanations of term structure; Running present value, Floatingrate bonds, Immunization, Convexity; Putable and callable bonds; Exchange-traded markets and over-the-counter markets; Derivatives: Forward contracts, Future contracts, Options, Types of traders, Hedging, Speculation, Arbitrage.

Unit-III: Mechanics of Options Markets

No-arbitrage principle, Short selling, Forward price for an investment asset; Types of options: Call and put options, Option positions, Underlying assets, Factors affecting option prices, Upper and lower bounds for option prices, Put-call parity, Effect of dividends.

Unit-IV: Stochastic Analysis of Stock Prices and Black–Scholes

Model Binomial option pricing model, Risk neutral valuation: European and American options on assets following binomial tree model; Lognormal property of stock prices, Distribution of rate of return, Expected return, Volatility, Estimating volatility from historical data, Extension of risk-neutral valuation to assets following geometric Brownian motion, Black–Scholes formula for European options.

Unit-V: Hedging Parameters, Trading Strategies and Swaps Hedging parameters: Delta, gamma, theta, rho and vega; Trading strategies involving options, Swaps, Mechanics of interest rate swaps, Comparative advantage argument, Valuation of interest rate swaps, Currency swaps, Valuation of currency swaps.

References:

1. John C. Hull & Sankarshan Basu (2018). Options, Futures and Other Derivatives (10th edition). Pearson Education
2. David G. Luenberger (2013). Investment Science (2nd edition). Oxford University Press.
3. Sheldon M. Ross (2011). An Elementary Introduction to Mathematical Finance (3rd edition). Cambridge University Press.

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FACULTY OF ARTS AND SCIENCE

B.Sc. Mathematics- LOCF-2020

YR	SEM	SUB.CODE	TITLE OF PAPER **Discipline Specific Elective Course:** **Advanced Mechanics**	L	T	P	C
			B.Sc-Mathematics	5	1	0	6

Objectives:

The course is designed to give fundamental knowledge of mechanics of deformable solids including stress, strain, stress – strain relations, theories of failure and energy methods.

Course Learning Outcomes:

This course will enable the students to:

i) Understand the reduction of force system in three dimensions to a resultant force acting at a base point and a resultant couple, which is independent of the choice of base of reduction.

ii) Learn about a nul point, a nul line, and a nul plane with respect to a system of forces acting on a rigid body together with the idea of central axis.

iii) Know the inertia constants for a rigid body and the equation of momental ellipsoid together with the idea of principal axes and principal moments of inertia and to derive Euler's equations of motion of a rigid body, moving about a point which is kept fixed.

iv) Study the kinematics and kinetics of fluid motions to understand the equation of continuity in Cartesian, cylindrical polar and spherical polar coordinates which are used to derive Euler's equations and Bernoulli's equation.

v) Deal with two-dimensional fluid motion using the complex potential and also to understand the concepts of sources, sinks, doublets and the image systems of these with regard to a line and a circle.

Unit-I: Statics in Space

Forces in three dimensions, Reduction to a force and a couple, Equilibrium of a system of particles, Central axis and Wrench, Equation of the central axis, Resultant wrench of two wrenches; Nul points, lines and planes with respect to a system of forces, Conjugate forces and conjugate lines.

Unit-II: Motion of a Rigid

Body Moments and products of inertia of some standard bodies, Momental ellipsoid, Principal axes and moments of inertia; Motion of a rigid body with a fixed point, Kinetic energy of a rigid body with a fixed

point and angular momentum of a rigid body, Euler's equations of motion for a rigid body with a fixed point, Velocity and acceleration of a moving particle in cylindrical and spherical polar coordinates, Motion about a fixed axis, Compound pendulum.

Unit-III: Kinematics of Fluid Motion

Lagrangian and Eulerian approaches, Material and convective derivatives, Velocity of a fluid at a point, Equation of continuity in Cartesian, cylindrical polar and spherical polar coordinates, Cylindrical and spherical symmetry, Boundary surface, Streamlines and pathlines, Steady and unsteady flows, Velocity potential, Rotational and irrotational motion, Vorticity vector and vortex lines.

Unit-IV: Kinetics of Fluid Motion

Euler's equations of motion in Cartesian, cylindrical polar and spherical polar coordinates; Bernoulli's equation, Impulsive motion.

Unit-V: Motion in Two-Dimensions

Stream function, Complex potential, Basic singularities: Sources, sinks, doublets, complex potential due to these basic singularities; Image system of a simple source and a simple doublet with regard to a line and a circle, Milne–Thomson circle theorem.

References:

1. A. S. Ramsay (1960). A Treatise on Hydromechanics, Part-II Hydrodynamics. G. Bell & Sons.
2. F. Chorlton (1967). A Textbook of Fluid Dynamics. CBS Publishers.
3. Michel Rieutord (2015). Fluid Dynamics An Introduction. Springer.
4. E. A. Milne (1965). Vectorial Mechanics, Methuen & Co.Limited. London

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FACULTY OF ARTS AND SCIENCE

B.Sc. Mathematics- LOCF-2020

YR	SEM	SUB.CODE	TITLE OF PAPER Ability Enhancement Courses:	L	T	P	C
I	I		B.Sc-Mathematics	4	1	0	4

ABILITY ENHANCEMENT COURSES

UNIT I- Introduction (12hours)
Introduction of communication
Theory of Communication,
Types of communication
Modes of Communication

UNIT II- Language of Communication (12 hours)
Verbal Communication and Non-verbal Communication
Personal, Social and Business
Barriers and Strategies
Intra-personal Communication
Inter-personal Communication
Group communication

UNIT III- Speaking Skills (12hours)
Monologue
Dialogue
Group Discussion
Effective Communication/ Mis- Communication
Interview Techniques
Public Speech

UNIT IV- Reading and Understanding (12hours)
Close Reading
Comprehension
Summary Paraphrasing
Analysis and Interpretation
Translation (from Indian language to English and vice-versa) Literary/Knowledge Texts

UNIT V- Writing Skills (12hours)
Documenting
Report Writing
Making notes
Letter writing (Formal & Informal)
Resume Writing

Reference:
1. *Fluency in English* - Part II, Oxford University Press, 2006.

2. *Business English*, Pearson, 2008.
3. *Language, Literature and Creativity*, Orient Blackswan, 2013.
4. *Language through Literature* (forthcoming) ed. Dr. Gauri Mishra, Dr Ranjana Kaul, Dr Brati Biswas

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FACULTY OF ARTS AND SCIENCE

B.Sc. Mathematics- LOCF-2020

YR	SEM	SUB.CODE	TITLE OF PAPER Ability Enhancement Courses: Environment science	L	T	P	C
I	I		B.Sc-Mathematics	4	1	0	4

OBJECTIVES

a) To expand awareness on the significance of natural resources and energy.
b) To comprehend the structure and function of an ecosystem
c) To understand an aesthetic value with respect to biodiversity, aware of the threats and its conservation and realize the concept of interdependence
d) To identify with the source of kind of pollution and disaster management

OUTCOMES

- Understand core concepts and methods from ecological and physical sciences and their application in environmental problem-solving.
- Realize key concepts from economic, political, and social analysis as they pertain to the design and evaluation of environmental policies and institutions.
- Understand the ethical, cross-cultural, and historical context of environmental issues and the links between human and natural systems.
- Appreciate that one can apply systems concepts and methodologies to analyze and understand interactions between social and environmental processes.
- Reflect critically about their roles and identities as citizens, consumers and environmental actors in a complex, interconnected world.

Total: 45 Hours

Unit I **2 Hours**

The multidisciplinary nature of environmental studies. Definition, scope and importance need for public awareness

Unit II Natural resources **8 Hours**

Renewable and non-renewable resources: natural resources and associated problems.

a) Forest resources: use and over-exploitation, deforestation, case studies. Timber extraction, mining, dams and their effect on forests and tribal people.
b) Water resources: use and over utilization of surface and ground water, floods, drought, conflicts over water, dams benefits and problems
c) Mineral resources: use and exploitation, environmental effects of extracting and using mineral resources, case studies.
d) Food resources: world food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer- pesticide problems, water logging, salinity, case studies.
e) Energy resources: Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources, case studies.
f) Land resources: land as a resource, land degradation, man induced landslides, soil erosion and desertification.
   Role of individual in conservation of natural resources. Equitable use of resources for sustainable lifestyles

Unit III: Ecosystems **3 Hours**

Concept of an ecosystem – structure and function of an ecosystem – producers, consumers and decomposers – energy flow in the ecosystem – ecological succession – food

chains, food webs and ecological pyramids – introduction, types, characteristic features, structure and function of the following ecosystem:

a) Forest ecosystem
b) Grassland ecosystem
c) Desert ecosystem
d) Aquatic ecosystem (ponds, streams, lakes, rivers, oceans, estuaries)

Unit IV: Bio-diversity and its conservation 8 Hours

Introduction – definition: genetic, species and ecosystem biodiversity – biogeographical classification of India – value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and optional values – biodiversity at global, national and local levels.

India as a mega diversity nation – hot-spots of biodiversity – threats to biodiversity: Habitat loss, poaching of wild life, man – wildlife conflicts – endangered and endemic species of India – conservation of biodiversity: in situ and Ex-situ conservation of biodiversity.

Unit V: Environmental pollution 6 Hours

Definition, causes, effects and control measures of;

a) Air pollution
b) Water pollution
c) Soil pollution
d) Marine pollution
e) Noise pollution
f) Thermal pollution
g) Nuclear hazards

Solid waste management: causes, effects and control measures of urban and industrial wastes – role of an individual in prevention of pollution – pollution case studies – disaster management: floods, earthquake, cyclone and landslides.

Unit VI: Social issues and environment: 8 Hours

From unsustainable to sustainable development – urban problems related to energy – water conservation, rain water harvesting, watershed management – resettlement and rehabilitation of people: its problems and concerns – case studies – environmental ethics: issues and possible solutions - climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust, case studies.

Wasteland reclamation – consumerism and waste products - environmental protection act – Air (prevention and control of pollution) act – water (prevention and control of pollution) act- wildlife protection act- forest conservation act – issues involved in enforcement of environmental legislation -public awareness.

Unit VII: Human population and environment: 4 Hours

Population growth, variation among nations – population explosion – family welfare programme – environmental and human health -human rights – value education HIV/AIDS - women and child welfare – role of information technology in environment and human health – case studies.

