M.O.P. VAISHNAV COLLEGE FOR WOMEN

(AUTONOMOUS)

Choice Based Credit System

Course of Study for the batch of Candidates admitted in

2020 – 2021

2019 – 2020

2018 – 2019

ACADEMIC YEAR 2020 – 2021

B. Sc Mathematics

Activities / Content with direct bearing on Employability/ Entrepreneurship/ Skill Development

M.O.P. VAISHNAV COLLEGE FOR WOMEN (AUTONOMOUS), CHENNAI-34

(Effective for the batch of candidates admitted in 2020-2021)

B.Sc. MATHEMATICS

Choice Based Credit System
Course of Study for the batch of
Candidates admitted in 2020 – 2021

M.O.P. VAISHNAV COLLEGE FOR WOMEN (AUTONOMOUS), CHENNAI-34

(Effective for the batch of candidates admitted in 2020-2021)

B.Sc. MATHEMATICS

CORE I - ALGEBRA & TRIGONOMETRY

COURSE CODE: 18UMAT301	YEAR/SEMESTER: I / I	MAXIMUM MARKS: 100
COURSE TYPE: THEORY	CREDITS: 4	TOTALTEACHING HOURS : 60

GENERAL OBJECTIVE:

To understand the fundamental concepts and solve higher degree algebraic / trigonometric equations in diversified fields.

COURSE OBJECTIVES (Co):

Co No.	Course Objective
Co1	To understand the nature of the real and complex roots, the relation between roots and coefficients of equations and to find the roots of the equations of higher degree applying the techniques of transformation of equations/Horner's method.
Co2	To determine the sum to infinity of Binomial, Exponential and Logarithmic Series.
Co3	To identify different types of real/complex square matrices, compute eigen values, eigen vectors and inverse of a square matrix using Cayley-Hamilton theorem.
Co4	To obtain the expansions of sin nθ, cos nθ using De Moivre's theorem, powers of sin θ and cosθ in terms of sine and cosine multiples of θ and use it to solve trigonometric equations.
Co5	To introduce hyperbolic, inverse hyperbolic functions, prove identities using circular functions and to obtain the general and principal value of logarithm of complex quantities.

UNIT I

Theory of equations

Polynomial equation, Imaginary and irrational roots,Relations between roots and coefficients of equations, Transformation of equations, Reciprocal equations, Increase or Decrease the roots of a given equation by a given quantity, Descartes rule of signs, Approximate solutions of roots of polynomials by Horner's method.

(15 hours)

UNIT II

Summation of series

Binomial, Exponential and logarithmic series (Statements only).

(13 hours)

UNIT III

Matrices

Symmetric, Skew-symmetric, Hermitian, Skew-Hermitian, Similar, Orthogonal and unitary matrices,Cayley-Hamilton theorem (Statement only),Eigen vectors, Diagonalization of a matrix.

(12 hours)

UNIT IV

Expansions

Expansions of sin θ and cos θ in a series of ascending powers of θ, Expansions of cosnθ, sin nθ, Expansion of tan nθ in powers of tanθ, Expansion of tan (A+B+C….), Power of sines and cosines of θ in terms of functions of multiples of θ.

(10 hours)

UNIT V

Hyperbolic Functions
Definition, Relations between Hyperbolic & Circular functions, Inverse hyperbolic functions.
Logarithm of complex quantities: Definition, Logarithm of (x+iy), General value of logarithm of (x+iy).

(10 hours)

TEXT BOOKS

- S.Narayanan&T.K.ManickavachagomPillay (2004), Algebra(Volume I), Vijay Nichole ImprintsPvt Ltd., Chennai.
- S.Narayanan&T.K.ManickavachagomPillay(2004), Algebra (Volume II), Vijay Nichole Imprints
  Pvt Ltd., Chennai.
- S.Narayanan&T.K.ManickavachagomPillay(2004), Trigonometry, Vijay Nichole Imprints Pvt.Ltd, Chennai.

REFERENCE BOOKS

- P.R.Vittal (2004), Algebra & Trigonometry (Volume I & II), Margham Publications, Chennai.
- S.Sudha (1998), Algebra and Trigonometry, Emerald Publishers, Chennai.
- B.S.Grewal (2002), Higher Engineering Mathematics, Khanna Publishers, New Delhi.

e-RESOURCES

Web Links

http://www.mathcentre.ac.uk/resources/workbooks/mathcentre/hyperbolicfunctions.pdf
http://www.ppup.ac.in/e-Content/_edetails.php?id=3566
http://www.wright.edu/~chaocheng.huang/lecture/mth255/mth255lect12.pdf
https://www.ucl.ac.uk/~zcahge7/files/6501-LecturesNotes-full.pdf
https://www.cuemath.com/calculus/hyperbolic-functions/

You Tube Video Links

https://www.youtube.com/watch?v=cbGWXQb3V38
https://www.youtube.com/watch?v=9M-ndkfrA8I
https://www.youtube.com/watch?v=Z1BlcU1d6Fg

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B.Sc. MATHEMATICS

ACTIVITY PLANNER:

List of activities for Employability / Skill Development / Entrepreneurship Skill Development

(Course faculty may conduct any, all or any other activities as well)

Worksheet: Problems on determining the nature of roots by Descarte's rule and solving higher degree algebraic equations by using the techniques of transformation of equations.

Peer teaching: Finding Eigen values, Eigen vectors and Diagonalisation of a matrix.

Net surfing: Students asked to surf the internet, explore the role of significance of eigen values and eigen vectors in civil engineering and present them in the class.

Seminar: On trigonometric expansions of sinnθ, cosnθ, tannθ in terms of sinθ, cosθ, tanθ

Audio Visual Presentation: Application of hyperbolic trigonometric functions in designing long transmission lines in electrical engineering and suspension bridges.

Brain storming: Proving identities and related problems on hyperbolic, inverse hyperbolic functions and logarithm of complex quantities.

COURSE OUTCOMES:

On completion of the course, students will be able to

CO No.	COURSE OUTCOME	PSOs ADDRESSED	COGNITIVE LEVEL
CO1	Estimate the roots of algebraic equations of higher degree. And apply them to solve problems in local or global environment	**1, 2**	**E**
CO2	Classify the series as binomial, exponential, logarithmic series and hence find the sum to infinity.	**1, 2,4**	**An**
CO3	Determine eigen values and eigenvectors of square matrices and implement them in fields of engineering & data science.	**1,2,3,4**	**E**
CO4	Construct trigonometric functions sinnθ, cosnθ, in powers of sinθ and cosθ.	**1,2**	**C**
CO5	Select appropriate identities to solve problems on hyperbolic & inverse hyperbolic functions and obtain the principal/ general value of logarithm of complex quantities.	**1,2,5**	**E**

- **PSO – Programme Specific Outcome; Co – Course Objective; CO – Course Outcome; R- Remember; U- Understand; Ap – Apply; An – Analyse; E- Evaluate; C – Create**

M.O.P. VAISHNAV COLLEGE FOR WOMEN (AUTONOMOUS), CHENNAI-34

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B.Sc. MATHEMATICS

CORE II - DIFFERENTIAL CALCULUS

COURSE CODE: 18UMAT302	YEAR/SEMESTER: I/I	MAXIMUM MARKS: 100
COURSE TYPE: THEORY	CREDITS: 4	TOTAL TEACHING HOURS: 60

GENERAL OBJECTIVE:

To provide an understanding of the fundamental principles of differential calculus, analyse the behavior of functions, develop mathematical continuity to learn advanced concepts and apply the computational tools to predict the effects of changing conditions in a global environment.

COURSE OBJECTIVES (Co):

Co No.	Course Objective
Co1	To understand the concepts of nth derivative, Leibnitz's theorem, partial derivatives, Euler's theorem and to compute Jacobian.
Co2	To enumerate the procedure for finding maxima and minima for a function of two variables, compute extremum values and employ Lagrange's multipliers method to obtain the maximum/minimum values for a function of three variables.
Co3	To understand the relationship between polar and Cartesian coordinates, compute angle between the radius vector & tangent, length of perpendicular and deduce p-r equation.
Co4	To compute radius of curvature, centre of curvature for equation of curves in Cartesian/ polar form and use it to determine evolutes.
Co5	To impart the knowledge of asymptotes, determine the equations of asymptotes for rational algebraic curves.

UNIT I

Differentiation

Successive differentiation, Formation of equations involving derivatives, n^{th} derivative, Leibnitz's theorem (without proof) and its applications, Partial differentiation-successive partial derivatives, Euler's theorem, Jacobian.

(14 hours)

UNIT II

Differentiation (contd)

Maxima and Minima of functions of two & three independent variables, Lagrange's method of undetermined multipliers (without proof), Concavity & Convexity, Simple problems.

(12 hours)

UNIT III

Polar Coordinates

Angle between the radius vector and tangent, Length of perpendicular from the pole to the tangent, p-r equation (no derivations).

(10 hours)

UNIT IV
Applications
Radius of curvatureincartesian& polar coordinates, Centre of curvature, Evolute (no derivations).

(12 hours)

UNIT V
Linear Asymptotes
Definition, Methods of finding asymptotes of rational algebraic curves with special cases (without proof), Intersection of curve with asymptotes.

(12 hours)

TEXT BOOK

- S. Narayanan & T.K. ManickavachagomPillay (2004), Calculus (Volume 1, Differential Calculus), Revised edition, Vijay Nichole Imprints Pvt. Ltd., Chennai.

REFERENCE BOOKS

- P.R.Vittal&V.Malini (2003), Calculus and Coordinate geometry of two dimensions, Margham Publications, Chennai.
- P.R.Vittal&V.Malini (2003), Calculus and Differential geometry, Margham Publications, Chennai.

e-RESOURCES

Web Links

- https://mathworld.wolfram.com/calculus
- http://www.calculus.org/
- http://tutorial.math.lamar.edu/Classes/CalcI/CalcI.aspx
- https://www.khanacademy.org

You Tube Video Links

- https://www.youtube.com/watch?v=oBmnt5tXRws
- https://www.youtube.com/watch?v=qGCKjuhA4eQ

ACTIVITY PLANNER:

List of activities for Employability / Skill Development / Entrepreneurship Skill Development

(Course faculty may conduct any, all or any other activities as well)

Quiz: On successive differentiation and partial differentiation.
Assignments: On computation of nth derivative and apply Leibnitz theorem for obtaining the desired result.
Think and apply: Maxima and minima principles are employed in any competitive market (global, national, local) to find the equilibrium price and revenue.

Solving challenging problems: On radius of curvature (Cartesian& polar) enhances their rational thinking and problem solving skills for advance learners and hence enables them to compete globally.
Collaborative learning activity: Students divide themselves into groups and each group adopts a particular situation pertaining to curvature and present them in class**.**
Sort and Sequence: Activity based on mapping the curves with their parametric equations and obtain their evolutes.:
Identify and explore: Different types of problems are given to students based on their learning/problem solving abilities. They identify the algebraic equations, employ appropriate methods and find the asymptotes.

COURSE OUTCOMES:

On completion of the course, students will be able to

CO No.	COURSE OUTCOME	PSOs ADDRESSED	COGNITIVE LEVEL
CO1	Determine the nth derivative, obtain the desired results using Leibnitz theorem and apply partial derivatives &Jacobians in diversified fields.	**1,2,4**	**E**
CO2	Evaluate the critical points of f(x,y) and apply Lagrange's multipliers method to obtain the maximum/minimum value of f(x,y,z).	**1,2,3**	**E**
CO3	Explain the concepts of polar coordinates, find angle between the radius vector and tangent and deduce the pedal equation.	**1,2,4**	**E**
CO4	Determine radius of curvature, centre of curvature, evolute and realize its significance in global context.	**1,2,4,5**	**E**
CO5	Construct equations of asymptotes for algebraic curves and apply them in relevant fields.	**1,2,4**	**C**

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B.Sc. MATHEMATICS

ALLIED I - C PROGRAMMING

COURSE CODE: 18UCSC301 & 18UCSC301P	**YEAR/SEMESTER: I/I**	**MAXIMUM MARKS: 60 (Theory), 40 (Practical)**
COURSE TYPE: THEORY & PRACTICAL	**CREDITS: 5**	**TOTAL TEACHING HOURS: 45 (Theory), 30 (Practical)**

GENERALOBJECTIVE:

To introduce the fundamentals of C language,understand the syntax, develop programming skills, solve modular programs and expose students to problem solving through C programming.

COURSE OBJECTIVES (Co):

Co No.	Course Objective
Co1	To introduce the fundamental concepts of C programming(constants, variables, data types, operators and expressions) and understand the syntax of writing a C program.
Co2	To familiarize with input, output operations, decision making statements-IF-ELSE,GOTO, WHILE,DO, FOR.
Co3	To establish array concepts, code and execute a well-structured C program.
Co4	To introduce one dimensional/two dimensional character arrays, its operations and various string handling functions.
Co5	To demonstrate the user defined functions, its characteristics and different types of functionswhich enable studentstowrite reusable modulesfor a given computational problem.

UNIT I

Constants, Variables and Data Types - Character Set, Keywordsand Identifiers, Constants, Variables, Data Types, Declaration of Variables, Assigning Values to Variables, Defining symbolic constants.