Unit VIII: Field Works: 6 Hours

Visit to local area to document environmental assets – rivers/ forest/ grassland/ hill/ mountain – visit to local polluted site – urban/ rural/ industrial/ agricultural – study of common plants, insects, birds – study of simple ecosystems – pond, river, hill, slopes etc. (Field work equal to 5 lecture works)

Reference books

1. Environmental Studies, N. Nandini, N. Sunitha and SucharitaTandon,Sapna Book House, 2007.
2. Text book of Environmental Science, RagavanNambiar, Scitech Publications, 2009.
3. Text book of Environmental Chemistry and Pollution Control, S.S.Dara, S.Chand and Co., 2002.
4. Environmental Chemistry, Colin Baird, W.H.Freeman and company, New York,1999.

5. Environmental Chemistry, Gary W. Van Loon and Stephen J. Duffy, Oxford University Press, 2000.
6. New Trends in Green Chemistry, V.K. Ahluwalia and M. Kidwai, Anamaya Publishers, 2006.
7. Perspectives in Environmental studies – Anubhakaushik and CP kaushik, New age international publishers, 4th edition, 2014.
8. Text Book of Environmental Studies for under gradute courses By ErachBharucha Reprinted in 2006, Orient Longman Private Limited /Universities Press India Pvt. Ltd

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FACULTY OF ARTS AND SCIENCE

B.Sc. Mathematics- LOCF-2020

YEAR	SEMESTER	TITLE OF PAPER Skill Enhancement Course **THEORY OF EQUATIONS**	L	T	P	C
		(B.Sc-Mathematics)	5	1	0	4

Objectives;

1.Use the fact that the derivative is the slope of the tangent line to the curve at a given point to help determine the derivatives of simple linear functions.

2. Determine whether the equation of a function given is differentiable or continuous at a particular value of x.

3. Determine the information from a graph that when the second derivative is positive the graph is concave upward, when the second derivative is negative the graph is concave downward, and when there is a switch in sign there is an inflection point.

4. Understand the various forms of a line including: standard form, point slope form, and slope intercept form.

5. Calculate definite integrals that may involve logarithms, exponentials, polynomials, and powers by using the Fundamental Theorem of Calculus.

Course Learning Outcomes:

This course will enable the students to:

i) Describe the relation between roots and coefficients
ii) Find the sum of the power of the roots of an equation using Newton's Method.
iii) Transform the equation through roots multiplied by a given number, increase the roots, decrease the roots, removal of terms
iv) Solve the reciprocal equations.
v) Analyse the location and describe the nature of the roots of an equation.
vi) Obtain integral roots of an equation by using Newton's Method.
vii) Compute a real root of an equation by Horner's method.

UNIT – I

Theory of Equations – Remainder Theorem - Imaginary roots – Irrational roots – Relation between the roots and the coefficients – Symmetric functions of the roots. Chapter 6(Sections 1 to 12)

UNIT – II

Sum of the powers of the roots of an equation – Newton's Theorem – Transformation of equations – Roots multiplied by a given number. Chapter 6(Sections 13 to 15.2)

UNIT – III

Reciprocal roots – Reciprocal equations – Standard forms - To increase and decrease the roots of a given equation by a given constant – Removal of terms and consequent problems. Chapter 6(Sections 15.3 to 19)

UNIT – IV

Transformation in general – Descartes'rule of signs – Roll's theorem – Multiple roots – Strum's theorem – Horner's method. Chapter 6(Sections 21 to 28, 30)

UNIT – V

General solution of cubic equations – Cardon's method –Ferrari's method of solving biquadratic equations. Chapter 6(Sections 34, 35)

Text Book(s):

1. Algebra Volume I, T.K.Manicavachagom Pillay T. Natarajan & K.S. Ganapathy, S. Viswanathan Pvt. Ltd., 2010.

Reference Book:

1. ALGEBRA: Theory of Equation, Theory of Numbers and Trigonometry, Dr. S. Arumugam and A.T. Isaac. New Gamma Publishing House, Edition Jan 2011

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FACULTY OF ARTS AND SCIENCE
B.Sc. Mathematics- LOCF-2020

YEAR	SEMESTER	TITLE OF PAPER Skill Enhancement Course **Matrices**	L	T	P	C
		(B.Sc-Mathematics)	5	1	0	4

Objectives:

1.Know what is meant by a system of linear equations (or linear system) and its solution set

2. Know how to write down the coefficient matrix and augmented matrix of a linear system

3. Use elementary row operations to reduce matrices to echelon forms

4. Make use of echelon forms in finding the solution sets of linear systems

5. Know how to manipulate with vectors in Euclidean space

6. Understand the meaning of linear independence/dependence and span

Course Learning Outcomes:

This course will enable the students to:

1. Work with matrices and determine if a given square matrix is invertible.

2. Learn to solve systems of linear equations and application problems requiring them.

3. Learn to compute determinants and know their properties.

4. Learn to find and use eigenvalues and eigenvectors of a matrix.

5. Learn about and work with vector spaces and subspaces.

6. Find the inverse of a square matrix.

7. Solve the matrix equation Ax = b using row operations and matrix operations.

8. Find the determinant of a product of square matrices, of the transpose of a square matrix, and of the inverse of an invertible matrix

9. Find the characteristic equation, eigenvalues and corresponding eigenvectors of a given matrix.

10. Determine if a given matrix is diagonalizable.

Unit I: Introduction of matrices, Different types of matrices, Operations on matrices, Properties of operations of matrices.

Unit II: Elementary row operations, Row-reduced echelon form, Linear independence of rows, Row rank, Rank of a matrix, Inverse of matrix by row-reduced echelon form.

Unit III: Method of diagonalization, Trace of matrix and its properties,Solving a system of homogenous & non homogenous linear equations using row-reduced echelon form.

Unit IV: Eigen values&Eigen vectors of a matrix, characteristic equation of a matrix, Application of Cayley- Hamilton theorem to find an inverse of a matrix.

Unit-V

Diagonalization and Powers of a Matrix, Applications of Matrices to Engineering Problems, Linear Transformation Orthogonal Transformation, Quadratic Forms.

References:

1. Krishnamurthy, Mainra, Arora : An Introduction to Linear Algebra, Affiliated East-West Press Pvt. Ltd., N.Delhi.

2. Erwin Kreyszig : Advanced Engineering Mathematics, Wiley India (P) Ltd., 2009. 3 Santinarayan : Text book of Matrices, S. Chand and Co., New Delhi..

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FACULTY OF ARTS AND SCIENCE
B.Sc. Mathematics- LOCF-2020

YEAR	SEMESTER	TITLE OF PAPER Skill Enhancement Course **Transportation and Game theory**	L	T	P	C
		(B.Sc-Mathematics)	5	1	0	4

Objectives;

1 To impart knowledge in concepts and tools of Operations Research

2. To understand mathematical models used in Operations Research

3. To apply these techniques constructively to make effective business decisions

Course Learning Outcomes:

This course will enable the students to:

i)Understanding the issues & challenges in the Transportation Sector

ii). To develop skills required for Transport planning & formulation.

iii). Understand optimization techniques for Transport Planning & Pricing.

iv). Analyzing the processes for Transport project execution and control.

v). Demonstrating contracting process as applied in Transport projects.

Unit-1Transportation and Assignment

Transportation Problems definition, Linear form, Solution methods: North west corner method, least cost method, Vogel's approximation method. Degeneracy in transportation, Modified Distribution method, Unbalanced problems and profit maximization problems. Transshipment Problems. Assignment Problems and Travelling sales man Problem.

Unit-2 Game Theory

Introduction, Characteristics of Game Theory, Two Person, Zero sum games, Pure strategy. Dominance theory, Mixed strategies (2x2, mx2), Algebraic and graphical methods.

Unit-3 Queueing Theory

Basis of Queuing theory, elements of queuing theory, Kendall's Notation, Operating characteristics of a queuing system, Classification of Queuing models, Preliminary examples of M/M/1:8/FCFA.

Unit-4 Replacement theory

Introduction, Replacement of capital equipment which depreciated with time, replacement by alternative equipment, Group and individual replacement policy

Unit-5 Decision Theory

Introduction, Decision under certainty, Decision under risk, Decision under uncertainty: Laplace criterion, MaxiMin criterion, MiniMax criterion, savage MiniMax regret criterion, hurwicz criterion, Decision tree.

References:

[1] Mokhtar S. Bazaraa, John J. Jarvis and Hanif D. Sherali, Linear Programming and Network Flows, 2nd Ed., John Wiley and Sons, India, 2004.

[2] F. S. Hillier and G. J. Lieberman, Introduction to Operations Research,- concepts and cases 9th Ed., Tata McGraw Hill, 2010.

[3] Hamdy A. Taha, Operations Research, An Introduction, Prentice- Hall, 9 th Ed., 2010.

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FACULTY OF ARTS AND SCIENCE
B.Sc. Mathematics- LOCF-2020

YEAR	SEMESTER	TITLE OF PAPER Skill Enhancement Course **Integral calculus**	L	T	P	C
		(B.Sc-Mathematics)	5	1	0	4

Objectives:

1.Computation of Riemann sums using left, right, and midpoint evaluation points.

2.Use of the Fundamental Theorem to evaluate definite integrals.

3.Use of the Fundamental Theorem to represent a particular antiderivative, and the analytical and graphical analysis of functions so defined.

4. Definite integral as a limit of Riemann sums over equal subdivisions

Course Learning Outcomes:

This course will enable the students to:

i) Evaluate indefinite and definite integrals.

ii) Use definite integrals to solve application problems.

iii) Use various integration techniques to evaluate integrals.

iv) Communicate mathematical ideas using correct and appropriate notation.

v) Compute the anti-derivative of a basic form (linear combinations of x n for any rational n, sin x, cos x and without use of formulas or a calculator.

vi) Compute an anti-derivative like those in (a) but which requires a step of algebraic manipulation prior to integration.

vii) Compute an anti-derivative using u-substitution.

viii). Compute an anti-derivative using partial fractions, for a quadratic denominator without repeated linear factors.

Unit-1

Volumes using Cross-Section, Volumes using Cylindrical shells, Arc lengths, Areas of surfaces of Revolution.

Unit- 2

Multiple Integrals- definition of the double integrals- evaluation of the double integrals- double integrals in polar coordinates – triple integrals – applications of multiple integrals – volumes of solids of revolution – areas of curved surfaces.

Unit- 3

Beta and Gamma functions- indefinite integral – definitions – convergence of Γ (n) – recurrence formula of Γ functions – properties of β-function- relation between β and Γ functions Chapter

Unit-4

Introduction, Gradient, divergence, curl, directional derivative, unit normal to a surface. Solenoidal and irrotational. Laplacian Differential Operator.

Unit-5

Line, surface and volume integrals; Theorems of Gauss, Stokes and Green. (Without proof) – Problems.

Reference

1. Integral Calculus and differential equations : Dipak Chatterjee (TATA McGraw Hill Publishing company Ltd.)

2. Vector Algebra and Analysis by Narayanan and T.K.Manickvachagam Pillay S .Viswanathan Publishers.

3. Vector Analysis: Murray Spiegel (Schaum Publishing Company, New York).

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FACULTY OF ARTS AND SCIENCE
B.Sc. Mathemaatics- LOCF-2020

YEAR	SEMESTER	TITLE OF PAPER Skill Enhancement Course **Vector calculus**	L	T	P	C
		(B.Sc-Mathematics)	5	1	0	4

Objectives;

1. Perform vector operations, including addition, subtraction, scalar multiplication, dot product, and cross product.

2.. Analyze the algebraic and geometric properties of vector operations.

3.. Determine a unit vector in the direction of a nonzero vector.

4. Determine the angle between two nonzero vectors.

5. Determine if two nonzero vectors are parallel, orthogonal, or neither.

Course Learning Outcomes:

This course will enable the students to:
i). Define concepts of point and vector and explain differences and similarities between them.

ii). Recognize when it is appropriate to use a point and when to use a vector in problem solving.

iii). Memorize formulae for length and direction of vector.

iv). Memorize algebraic definitions and explain geometric meanings of dot and cross products.

v). Compute dot and cross products given either algebraic or geometric information.

vi). Apply dot or cross product to determine angles between vectors, orientation of axes, areas of triangles and parallelograms in space, scalar and vector projections, and volumes of parallelipipeds. Reproduce sketches and written explanations deriving these formulae.

Unit-1 Vectors:

Introduction, Definition of vectors, cartesian coordinates, dot product, cross product, analytical geometry of lines, analytical geometry off planes.

Unit-2 Function of two variables

Introduction, limits and continuity, partial derivatives, the gradient and directional derivatives, tangent planes and differential, the chain rule for function of two variables.

Unit-3 Vector integration

Double integration in rectangular coordinates, Double integration in polar coordinates, triple integration, triple integration in cylindrical and spherical coordinates, surface area.

Unit-4 Vector functions

Introduction, the derivative, unit tangent vector and arc length, curvature, velocity and acceleration gradient and direction derivatives, maximization and minimization of two variables, change of variables for multiple integrals.

Unit-5 Vector field

Introduction, example of gravitational electric fields, divergence and curl, line integral of vector field, fundamental theorem for vector field, green's theorem, stokes theorem and Gauss divergence theorem.

References

1. Anton, Bivens and Davis, Calculus (10th Edition) International Student Version, John Wiley & sons 2015

2. David M. Burton, Elementary Number Theory (7th Edition), Mc Graw Hill Education

3. H.F. Davis and A.D. Snider: Introduction to Vector Analysis, 6th ed., Universal Book Stall, New Delhi.

4. Shanti Narayan, P.K Mittal – Vector Calculus (S. Chand)

5. Merle C. Potter, J. L. Goldberg, E. F. Aboufadel – Advanced Engineering Mathematics (Oxford)

6. Ghosh, Maity – Vector Analysis (New Central books)

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FACULTY OF ARTS AND SCIENCE
B.Sc. Mathematics- LOCF-2020

YEAR	SEMESTER	TITLE OF PAPER	L	T	P	C
		Skill Enhancement Course BOOLEAN ALGEBRA & AUTOMATA THEORY				
		(B.Sc-Mathematics)	**5**	**1**	**0**	**4**

Objectives:

Boolean algebra is a mathematical system for the manipulation of variables that can have one of two values. –In formal logic, these values are "true" and "false." –In digital systems, these values are "on" and "off," 1 and 0, or "high" and "low." Boolean expressions are created by performing operations on Boolean variables. –Common Boolean operators include AND, OR, and NOT

Course Learning Outcomes:

This course will enable the students to:

i). To study the basic philosophy underlying the various number systems, negative number representation, binary arithmetic, binary codes and error detecting and correcting binary codes.

ii). To study the theory of Boolean algebra and to study representation of switching functions using Boolean expressions and their minimization techniques.

iii). To study the combinational logic design of various logic and switching devices and their realization.

iv). To study the sequential logic circuits design both in synchronous and Asynchronous modes for various complex logic and switching devices, their minimization techniques and their realizations.

v). To study some of the programmable logic devices and their use in realization of switching functions.

Unit-1

Definition, examples and basic properties of ordered sets, maps between ordered sets, duality principle, lattices as ordered sets, lattices as algebraic structures, sublattices, products and homomorphisms.

Unit-2

Definition, examples and properties of modular and distributive lattices, Boolean algebra, Boolean polynomials, minimal and maximal forms of Boolean polynomials, Quinn-McCluskey method, Karnaugh diagrams, Logic gates, switching circuits and applications of switching circuits.

Unit 3

Introduction: Alphabets, strings and languages. Finite automata and regular languages: deterministic and non deterministic finite automata, regular expressions, regular languages and their relationship with finite automata, pumping lemma and closure properties of regular languages.

Unit 4

Context free grammars and pushdown automata: context free grammars (CFG), parse trees, ambiguities in grammars and languages, pushdown automaton (PDA) and the language accepted by PDA, deterministic PDA, Non deterministic PDA, properties of context free languages, normal forms, pumping lemma, closure properties, decision properties.

Unit 5 Turing Machines: Turing machine as a model of computation, programming with a Turing machine, variants of Turing machine and their equivalence.

References Books:

1. B. A. Davey and H. A. Priestley, Introduction to Lattices and Order, Cambridge University Press, Cambridge 1990.

2. Edgar G. Goodaire and Michael M. Parmenter, Discrete Mathematics with Graph Theory, (2nd Ed.), Pearson Education (Singapore) P. Ltd., Indian Reprint 2003. 26 .

3.Rudolf Lidl and Gunter Pilz, Applied Abstract Algebra, 2nd Edition, Undergraduate Texts in Mathematics, Springer (SIE), Indian reprint, 2004.

4.J. E. Hopcroft, R. Motwani and J. D. Ullman, Introduction to Automata Theory, Languages and Computation, 2nd Ed., Addison-Wesley, 2001.

5.H. R. Lewis, C. H. Papadimitriou, C. Papadimitriou, Elements of the Theory of Computation, 2nd Ed., Prentice-Hall, NJ, 1997.

6. J. A. Anderson, Automata Theory with Modern Applications, Cambridge University Press, 2006.

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FACULTY OF ARTS AND SCIENCE
B.Sc. Mathematics- LOCF-2020

YEAR	SEMESTER	TITLE OF PAPER Skill Enhancement Course **Logic and Sets**	L	T	P	C
		(B.Sc-Mathematics)	5	1	0	4

Objectives:

1. Construct a truth table for a conditional.
2. Construct a truth table for a biconditional.
3. Construct a truth table for a compound statement involving negations, conjunctions, disjunctions, conditionals, and biconditionals.
4. Indicate sets by the description method, roster method, and by using set builder notation.
5. Determine if a set is well defined.
6. Determine if a set is finite or infinite.

Course Learning Outcomes:

This course will enable the students to:

i) Learn about the logical foundations of such mathematical concepts as number, continuity and set.

ii) Gain an appreciation of the usefulness and limitations of the development of theories from axioms

iii) Understand the concept of infinity and its role in mathematics.

iv) Describe memberships of sets, including the empty set, using proper notation, and decide whether given items are members and determine the cardinality of a given set.

v) Describe the relations between sets regarding membership, equality, subset, and proper subset, using proper notation.

vi) Perform the operations of union, intersection, complement, and difference on sets using proper notation.

vii) Be able to draw and interpret Venn diagrams of set relations and operations and use Venn diagrams to solve problems.

viii) Recognize when set theory is applicable to real-life situations, solve real-life problems, and communicate real-life problems and solutions to others.

Unit 1 : Set Theory :

Fundamentals - Sets and subsets, Venn Diagrams, Operations on sets, Laws of Set Theory, Power Sets and Products, Partition of sets, The Principle of Inclusion - Exclusion. Logic : Propositions and Logical operations, Truth tables, Equivalence, Implications, Laws of Logic, Normal forms, Predicates and quantifiers, Mathematical Induction.

Unit 2 : Relations, diagraphs and lattices :

Product sets and partitions, relations and diagraphs, paths in relations and diagraphs, properties of relations, equivalence and partially ordered relations, computer representation of relations and diagraphs, manipulation of relations, Transitive closure and Warshall's algorithm, Posets and Hasse Diagrams, Lattice.

Unit 3 : Functions and Pigeon Hole Principle :

Definitions and types of functions : injective, subjective and bijective, Composition, identity and inverse, Pigeon hole principle.

Unit 4 : Graphs and Trees :

Graphs, Euler paths and circuits, Hamiltonian paths and circuits, Planner graphs, coloring graphs, Isomorphism of Graphs. Trees : Trees, rooted trees and path length in rooted trees, Spanning tree and Minimal Spanning tree, Isomorphism of trees, Weighted trees and Prefix Codes.

Unit 5 : Algebric Structures :

Algebraic structures with one binary operation - semi groups, monoids and groups, Product and quotient of algebraic structures, Isomorphism, homomorphism, automorphism, Cyclic groups, Normal sub group, codes and group codes, Algebraic structures with two binary operations - rings, integral domains and fields. Ring homomorphism and Isomorphism.

Reference:

1.Discrete structures by Liu, Tata McGraw -Hill. Digital Logic John M Yarbrough Brooks / cole,

Thompson Learning

2. Discrete Mathematics and its Applications, Kenneth H. Rosen, Tata McGraw - Hill.

3. Discrete Mathematics for computer scientists and Mathematicians, Joe L. Mott, Abraham Kandel Theodore P. Baker, Prentice - Hall of India Pvt. Ltd.