Operators and Expressions - Introduction, Arithmetic, Relational, Logical, Assignment, Increment and decrement, Conditional, Special Operators, Arithmetic expressions, Evaluation of expressions, Precedence of arithmetic operators.

(10hours)

UNIT II

Managing input and output operations - Reading a character, Writing a character, Formatted input,Formatted output.

Decision making and Branching - Introduction, Decision making with IF statement, Simple IF…ELSE statement, The IF…ELSE statement, Nesting of IF…ELSE statements, The ELSE IF Ladder, The Switch statement, The ?: Operator, The GOTO statement.

Decision making and Looping -The WHILE statement, DO statement, FOR statement, Jumps in LOOPS.

(8hours)

UNIT III

Arrays

Introduction, One - dimensional Arrays, Declaration of One- dimensional Arrays, Initialization of one- dimensional Arrays, Two- dimensional Arrays, Initializing Two -dimensional Arrays.

(9 hours)

UNIT IV

Character Arrays and Strings

Introduction, Declaring and Initializing String variables, Reading strings from terminal,Writing strings to screen, Putting strings together, Comparison of two strings, String-Handlingfunctions.

(9 hours)

UNIT V

User-defined Functions:

Introduction, Need for User-defined Functions, A Multi – function program, Elements of user – defined functions, Definition of functions, Return values and their types, Function Calls, Function declaration, Category of functions - No arguments and no return values, No arguments but returns a value, Recursion.

(9 hours)

TEXT BOOK

- E. Balagurusamy (2009), Programming in ANSI C, Tata McGraw Hill Publishing Company Ltd., New Delhi.
  Unit I: Chapter 2: 2.2, 2.4, 2.5, 2.6, 2.7, 2.8, 2.10, 2.11.
  Chapter 3: 3.1-3.7, 3.9-3.12.
  Unit II: Chapter 4: 4.2-4.5, Chapter 5: 5.1-5.9 & Chapter 6: 6.2- 6.5.
  Unit III: Chapter 7: 7.1-7.6.
  Unit IV: Chapter 8: 8.1, 8.2, 8.3, 8.4, 8.6, 8.7, 8.8.
  Unit V: Chapter 9: 9.1-9.10, 9.13, 9.16.

REFERENCE BOOKS

- B.W.Kernighan and D.M.Ritchie (1998), The C Programming Language, Prentice Hall of India.
- H.Schildt (2000), C: The Complete Reference, Tata McGraw Hill, New York.
- B.S.Gottfried (1996), Programming in C, Tata McGraw Hill, New York.

e-RESOURCES

Web Links

www.learn-c.org/
nptel.ac.in/courses/106/104/106104128/

https://nptel.ac.in/courses/106/105/106105085/

You Tube Video Links

https://youtu.be/rLf3jnHxSmU?list=PLBlnK6fEyqRggZZgYpPMUxdY1CYkZtARR
https://youtu.be/-CpG3oATGIs

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ACTIVITY PLANNER:

List of activities for Employability / Skill Development / Entrepreneurship Skill Development

(Course faculty may conduct any, all or any other activities as well)

Syntactical & Team work: Students prepare a report on glossary in C, syntax, operators and data types, thus inducing fundamental skills needed for writing a program.

Code interpret: Find the output for the given coding and simplify the compound mathematical expressions using input/output operations, branching and looping, develops coding skills needed for employment.

Pair programing: Students work in pair to architect, code and then test their codes on arrays concepts in matrices and pattern programs.

Error debugging: Identify coding errors at various development stages of C program using the concept of character arrays, string manipulations in finding the frequency of a character, removal of a character, counting the number of vowels, consonants, digits and white spaces.

Code modification: Students develop code for mathematical computations (GCD, nP_r, nC_r) with user-defined functions to transform theoretical knowledge into programming codes.

Practice – based learning on Matrix manipulations using arrays and develop coding for finding inverse and adjoint of a matrix, synchronising problem solving skills with coding skills.

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B.Sc. MATHEMATICS

ALLIED I - C PROGRAMMING -PRACTICAL

1. Summation of series
    i. sinx, cosx,$e^x$and comparison with built in function.
    ii. Approximate value of π using Gregory series
2. String Functions
    i. Counting the number of vowels, consonants, words, white spaces in a line of text and array of lines.
    ii. Reverse a string and checking for palindrome.
3. Recursion
    i. nP_r and nC_r
    ii. Generation of nth terms in the Fibonacci series.
    iii. GCD of two numbers
4. Matrix manipulation
    i. Multiplication
    ii. Transpose and trace of a matrix
    iii. Determinant of a matrix

COURSE OUTCOMES:

On completion of the course, students will be able to

CO No.	COURSE OUTCOME	PSOs ADDRESSED	COGNITIVE LEVEL
CO1	Build a C program utilizing the fundamental concepts of C language.	**1,2**	**Ap**
CO2	Develop programming skills using input/output operations, branching and looping needed for employment.	**1,2,5**	**Ap**
CO3	Analyse the different types of arrays and employ them in program coding.	**1,2,4,5**	**An**
CO4	Explain the concepts of character arrays, strings and employ them in C coding.	**1,2,4**	**E**
CO5	Analyse user defined functions, synchronize mathematical knowledge with coding skills and develop error debugging & testing skills to compete in a global environment.	**1,2,5**	**An**

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B.Sc. MATHEMATICS

CORE III - INTEGRAL CALCULUS & FOURIER SERIES

COURSE CODE: 18UMAT306	**YEAR/SEMESTER: I/II**	**MAXIMUM MARKS :100**
COURSE TYPE: THEORY	**CREDITS: 4**	**TOTAL TEACHING HOURS: 60**

GENERAL OBJECTIVE:

To provide an insight into the concepts of improper integrals, multiple integrals, Fourier series and recognize its significance in applied sciences globally.

COURSE OBJECTIVES (Co):

Co No.	Course Objective
Co1	To provide the different techniques of solving integrals of standard forms, integration by parts and Bernoulli's formula.
Co2	To evaluate integrals using reduction formulae and properties of definite integrals.
Co3	To introduce beta and gamma functions, recurrence formula, properties and solve challenging problems.
Co4	To determine the area of a closedregion/volume of solid using double/triple integrals respectively.
Co5	To compute Fourier constants using the techniques of integration and obtain the Fourier series expansion for a periodic function.

UNIT I

Integrals

Integration of the form: $\int dx / ax^2 + bx + c$, $\int (lx+m)\, dx / ax^2 + bx + c$
$\int dx / \sqrt{ax^2 + bx + c}$, $\int (px + q)\, dx / \sqrt{ax^2 + bx + c}$, $\int \sqrt{ax^2 + bx + c}\, dx$, $\int dx / (a + b\cos x)$, $\int dx / (a + b\sin x)$, Integration by parts, Bernoulli's Formula.

(12 hours)

UNIT II

Integrals (contd)

Definition, Properties of definite integral, Reduction formulae $\int x^n e^{ax} dx$, $\int x^n \cos ax\, dx$, $\int x^n \sin ax\, dx$, $\int \sin^n x\, dx$, $\int \cos^n x\, dx$, $\int \sin^m x \cos^n x\, dx$, $\int \tan^n x\, dx$, $\int \cot^n x\, dx$, $\int \sec^n x\, dx$, $\int \operatorname{cosec}^n x\, dx$ (m,n are positive integers), $\int x^m (\log x)^n\, dx$, Simple problems.

(12 hours)

UNIT III

Beta and Gamma functions

Definition, Recurrence formula of gamma functions, Properties of beta and gamma functions, Relation between beta and gamma function, Simple problems.

(12 hours)

UNIT IV

Multiple Integrals

Evaluation of Double integrals and Triple integrals, Change of order of integration, Application to Area and Volume (cartesian co-ordinates only) Simple problems.

(12 hours)

UNIT V

Fourier series

Introduction, Definition, Expansion of periodic functions of 2π, Expansion of even and odd functions, Half range series.

(12 hours)

TEXT BOOKS

- S.Narayanan&T.K.ManickavachagomPillay (2010), Calculus (Volume II, Integral Calculus), Vijay Nichole Imprints Pvt. Ltd., Chennai.
- S.Narayanan, T.K.ManickavachagomPillay (2004), Calculus (Volume III, Differential Equations & Fourier Series), Vijay Nichole Imprints Pvt. Ltd., Chennai.

REFERENCE BOOKS

- Shanti Narayan (2001), Integral Calculus, S.Chand& Co., New Delhi.
- P.R.Vittal&V.Malini (2004), Integral Calculus, Margham Publications, Chennai.

e-RESOURCES

Web Links

https://tutorial.math.lamar.edu/classes/calci/integralsintro.aspx
https://integralmaths.org
https://archive.org/

You Tube Video Links

https://www.youtube.com/watch?v=Vc8dIykQRhY

https://www.youtube.com/watch?v=vA9dfINW4Rg

ACTIVITY PLANNER:

List of activities for Employability / Skill Development / Entrepreneurship Skill Development

(Course faculty may conduct any, all or any other activities as well)

Concept mapping: Students map the appropriate formula with procedure to evaluate various types of integrals.

Participatory learning activity: Students are encouraged to find different types of techniques to solve problems on definite integrals and reduction formulae.

Drag and Drop: Choose appropriate form of beta/gamma function, properties to solve improper integral and extend the concepts for future learning.

Worksheet: Problems on finding area of any closed region using double integration and volume of solids using triple integration.

Audio Visual Presentation: Application of Fourier series in image and signal processing in engineering sciences globally.

COURSE OUTCOMES:

On completion of the course, students will be able to

CO No.	COURSE OUTCOME	PSOs ADDRESSED	COGNITIVE LEVEL
CO1	Choose suitable methods of integration, implement integration by parts and Bernoulli's formula to evaluate integrals.	**1,2,4**	**E**
CO2	Explain the properties of definite integrals, apply them appropriately to solve problems and deduce reduction formulae for trigonometric functions.	**1,2,4**	**E**
CO3	Estimate improper integrals using beta and gamma functions and develop skills for future learning.	**1,2,4**	**E**
CO4	Evaluate the area of surfaces/volume of solids using double and triple integrals.	**1,2,4**	**E**
CO5	Determine Fourier series for periodic functions and recognize its significance in applied sciences globally.	**1,2,4,5**	**E**

- **PSO – Programme Specific Outcome; Co – Course Objective; CO – Course Outcome; R- Remember; U- Understand; Ap – Apply; An – Analyse; E- Evaluate; C – Create**

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B.Sc. MATHEMATICS

CORE IV- DIFFERENTIAL EQUATIONS & APPLICATIONS

COURSE CODE: 15UMAT302	YEAR/SEMESTER: I/II	MAXIMUM MARKS: 100
COURSE TYPE: THEORY	CREDITS: 4	TOTAL TEACHING HOURS: 60

GENERAL OBJECTIVE:

To apply the formulae and problem solving procedures of ordinary/ partial differential equations in construction and solution of relevant physical models.

COURSE OBJECTIVES (Co):

Co No.	Course Objective
Co1	To recognize and solve linear, Bernoulli and differential equations of first order but of higher degree.
Co2	To enumerate the procedures for solving second order differential equations with constant and variable coefficients and method of variation of parameters.
Co3	To formulate partial differential equationsby eliminating arbitrary constants/functions.
Co4	To classify and apply appropriate methods to solve first order partial differential equations-Lagrange's method,special methods, Clairaut's form.
CO5	To explain and solve the problems related to Oscillations of springs and Oscillatory electric circuits.

UNIT I

Ordinary differential equations

Linear equation, Bernoulli's equation, Differential Equations of first order but of higher degree , Equations Solvable for p, Solvable for x, Solvable for y, Clairaut's form.

(12 hours)

UNIT II

Ordinary differential equations (Contd)

Second order differential equations with constant coefficients, Finding the complementary function and P.I of the form e^{ax} , sin ax or cos ax where a is a constant, $x^m$where m is a positive integer , Special methods for finding P.I – $e^{ax}X$ where X is any function of x,Second order differential equations with variable coefficients: $ax^2\, d^2y/dx^2 + bxdy/dx + cy = X$, where X is a function of x, Finding the complementary function and P.I using z = log x, Method of variation of parameters.

(12 hours)

UNIT III

Partial differential equations

Classification of integrals – complete, singular and general integrals, Formation of P.D.E byeliminating arbitrary constants and arbitrary functions.

(12 hours)

UNIT IV

Partial differential equations (Contd)

Lagrange's method of solving linear equation $Pp + Qq = R$, Special methods : standard forms $f(p, q) = 0$, $f(x, p, q) = 0$, $f(y, p, q) = 0$, $f(z, p, q) = 0$, $f(x, p) = f(y, q)$, Clairaut's form [simple problems].

(12 hours)

UNIT V

Applicationsof differential equations

Oscillations of spring: Free oscillations, Damped oscillations, Forced oscillations (Without Damping), Oscillatory Electrical Circuits: L-C circuit, L-C-R circuits, L-C Circuit with e.m.f. L-C-R circuit with e.m.f.

(12 hours)

TEXT BOOKS

- S.Narayanan,T.K.ManickavachagomPillay (2004),Calculus(volume III) (Differential equations and Fourier series), Vijay Nichole Imprints Pvt.Ltd., Chennai.
- Dr.B.S.Grewal (June 2001), Higher Engineering Mathematics, 36th edition, Khanna Publisher.
  Unit V: Chapter 14- 14.4, 14.5.