4. Discrete Mathematics With Applications, Susanna S. Epp, Books / Cole Publishing Company.

5. Discrete Mathematics, Schaum's Outlines Series, Seymour Lipschutz, Marc Lipson, Tata McGraw - Hill.

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FACULTY OF ARTS AND SCIENCE

B.Sc. Mathematics- LOCF-2020

YEAR	SEMESTER	TITLE OF PAPER Skill Enhancement Course **Mathematical Modelling**	L	T	P	C
		(B.Sc-Mathematics)	5	1	0	4

Objectives:

1.Understand the reasons why models are developed and used.
2. Understand how models can summarise or 'compress' data.
3. Understand how models can be used to study pharmacokinetic mechanisms.
4. Understand how models can be used to predict concentrations or dosage regimens.

Course Learning Outcomes:

This course will enable the students to:

i) Assess and articulate what type of modeling techniques are appropriate for a given physical system.
ii) Construct a mathematical model of a given physical system and analyze it.
iii) Make predictions of the behavior of a given physical system based on the analysis of its mathematical model.
iv) Solve mathematical problems using analytical methods.
v) Solve mathematical problems using computational methods.
vi) Recognize the relationships between different areas of mathematics and the connections between mathematics and other disciplines.
vii) Give clear and organized written and verbal explanations of mathematical ideas to a variety of audiences.

Unit- I:

Introduction, Basic Steps of Mathematical Modeling, its needs, types pf models, limitations, Elementary ideas of dynamical systems, autonomous dynamical systems in the plane- linear theory, Equilibrium point, node, saddle point, focus, centre and limitcycle idea with simple illustrations and figures, Linearization of non-linear plane autonomous systems.

Unit-II:

Population Models: Basic concepts, Exponential growth model, formulation , solution, interpretation and limitations. Compensation and depensation, Logistic growth model, formulation, solution, interpretation and limitations. Lotka- Volterra model of two competing species, formulation, solution, interpretation and limitations.

Unit-III:

Epidemic Models: Basic concepts, Simple epidemic model, formulation, solution, interpretation, and limitation, General epidemic model, formulation, solution, interpretation and limitations.

Unit-IV:

Economic models: Production and supply functions, price-elasticities, utility of consumption and consumer surplus, pure competition, competitive equilibrium, monopoly versus competition, duopoly, oligopoly, conjectural variation, theory of production, production function , Cobb-Douglas production function and its properties , Costs of production and related models .

Unit-V:

Mathematical modeling in Bio-logical Environment: Blood flow and oxygen transfer, Modeling blood flow, viscousity, Poiseuille law, mathematical formulation of the problem, solution and interpretation, oxygen transfer in red cells, mathematical formulation, solution, interpretation and limitations.

References:

1. Mark M. Meerschaert, Mathematical Modeling, Academic Press, New Work, 1993
2. W. Meyer , Concepts of Mathematical Modeling, McGraw Hill, New York, 1994
3. E. Beltrami , Mathematics for Dynamic Modeling, Academic Press, Orlando, Florida, 1987
4. N. Bailey, The Mathematical Theory of Infectious Diseases, Haftier press, New York, 1975

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FACULTY OF ARTS AND SCIENCE
B.Sc. Mathematics- LOCF-2020

YEAR	SEMESTER	TITLE OF PAPER Skill Enhancement Course **Fuzzy set and Fuzzy logic**	L	T	P	C
		(B.Sc-Mathematics)	5	1	0	4

Objectives:

Provide an understanding of the basic mathematical elements of the theory of fuzzy sets. Provide an emphasis on the differences and similarities between fuzzy sets and classical sets theories. The main objective of this course is to establish thorough background knowledge on evolutionary algorithms in post graduate students and enable them to pursue individual research in solving real world optimization problems like Constrained, Multimodal, Multi objective and Combinatorial Optimizations.

Course Learning Outcomes:

This course will enable the students to:

i). Comprehend the concepts of feed forward neural networks

ii). Analyze the various feedback networks.

iii). Understand the concept of fuzziness involved in various systems and fuzzy set theory.

iv). Comprehend the fuzzy logic control and adaptive fuzzy logic and to design the fuzzy control using genetic algorithm.

v). Analyze the application of fuzzy logic control to real time systems.

UNIT I

FUNDAMENTALS OF FUZZY LOGIC

Basic concepts: fuzzy set theory- basic concept of crisp sets and fuzzy sets- complements-unionintersection- combination of operation- general aggregation operations- fuzzy relations-compatibility relations-orderings- morphisms- fuzzy relational equations-fuzzy set and systems
UNIT II

ARCHITECTURE OF NEURAL NETWORKS

Architectures: motivation for the development of natural networks-artificial neural networks-biological neural networks-area of applications-typical Architecture-setting weights-common activations functionsBasic learning rules- Mcculloch-Pitts neuron- Architecture, algorithm, applications-single layer net for Page 1 of 7 pattern classification- Biases and thresholds, linear separability - Hebb'srule- algorithm -perceptron - Convergence theorem-Delta rule

UNIT III BASIC NEURAL NETWORK TECHNIQUES

Back propagation neural net:standard back propagation-architecture algorithm- derivation of learning rulesnumber of hidden layers--associative and other neural networks- hetro associative memory neural net, auto associative net- Bidirectional associative memory-applications-Hopfield nets-Boltzman machine

UNIT IV

COMPETITIVE NEURAL NETWORKS

Neural network based on competition: fixed weight competitive nets- Kohonenself organizing maps and applications-learning vector quantization-counter propagation nets and applications adaptive resonance theory: basic architecture and operation-architecture, algorithm, application and analysis of ART1 & ART2

UNIT V

SPECIAL NEURAL NETWORKS

Cognitron and Neocognitron - Architecture, training algorithm and application-fuzzy associate memories, fuzzy system architecture- comparison of fuzzy and neural systems.

References:

1. Bart Kosko, ―Neural network and Fuzzy System‖ - Prentice Hall-1994.

2. J.Klin and T.A.Folger, ―Fuzzy sets‖ University and information- Prentice Hall -1996.

3. J.M.Zurada, ―Introduction to artificial neural systems‖-Jaico Publication house,Delhi 1994.

4. VallusuRao and HayagvnaRao , ―C++ Neural network and fuzzy logic‖-BPB and Publication, New Delhi,1996.

5. Intelligent Systems and Control-http://nptel.ac.in/courses/108104049/16.

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FACULTY OF ARTS AND SCIENCE
B.Sc. Mathematics- LOCF-2020

YR	SEM	SUB.CODE	TITLE OF PAPER **Discipline Specific Elective Course:** **Computer Graphics**	L	T	P	C
I	I		**B.Sc-Mathematics**	5	1	0	6

Objectives:

Making the student understand how graphics created in computer world is the main goal of this course. Using colors in different places and for different objects is also one of the goals of the course. Learning how to rescale, transmit (shift), shear (skew), and rotate different graphical objects is another goal. Animating some simple graphics is the last aim of the course.

10. Computer Graphics;

Course Learning Outcomes:

This course will enable the students to:

i). Understand the basics of computer graphics, different graphics systems and applications of computer graphics.

ii). Discuss various algorithms for scan conversion and filling of basic objects and their comparative analysis.

iii). Use of geometric transformations on graphics objects and their application in composite form.

iv). Extract scene with different clipping methods and its transformation to graphics display device.

v). Explore projections and visible surface detection techniques for display of 3D scene on 2D screen.

vi). Render projected objects to naturalize the scene in 2D view and use of illumination models for this.

Unit-I

OVERVIEW OF COMPUTER GRAPHICS SYSTEM

Over View of Computer Graphics System – Video display devices – Raster Scan and random scan system – Input devices – Hard copy devices

Unit –II

OUTPUT PRIMITIVES AND ATTRIBUTES

Drawing line, circle and ellipse generating algorithms – Scan line algorithm – Character generation – attributes of lines, curves and characters – Antialiasing.

Unit –III

TWO-DIMENSIONAL GRAPHICS TRANSFORMATIONS AND VIEWING

Two-dimensional Geometric Transformations – Windowing and Clipping – Clipping of lines and clipping of polygons.

Unit –IV

THREE-DIMENSIONAL GRAPHICS AND VIEWING

Three-dimensional concepts – Object representations- Polygon table, Quadric surfaces, Splines Bezier curves and surfaces – Geometric and Modelling transformations – Viewing - Parallel and perspective projections.

Unit –V

REMOVAL OF HIDDEN SURFACES

Visible Surface Detection Methods – Computer Animation.

References;

1 Hearn, D. and Pauline Baker,M., Computer Graphics (C-Version),2nd Edition, Pearson Education.

2. Neuman, W.M., and Sproull, R.F., Principles of Interactive Computer Graphics, 2nd Edition, McGraw Hill Book Co.

3. http://www.freebookcentre.net/CompuScience/Free-Computer-Graphics-BooksDownload.html https://www.mooc-list.com/tags/computer-graphics.

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FACULTY OF ARTS AND SCIENCE
B.Sc. Mathematics- LOCF-2020

YR	SEM	SUB.CODE	TITLE OF PAPER **Discipline Specific Elective Course:** **Operating system Linux**	L	T	P	C
I	I		**B.Sc-Mathematics**	5	1	0	6

Objectives:

1.Convenience: An OS makes a computer more convenient to use.

2.Efficiency: An OS allows the computer system resources to be used in an efficient manner.

3.Ability to evolve: An OS should be constructed in such a way as to permit the effective development, testing, and introduction of new system functions without interfering with service.

Course Learning Outcomes:

This course will enable the students to:
i). Describe and explain the fundamental components of a computer operating system.

ii). Describe and explain the fundamental components of a computer operating system.

iii). Define, restate, discuss, and explain the policies for scheduling, deadlocks, memory management, synchronization, system calls, and file systems.

iv). Describe and extrapolate the interactions among the various components of computing systems.

v). Design and construct the following OS components: System calls, Schedulers, Memory management systems, Virtual Memory and Paging systems.

vi). Illustrate, construct, compose and design solutions via C/C++ programs, and through NACHOS.

vii). Measure, evaluate, and compare OS components through instrumentation for performance analysis.

viii). Discuss with fellow students about designing new components of OS.

Unit I

Introduction to Operating System Concept: Types of operating systems, operating systems concepts, operating systems services, Introduction to System call, System call types.