REFERENCE BOOKS

- A.Singaravelu (2002), Differential Equations, Fourier series and Laplace transforms, First edition, Meenakshiagency,Chennai.
- P.R.Vittal (2002), Differential equations and Laplace transforms, First edition, Meenakshi agency, Chennai.

e-RESOURCES

Web Links

https://www.ams.org/open-math-notes/omn-advanced-search
https://www.khanacademy.org/math/differential-equations
https://www.whitman.edu/mathematics/calculus_online/section04.11.html

You Tube Video Links

https://www.youtube.com/watch?v=dXe0-3b2fnE
https://www.youtube.com/watch?v=3c71y8N9qj0
https://www.youtube.com/watch?v=c0UQ_UD0ib0

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B.Sc. MATHEMATICS

ACTIVITY PLANNER:

List of activities for Employability / Skill Development / Entrepreneurship Skill Development

(Course faculty may conduct any, all or any other activities as well)

Solving challenging problems: On linear differential equations of first order, Bernoulli's equation and differential equations of first order but of higher degree.
Peer teaching: Procedures of obtaining the particular integral for special cases in solving differential equations of second order in real time problems globally.
Brain writing: Students think independently and form partial differential equations by eliminating arbitrary constants and functions.
Worksheets: Problems on solutions to standard types of partial differential equations of first order.
Class Seminar: On application of second order differential equations in governing the flow of charge in an L-C & L-C-R circuit with and without emf.
Group Discussion: On solving problems related to oscillations of spring with and without emf and to find displacement of the mass attached to the spring at any time t.

COURSE OUTCOMES:

On completion of the course, students will be able to

CO No.	COURSE OUTCOME	PSOs ADDRESSED	COGNITIVE LEVEL
CO1	Select the appropriate procedures to solve linear, Bernoulli, first order but of higher degree differential equations.	**1,2,4**	**E**
CO2	Determine the solution of second order differential equations with constant and variable coefficients.	**1,2,4**	**E**
CO3	Formulate a partial differential equation by eliminating the arbitrary constants and functions.	**1,2**	**C**
CO4	Evaluate first order partial differential equations using appropriate methods in real time problems globally.	**1,2,4,5**	**E**
CO5	Analyse and determine the solution of differential equations for oscillations of spring & oscillatory electric circuits.	**1,2,3,4**	**An, E**

- **PSO – Programme Specific Outcome; Co – Course Objective; CO – Course Outcome; R- Remember; U- Understand; Ap – Apply; An – Analyse; E- Evaluate; C – Create**

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(Effective for the batch of candidates admitted in 2020-2021)

B.Sc. MATHEMATICS

ALLIED II - COMPUTER ORIENTED NUMERICAL METHODS

COURSE CODE 18UMAT307 & 18UMAT307P	**YEAR/SEMESTER: I / II**	**MAXIMUM MARKS : 60 (Theory), 40 (Practical)**
COURSE TYPE: THEORY & PRACTICAL	**CREDITS: 5**	**TOTALTEACHING HOURS: 45(Theory), 30(Practical)**

GENERAL OBJECTIVE:

To provide a basic understanding of numerical differentiation, numerical integration, interpolation and develop C programs to solve numerical problems.

COURSE OBJECTIVES (Co):

Co No.	Course Objective
Co1	To introduce finite differences and solve problems for equal intervals using Newton forward, backward and central difference interpolation formulae.
Co2	To understand divided differences and obtain the value of a function using Newton's divided difference and Lagrange'sformulae.
Co3	To evaluate first, second and third order derivatives of a function at a point using Newton's/Gauss /Stirling's forward and backward interpolation formulae.
Co4	To evaluate definite integrals using Trapezoidal, Simpson's rules and fit a curve for given numerical data.
Co5	To find the approximate roots of algebraic/ transcendental equations correct to required decimal places by using Bisection, Newton-Raphson, Regula-Falsi and iteration methods.

UNIT I

Finite differences

First Differences, Higher Differences, Difference tables, Backward differences, Central differences, Properties of the operators E, Δ, ∇ , Relation between the operators E, Δ, ∇ and D. Interpolation with equal intervals -Newton's forward and backward interpolation formula.,Central difference formulae - Gauss forward and backward interpolation formulae, Stirling's formula (No derivations).

(13 hours)

UNIT II

Interpolation with unequal intervals

Divided differences, Newton's divided difference formula for interpolation and Lagrange's formula for interpolation(No derivations).

(8 hours)

UNIT III

Numerical Differentiation

Derivatives using Newton's forwardand backward difference formulae, Stirling's formula and divided difference formulae(No derivations).

(8 hours)

UNIT IV
Numerical Integration
Trapezoidal formula, Simpson's one-third rule, Simpson's three-eighth rule, Curve Fitting - Fitting of straight line and parabolic curve by the method of least squares (No derivations).
(8 hours)

UNIT V
Solutions of algebraic and transcendental equations
Bisection method, Regula-Falsimethod,Newton-Raphson method and Iteration method (No derivations).
(8 hours)

TEXT BOOK

- M.K.Venkatraman (1999), Numerical methods in Science and Engineering, The National Publishing Company, Chennai.

REFERENCE BOOKS

- C.Xavier (1999), C Language and Numerical methods, New Age International Ltd., Chennai.
- Prof. P. Kandasamy, K. Thilakavathy& K. Gunavathy (1999), Numerical methods, S.Chand and Company Ltd., New Delhi.
- A.Singaravelu (1999), Numerical Methods, Meenakshi Publications, Chennai.

e-RESOURCES

Web Links

http://www.math.wsu.edu/kcooper/M448/resources.php
https://nptel.ac.in/courses/111/106/111106101/

https://numericalmethodstutorials.readthedocs.io/en/latest/

You TubeVideo Links

https://nptel.ac.in/courses/111/101/111101003/
https://youtu.be/-wv-OERJK3M

ACTIVITY PLANNER

List of activities for Employability / Skill Development / Entrepreneurship Skill Development
(Course faculty may conduct any, all or any other activities as well)

Class presentation: On interpolation methods to predict the effect of environmental changes for any geographical data and financial analysis in global environment.

Programming assignment: Design a C program to forecast the unknown values and estimate functions for a given data using Lagrange's, Newton divided difference methods thus developing programming skills to solve numerical problems.

Code Modification: Students are assigned in groups task of coding & modifying numerical problems in engineering and technology using Bisection and Newton- Raphson methods to find the zeroes of nonlinear functions of a single variable.

Project based learning: Focuses students to present their problems, methods and results on applications of numerical differentiation using C coding to estimate the profit and loss for certain ventures.

Worksheet: Solving problems on numerical integration in real world scenario to compute pressure-volume, work done by a piston, calculate displacement.

Code Formulation: Application oriented numerical problems in engineering and technology are solved by implementing C coding.

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B.Sc. MATHEMATICS

ALLIED II- COMPUTER ORIENTED NUMERICAL METHODS-PRACTICAL

FINDING ROOTS OF EQUATION

1. Newton –Raphson method
2. Bisection method

INTERPOLATION

1. Newton's forward and backward formula for equal intervals.
2. Lagrange's formula for unequal intervals.

NUMERICAL DIFFERENTIATION

1. Derivatives (1^{st} and 2^{nd}) using Newton's forward and backward interpolation formula.

NUMERICAL INTEGRATION

1. Trapezoidal rule.
2. Simpson's 1/3 rule.
3. Simpson's $3/8^{th}$ rule.

CURVE FITTING

1. Straight line.
2. Parabolic curve.

COURSE OUTCOMES:

On completion of the course, students will be able to

CO No.	COURSE OUTCOME	PSOs ADDRESSED	COGNITIVE LEVEL
CO1	Explain the relationship between difference operators and apply Newton's forward/backward/central interpolation formulae in forecasting of population census data nationally/globally.	**1,2,3,5**	**E**
CO2	Implement Lagrange's and divided difference formulae for interpolating data with unequal intervals pertaining to any physical environment.	**1,2,4**	**Ap**
CO3	Determine the derivatives of a function using techniques of Numerical differentiation wherever routine methods are not applicable.	**1,2,4**	**E**
CO4	Evaluate approximate value of a definite integral using Trapezoidal and Simpson's formulae.	**1,2,4**	**E**
CO5	Estimate the roots of algebraic and transcendental equations using iterative procedure.	**1,2,4**	**E**

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Choice Based Credit System Course of Study for the batch of Candidates admitted in 2019 – 2020

M.O.P. VAISHNAV COLLEGE FOR WOMEN (AUTONOMOUS), CHENNAI-34

(Effective for the batch of candidates admitted in 2020-2021)

B.Sc. MATHEMATICS

CORE V - VECTOR ANALYSIS & CO-ORDINATE GEOMETRY OF 3 DIMENSIONS

COURSE CODE: 14UMAT315	YEAR/SEMESTER: II/III	MAXIMUM MARKS: 100
COURSE TYPE: THEORY	CREDITS: 4	TOTAL TEACHING HOURS: 60

GENERAL OBJECTIVE:

To provide an in-depth knowledge of differentiation/integration for vector valued functions and apply the concepts of lines/planes/spheres to any local environment in two/three dimensions.

COURSE OBJECTIVES (Co):

Co No.	Course Objective
Co1	To introduce vector valued functions, gradient, divergence, curl of scalar/vector valued functions.
Co2	To impart the knowledge on line, surface, volume integrals and evaluate them using integral theorems(Gauss, Stokes, Green's).
Co3	To determine equations of intersecting/bisecting/ parallel planes and angle between them.
Co4	To find the equations of different forms of straight lines in three dimension and theshortest distance/ equation of shortest distance between any two lines.
Co5	To compute the equation of spheres, orthogonal spheres and solve problems relating planes, lines and spheres.

UNIT I

Vector differentiation

Derivative, Partial derivative of a vector function, Gradient, definition of level surface, Directional derivative of a scalar point function (without proof) , Equations of tangent plane & normal line to level surface, Divergence & Curl of a vector point function.

(12 hours)

UNIT II

Vector integration

Integration of vector function, Line, Surface and Volume integrals,Theorems of Gauss, Stokes and Green's (without proof), Simple problems.

(10 hours)

UNIT III

Planes

Equations to planes, General first degree equation represents a plane(B. W.),Angle between two planes, perpendicular distance of a point from a plane (without proof), Distance between two parallel planes (without proof), Condition for two planes to be parallel, Perpendicular, bisector planes, Plane through the intersection of two given planes.

(13 hours)

UNIT IV

Straight Lines

Conditions for two lines to be parallel, Perpendicular **,**Condition for a line to be parallel, Perpendicular to a plane, Reduction to symmetric form of a line given by a pair of planes, Conditions for two lines to be coplanar and equations of the plane containing the lines, Length and equation of shortest distance between two parallel lines.

(13 hours)

UNIT V

Spheres

Equation of a sphere, General equation – Length of a tangent from an external point, Power of a point with respect to a sphere, Tangent plane, Section of a sphere by a plane, Orthogonal sphere.

(12 hours)

TEXT BOOKS

- P.Duraipandian&LaxmiDuraipandian (1998), Vector Analysis (Chapter I to IV), Revised Edition, Emerald Publishers.
- P.R.Vittal& V. Malini (2004), Co,ordinate geometry of 3dimensions and Probability (Chapter 1, 2, &3), First Edition, Margham Publications.

REFERENCE BOOKS

- P.R.Vittal& V. Malini (1997),Vector analysis (Chapter 1&2), First Edition, Margham Publications.
- P. Duraipandian, LaxmiDuraipandian (1995), D.MuhilanCo,ordinate Geometry of 3, Dimensions (Chapters 3, 4, 5), First Revised Edition, Emerald Publishers..
- K.Viswanathan&S.Selvaraj (1999), Vector Analysis (Chapter 1 to 4), First Edition, Emerald Publishers.

e-RESOURCES

Web Links

https://ocw.mit.edu/courses/mathematics
https://www.intmath.com/vectors/3d-space-interactive-applet.php
https://www.intmath.com/vectors/7-vectors-in-3d-space.php

You TubeVideo Links

https://www.youtube.com/watch?v=qN5wxhHHCIM

https://www.youtube.com/watch?v=hCkbBU9E_40

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B.Sc. MATHEMATICS

ACTIVITY PLANNER:

List of activities for Employability / Skill Development / Entrepreneurship Skill Development

(Course faculty may conduct any, all or any other activities as well)

Audio Visual presentation: On physical interpretation of directional derivatives, curl and divergence of a scalar/vector point functions.

Assignment: Evaluation of challenging problems on line, surface and volume integrals using Gauss, Greens and Stokes theorems and extend it for higher learning.

Internet surfing: Students browse the net for some application of planes in different practical situations and find its solution.

Work sheet: Problems in combination of planes and straight lines emphasizing on real life situation.

Seminar: Applications of spheres and planes in spherical geometry in planning flight, cruises, satellites orbits in local/global environment.