Unit II

Process Management, Process concept, The process, Process State Diagram, Process control block, Process Scheduling, Scheduling Queues, Schedulers, Operations on Processes, Interprocess

Communication, Threading Issues, Scheduling, Basic Concepts, Scheduling Criteria, Scheduling Algorithms

Unit III

Memory Management: Swapping, Contiguous Memory Allocation, Paging, the structure of the Page Table, Segmentation
Virtual Memory Management: Virtual Memory, Demand Paging, Page-Replacement Algorithms, Thrashing

Unit IV

Concurrency: ProcessSynchronization, The Critical Section Problem, Synchronization Hardware, Semaphores, Classic Problems of Synchronization, Monitors, Synchronization examples, Principles of deadlock – System Model, Deadlock Characterization, Deadlock Prevention, Detection and Avoidance, Recovery from Deadlock

Unit V

File system Interface- the concept of a file, Access Methods, Directory structure, File system mounting, file sharing, protection.
File System implementation- File system structure, allocation methods, free-space management mass-storage structure overview of Mass-storage structure, Disk scheduling, Device drivers.

References:

1. Modern Operating Systems, Andrew S. Tanenbaum, Second Edition, Addison Wesley, 2001.
2. Operating Systems: A Design-Oriented Approach, Charles Crowley, Tata Mc Graw Hill Education", 1996.
3. The Operating Systems: A Concept-Based Approach, D M Dhamdhere, Second Edition, Tata Mc Graw-Hill Education, 2007.
4. Operating System Concepts, Abraham Silberschatz, Peter Baer Galvin and Greg Gagne 9th Edition, John Wiley and Sons Inc., 2012.
5. The Operating Systems – Internals and Design Principles, William Stallings, 7th Edition, Prentice Hall, 2011.
6. Operating Systems-S Halder, Alex A Aravind Pearson Education Second Edition 2016.

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FACULTY OF ARTS AND SCIENCE
B.Sc. Mathematics- LOCF-2020

YR	SEM	SUB.CODE	TITLE OF PAPER Discipline Specific Core Course: Tamil-1	L	T	P	C
I	I		B.Sc-Mathematics	3	1	0	3

TAMIL - I

ghl Nehf;fk; :

jkpo; kuGf;ftpij> GJf;ftpij Kjyhdtw;iw mwpKfg;gLj;Jjy;.
rpWfij> ehty;> fl;Liu Kjyhd ,yf;fpa tbtq;fisf; fw;gpj;jy;.
,f;fhy ,yf;fpaj;jpd; kPjhd <h;g;ig kpFtpj;jy;.

fw;wy; gad; :

jkpo; ,yf;fpaj;jpd; kPjhd Mh;tk; kpFk;.
Gjpa ,yf;fpa tbtq;fis mwpth;
ftpij> rpWfij Mfpatw;iw gilf;f Kay;th;.

myF – 1 kuGf;ftpijfs; (hours : 9)

1.ghujpahu; - GJikg;ngz;
2.ghujpjhrd; - thd; (,aw;if)
3.ehkf;fy; ftpQu; - cyfk; tho;f
4.fz;zjhrd; - fhyf;fzpjk;
5.ftpQu; Rujh - fyg;ig
6.ty;yk; Ntq;flgjp - neUg;gpypL

myF – 2 GJf;ftpijfs; (hours : 9)

1.rpw;gp – xU tpijapd; fij
2.mwpTkjp – el;Gf;fhyk;
3.jhkiu - xU fjTk; nfhQ;rk; fs;spg;ghYk;
4.<NuhL jkpod;gd; - i`f;$ ftpijfs; (10 ftpijfs;)
5.mg;Jy; uFkhd; - xg;Gjy; thf;F %yk;
6.mgp - khg;gps;isfs;
7.Fl;b Nutjp - FLFLg;igr; rpWtd;
8.khyjp ikj;up - mfjp

myF - 3 ciueil (hours : 9)

1.ftpg;NguuR ituKj;J - rpw;gpNa cd;id nrJf;FfpNwd;

myF – 4 ,yf;fpa tuyhW - ,yf;fzk; (hours : 9)

1.GJf;ftpij> i`f;$ ftpij Njhw;wKk; tsu;r;rpAk;
2.gbkk;> FwpaPL gw;wpa tpsf;fq;fs;
3.rpWfijapd; Njhw;wKk; tsu;r;rpAk;
4.ciueilapd; Njhw;wKk; tsu;r;rpAk;
5.,yf;fzf; Fwpg;ngOjp tpsf;fk; mwpjy;
6.fiyr;nrhy;yhf;fk;> vOj;Jg;gpio ePf;fk;
7.jkpo; vz;fs;

myF - 5 gad;ghl;Lf;fy;tp - nkhopngau;g;G (hours : 9)

1.ftpij gilj;jy;
2.tpdh tpil mikj;jy;
3.fw;gid re;jpg;gpw;F ciuahly; vOJjy;
4.rpWfijfs; Fwpj;j tpku;rdk;
5.nghJg;gFjp mYtyfg;gFjp Mq;fpyj;jpypUe;J jkpopy;
nkhopngau;j;jy;

6.jd;Kidg;G gbg;G - rpWfij

1.xU fhl;by; xU khd; - mk;ig 2.Re;jutdk; - NjtNjtd;
3.ktuhru;fs; - tpe;jd; 4.xU rpW ,ir - tz;zjhrd.

5.khj;jpiu - ePygj;kehgd;

ghh;it Ehy;fs;

1.,yf;fpa tuyhW - Kidtu; ghf;aNkup
2.,yf;fzKk; nkhopg;gapw;rpAk; - f.Nfh.Ntq;fl;uhkd;

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FACULTY OF ARTS AND SCIENCE

B.Sc. Mathematics- LOCF-2020

YR	SEM	SUB.CODE	TITLE OF PAPER **Discipline Specific Core Course: Calculus**	L	T	P	C
I	I		**B.Sc-Mathematics**	2	1	0	2

TAMIL – II

ghl Nehf;fk; :

jkpo; kuGf;ftpij> GJf;ftpij Kjyhdtw;iw mwpKfg;gLj;Jjy;.
rpWfij> ehty;> fl;Liu Kjyhd ,yf;fpa tbtq;fisf; fw;gpj;jy;.
,f;fhy ,yf;fpaj;jpd; kPjhd <h;g;ig kpFtpj;jy;.

fw;wy; gad; :

jkpo; ,yf;fpaj;jpd; kPjhd Mh;tk; kpFk;.
Gjpa ,yf;fpa tbtq;fis mwpth;
ftpij> rpWfij Mfpatw;iw gilf;f Kay;th;.

myF – 1 – rq;f ,yf;fpak; (hours : 9)

1.FWe;njhif
1.FwpQ;rp - nfhq;FNju; tho;f;if (2)
2.Ky;iy - fhu; Gwe;je;j (162)
3.kUjk; - fodp kh mj;J (8)
4.nea;jy; - es;nsd;ww;Nw (6)
5.ghiy - vWk;gp misapd; (12)
2. Iq;FWEhW - md;dha; thopg;gj;J (21)
3. GwehDhW - ghly; vz; : 91> 142>192>195>312.

myF – 2 ePjp ,yf;fpak; (hours : 9)

1.jpUf;Fws; - el;ghuha;jy;
2.ehybahu; - el;gpw;gpio nghWj;jy;
3.,dpait ehw;gJ – 1>3>5>6>20
4.gonkhop ehDhW – 5>27>46>73>114
5.%Jiu – 1>2>5>10>16>17>18>26>30

myF -3 – ehty; (hours : 9)

1.Ntupy; gOj;j gyh – R.rKj;jpuk;

myF - 4 - ,yf;fpa tuyhW (hours : 9)

1.gjpndz; Nkw;fzf;F Ehy;fs; mwpKfk;
2.gjpndz; fPo;f;fzf;F Ehy;fs; mwpKfk;
3.ehtypd; Njhw;wKk; tsu;r;rpAk;

myF – 5 - ,yf;fzk; - gilg;ghw;wy; (hours : 9)

1.ty;ypdk; kpFk;> kpfh ,lq;fs;
2.tpdh> tpil tiffs; (mWtif tpdh> vz;tif tpil)
3.njhif epiyj;njhlu;
4.njhfh epiyj;njhlu;
5.kuGf;ftpij GJf;ftpij gilj;jy;

6.jd;Kidg;G gbg;G – Gjpdk; - 1> Gjpdk; - 2
(Gjpdj;Nju;T khztu; tpUg;gj;jpw;FupaJ)

ghu;it Ehy;fs;

1.,yf;fpa tuyhW – Kidtu; ghf;aNkup

2.rq;f ,yf;fpak; %yKk; ciuAk; - ciuahrpupau; Kidtu;
Kidtu; tp.ehfuhrd;
3.gjpndz; fPo;f;fzf;F Ehy;fs; - ciuahrpupau; m.khzpf;fdhh

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FACULTY OF ARTS AND SCIENCE
B.Sc. Mathematics- LOCF-2020

YR	SEM	SUB.CODE	TITLE OF PAPER Discipline Specific Core Course: Calculus	L	T	P	C
I	I		B.Sc-Mathematics	5	1	0	6

TAMIL – III

Nehf;fk;:

jkpo; ,yf;fpa tuyhw;wpy; Ik;ngUk;fhg;gpaq;fs;> ehlfq;fs;> gf;jp ,yf;fpak; ngWk; ,lk; Fwpj;J tpsf;Fjy;.fhg;gpar; RitAk; ehlf ,d;gj;ijAk; gf;jp ngUf;ifAk; khzth;fs; mwpar; nra;jy;.

fw;wy; gad;fs; :

khzth;fs; jkpo; ,yf;fpa tuyhw;wpd; fhg;gpak;> ehlfk;> gf;jp ,yf;fpak; gf;jp ,yf;fpak; gw;wp mwpjy;.tho;tpd; topghl;bd; Kf;fpaj;Jtk; czh;e;J filg;gpbg;gh;.

myF – 1 (hours : 9)

rpyg;gjpfhuk; - (fl;Liu fhij)

kzpNkfiy - (rpiw tpL fhij)

myF – 2 (hours : 9)

m. Njthuk; - jpUehTf;furh;