COURSE OUTCOMES:

On completion of the course, students will be able to

CO No.	COURSE OUTCOME	PSOs ADDRESSED	COGNITIVE LEVEL
CO1	Interpret divergence and curl of a vector field and apply the concept of gradient to solve problems which involves normal vectors.	**1,2,4**	**E**
CO2	Evaluate line, surface, volume integrals using vector integration and develop higher learning skills.	**1,2,4**	**E**
CO3	Analyze the concepts of planes and interpret its significance in engineering sciences.	**1,2,4**	**An, E**
CO4	Determine the shortest distance between two parallel/ skew lines and check the conditions for a plane and a straight line to be parallel/perpendicular.	**1,2,4**	**E**
CO5	Analyse the concepts of spheres/orthogonal spheres and apply them in local environment.	**1,2,5**	**An**

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B.Sc. MATHEMATICS

ALLIED III - MATHEMATICAL STATISTICS

COURSE CODE: 17UMAT303 & 17UMAT303P	**YEAR/SEMESTER: II/III**	**MAXIMUM MARKS: 80 (Theory) & 20(Practical)**
COURSE TYPE: THEORY & PRACTICAL	**CREDITS: 5**	**TOTAL TEACHING HOURS: 50 (Theory) & 25 (Practical)**

GENERAL OBJECTIVE:

To impart the knowledge of theoretical distributions correlation, regression, testing of hypothesis and use them effectively in analysis and interpretation of qualitative/quantitative data in relevant fields.

COURSE OBJECTIVES (Co):

Co No.	Course Objective
Co1	To understand the concepts of discrete/continuous random variables, distribution functions, mathematical expectation, moment generating function and compute mean and variance for continuous probability distributions.
Co2	To obtain the mean, variance, moment generating functions of Binomial, Poisson, Normal distributions and employ them in fitting of distributions.
Co3	To identify linear correlation as a tool to obtain the degree of relationship between two variables and utilize regression analysis for purposes of description and prediction.
Co4	To understand the essentials of sampling theory, enumerate the procedure of testing of hypothesisand apply appropriate tests of significance(large sample,student's t,chi square tests) to draw conclusions.
Co5	To analyze and check the impact of one or more factors by comparing the means of different samples using ANOVA.

UNIT I

Distribution Functions & Mathematical Expectation

Random variable, Distribution functions, Properties of distribution function, Discrete random variable, Probability mass function, Discrete distribution function, Continuous random variable, Probability density function, Mean and variance for continuous probability distribution.

Mathematical expectation, Addition theorem of expectation, Multiplication theorem of expectation, Expectation of a linear combination of random variables, Variance of a linear combination of random variables, Moment generating function, Simple problems.

(10 hours)

UNIT II

Standard Distributions

Binomial & Poisson Distribution-Definition, Moment generating function, Fitting of distributions.

Normal Distribution - Definition, Chief characteristics, Moment generating function, Simple problems. (Excluding limiting case of the Binomial distribution for Poisson and Normal distribution)

(8 hours)

UNIT III

Correlation

Introduction, Significance, Types of correlation**,** Scatter diagram, Karl Pearson's coefficient of correlation, Rank correlation.

Regression

Introduction, Uses of regression analysis, Difference between correlation and regression analysis, Regression lines, Regression equations (only ungrouped data & no derivations) .

(9 hours)

UNIT IV

Tests of Hypothesis

Procedure for testing hypothesis, Null hypothesis, Alternative hypothesis, Type I and Type II errors, Critical region, Level of significance, One tailed and two tailed tests, Standard error and its significance.

Large Sample Tests: Single mean, Difference of means.

Small Sample Tests: t test for single mean and Difference of means, Paired t test.

Non Parametric test: Chi - Square test for goodness of fit and independence of attributes, (Problems only).

(9 hours)

UNIT V

F-Test and Analysis of Variance

The F test or the Variance ratio test, Assumptions in F test, Applications of F test, Analysis of variance: Definition, Assumptions, One way and Two way classification (Problems only).

(14 hours)

TEXT BOOKS

- S.C.Gupta, V.K.Kapoor (2000), Fundamentals of Mathematical Statistics, 9th revised edition, Sultan Chand & Sons, New Delhi. (Unit I &II)
- S.P.Gupta (2008), Statistical Methods, 25th Edition, Sultan Chand & Sons, New Delhi (Unit III, IV & V).

RFERENCE BOOKS

- T. Veerarajan, (2007) Probability, Statistics and Random Processes,TataMcGraw,Hill Publishing Company Limited Edition, Chennai.
- P.R.Vittal (2004), Mathematical Statistics, First Edition, Margham Publications, Chennai.

e-RESOURCES

Web Links

https://www0.gsb.columbia.edu/faculty/pglasserman/B6014/RandomVariables.pdf
https://www.westga.edu/academics/research/vrc/assets/docs/tests_of_significance_notes.pdf

You Tube Video Links

https://www.youtube.com/watch?v=8RbXCXVCRcA

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https://www.youtube.com/watch?v=Q1yu6TQZ79w

ACTIVITY PLANNER:

List of activities for Employability / Skill Development / Entrepreneurship Skill Development

(Course faculty may conduct any, all or any other activities as well)

Worksheets: Calculate the mean and variance of discrete/continuous random variables for data describing real-world system.

Individual Learning: Students compute mean, standard deviation of the marks secured by them in the end semester examination and plot them on a normal curve using the characteristics of normal distribution.

Compare and Contrast: Students use regression analysis to estimate the line of best fit for their own data sets, create scatter plots that will have a specific correlation coefficient.

Concept mapping activity:Map any practical situation with the appropriate tests of significance and derive conclusions.

Project Based Learning: Students undertake projects and apply appropriate computational techniques to draw conclusions.

Blended Learning: Students apply R programming to compute measures of location & dispersion and develop programming skills needed for employment.

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B.Sc. MATHEMATICS

ALLIED III - MATHEMATICAL STATISTICS-PRACTICAL (USING R)

- **DIAGRAMMATIC REPRESENTATION**
  Column, Bar Diagram, Line, Pie and Area
- **METHODS OF CENTRAL TENDENCY**
  Mean, Median, Mode.
- **MEASURES OF DISPERSION**
  Standard deviation, Quartile deviation, Range
- **CORRELATION**
  Correlation co-efficient
  Rank Correlation (without repeated ranks)
  Regression co-efficient and Regression lines
- **TESTS OF SIGNIFICANCE**
  Small samples- t test for single mean, difference of means and paired t test. Chi-square for independence of attributes. ANOVA-One way and two way classification

COURSE OUTCOMES:

List of activities for Skill Development/Employability

On completion of the course, students will be able to

CO No.	COURSE OUTCOME	PSOs ADDRESSED	COGNITIVE LEVEL
CO1	Determine the mean and variance of discrete and continuous random variables of a probability distribution.	**1,2**	**E**
CO2	Explain the characteristics of standard distributions and employ them to solve problems in local/national/global environment.	**1,2,5**	**E**
CO3	Measure the degree of relationship between two random variables using correlation and predict their linear relationship using regression analysis.	**1,2,3**	**E**
CO4	Select appropriate statistical tools to analysedata in real time / survey based projects and derive inferences.	**1,2,4**	**E**
CO5	Test the impact of one or more factors in environmental changes that contribute to sustainable development by employing the principles of ANOVA.	**1,2,3,4**	**E**

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B.Sc. MATHEMATICS

ELECTIVE I - FINANCIAL MATHEMATICS

COURSE CODE: 17UMAT302	YEAR/SEMESTER: II/III	MAXIMUM MARKS: 100
COURSE TYPE: THEORY	CREDITS: 5	TOTALTEACHING HOURS: 75

GENERAL OBJECTIVE:

To introduce the key topics and principles necessary to financial literacy and implement mathematical tools to solve problems in finance.

COURSE OBJECTIVES (Co):

Co No.	Course Objective
Co1	To introduce the concept of nominal rates and find the accumulated value, discounted value, rate and time.
Co2	To analyze difference between lending in installment and repaying in lump sum and vice versa in finding the average due date.
Co3	To determine the rate of interest using linear interpolation method in annuities.
Co4	To explain the concepts of amortization of a debt, outstanding principal and methods to refinance a loan
Co5	To understand the techniques in capital budgeting - Net Present Values, Internal Rates of Return and formulate depreciation schedule of an asset using various methods.

UNIT I

Compound Interest

Accumulated value, Equivalent rates, Discounted value, Accumulated and discounted values for fractional interest periods, Finding the rate, Finding the time, Equations of value.

(15 hours)

UNIT II

Average Due Date

Meaning and uses of Average Due date, Determination of Due date, Average Due dates as basis for calculation of interest.

Investment Accounts

Meaning of Investments, Types of Investments- Fixed and Variable income securities, Cum-interest and ex-interest quotations, simple calculations to compute capital and interest component (no journal and ledger entries), simple problems.

(13 hours)

UNIT III
Simple Annuities
Definitions and notations, Accumulated value of an ordinary simple annuity, Discounted value of an ordinary simple annuity, Finding the term of an annuity, Finding the interest rate.
(16 hours)

UNIT IV
Amortization
Amortization of a debt, Outstanding principal, Mortgages, Refinancing a loan.
(14 hours)

UNIT V
Capital Budgeting and Depreciation
Net present value, Internal rate of return, Capitalised cost and capital budgeting, Depreciation – The Straight-line method, The constant-percentage method, The sum-of- digits method, The Physical-Service method and Depletion. (17 hours)

TEXT BOOKS

- Petr Zima & Robert L.Brown (2005), Mathematics of Finance, Tata McGraw,Hill Publishing Company Limited, New Delhi.

  Unit I: Chapter 4: 4.1 – 4.7.
  Unit III: Chapter 5: 5.1, 5.2, 5.3, 5.5, 5.6.
  Unit IV: Chapter 7: 7.1 – 7.4.
  Unit V: Chapter 9: 9.1- 9.4.
- T.S.Reddy& A Murthy (2008), Financial Accounting, Margham Publications, Chennai.
  Unit II: Chapter 7: Pg 7.1-7.15 &
  Chapter 15: Pg15.1-15.11

e-RESOURCES

Web Link:

https://www.georgebrown.ca/sites/default/files/uploadedfiles/tlc/_documents/formula_sheet_for_financial_mathematics.pdf

https://www.yourarticlelibrary.com/accounting/procedure-for-calculation-of-average-due-date-2-methods/50725

https://www.projectmaths.ie/documents/modulars/4/FinancialMathsExtraQuestions.pdf

You Tube Video Links

www.youtube.com/watch?v=C5o6U7zOebM
www.youtube.com/watch?v=Iysb35FJrYU
www.youtube.com/watch?v=SjLzJ1WkOE0
www.youtube.com/watch?v=CBIJwb37O_4

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ACTIVITY PLANNER:

List of activities for Employability / Skill Development / Entrepreneurship Skill Development

(Course faculty may conduct any, all or any other activities as well)

Assignments: Problems on Compound interest and compound discount to determine the cost of a loan or an asset by fixing the nominal rates in business environment.

Participatory learning activity: Computing the average due dates for lending in instalment and repaying in lump sum and vice versa in finance sector.

Role Play: Students play the role of a Finance Manager, explain types of Investments and perform calculations to compute Capital and Interest component (cum-interest andex-interest) and emerge as a financial consultant.

Drag and drop: Students link the concepts of accumulated value, discounted value, and rate of interest in simple annuities which is designed to provide income at regular intervals after retirement.

Group activity on Amortization: Paying of debt through regular principal and interest payments over a time for any real life situation such as availing a house loan or a vehicle loan and emerge as an investment analyst in competitive environment.

Worksheets: Problems to compute Net Present Value of cash inflows which is used to measure the profitability of the project or investment.

COURSE OUTCOMES:

On completion of the course, students will be able to

CO No.	COURSE OUTCOME	PSOs ADDRESSED	COGNITIVE LEVEL
CO1	Determine the accumulated value, discounted value for fractional interest periods.	**1,2**	**E**
CO2	Estimate the due dates for payment of various transactions and investments pertaining to local/global needs.	**1,2,4,5**	**E**
CO3	Evaluate accumulated value, discounted value and find the term of an annuity.	**1,2**	**E**
CO4	Explain the concepts of amortization, apply it in refinancing a loan and develop skills needed for employment in banking/finance sector.	**1,2,4,5**	**E**
CO5	Estimate the capital cost of an asset and prepare a depreciation schedule.	**1,2,4,5**	**E**

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B.Sc. MATHEMATICS

CORE VI – MECHANICS

COURSE CODE: 16UMAT302	YEAR/SEMESTER: II /IV	MAXIMUM MARKS: 100
COURSE TYPE: THEORY	CREDITS: 4	TOTAL TEACHING HOURS: 60

GENERAL OBJECTIVE:

To understand the fundamental concepts in the dynamics of system of particles, motion of rigid bodies, kinematics and develop mathematical skills to solve related problems in global environment.

COURSE OBJECTIVES (Co):

Co No.	Course Objective
Co1	To impart the conceptual knowledge of forces, types of forces, resultant of two/three forces and calculate moment of a force using Varignon'stheorem.
Co2	To find center of mass for circular arc, lamina in the form of sector of a circle, Solid hemisphere, right circular cone, hemispherical shell using integration.
Co3	To provide a basic understanding of velocity, relative velocity, acceleration and derive the equations for rectilinear motions.
Co4	To understand the notion of rectilinear motion and obtain the equation of simple harmonic motion and the projection of a particle having uniform circular motion.
Co5	To introduce projectile, the various features associated with a projectile's trajectory (Horizontal range, time of flight, components of displacement, velocity and acceleration) and solving related problems.
Co6	To familiarize with the concept of moment of inertia, to measure the moments of inertia of several objects by using parallel axis and perpendicular axis theorems.

UNIT I

Forces and Moments

Newton's laws of motion - Forces, Types of Forces, Resultant of two Forces on a particle, Resultant of three Forces related to a triangle acting at a point, Equilibrium of a particle - Equilibrium of a particle under three forces. Moment of a force – Moment of a force about a line, Scalar moment.Parallel forces-Varignon's Theorem, Parallel forces at the vertices of a triangle, Simple problems. (12 hours)

UNIT II

Centre of Mass

Centre of Mass**,** Centre of gravity, Finding mass centre (using integration). Thin wire in the form of a circular arc, Lamina in the form of a sector of a circle, Solid hemisphere of radius a, Solid right circular cone of height h, Hemispherical shell, Related simple problems.

(12 hours)

UNIT III

Kinematics

Velocity, Velocity of a particle describing a circle, Resultant Velocity, Relative Velocity, Acceleration, Rectilinear motion,Rectilinear motion with constant acceleration.

Rectilinear motion under varying force: Simple harmonic motion - Definition, Equation of Simple harmonic motion, Projection of a particle having a uniform circular motion, Composition of two simple harmonic motions of same period, Simple problems.

(12 hours)

UNIT IV

Projectiles

Forces on a Projectile, Displacement as a combination of vertical and horizontal displacements, Nature of trajectory, Results pertaining to the motion of the projectile, Maximum horizontal range for a given velocity, Projectile projected horizontally, Simple problems. (12 hours)

UNIT V

Moment of Inertia

Definition, Moment of inertia of uniform bodies - Circular ring, Right circular hollow cylinder, Circular lamina, Solid right circular cylinder, Solid sphere, Solid right circular cone about the axis of the cone, Spherical shell, Perpendicular and parallel axes theorems (Statement only), Related simple problems. (12 hours)

TEXT BOOK

- P. Duraipandian, LaxmiDuraipandianandMuthamizhJayapragasam (2015), Mechanics (Sixth Revised Edition), S.Chand and Co. Pvt, Ltd., New Delhi.
  Unit I: Chapter 2: 2.1-2.1.1, 2.1.2, 2.2- 2.2.1.
  Chapter 3: 3.1- 3.1.1.
  Chapter 4: 4.1 - 4.1.1, 4.1.2, 4.4- 4.4.2, 4.4.3.
  Unit II: Chapter 6: 6.1- 6.1.1, 6.2- 6.2.2.
  Unit III: Chapter 1: 1.2 – 1.2.1,1.2.2,1.2.3, 1.3 - 1.3.1, 1.3.2.
  Chapter 12: 12.1- 12.1.1, 12.1.2.
  Unit IV: Chapter 13: 13.1-13.1.1,13.1.2, 13.1.3,13.1.4, 13.1.6.
  Unit V: Chapter 17: 17.1 – 17.1.1.

REFERENCE BOOKS

- K. V. Naik and M. S. Kasi (2007), Statics and Dynamics, Emerald Publishers, Chennai.
- S.G.Venkatachalapathy (2003), Mechanics, Margham Publications, Chennai.

e-RESOURCES

Web Links

https://eng.umd.edu/

https://ocw.mit.edu/courses

You Tube Video Links

https://youtu.be/xnFvcdCcVxk
https://www.khanacademy.org/science/physics/mechanical-waves-and-sound/simple-harmonic-motion-with-calculus/v/introduction-to-harmonic-motion

ACTIVITY PLANNER:

M.O.P. VAISHNAV COLLEGE FOR WOMEN (AUTONOMOUS), CHENNAI-34

(Effective for the batch of candidates admitted in 2020-2021)

B.Sc. MATHEMATICS

List of activities for Employability / Skill Development / Entrepreneurship Skill Development

(Course faculty may conduct any, all or any other activities as well)

Buzz session: Open discussion on recall and analyze the principles of forces, applications of Lami's theorem and moments to solve real life physical problems.

Brain writing: Brain storming session on inducting innovative ideas pertaining to projectile motion of an object in real life situations and obtain the desired results.

Seminar: On describing the physical situation based on principles of different Kinematics motion and solve problems linking the applications of simple harmonic motion.

Exhibition: Students display their creative thinking by developing mathematical models using the underlying principles of Projectile motion.

Concept mapping: Map the concepts and application of parallel & perpendicular axis theorems in finding the moment of inertia for certain geometrical bodies.

COURSE OUTCOMES:

On completion of the course, students will be able to

CO No.	COURSE OUTCOME	PSOs ADDRESSED	COGNITIVE LEVEL
CO1	Determine the resultant of two/three forces acting at a point, moment of force and prove Varignon's theorem.	**1,2,4**	**E**
CO2	Estimate the mass centers of homogenous bodies using integration.	**1,2,4**	**E**
CO3	Explain the principles of kinematics and obtain various results pertaining to rectilinear motion with constant acceleration / varying force.	**1,2,4**	**E**
CO4	Explain the terminology of a projectile motion and use it to formulate and solve related problems in a global environment.	**1,2,3,4,5**	**E**
CO5	Determine the moment of inertia of simple symmetric rigid bodies.	**1,2**	**E**

- **PSO – Programme Specific Outcome; Co – Course Objective; CO – Course Outcome; R- Remember; U- Understand; Ap – Apply; An – Analyse; E- Evaluate; C – Create**

ALLIED IV - MATHEMATICS FOR LIFE INSURANCE

M.O.P. VAISHNAV COLLEGE FOR WOMEN (AUTONOMOUS), CHENNAI-34

(Effective for the batch of candidates admitted in 2020-2021)

B.Sc. MATHEMATICS

COURSE CODE: 14UMAT327	YEAR/SEMESTER: II / IV	MAXIMUM MARKS: 100
COURSE TYPE: THEORY	CREDITS: 5	TOTALTEACHING HOURS: 75

GENERAL OBJECTIVE:

To acquaint students with the principles of life Insurance, compute life assurance premiums, annuities and understand their applications in banking/insurance sectors globally.

COURSE OBJECTIVES (Co):

Co No.	Course Objective
Co1	To provide the knowledge on life functions and calculate premiums for different age groups using ultimate table.
Co2	To understand the basic concepts of various assurance benefits and calculate present values with / without interest.
Co3	To impart in depth knowledge of annuities, various types of annuities and solve problems related to them.
Co4	To study the difference between net premiums / level annual premiums and derive premium conversion tables.
Co5	To explain the concepts of bonus loading in premium rates for expenses.

UNIT I

Mortality Table:

Life functions, Stationary Population, Expectation of Life, Selection and Select rates, Ultimate Table, Aggregate Table. (15 hours)

UNIT II

Life Assurance Premiums:

General Considerations, Assurance Benefits, Pure Endowment Assurance, Endowment Assurance, Temporary Assurance or Term Assurance, Whole life Assurance, Endowment Assurance, Endowment Assurance, Double Endowment Assurance, Increasing Temporary Assurance, Increasing whole life Assurance, Commutation Functions, Expressions for Present values of Assurance Benefits in terms of Commutation Functions**.** (15 hours)

UNIT III

Life Annuities and Temporary Annuities:

Introduction – Commutation Function Nx, Present value of an Annuity due, Deferred Life Annuity, Temporary Immediate life Annuity, Expression for $a_{x:n|}$ and $\ddot{a}_{x:n|}$Deferred Temporary Life Annuity, Variable Life Annuity, Increasing Life Annuity, Commutation Function S_x. Increasing Temporary Life Annuity**.** (15 hours)

UNIT IV

Net Premiums for Assurance Plans:

Natural Premiums, Level Annual Premiums, Mathematical Expressions for level Annual Premiums for Temporary Assurance, Pure Endowment Assurance, Endowment Assurance, Whole life Assurance, Net Premiums, Premium Conversion Tables**.** (15 hours)

UNIT V

Office Premiums:

Loading in premium rates for expenses, Expressions for office premiums, Bonus loading in premium rates, Adequacy of premiums, Consistency of premiums.

(15 hours)

TEXT BOOK

- S.P.Dixit, C.S.Modi, R.V.Joshi, (2000), Mathematical Basis of Life Insurance, Insurance Institute of India.
  Unit I: Chapter V: 1-16.
  Unit II: Chapter VIII, Chapter IX: 1-15.
  Unit III: Chapter X: 1-13.
  Unit IV: Chapter XI: 1- 4 (a-d), 5, Chapter XIII.
  Unit V: Chapter XIV: 1-7.

REFERENCE BOOKS

- Atkinson,M.E. and Dickson,D.C.M (2000), An Introduction to Actuarial Studies, Elgar Publishing.
- Philip,M.et.al(1999), Modern Actuarial Theory and Practice, Chapman and Hall.

e-RESOURCES

Web Links

http://mech.math.msu.su/

https://link.springer.com/

www.slideshare.net/FloydSaunders/life-insurance-basics-13675104

You Tube Video Links

www.youtube.com/watch?v=ffgbre70Ga0
www.youtube.com/watch?v=Maw_CtrNW2I
www.youtube.com/watch?v=eFNeKCU-ecQ
www.youtube.com/watch?v=2VxKIlomnqE

M.O.P. VAISHNAV COLLEGE FOR WOMEN (AUTONOMOUS), CHENNAI-34

(Effective for the batch of candidates admitted in 2020-2021)

B.Sc. MATHEMATICS

ACTIVITY PLANNER:

List of activities for Employability / Skill Development / Entrepreneurship Skill Development

(Course faculty may conduct any, all or any other activities as well)

Assignment: Compute probabilities of survival and death at different age groups using Ultimate mortality table.

Role Play: Students play the role of an insurance advisor, explain the benefits and types of Assurances and emerge as an Insurance Agent.

Participative learning activity: Identify the appropriate assurance benefits and compute premiums Locally and Globally which develops Employability skills.

Team Work: Class interactive session to compute the premium for deferred annuities at different age groups, develops competency skills needed for employment.

Case Study Analysis: Students understand the purpose of bonus loading in premium rates and its effects on policy premium when an insurance company is dealing with high risky candidates

COURSE OUTCOMES:

On completion of the course, students will be able to

CO No.	COURSE OUTCOME	PSOs ADDRESSED	COGNITIVE LEVEL
CO1	Analyze the death rate and risk associated with the individuals who have recently purchased life insurance policy and estimate premiums for policy using Ultimate and Aggregate tables.	**1,2,4**	**An, E**
CO2	Recommend the appropriate Assurance plans for an event that is certain to happen and develop skills to compute premiums needed for employment in an insurance sector.	**1,2,4,5**	**E**
CO3	Choose the suitable type of life annuities and compute the premium.	**1,2**	**E**
CO4	Select the premium beneficial to the policy holder by illustrating the calculation of natural premium and level annual premiums for various assurance plans.	**1,2,4,5**	**E**
CO5	Estimate office annual premium with and without bonus loading in premium rates.	**1,2,4,5**	**E**

- **PSO – Programme Specific Outcome; Co – Course Objective; CO – Course Outcome; R- Remember; U- Understand; Ap – Apply; An – Analyse; E- Evaluate; C – Create**

M.O.P. VAISHNAV COLLEGE FOR WOMEN (AUTONOMOUS), CHENNAI-34

(Effective for the batch of candidates admitted in 2020-2021)

B.Sc. MATHEMATICS

ELECTIVE - II INTER DISCIPLINARY ELECTIVE- FUNCTIONAL MATHEMATICS

COURSE CODE: 11UELE302I	YEAR/SEMESTER :II/IV	MAXIMUM MARKS :100
COURSE TYPE: THEORY	CREDITS: 5	TOTAL TEACHING HOURS: 75

GENERAL OBJECTIVE: To enhance problem solving skills, analytical, logical, verbal reasoning skills to compete in competitive examinations.

COURSE OBJECTIVES (Co):

Co No.	Course Objective
Co1	To inculcate the skills of solving problems under Arithmetic Progression, Geometric progression and counting principles.
Co2	To formulate algebraic equation and solveproblems on ages, numbers, ratio & proportion, percentages.
Co3	To obtain the solution of problems based on profit & loss, simple interest & compound interest.
Co4	To understand the mathematical ideas in solving problems on Time & work, Time & Distance.
Co5	To analyse and interpret the given datarepresented in the form of tabulation, Bar Graphs, Pie charts and enhance reasoning skills.

UNIT I

Arithmetical Ability

Arithmetic and Geometric Progressions, Permutation & Combination.

(10 hours)

UNIT II

Arithmetical Ability (contd.)

Problems on Numbers, Problems on Ages, Percentage, Ratio & Proportion.

(10 hours)

UNIT III

Arithmetical Ability (contd.)

Profit & Loss, Simple Interest & Compound Interest.

(20 hours)

UNIT IV

Arithmetical Ability (contd.)

Time & work, Time & Distance.