M. jpUthrfk; - khzpf;fthrfh; (jpUntk;ghit Kjy; 10 nra;Al;fs;)

,. ehyhapuj; jpt;a gpuge;jk; - ehr;rahh; jpUnkhop 10 nra;Al;fs;

myF -3 (hours : 9)

m. fk;g ,uhkhazk; - thyp tijg;glyk; (70 ghly;fs;)

M. nghpaGuhzk; - (fhiuf;fhy; mk;ikahh; Guhzk;)

myF -4 (hours : 9)

cly;nkhop : (MSik tsh;r;rp)

m.mbg;gilfisg; Ghpe;J nfhs;tJ

M.jpdKk; ghh;f;Fk; gpugykhd iriffs;

ehlfk; :ePjp Njtd; kaf;fk; - mwpQh; mz;zh

myF -5 (hours : 9)

1.mzpfs;

m. ctikazpM. vLj;Jf;fhl;L ctikazp

,. ,ul;Lw nkhopjy; mzp<. tQ;rg; Gfo;r;rp mzp

2.nghJf;fl;Liu

m. Rw;Wg;Gwr;Roy;M. ngz;zpak;,. Ntshz;ik

<. r%fj; jiyth;fs; Fwpj;j jiyg;Gfspy; vOjr; nra;jy;

3.ehlfj;jpd; Njhw;wKk; tsh;r;rpAk;

4. gf;jp ,yf;fpaq;fs;

5.,ul;ilf;fhg;gpaq;fs;

ghh;it Ehy;fs;

1.cly;nkhop - Myd;& ghh;guhgP];

2.ePjp Njtd; kaf;fk; - mwpQh; mz;zh

3.jkpo; ,yf;fpa tuyhW - Kidth; f.ghf;a Nkhp

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FACULTY OF ARTS AND SCIENCE
B.Sc. Mathematics- LOCF-2020

YR	SEM	SUB.CODE	TITLE OF PAPER Discipline Specific Core Course: Calculus	L	T	P	C
I	I		B.Sc-Mathematics	2	1	0	2

TAMIL - IV

Nehf;fk;:

gz;ila ,yf;fpaj;jpd; Kf;fpaj;Jtk; czur; nra;jy;.

ehl;lhh; tho;tpay; $Wfis mwpar; nra;jy;.

fw;wy; gad; :

gz;ila ,yf;fpaj;jpid czh;e;J mjd; newpapy; tho Kw;gLjy;.

goe;jkpohpd; kugpid gpd;gw;wp mjd; tpOkpaq;fis eilKiwg;gLj;Jjy;.

myF - 1 (hours : 9)

nka;apay;

1. (,uhkypq;f ts;syhu; ghly;fs;)

m. nghd;dhfp kzpahfp …….

M. nghq;F gy rkak; ……..

,. nka;Q; Qhd ……

<. Nguha mk; ……

2.jhAkhdth; ghly;fs;

m. fhahj kukPJ fy;NyW …..

M. vy;yhk; mwpe;jtUk; …..

,. GfOk; fy;tpAk; ……

<. Ith; vd;w gy Ntlh;

3.jpUke;jpu ghly;fs;

m. ehYk; ,U %d;Wk; …..

M. ,ypq;fKJ …….

,. jd;idawpjy;

<. ,lndhW %q;fpy; ….

myF – 2 (hours : 9)

jdpg;ghly; jpul;L

m. fhsNkfk; - ePhpYs;s…..

M. xsitahh; - jhNahlW Rit …

,. ,ul;ilg;Gyth; - khjh gpjh…

<. Xg;gpyhkzpg;Gyth; - MW ngUf;fhw;….

c. xl;lf;$j;jh; - fiythzp …

myF -3 ehl;lhh; tho;tpay; (hours : 9)

m. tha;nkhop ,yf;fpaKk;> ehl;lhpyf;fpaKk;

M. iftpidf; fiyfs;

,. kz;ghz;lf; fiyfs;

<. gj;j kilg;gha;

c. ehl;lhh; czT

C. ehl;lhh; tpisahl;L

v. njUf;$j;J

V. ghitf;$j;J

I. tpLfijfs;

x. kuGj; njhlh;fs;
myF -4 fl;Liufs; (hours : 9)
m. R[hjh - %isapd; rhg;ghL
M. mfpyd; - vOj;jhsh; fhh;f;fp (fijfs;)

,. R.eNue;jpud; - jkpo;ehl;L mwptpay; mwpQh;fs;
<. ,sk;gpiw kzpkhwd; - md;gpd; tz;zk; fk;gdpd; vz;zk;
myF -5 gad;ghl;Lf; fy;tp / **,yf;fzk; (**hours : 9)
m. ,jo; cUthf;fk; (ehl;Lg;Gwtpay;)
M. kuGj; njhlh; top – fij cUthf;fk;
,. tl;lhu tof;Fr; nrhw;fs; (cjhuzk; : crph; - caph; > rpyT – nryT
<. mUQ;nrhw; nghUs; mwpf
,. ciu eil Njhw;wKk; tsh;r;rpAk;

ghh;it Ehy;fs; :
1.,uhkypq;f ts;syhhpd; kfh Njtkhiy - ,uhk. ,URg;gps;is
2.jhAkhd Rthkpfs; ghly;fs; - tP. rptQhdk;
3.jdpg;ghly; jpul;L - fh.R.gps;is
4.jpUke;jpuk; - mbad; kzpthrfk;
5.ehl;lhh; tof;fhw;wpay; - Nj.Yhh;J
6.jkpo; ,yf;fpa tuyhW - kJ.r.tpkyhde;jk;

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YR	SEM	SUB.CODE	TITLE OF PAPER Discipline Specific Core Course: Calculus	L	T	P	C
I	I		B.Sc-Mathematics	2	1	0	2

UNIT – I

1.कबीरदास
2.सूरदास
3. तुलसीदास
4. रहिमदास

UNIT – II

1. मैथिलि सारण गुप्तः – आर्य,
2. सूर्यकांत त्रिपाठी निराला - जागो फिर एक बार
3. महादेवी वर्मा - पंथ होने दो अपरिचित
4. हरिवंशराय बच्चन – अग्निपथ

UNIT – III

1. सर्वेश्वर दयाल सक्सेना - कितना अच्छा होता है
2. आग्नेय – नाच

UNIT – IV
1. कुंवर नारायण - घर पहुंचना
2. लीलाधर गजुडी - जरूरत है
3. अरुण कमल - पुतली संसार

UNIT – V

1. अशोक बाजपै - एक खिड़की
2. कात्यायनी –एक सफल नागरिक
3. ओमप्रकाश वाल्मिकी - ठाकुर का कुवा
4. हिन्दी के लेखक के घर / ज्ञानेन्द्रपति

Reference :

हिंदी कविता - राजकमल प्रशासन , नई दिल्ली

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YR	SEM	SUB.CODE	TITLE OF PAPER **Discipline Specific Core Course: Calculus**	L	T	P	C
I	I		**B.Sc-Mathematics**	2	1	0	2

UNIT – I

1.सज्ञा, सज्ञा के बेद
2. सर्वनाम
3. विशेषण
4.क्रिया
5. लिंग
6. वचन

UNIT – 2

1.निबंध लेखन,
2. उपसंहार,
3.यात्रा जिसे में भुला नहीं पाता
4. समय का महत्व
5. इंटरनेट की दुनिया
6. प्रदूषण की समस्या
7. ब्रष्टाचार : एक समस्या
8. साम्प्रदायिकता - एक अभिशाप

UNIT – 3

1. आरक्षण - कितना उचित कितना अनुचित
2. भारत में आतंगवाद
3. विद्याधि और अनुशासन
4. खेल और व्यायाम

UNIT – 4

1. संकेत बिन्दुओं पर कहानी लेखन
2. वार्तालाप
3. सम्प्रेक्षण,
4. पत्र लेखन
5. रपट

UNIT – 5

1.पारिभाषिक सब्दावली
2. अंग्रेजी, हिंदी अनुवाद

Reference
लोकमंगल प्रकाशन , दिल्ली
सुबोध हिंदी

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B.Sc. Mathematics- LOCF-2020

YR	SEM	SUB.CODE	TITLE OF PAPER Discipline Specific Core Course: Calculus	L	T	P	C
I	I		B.Sc-Mathematics	2	1	0	2

UNIT – I

1. दोपहर का भोजन - अमरकांत

UNIT – II
1. पूस की रात – प्रेमचंद
2. बिसाती - जयशंकर प्रसाद

UNIT – III
1. मक्रील – यशपाल

UNIT – IV

1.सुम्मिंगपूल - असगर बजाहत

UNIT – V

1. तलाश - जयप्रकाश कर्दम
2. हरी बिंदी - मृदुला गर्ग

Reference
राजकमल प्रकाशन , दरियागंज , नई दिल्ली- 110002
राजपाल एंड सन्स , कश्मीरी गेट , नई दिल्ली- 110006

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B.Sc. Mathematics- LOCF-2020

YR	SEM	SUB.CODE	TITLE OF PAPER Discipline Specific Core Course: Calculus	L	T	P	C
I	I		B.Sc-Mathematics	2	1	0	2

UNIT – I

1. ठेले पर हिमालय - धर्मवीर भारती

UNIT - 2

1. गिल्लू - महादेवी वर्मा

UNIT - 3

चोरी और प्रयश्चित - महात्मा गाँधी

UNIT - 4

1. अपरिचित - मोहन राकेश

UNIT - 5

1. चीफ़ की दावत - भीष्म साहनी

Reference
लोक भारती प्रकाशन , महात्मा गाँधी मार्ग , इलाहाबाद

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YR	SEM	SUB.CODE	TITLE OF PAPER Discipline Specific Core Course: Calculus	L	T	P	C
I	I		B.Sc-Mathematics	2	1	0	2

1. ENGLISH - I

Objective:

To understand the various literary writers and their portrayal of life and society.
To understand the use of language in expression.

To enable the students to read English and comprehend and interpret the text.

Course Outcome:

After completion of the course

The Students will be able to understand various literary writers and their portrayal of life and society.

The students will be able to understand the use of language in expression

The students will be able to read English and comprehend and interpret the text.

UNIT I **Hours: 9**

Poetry Harmony, ED. K. TRIPATHY – PUB. OUP, CHENNAI.