(15 hours)

UNIT V

Data Interpretation- Tabulation, Bar Graphs, Pie Charts.

General Mental Ability

Verbal Reasoning- Series Completion, Analogy, Coding- Decoding.

(20 hours)

M.O.P. VAISHNAV COLLEGE FOR WOMEN (AUTONOMOUS), CHENNAI-34

(Effective for the batch of candidates admitted in 2020-2021)

B.Sc. MATHEMATICS

TEXT BOOKS:

- Unit I: P.R.Vittal(2012), Business Mathematics, Margham Publications, Chennai – 17.
- Unit II – V: R. S. Aggarwal (2012), Quantitative Aptitude, S,Chand& Company Ltd., New Delhi.
- Unit V: General Mental Ability- R. S. Aggarwal (2012), A Modern Approach to Verbal & Non-Verbal Reasoning, S.Chand& Company, New Delhi.

e-RESOURCES

Web Links

https://www.slideshare.net/
https://www.javatpoint.com/aptitude/quantitative

You Tube Video Links

https://www.youtube.com/watch?v=pq0eq9OOBuo
https://www.youtube.com/watch?v=0NAASclUm4k
https://www.youtube.com/watch?v=wwN3mJ-b4FY

ACTIVITY PLANNER:

List of activities for Employability / Skill Development / Entrepreneurship Skill Development

(Course faculty may conduct any, all or any other activities as well)

Brainstorming: On topics arithmetic progression, geometric progression, permutation and combination **Mock test:** Problems related with ages, numbers, percentages and ratio and proportion nurtures employability skill.
Quiz:On profit & loss, Simple interest, Compound interest.
Worksheets: On topics time and distance, time and work.
Aptitude test: Problems on verbal reasoning, series completion, analogy, coding, improves reasoning ability to excel in professional/competitive exams nationally/globally and develops employability skills.
D**ata interpretation:** Analyse and interpret data presented in tables, bar diagrams, pie charts.

COURSE OUTCOMES:

On completion of the course, students will be able to

CO No.	COURSE OUTCOME	PSOs ADDRESSED	COGNITIVE LEVEL
CO1	Apply the principles ofarithmetic progression, geometric progression, permutation and combination in circumstances pertaining to local environment and obtain the desired solutions.	**1,2,4**	**Ap**

CO2	Select the appropriate algebraic techniques to solve problems on percentages, ages/numbers, ratio & proportions.	**1,2,4**	**E**
CO3	Estimate profit/loss, simple interest/ compound interest in business world scenario.	**1,2,4,5**	**E**
CO4	Evaluate problems on time-work, time-distance & speed – distance and develop problem solving skills needed for employment.	**1,2,4,5**	**E**
CO5	Interpret data using analytical ability and enhance verbal reasoning skills needed to compete nationally/globally.	**1,2,4,5**	**E**

- **PSO – Programme Specific Outcome; Co – Course Objective; CO – Course Outcome; R- Remember; U- Understand; Ap – Apply; An – Analyse; E- Evaluate; C – Create**

M.O.P. VAISHNAV COLLEGE FOR WOMEN (AUTONOMOUS), CHENNAI-34

(Effective for the batch of candidates admitted in 2018-2019)

B.Sc. Mathematics

Choice Based Credit System
Course of Study for the batch of Candidates admitted in 2018 – 2019

M.O.P. VAISHNAV COLLEGE FOR WOMEN (AUTONOMOUS), CHENNAI-34

(Effective for the batch of candidates admitted in 2018-2019)

B.Sc. Mathematics

CORE VII - MODERN ALGEBRA

COURSE CODE: 16UMAT303	YEAR/SEMESTER: III/V	MAXIMUM MARKS: 100
COURSE TYPE: THEORY	CREDITS: 4	TOTAL TEACHING HOURS: 60

GENERAL OBJECTIVE:

To emphasize the concepts of algebraic structures and to develop mathematical continuity to learn advanced / related concepts for future learning.

COURSE OBJECTIVES (Co):

Co No.	Course Objective
Co1	To enable student's to understand the abstract concepts of groups, subgroups, cosets,normal subgroups, quotient groups and prove related results.
Co2	To definehomomorphisms,isomorphisms on groups and prove theorems related to homomorphism, Cayley's theorem.
Co3	To introduce the basic concepts ofrings, fields and to understand and extend the study of homomorphisms on rings, the role of ideals with respect to rings.
Co4	To recognize vector algebra as a vector space and to familiarize with the concepts of subspace, linear span, linearly independent/dependent vectors, basis.
Co5	To understand the concepts of inner product space, subspace, norm of a vector and to inculcate the skill of constructing an orthonormal set as a basis for a finite dimensional inner product space using Gram-Schmidt orthogonalization process

UNIT I

Groups

Definition of a group, Examples of groups, Some preliminary lemmas, Subgroups, Lagrange's theorem, A counting principle, Normal subgroups and quotient groups.

(12 hours)

UNIT II

Groups (Contd.)

Homomorphism, Theorems related to homomorphism, Cayley'stheorem.

(12 hours)

UNIT III

Rings

Definition and examples of rings, Some special classes of rings, Integral domain, Homomorphism, Ideals and quotient rings, More ideals and quotient rings.

(13 hours)

UNIT IV

Vector spaces

Definition and examples, subspace, Linear independence and Bases.

(12 hours)

UNIT V

Vector spaces (Contd.)

Inner product spaces- Definitions and examples, Theorems.

(11 hours)

M.O.P. VAISHNAV COLLEGE FOR WOMEN (AUTONOMOUS), CHENNAI-34
(Effective for the batch of candidates admitted in 2018-2019)
B.Sc. Mathematics

TEXT BOOK

- I.N.Herstein (2017), Topics in Algebra, (2nd Edition), Wiley Eastern, New Delhi.
  Unit I : Sections: 2.1, 2.2, 2.3, 2.4, 2.5, and 2.6.
  Unit II : Sections: 2.7 (Omitting Applications 1 & 2) and 2.9.
  Unit III : Sections: 3.1, 3.2, 3.3, 3.4, and 3.5.
  Unit IV : Sections 4.1, 4.2.
  Unit V : Section: 4.4.

REFERENCE BOOKS

- S.Arumugam (2007), Modern Algebra, Scitech Publications, Chennai.
- M.L.Santiago (2002), Modern Algebra, Tata McGraw Hill, New Delhi.
- S.G.Venkatachalapathy (2004), Modern Algebra, Margham Publishers, Chennai.

e-RESOURCES

Web Links

https://ocw.mit.edu/courses/mathematics/18-703-modern-algebra-spring-2013/
https://mathcs.clarku.edu/~djoyce/ma225/algebra.pdf

You Tube Video Links

https://www.youtube.com/watch?v=ec7d8MWdZ48
https://www.youtube.com/watch?v=F0wA0xLZSQ8
https://www.youtube.com/watch?v=ozwodzD5bJM

ACTIVITY PLANNER:

List of activities for Employability / Skill Development / Entrepreneurship Skill Development

(Course faculty may conduct any, all or any other activities as well)

Participatory Learning Activity: On abstract concepts of groups, subgroups, cosets and related problems.

Multiple Choice Questions: On normal subgroups, group homomorphism, finding kernel of homomorphism, isomorphism related problems.

Quiz: On rings, division rings, zero divisors, integral domain, ideals, ring homomorphisms and problems.

Class Seminar: On vector space over a field F, subspace, internal/external direct product of vector spaces, linearly independent/ dependent vectors, basis and extend it to prove results based on advanced concepts needed for future learning.

Assignment: On inner product spaces, norm of a vector, orthonormal vectors and construction of orthonormal vectors from a given basis.

COURSE OUTCOMES:

On completion of the course, students will be able to

CO No.	COURSE OUTCOME	PSOs ADDRESSED	COGNITIVE LEVEL
CO1	Analyse the fundamental concepts of groups, prove related theorems and recognize its relevance in modern mathematics and global contexts.	1,2	An, E
CO2	Explain homomorphism, isomorphism between groups and prove Cayley's theorem.	1,2	E
CO3	Prove the theorems on ring theory and solve related problems.	1,2,5	E
CO4	Test for linear independency/dependency in finite dimensional vector spaces,prove related theorems and develop higher thinking skills for future learning.	1,2,4,5	An, E
CO5	Construct an orthonormal set as a basis for a finite dimensional vector space.	1,2,5	C

- **PSO – Programme Specific Outcome; Co – Course Objective; CO – Course Outcome; R- Remember; U- Understand; Ap – Apply; An – Analyse; E- Evaluate; C – Create**

M.O.P. VAISHNAV COLLEGE FOR WOMEN (AUTONOMOUS), CHENNAI-34
(Effective for the batch of candidates admitted in 2018-2019)
B.Sc. Mathematics

CORE VIII - REAL ANALYSIS

COURSE CODE: 16UMAT304	YEAR/SEMESTER: III / V	MAXIMUM MARKS: 100
COURSE TYPE:THEORY	CREDITS: 4	TOTALTEACHING HOURS: 60

GENERAL OBJECTIVE:
To provide a profound knowledge of real valued functions, sequences, series, metric spaces, Riemann integral and extend it to advanced concepts of higher learning.

COURSE OBJECTIVES (Co):

Co No.	Course Objective
Co1	To introduce the concepts of real valued functions, sequence, subsequence, limit of a sequence, convergent / divergent, bounded and Cauchy sequence.
Co2	To impart the knowledge of absolute and conditional convergence and examine the nature of sequence using the tests for convergences.
Co3	To explain the real number system, limits, continuity of real-valued functions and compute limit of a function at a point.
Co4	To understand the concepts of completeness, compactness, open set and closed set, limits, metric space and continuous function on a real line.
Co5	To define Riemann integral, enumerate their properties and prove Fundamental theorem of Calculus.

UNIT I
Sets and Functions
Real - valued functions, Equivalence, Countability. Real numbers, Least upper bounds.
Sequences of real numbers
Definition of sequence and subsequence, Limit of a sequence, Convergent sequences, Divergent sequences, Bounded sequences, Cauchy sequences.

(12 hours)

UNIT II
Series of real numbers
Convergence and divergence, Series with non- negative terms, Alternating series, Conditional convergence and absolute convergence,Tests for absolute convergence.

(12 hours)

UNIT III
Limits and Continuity on the Real line
Limit of a function on the real line, Functions continuous at a point on the real line, Reformulation.

(8 hours)

UNIT IV
Metric spaces
Metric spaces, Limits in metric spaces. Functions continuous on a metric space,
Open sets, Closed sets, Connected Sets, Complete Metric spaces, Compact Metric spaces - Definitions and Examples only.

(16 hours)

M.O.P. VAISHNAV COLLEGE FOR WOMEN (AUTONOMOUS), CHENNAI-34
(Effective for the batch of candidates admitted in 2018-2019)
B.Sc. Mathematics

UNIT V
Calculus
Definition of the Riemann Integral, Existence of the Riemann Integral (Statement only),Properties of the Riemann Integral, Derivatives, Fundamental theorems of calculus.
(12 hours)

TEXT BOOK

- RichardR. Goldberg(2017), Methods of Real Analysis, Oxford & IBH Publishing Co., New Delhi.
  UNIT I: Chapter 1: Sections 1.4 -1.7.
  Chapter 2 : Sections 2.1 - 2.5, 2.10.
  UNIT II: Chapter 3: Sections 3.1-3.4, 3.6.
  UNIT III:Chapter 4: Sections 4.1&Chapter 5: 5.1, 5.2.
  UNIT IV:Chapter4: Sections 4.2, 4.3, Chapter 5:5.3-5.5 &Chapter 6: 6.2, 6.4, 6.5.
  UNIT V: Chapter 7: Sections 7.2 - 7.5, 7.8.

REFERENCE BOOKS

- Tom M.Apostol (1974), Mathematical Analysis, 2nd Edition, Addison,Wesley Publishing Company Inc. New York.
- Rudin(1976), Principles of Mathematical Analysis, 3rd Edition, McGraw Hill Company, New York.

e-RESOURCES

Web Links

https://ocw.mit.edu/courses/mathematics/18-100c-real-analysis-fall-2012/
https://digitalcommons.trinity.edu/mono/

You Tube Video Links

www.youtube.com/watch?v=gJ1pYz1k0qM
www.youtube.com/watch?v=zUEreuTZEOM
www.youtube.com/watch?v=c_1Dl2UKAjM
www.youtube.com/watch?v=AZ1CtTfsPmI

ACTIVITY PLANNER:

List of activities for Employability / Skill Development / Entrepreneurship Skill Development

(Course faculty may conduct any, all or any other activities as well)

Concept mapping: Map the concepts of limit of a sequence to identify whether the sequence converges or diverges.
Class interaction: On determining the absolute convergence and conditional convergence of a series using appropriate tests.

Internet surfing: Students are instructed to browse the applications of limits and continuity in real world scenario.
Class Presentation: Presentation on metric spaces, compactness and connectedness.
Team work: Group discussion on properties of Riemann integral and its application in Calculus.

COURSE OUTCOMES:

On completion of the course, students will be able to

CO No.	COURSE OUTCOME	PSOs ADDRESSED	COGNITIVE LEVEL
CO1	Analyse the concepts of bounded, convergent, divergent, Cauchy sequences and prove related theorems.	**1,2**	**An, E**
CO2	Examine the absolute/conditional convergence of series using appropriate tests and prove theorems.	**1,2**	**An, E**
CO3	Investigate the limit of a function on a real line using the concepts of limits.	**1,2**	**An**
CO4	Prove theorems based on the concepts of metric spaces, complete and compact metric spaces and extend it to higher learning/research.	**1,2,5**	**E**
CO5	Prove fundamental theorem of calculus and results pertaining to derivatives using the concepts of Riemann integral.	**1,2,5**	**E**

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M.O.P. VAISHNAV COLLEGE FOR WOMEN (AUTONOMOUS), CHENNAI-34

(Effective for the batch of candidates admitted in 2018-2019)

B.Sc. Mathematics

CORE IX - NUMBER THEORY & CRYPTOGRAPHY

COURSE CODE: 18UMAT310	YEAR/SEMESTER: III / V	MAXIMUM MARKS: 100
COURSE TYPE: THEORY	CREDITS: 4	TOTALTEACHING HOURS: 60

GENERAL OBJECTIVE:

To familiarize with essential features of number theory and apply cryptography techniques in cyber security.

COURSE OBJECTIVES (Co):

Co No.	Course Objective
Co1	To introduce various concepts of number theory and inculcate problem solving skills on finding sum and product of the divisors of a given number, reminders using the properties of congruences and Euler's function.
Co2	To prove and understand the significance of Fermat's and Wilson's theoremin computing powersof large integers modulo primes.
Co3	To list and identify the security issues in the network, key distribution and management schemes.
Co4	To demonstrate standard cryptographic algorithms and solve systems of linear congruence using Chinese reminder theorem.
Co5	To employ RSA cryptosystem for bulk encryption and decryption in transit networks.

UNIT I

Number Theory

Decomposition of a composite number as a product of primes uniquely (without proof), Euler function φ (N) (without proof), Highest Power of prime number p contained in n! (Without proof), The product of r consecutive integers is divisible by r!,Congruence modulo n.

(12 hours)

UNIT II

Number Theory (contd)

Fermat's and Wilson's theorems, Simple problems.

(10 hours)

UNIT III

Cryptography

Introduction,Security goals,Cryptographic attacks - Cryptanalytic attacks, non- cryptanalytic attacks, Services and mechanism – Security Services, Security Mechanisms, Relation between services and mechanisms.

Traditional Symmetric - Key Ciphers

Introduction - Kerckhoff's principle, Cryptanalysis, Substitution ciphers – Monoalphabetic ciphers, Additive Cipher, Shift cipher, Caesar cipher, Multiplicative cipher, Affine ciphers, Monoalphabetic substitution cipher.

(14 hours)

UNIT IV

Cryptography (Cont.)

Divisibility - Greatest common divisor, Euclidean algorithm, Extended Euclidean algorithm, Inverses - Additive inverse, Multiplicative inverse, Chinese Remainder theorem (Statement only).

(12 hours)

UNIT V

Asymmetric- Key Cryptography

Introduction - Keys, plain texts/cipher text, encryption/decryption, Trapdoor one-way function, RSA Cryptosystem – Introduction, Procedure, Some Trivial Examples, Attacks on RSA- Factorization attack, Chosen- cipher text attack.

(12 hours)

TEXT BOOKS

- T.K.ManicavachagomPillay, T.Natarajan and K.S. Ganapathy (2011), Algebra (Volume II), S.Viswanathan (Printers and Publishers) Pvt. Ltd., Chennai.
  Unit I & Unit II: Chapter 5.
- BehrouzA.Forouzan, DebdeepMukhopadhyay (2010), Cryptography and Network Security, second edition, Tata McGraw Hill, New Delhi.
  Unit III: Chapter I- Sections 1.1, 1.2 - 1.2.1, 1.2.2, 1.3- 1.3.1, 1.3.2, 1.3.3, and Chapter III- Sections 3.1- 3.1.1, 3.1.2, 3.2- 3.2.1,
  Unit IV: Chapter II -Sections 2.1.2, 2.2.5 and Chapter IX- Section 9.4.
  Unit V : Chapter X -Sections 10.1- 10.1.1, 10.1.2, 10.1.4, 10.2- 10.2.1, 10.2.2, 10.2.3, 10.2.4.

e-RESOURCES

Web Links

https://ocw.mit.edu › courses ›
https://freevideolectures.com/course/3027/cryptography-and-network-security/3
http://pi.math.cornell.edu/~mec/2008-2009/Anema/numbertheory/intro.html

You Tube Video Links

https://youtu.be/XSCNLPyoKrk
https://youtu.be/SCvtxjpVQms

ACTIVITY PLANNER:

List of activities for Employability / Skill Development / Entrepreneurship Skill Development

(Course faculty may conduct any, all or any other activities as well)

Assignment: Solving challenging problems on large positive integer to compute least residue, reduce factorials and powers (modulo p), Primality test.

Problem set: Solving challenging problems on large positive integer to compute least residue, reduce factorials and powers (modulo p), Primality test - Develops lateral thinking and problem solving skills.

Real time reactions: Group interaction on public and private key cryptography, its attacks which helps students to spot trends and consider new points of view- Develops collaborative learning and reach across diverse disciplines to apply theories

.

Seminar: On applications of Euclidean algorithm and Chinese reminder theorem to solve linear congruence equations and their significance in cryptography.

Project (Collaborative learning): Concepts of symmetric-key /asymmetric-key cryptosystem are linked with RSA techniques and employed to ensure authenticity of information in a global environment

COURSE OUTCOMES:

On completion of the course, students will be able to

CO No.	COURSE OUTCOME	PSOs ADDRESSED	COGNITIVE LEVEL
CO1	Determine the sum/ number of divisors of an integer, Highest Power of prime number p contained in n! and solve problems using properties of congruence modulo n.	1,2,4	E
CO2	Prove Fermat's and Wilson's theorems and solve related problems.	1,2,4	E
CO3	Implement security mechanisms and cipher techniques to encrypt and decrypt a message and develop skills to compete globally	1,2,4,5	Ap
CO4	Determine the solution of simultaneous congruence equations using Chinese remainder theorem.	1,2	E
CO5	Explain the RSA cryptosystem and apply it in digital data security**.**	1,2,4,5	E

- **PSO – Programme Specific Outcome; Co – Course Objective; CO – Course Outcome; R- Remember; U- Understand; Ap – Apply; An – Analyse; E- Evaluate; C – Create**

M.O.P. VAISHNAV COLLEGE FOR WOMEN (AUTONOMOUS), CHENNAI-34

(Effective for the batch of candidates admitted in 2018-2019)

B.Sc. Mathematics

CORE X - DISCRETE MATHEMATICS

COURSE CODE: 15UMAT306	YEAR/SEMESTER: III/V	MAXIMUM MARKS: 100
COURSE TYPE: THEORY	CREDITS: 4	TOTAL TEACHING HOURS: 60

GENERAL OBJECTIVE:

To equip students with the notion of recurrence relations, posets,lattices, Boolean algebra and apply mathematical logic for analyzing propositions and proving theorems.

COURSE OBJECTIVES (Co):

Co No.	Course Objective
Co1	To introduce recurrence relations, generating functions, properties and the procedure of solving recurrence relations using generating functions.
Co2	To use the concepts of mathematical logic for analyzing propositions via truth tables and proving theorems.
Co3	To introducePosetsand Lattices through algebraic operations, their properties and analyze the different types of lattices.
Co4	To impart the knowledge of Boolean algebra, properties and apply them for simplifying Boolean expressions.
Co5	Toprovide an insight into group code, Hamming distance, errors in coding and explain the procedure for decoding group codes.

UNIT I

Recurrence Relations and Generating functions

Polynomial expression, Sequences or Discrete Functions, Recurrence Relations, Generating functions, Properties of generating functions, Solution of a Recurrence Relation using Generating Function.

(12 hours)

UNIT II

Mathematical Logic

Introduction, Logical statement or proposition, Truth tables, Logical equivalence, Involved logical operators, Laws of statement Algebra.

(12 hours)

UNIT III

Posets

Antisymmetric relations, Partial ordering (Partial order relation), Poset, Hasse Diagram, Greatest and least element in a Poset.

Lattices

Introduction, Upper bounds and lower bounds, Lattices, Properties of a Lattice, Greatest and least elements in a Lattice, Complement of an element, Complemented Lattice, Distributive Lattice, Modular lattice.

(12 hours)

UNIT IV

Boolean algebra

Boolean algebra, Definition of Boolean algebra, Boolean algebra through Lattices, Properties of a Boolean algebra, Boolean function and its Boolean expressions.

(12 hours)

UNIT V

Coding Theory

Introduction, Encoders and Decoders, Group Code, Hamming Codes, Basic notions of error correction using Matrices, Error correction in Group Codes, Step by step procedure for decoding Group Codes.

(12 hours)

TEXT BOOKS:

- V. Sundaresan , K.S. Ganapathy Subramanian , K. Ganesan (1998) Discrete Mathematics, A.R.Publishers,Tamil Nadu
  Unit I: Chapter 3: Sections 3.1 to 3.6.
- P. Duraipandian (2008), Discrete Mathematics For Computer Science Courses, Muhil publishers, Chennai 28.
  Unit II : Chapter 11: Sections 11.1 to 11.5.
  Unit III: Chapter 8: Sections 8.1 to 8.5
  Chapter 9: Sections 9.1 to 9.7.
  Unit IV: Chapter 10: Sections 10.1 to 10.5.
- T. Veerarajan (2007) Discrete Mathematics with Graph Theory and Combinatorics, The McGraw,Hill Education Private Ltd. New Delhi.
  Unit V : Chapter 5: Page no 290 to 307.

REFERENCE BOOKS:

- R.Johnsonbaugh,(2001) Discrete mathematics ,Pearson Education Asia.
- C.L.Liu, (1985) Elements of Discrete mathematics, McGraw Hill, New York.
- J. Truss (2000) Discrete Mathematics for Computer Scientists (2nd Edition) Pearson Education Asia.

e-RESOURCES

Web Links

https://www.ams.org/open-math-notes/omn-advanced-search
https://www.slideshare.net/

You Tube Video Links

https://www.youtube.com/watch?v=eihhu72YdpQ
https://www.youtube.com/watch?v=gj8QmRQtVao
https://www.youtube.com/watch?v=X8jsijhllIA

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ACTIVITY PLANNER:

List of activities for Employability / Skill Development / Entrepreneurship Skill Development

(Course faculty may conduct any, all or any other activities as well)

Assignment: Formulate recurrence relations and obtain the solution using generating functions.
Presentation: Applications of recurrence relations in recursive backtracking and in complexity analysis of binary search
Concept inventories: Multiple choice questions on Logical operators, Logical equivalences, Involved logical operators.
Identify and explore: Identify the given set as poset/ lattice, modular/complemented/distributive lattice and explore its properties. **Video screening session and discussion:**On importance and application of Boolean algebra in analyzing and simplifying digital logic circuits in local and global environments
Peer teaching -Algorithmic approach of identifying errors in group codes and rectifying them.
Presentation: On applying the concepts linear algebra in coding theory and step by step procedure for decoding group codes.
Workshop was conducted on topic "combinatorics" which focused on exploring the research aspect of Mathematics, using experimentation to arrive at solutions to problems in Combinatorial Geometry.

COURSE OUTCOMES:

On completion of the course, students will be able to

CO No.	COURSE OUTCOME	PSOs ADDRESSED	COGNITIVE LEVEL
CO1	Determine the solution of recurrence relations by employing generating function techniques.	**1,2,4**	**E**
CO2	Prove logical implications using truth tables	**1,2,4**	**E**
CO3	Analyse posets, lattices, complemented, distributive lattice and prove related results.	**1,2,4**	**An, E**
CO4	Simplify Boolean functions using the properties of Boolean algebra and incorporate Boolean logic in switching theory globally.	**1,2,4,5**	**An**
CO5	Explain group code, Hamming code and develop skills to select appropriate error control codes in suitable situations needed for employment in the field of information technology.	**1,2,4,5**	**E**

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M.O.P. VAISHNAV COLLEGE FOR WOMEN (AUTONOMOUS), CHENNAI-34

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ELECTIVE III – FUZZY MATHEMATICS

COURSE CODE: 15UMAT305	YEAR/SEMESTER: III/V	MAXIMUM MARKS: 100
COURSE TYPE: THEORY	CREDITS: 5	TOTAL TEACHING HOURS: 75

GENERAL OBJECTIVE:

To understand the fundamental concepts in fuzzy set theory, logic and relate the applications of fuzzy logics in real time probabilistic situations in a global environment.

COURSE OBJECTIVES (Co):

Co No.	Course Objective
Co1	To introduce the basic concepts of fuzzy sets, fuzzy operations and the numbers associated with fuzzy sets.
Co2	To enable student's to understand certain crisp sets associated with fuzzy sets, the cardinal numbers associated to fuzzy sets and apply them in fuzzification.
Co3	To provide an insight into extension principle of fuzzy sets, various level setsand some standard operations on fuzzy sets. .
Co4	To impart the knowledge of max-min composition of fuzzy relations and to describe the geometrical interpretation of fuzzy sets.
Co5	To explain the applications of fuzzy logics in fuzzy modelling in medicine, management/decision making.