1. Wordsworth : Solitary Reaper
2. Robert Frost : Stopping by Woods on a Snowy Evening
3. Shakespeare : All the World is a Stage

UNIT II **Hours:9**

Short Stories: Popular Short Stories ED. Board OF EDITORS – PUB. OUP, CHENNAI.

1. Katherine Mansfield :A cup of tea
2. R.K.Narayan :The Gateman's Gift
3. Leo Tolstoy : How Much Land Does a Man Need?

UNIT III **Hours: 9**

Plays: Tales from Shakespeare, Published by Madhuban Educational Books, UBS Publishers & Distributors, New Delhi.

1. The Merchant of Venice
2. Macbeth
3. Twelfth Night

UNIT IV **Hours: 9**

Grammar: Form And Function, By V.Sasikumar& V.S yamala, Emerald Publishers, Chennai-8.

1. Statements and Questions
2. Determiners including Articles
3. Conjunctions and other Devices

Composition: Communication Skills For Undergraduates, Dr. T.M.Farhathulah, RBA Publications, Chennai

UNIT V **Hours: 9**

1. Letter Writing
2. Telegrams
3. Advertisements

Further Reading and Reference Book:

1.Shakespeare,William *The Merchant of Venice*. Harlow,Essex,England: Longma,1994.

2.Shakespeare,William, Mowat,Barbara A. Werstine,Paul. *The Tragedy of Macbeth*. New York: Washington, Square press,2004, c1992 print.

3.Shakespeare, William, *Twelfth Night*. Boston; New York: Houghton Mifflin,1928.

4. Sokkalingam,S.R.M, *The Art of Speaking English*. Versatile Publishing House: Chennai Platinum digital prints.2010.

5. Word Worth,William. *The Collected poems of William Words Worth*. Words Worth Editions, 1994

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FACULTY OF ARTS AND SCIENCE
B.Sc. Mathematics- LOCF-2020

YR	SEM	SUB.CODE	TITLE OF PAPER **Discipline Specific Core Course:**	L	T	P	C
I	I		**B.Sc-Mathematics**	2	1	0	2

2. ENGLISH II

Objective:

To understand the nuances of Poetry.
To learn the grammar, which in turn enhances reading of literature.
To train the students to write effectively

Course Outcome:

After the completion of the course

The Students will be able to understand the nuances of poetry

The students will be able to use basic grammatical structures in short conversations and discussions.

The students will be able to write effectively.

Unit-I. Poetry:

HarmonyEd. K.Tripathy– pub. OUP, Chennai. **Hours: 9**

1. Milton : On His Blindness
2. Shelley : Ozymandias
3. Keats : La Belle Dame Sans Merci

Unit-II.

Short Stories : Popular Short Stories. Board of editors – pub. OUP, Chennai.

1. Sir Arthur Conan Doyle : The Dying Detective **Hours: 9**
2. Ernest Hemingway : Old Man at the Bridge
3. Guy de Maupassant : The Necklace

Unit–III

Plays: Tales from Shakespeare, published by Madhuban educational books, UBS Publishers & Distributors, New Delhi

1. A Midsummer Night's Dream **Hours: 9**
2. Much Ado About Nothing
3. Julius Caesar

Unit-IV.

Grammar: Form and Function, **By V. Sasikumar & V. Syamala, Emerald Publishers, Chennai.**

Hours: 9

1. The Active and Passive Voice
2. Reported Speech
3. Conditional Clauses

Unit-V.

Composition: Communication Skills for Undergraduates, **Dr.T.M.Farhathulah, RBA Publications, Chennai.**

Hours: 9

1. Notices
2. Designing a Resume
3. Writing a Report

Further Reading &Reference Book:

Doyle, Arthur Conan. *The Adventure of Dying Detective*. The Strand Magazine.1913.

Shakespeare, William. *A Midsummer Night's Dream*. New York: Signet Classic,1998.

Shakespeare, William. *Much Ado About Nothing*. London; New York: Penguin,2005.

Shakespeare, William. *Julius Caesar*. New York: Dover Publications, 1991.Print.

Sokkalingam,S.R.M, *The Art of Speaking English*. Versatile Publishing House: Chennai Platinum digital prints.2010.

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FACULTY OF ARTS AND SCIENCE
B.Sc. Mathematics- LOCF-2020

YR	SEM	SUB.CODE	TITLE OF PAPER **Discipline Specific Core Course:**	L	T	P	C
I	I		**B.Sc-Mathematics**	2	1	0	2

OBJECTIVE:

1. To enable the students to develop their communication skills in English
2. To empower the students with fluency and accuracy in the use of English language.
3. To transform into globally employable persons with placement skills

Course Outcomes:

After completion of the course students will be able to:

1. Learn or equipped with the practical, emotional, intellectual and creative aspects of language by integrating knowledge and skills.
2. Enhance language through a task-based & learner – centric syllabus
3. Develop their critical thinking capabilities focused through the course as an important need.

UNIT-I **Hours: 9 hours**

Prose: Education

Poem: Sarojini Naidu- "Harvest Hymn"

Letter writing: Formal and Information

Short story: O Henry-Robe of Peace (Extensive Reading)

Essential English Grammar: 1 - 6 units

UNIT- II **Hours: 9hours**

Prose: Application,

Poem: Ben Johnson – "On Shakespeare" (Reading Comprehension)

Short Story: Rudyard Kipling – The Miracle of Puran Bhagat (Extensive Reading)

Essential English Grammar: 7 - 12 units

UNIT- III **Hours: 9 hours**

Prose: Interview

Poem: Robert Herrick –'Gather Ye Rosebuds' (Note Making)

Short Story: H. G. Wells – The Truth About Pyecraft(Extensive Reading)

Essential English Grammar: 13 - 18 units

UNIT- IV **Hours: 9 hours**

Prose: Review (Super Toys)

Poem: Oliver Gold Smith- 'The Village School Master'(Developing story from hints)

Short Story: John Galsworthy – 'Quality' (Extensive Reading)

Essential Grammar Reading 19- 24 units

UNIT –V **Hours: 9 hours**

Prose: Killers

Poem: William Blake – From Auguries of Innocence (Precise Writing)

Short Story: William Somerset Maugham-Mabel (Extensive Reading)

Essential Grammar Reading 25- 50 units

TEXT BOOKS:

1.Krishnaswamy.N.T.Current English for colleges. Hyderabad: MacMillan india Ltd,2006.

2.Dahiya SPS Ed.Vision in Verse,An Anthology of Poems. New Delhi: Oxford University Press, 2002.

3.Murphy, Raymond. Essential English Grammar. New Delhi:Cambridge University Press,2009.

4.Seshadri K G Ed. Stories for Colleges. Chennai:Macmillan India Ltd,2003.

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FACULTY OF ARTS AND SCIENCE
B.Sc. Mathemaatics- LOCF-2020
Value Added Course

Subject: Value Added Course **Subject Code:**
Subject title: Women's Studies **Pattern: Theory**
No: Credits: 2 **No. of hours: 30**

Objectives:

1. This paper aims to familiarize students with key concepts, issues, and debates in Women's Studies

2. To make them aware of the Women's exclusion from knowledge and need for Women's Studies

3. As an academic discipline. It deliberates on the prevailing strategies of the growth of Women's Studies in India and abroad

Course Outcomes:

Upon successful completion of this course, students should be able to:

1. Understand and engage with central debates in the field of Women's and Gender Studies.

2. Define and apply basic terms and concepts central to this field.

3. Apply a variety of methods of analyzing gender in society, drawing upon both primary and secondary sources.

4. Apply concepts and theories of Women's and Gender Studies to life experiences and historical events and processes.

5. Communicate effectively about gender issues in both writing and speech, drawing upon Women's and Gender Studies scholarship and addressing a public audience.

Unit I – Introduction to Women's Studies **Hours: 6 hours**

Key concepts in Gender studies.

Need, Scope and challenges of Women's Studies – Women's Studies as an academic discipline. Women's Studies to Gender Studies, Need for Gender Sensitization.

Women's Movements – global and local: Pre-independence, Post-independence and Contemporary Debates.National Committees and Commissions for Women.

Unit II – Women and Health **Hours: 6 hours**

Life Cycle Approach to Women's Health – Health status of women in India, factors influencing health and Nutritional status.

Maternal and Child Health (MCH) to Reproductive and Child health approaches.

Issues of declining Child Sex Ratio, Widowhood and old age.

Occupational and mental health.

Health, Hygiene and Sanitation.

National Health and Population Policies and Programmes.

Unit III – Women Empowerment and Development **Hours: 6 hours**

Theories of Development, Alternative approaches – Women in Development (WID), Women and Development (WAD) and Gender and Development (GAD).

Empowerment- Concept and indices: Gender Development Index (GDI), Gender Inequality Index (GII), Global Gender Gap Index (GGGI).

Women Development approaches in Indian Five – Year Plans.

Women and leadership– Panchayati Raj and Role of NGOs and Women Development.

Sustainable Development Goals, Policies and Programmes.

Unit IV – Women Law and Governance **Hours: 6 hours**

Rights: Gender Equality, Gender Discrimination, Women's Rights as Human Rights.

Constitutional provisions for Women in India.

Personal laws, Labour Laws, Family Courts, Enforcement machinery – Police and Judiciary.

Crime against Women and Child: Child Abuse, Violence, Human Trafficking, Sexual Harassment at Workplace Act, 2013 – Legal protection

International Conventions and Legislations Related to Women's Rights.

Unit V – Gender and Media **Hours: 6 hours**

Discourse on Women and Media Studies- Mainstream Media, Feminist Media.

Coverage of Women's issues and issues of women in Mass Media and Media Organizations (Audio-Visual and Print media).

Digital Media and legal protection.

Alternative Media – Folk Art, Street Play and Theatre.

Indecent Representation of Women (Prohibition) Act, 1986, Impact of media on women.

Recommended Reading Text Books / Reference Books

1. Khullar, Mala. Writing the Women's Movement: A Reader ed. New Delhi: Zubaan, 2005.
2. Jain, Devaki and Pam Rajput. Narratives from the Women's Studies Family: Recreating knowledge. New Delhi: Sage, 1942.
3. Programme of Women's Studies. New Delhi: ICSSR, 1977. Desai, Neera and Maithrey Krishnaraj. Women and Society in India. Delhi: Ajantha, 1987.
4. Women in Contemporary India. Ed. Alfred De Souza Delhi: Ajanta, 1987.
5. Mies, Maria Indian Women and Patriarchy. Delhi: Concept, 1980. Nanda, B.R. Indian Women: From Purdah to Modernity. Delhi: Vikas, 1976.
6. Women's Studies in India: A Reader. Ed. Mary John. Penguin: New Delhi, 2008.

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FACULTY OF ARTS AND SCIENCE
B.Sc. Mathemaatics- LOCF-2020

Subject : Value Added Course – 2	**Subject Code** :U9VA2IC
Subject Title : Indian Constitution – Configurable Structure	**Pattern : Theory**
No of Credits : 2	**No of Hours : 30**

Objective	:	To provide the basic knowledge of the development and of principles enshrined in the Constitution of India
Outcome		It frames fundamental political principles, procedures, practices, rights, powers, and duties of the government

Unit – I **6 hours**

Introduction: Significance of the Constitution; Making of the Constitution - Role of the Constituent Assembly, Salient features, the preamble, Citizenship, procedure for amendment of the Constitution.

Unit – II **6 hours**

Fundamental Rights: Right to Equality, the Right to Freedom, the Right against Exploitation, the Right to Freedom of Religion, Cultural and Educational Rights and Right to Constitutional Remedies.

Unit – III **6 hours**

Nature of the Directive principles of State Policy: Difference between of Fundamental Rights and Directive Principles of State Policy – Implementation of Directive Principles of State Policy, Fundamental Duties.

Unit – IV **6 hours**

Union Government – Powers and Functions of the President, the Prime Minister, Council of Ministers. Composition, Powers and functions of the Parliament, Organisation of Judiciary, The Supreme Court: Powers and Functions. LokSabha and RajyaSabha - Powers and Functions.

Unit – V **6 hours**

State Government – Powers and Functions of Governor, Chief Minister, Council of Minister. Composition, Powers and functions of state Legislature, Local Government and the Constitution, Relation between the Union and the States. The High Court: Powers and Functions.

Text Books

1. M. V. Pylee – An Introduction to Constitution of India, Vikas Publications, New Delhi-2005.
2. Subhash C. Kashyap – Our Constitution: An Introduction to India's Constitution & Constitutional Law, National Book Trust, New Delhi-2000.
3. Durga Das Basu – Introduction to the Constitution of India, PHI, New Delhi-2001.
4. D. C. Gupta – Indian Government & Politics, Vikas Publications, New Delhi-1994, VIII Edition.
5. J. C. Johari – Indian Government & Politics, Sterling Publishers, Delhi-2004.

Reference Books

1. V. D. Mahajan – Constitutional Development & National Movement in India, S. Chand & Company, New Delhi.
2. Constituent Assembly Debates, Lok-Sabha Secretariat, New Delhi-1989.
3. Granville Austin – Working of a Democratic Constitution: The Indian Experience, Oxford University Press, New Delhi-1999.
4. A. P. Avasthi – Indian Government & Politics, Naveen Agarwal, Agra-2004.
5. S. A. Palekar – Indian Constitution, Serials Publication, New Delhi-2003.

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FACULTY OF ARTS AND SCIENCE
B.Sc. Mathemaatics- LOCF-2020

Semester	Sub. Code	Title of the Paper	L	T	P	Credits
	U9VA4FS (DEMO)	**Fire safety**	3	0	0	4

INSTRUCTIONAL OBJECTIVES

e) To expand awareness on the fire accidents.
f) To know the minimum requirement of the industrial establishment
g) To identify the sources of fire accidents in various places

SUBJECT OUTCOMES

- Understand basic fire safety and what to do in the event of an emergency.
- Understand the values of fire risk control.

- Understand the generic necessities of a Fire Marshal
- Have the skills to initiate emergency processes and promote a positive answer from others
- Be able to detect fire safety hazards and risks in the workplace and public sector.
- Be able to ensure the availability and usage of fire safety equipment's.
- Know how to establish alternative evacuations and fire movements in the workplace and report on their effectiveness

UNIT – IINTRODUCTION ABOUT FIRE SOURCES

Fire reasons and sources in institutions, shopping mall, theatres, industries, electrical and forest, types of fuels, fire safety symbols

UNIT – II IMPACT OF FIRE ACCIDENTS

Various impact of fire accidents in industries, petrol bunks and public sector places (Economic loss, resettlement, and reconstruction)

UNIT – III FIRE SAFETY RULES

Fire safety rules for machinery industries, schools, vehicles, commercial places, and petrochemical industries.

UNIT – IV FIRE ACCIDENTS CONTROL METHODS

First aid for Industrial fire accidents, petrol bunk accidents, vehicle fire accidents, school fire accidents, complex fire accidents, and forest fire accidents

UNIT – V FIRE SAFETY LAWS

Various fire safety laws for establishing academic institutions, industries, and public sector places

Text Book

1. Manual of Fire Safety, Seshaprakash, cbs publishers and distributors pvt ltd.
2. Fire Safety in Buildings 2nd Edition (English, Hardcover, Shri V. K. Jain), Publisher: New Age International, ISBN: 9788122430837, 812243083X, Edition: 2ndEdition, 2010, Pages: 652.
3. Fire Safety Management Handbook, 3rd Edition, Daniel E. Della-Giustina, CRC Press, Published February 7, 2014, Reference - 279 Pages - 40 B/W, llustrations, ISBN 9781482221220.

Reference books

1. Evaluation of Fire Safety, Author(s): D. Rasbash, G. Ramachandran, B. Kandola, J. Watts, M. Law Publisher: Wiley, Year: 2004, ISBN: 9780471493822, 0471493821.

2. Fire Risk: Fire Safety Law and Its Practical Application, Author(s): Allan Grice, Publisher: Thorogood Publishing, Year: 2009, ISBN: 1854186035,9781854186034.

3. Introduction to Fire Safety Management: The handbook for students on NEBOSH and other fire safety courses, Author(s): Andrew Furness, Martin Muckett, Year: 2007, ISBN: 0750680687, 9780750680684, 9780080 551 791.

VINAYAKA MISSION'S RESEARCH FOUNDATION
(Deemed to be University under section 3 of the UGC Act 1956)

FACULTY OF ARTS AND SCIENCE
B.Sc. Mathemaatics- LOCF-2020

Semester	Sub. Code	Title of the Paper	L	T	P	Credits
	U19VA5IS	**Industrial safety**	3	0	0	4

INSTRUCTIONAL OBJECTIVES

h) To enable students to conduct safety audit reports effectively.
i) To have awareness about sources of information for safety promotion and training.
j) To train students with estimation of safety performance.
k) To know about the different kinds of industries and their operations.
l) To know the minimum requirement of the industry establishment
m) To identify the sources of accidents in various places.
n) To achieve and understand the principles of safety management.

SUBJECT OUTCOMES

- Design,Establish,and Implement the industrial systemto improve safety.
- Manner of investigationsonunwantedincidents or accidents using rootcauseanalysis
- Achieve the comfort of industry, worker and machine safety.
- Develop communication system effectivelyonhealthandsafetyamongtheemployeesandwith societyatlarge.

- Demonstratesensitivity ofthesafety, and legal issues regarding accidents.
- Understand theimpact of Firesafety and environment safety while the productivity for societyatlarge.

UNIT – ICONCEPTS AND TECHNIQUES

Types of industries (construction, machinery, chemical, petrochemical, textile, and cracker), Evolution of modern safety concept- Safety policy - Safety Organization - line and staff functionsfor safety- Safety Committee. Incident Recall Technique (IRT), safety survey, safety inspection, safety sampling, evaluation of performance of supervisors on safety.

UNIT – II INDUSTRIAL SAFETY EDUCATION AND TRAINING

Safety training, needs of Training methods – programme, seminars,conferences, competitions – method of promoting safe practice - motivation – communication - role of government agencies and private consulting agencies in safety training – creatingawareness, awards, celebrations, safety posters, safety displays, safety pledge, safety incentive.

UNIT – III HAZARDOUS WASTE MANAGEMENT

Hazardous waste management in India-waste identification, characterization and classification-technological options for collection, treatment and disposal of hazardous waste, Health hazards-toxic and radioactive wastes-incineration and verification.

UNIT – IV POLLUTION CONTROL IN PROCESS INDUSTRIES

Pollution control in process industries like cement, paper, petroleum-petroleum products-textile-tanneries-thermal power plants – dying and pigment industries - eco-friendly energy

UNIT – V INDUSTRIAL FIRE PROTECTION SYSTEMS

Sprinkler – hydrants-special fire suppression systems like deluge and emulsifier, selection criteria of the above installations and maintenance– alarm and detection systems. Other suppression systems –CO_2 system, foam system, Dry chemical powder (DCP) system, halon system – need for halon replacement – smoke venting.

Text Book

1. Dan Petersen, "Techniques of Safety Management", McGraw-Hill Company, Tokyo, 1981.
2. Relevant Indian Standards and Specifications, BIS, New Delhi.
3. "Safety and Good House Keeping", N.P.C., New Delhi, 1985.
4. T Miller, Environmental Science: Working with the Earth, 11th Edition, Wadsworth Publishing Co., Belmont, CA, 2006
5. M.J Hammer,., and M.J Hammer,., Jr., Water and Wastewater Technology, Pearson Prentice Hall, 2006
6. Rao, CS, "Environmental pollution engineering" Wiley Eastern Limited, New Delhi, 1992.
7. S. P. Mahajan, "Pollution control in process industries", Tata McGraw Hill Publishing Company, New Delhi, 1993.
8. V., Subramanian. The Factories Act 1948 with Tamilnadu factories rules 1950, Madras, Book Agency, 21st ed., Chennai, 2000.
9. C.Ray Asfahl , Industrial Safety and Health management, Pearson Prentice Hall,2003.
10. N.V Krishnan. Safety Management in Industry Jaico Publishing House, Bombay, 1997
11. R.S.Gupta., Hand Book of Fire Technology, Orient Blackswan, 2010

Reference books

1. "Accident Prevention Manual for Industrial Operations", N.S.C.Chicago, 1982.
2. Blake R.B., "Industrial Safety" Prentice Hall, Inc., New Jersey, 1973.
3. Heinrich H.W. "Industrial Accident Prevention" McGraw-Hill Company, New York, 1980

4.John Ridley, "Safety at Work", Butterworth and Co., London, 1983.