UNIT I

Fuzzy Set Theory

Introduction, Concept of a fuzzy Set, Relation between fuzzy Sets, Operations on fuzzy sets, Properties of the standard operations, Certain numbers associated with a fuzzy Set - Height of a fuzzy set, Normal fuzzy set, Normalization of a fuzzy set.

(15 hours)

UNIT II

Fuzzy Set Theory(contd)

Certain Crisp Sets associated with a fuzzy set - Core of a fuzzy set, Support of a fuzzy set, Level set associated with a fuzzy set, α −cuts of fuzzy set, Restricted Scalar Multiplication, α −cut Decomposition Theorem, Synthesis of a fuzzy set, Certain fuzzy sets associated with a given fuzzy set - Associating a fuzzy set through RSM, Fuzzy cardinality of a fuzzy set, Fuzzification of a fuzzy set, The Power of a fuzzy set, Contrast intensification of a fuzzy set.

(15 hours)

UNIT III

Fuzzy Set Theory(contd)

Extension Principle, Fuzzy sets of Type - K and Level – K.

Non – Standard Operations on Fuzzy Sets:

T-Norms, T- Conorms, Complementation Operator, De – Morgan Pairs.

(15 hours)

UNIT IV

Fuzzy Relations

Introduction, fuzzy relations, Operations on fuzzy relations, α −cuts of fuzzy relation, Composition of fuzzy relations – Max-min Composition of two fuzzy relations, Projections of fuzzy relations, Cylindric Extensions, Cylindric Closure, Fuzzy Relation on a Domain.

(15 hours)

UNIT V

Fuzzy Logic and Applications

Introduction, Three-valued logics, Fuzzy logics, Fuzzy propositions and their interpretations in terms of fuzzy sets, Applications to Fuzzy logic in Medicine &Management and Decision making.

(15 hours)

TEXT BOOKS

- Ganesh M. (2006), Introduction to Fuzzy Sets and Fuzzy Logic, Prentice-Hall of IndiaPvt Ltd., New Delhi.
  Unit I: Chapter 6: 6.1 – 6.6.
  Unit II: Chapter 6: 6.7, 6.8
  Unit III: Chapter 6: 6.9, Annexure 6.3, 6.4.
  Unit IV: Chapter 7: 7.1 –7.9.
  Unit V: Chapter 8: 8.1, 8.2, 8.5, 8.6.
- George J. Klir, Tina A.Folger (2001), Fuzzy sets, Uncertainty and Information, Prentice-Hall of IndiaPvt Ltd., New Delhi.
  Unit V: Applications: 6 - 6.4 & 6.5 (Page nos: 246 – 260).

e-RESOURCES

Web Links

https://booksite.elsevier.com/9780750676052/content/Resources/Chapter2.html
https://csu-sb.primo.exlibrisgroup.com/

You Tube Video Links

https://www.youtube.com/watch?v=a2i-lHS-c_I

https://www.youtube.com/watch?v=5UX1w16VQCg

https://www.youtube.com/watch?v=H1C8tilyIdw

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(Course faculty may conduct any, all or any other activities as well)

MCQs: Fundamental concepts of fuzzy sets, fuzzy operations, support/core of fuzzy sets, scalar cardinality and problems.

Brain Storming: On height of a fuzzy set, normal fuzzy set and α-cut decomposition theorem and problems.

Work Sheets: On Cartesian product of fuzzy sets using max-min principle, various level fuzzy sets and non- standard operations on fuzzy sets.

Assignment: On fuzzy relations, operations on fuzzy relation, cylindric extension and cylindric closure of fuzzy sets.

Audio visual presentation: Application of fuzzy sets, fuzzy relation and fuzzy logic in home appliances/Management decision making /medicine in global environment.

COURSE OUTCOMES:
On completion of the course, students will be able to

CO No.	COURSE OUTCOME	PSOs ADDRESSED	COGNITIVE LEVEL
CO1	Apply the concepts of fuzzy sets, their properties, operations on fuzzy sets and extend it to the normalization of fuzzy sets	**1,2**	**Ap**
CO2	Prove α −cut decomposition theorem and perform fuzzification of a fuzzy set using related concepts.	**1,2**	**E**
CO3	Analyze various levels and types of fuzzy sets and apply them for pursuing higher studies and research.	**1,2,4**	**An**
CO4	Determine the image of the cartesian product of two fuzzy sets using max-min composition of two fuzzy sets.	**1,2,4**	**E**
CO5	Recommend the application of fuzzy sets, fuzzy logic in the fields of medicine and management decision making globally.	**1,2,4,5**	**E**

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CORE XI - INTEGRAL TRANSFORMS & APPLICATIONS

COURSE CODE: 16UMAT307	YEAR/SEMESTER : III/VI	MAXIMUM MARKS: 100
COURSE TYPE: THEORY	CREDITS: 4	TOTAL TEACHING HOURS: 60

GENERAL OBJECTIVE:
To provide an in-depth knowledge of Laplace and Fourier transforms and apply them to solve ordinary/partial differential equations with boundary conditions in real life situations.

COURSE OBJECTIVES (Co):

Co No.	Course Objective
Co1	To introduce Laplace transform, their properties,Laplace transform of basic functions and to evaluate integrals using Laplace transform.
Co2	To compute inverse Laplace transforms,to solve first and second order differential equations with constant coefficients.
Co3	To understand Fourier integral theorem and obtain the Fourier transforms and its inverse.
Co4	To obtain the Fourier sine and cosine transformsand their inverses.
Co5	To derive the solution for one dimensional wave,heat equation and to solve related problems.

UNIT I
Laplace transforms
Definition, Transforms of elementary functions, Properties of Laplace transforms, Transforms of derivatives, Transforms of integrals, Multiplication of t^n, Division by t, Evaluation of integrals by Laplace transforms.

(12 hours)

UNIT II
The Inverse Laplace transforms
Definition, Method of partial fraction, Other methods of finding inverse transforms, Solving linear differential equation with constants coefficients of first and second order.

(12 hours)

UNIT III
Fourier Transforms
Complex form of Fourier Integral Formula, Fourier Integral Theorem (without proof), Properties of Fourier Transforms, Simple problems.

(12 hours)

UNIT IV
Fourier Transforms (Contd.)
Fourier cosine transforms, Fourier sine transforms, Properties of Fourier sine and cosine transforms, Parseval's identity, Convolution theorem (no derivations).

(12 hours)

UNIT V

Applications

Solution of one dimensional wave equation - Derivation and solution by method of separation of variables. Problems on vibrating string with zero initial velocity. One dimensional equation of heat conduction - Derivation and solution by method of separation of variables. Problems with zero boundary values.

(12 hours)

TEXT BOOKS

- S.Narayanan, T.K.ManickavachagomPillay (2004), Calculus (volume III) (Differential equations and Fourier series), Vijay Nichole Imprints Pvt. Ltd, Chennai.
  Unit I: Chapter 5: 1, 2, 4, 5.
  Unit II: Chapter 5: 6, 7, 8, 9.
  Unit III: Chapter 6: 9, 10.
  Unit IV: Chapter 6: 11, 12, 13, 14, 15.
- Dr. G. Balaji, Transforms and Partial Differential Equations, 12th edition.
  Unit V: 3.9-3.46, 3.70-3.85.

REFERENCE BOOKS

- P.R.Vittal, V.Malini (2004), Vector Calculus, Fourier series and Laplace transforms, First edition, Margham publications, Chennai.
- A.Singaravelu (2000), Engineering Mathematics IV, Meenakshi Agency Chennai.

e-RESOURCES

Web Links

https://tutorial.math.lamar.edu/classes/de/LaplaceIntro.aspx

https://www.wolframalpha.com/examples/mathematics/calculus-and-analysis/integral-transforms/

You Tube Video Links

https://www.youtube.com/watch?v=bHofQZHUFMo

https://www.youtube.com/watch?v=rCw-FVegWJA

https://www.youtube.com/watch?v=wPMfMuSc9RQ

ACTIVITY PLANNER:

List of activities for Employability / Skill Development / Entrepreneurship Skill Development

(Course faculty may conduct any, all or any other activities as well)

Concept inventories: Multiple Choice Questions on fundamental concepts of Laplace transforms and evaluation of definite integral using Laplace transforms.

Concept mapping: Identify and apply appropriate properties of Laplace transform to find inverse Laplace transform of a given function.

Seminar: On derivation of the partial differential equation governing one dimensional wave equation, finding its D'Alembert's solution and solving problems on strings.**Participatory Learning:** Students discuss and solve problems on inverse Laplace transforms utilizing the appropriate techniques.**Audio Visual Presentation:** On real time applications of Fourier transform for analysing signals in engineering and physical sciences environment.

Peer teaching: Evaluating certain integrals using Fourier sine/ cosine transforms and Parseval's identity.

Seminar: On derivation of the partial differential equation governing one dimensional heat equation, finding its solution by variable separable method and solving related problems globally.

COURSE OUTCOMES:

On completion of the course, students will be able to

CO No.	COURSE OUTCOME	PSOs ADDRESSED	COGNITIVE LEVEL
CO1	Explain the properties of Laplace transforms, obtain the Laplace transform of elementary functions and evaluate integrals.	**1,2**	**E**
CO2	Determine the solution of first and second order linear differential equations using Laplace transform techniques.	**1,2,4**	**E**
CO3	Prove the properties of Fourier transforms and solve integral equations.	**1,2,4**	**E**
CO4	Evaluate Fourier sine/cosine transforms for a given function and find its inverse fora function of one variable.	**1,2,4**	**E**
CO5	Determine the solution of one dimensional wave/heat equation and recognize its significance in national/global environment.	**1,2,3,5**	**E**

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B.Sc. Mathematics

CORE XII - COMPLEX ANALYSIS

COURSE CODE: 16UMAT305	YEAR/SEMESTER: III/VI	MAXIMUM MARKS: 100
COURSE TYPE: THEORY	CREDITS: 4	TOTAL TEACHING HOURS: 60

GENERAL OBJECTIVE:

To render a modern treatment of concepts and techniques of complex function theory and to solve problems in pure as well as in applied mathematics.

COURSE OBJECTIVES (Co):

Co No.	Course Objective
Co1	To impart the knowledge of continuity, differentiability, analytic function, harmonic function of complex valued function and inculcate problem solving skill on construction of analytic functions using Cauchy-Riemann equations.
Co2	To enable the students to acquire the concepts of conformal / isogonal, bilinear transformation and cross ratio of complex numbers on extended complex plane.
Co3	To inculcate problem solving skill on complex integration and to determine the value of an analytic function and its higher derivatives of f(z) at a point inside a simple closed curve using Cauchy's integral formula.
Co4	To understand and interpret the concepts of zero's / singularities and various types of an analytic functions and use it to obtain the expansions of Taylor's and Laurent's series.
Co5	To introduce residues, inculcate problem solving skill to determine residues of f(z) at its poles and to compute definite integrals of Type I and Type II using Cauchy's residue theorem.

UNIT I

Analytic functions

Functions of a complex variable, Limits, Continuous Functions, Differentiability, The Cauchy-Riemann Equations, Analytic Functions, Harmonic Functions.

(12 hours)

UNIT II

Bilinear transformations

Conformal Mapping- Definitions, Elementary Transformations, Bilinear transformations, Cross ratio, Mapping by Elementary functions – $w = z^2$, $w = e^z$, $w = \sin z$.

(12 hours)

UNIT III

Complex Integration

Cauchy theorem, Cauchy Goursat's theorem (Statement only), Cauchy's integral formula, Maximum Modulus theorem (Statement only) Higher derivatives, Cauchy's inequality, Liouville's theorem, Fundamental theorem of algebra, Morera's theorem.

(12 hours)

UNIT IV

Series Expansions

Taylor's series and Laurent's series (Statement only), zeros of an analytic function, Singularities (Problems only).

(12 hours)

UNIT V

Calculus of Residues

Residues, Computation of residues, Cauchy's residue theorem, Evaluation of Definite Integrals – Type 1 and Type 2 (no pole of f(z) lies on the real axis) Simple problems.

(12 hours)

TEXT BOOK

- Dr. S. Arumugam, A.Thangapandi Isaac, A. Somasundaram (2014), Complex Analysis, Scitech Publications (India) Private Ltd, Chennai.
  Unit I: Chapter 2: 2.1 – 2.2, 2.4 – 2.8.
  Unit II: Chapter 2: 2.9, Chapter 3: 3.1-3.3, Chapter 5: 5.1, 5.3-5.5.
  Unit III: Chapter 6: 6.1-6.4.
  Unit IV: Chapter 7: 7.1 – 7.4.
  Unit V: Chapter 8: 8.1- 8.3.

REFERENCE BOOKS

- R.V. Churchill and J.W. Brown (1990), Complex Variables and applications, McGraw Hill International Book Co. Chennai.
- Dr.B.S.Grewal (2007), Higher Engineering Mathematics, Khanna Publishers, New Delhi.
- P. Duraipandian (2009), Complex analysis, Emerald Publishers, Chennai.
- S. Ponnusamy (2000), Foundation of Complex analysis, Narosa Publishing House, New Delhi.

e-RESOURCES

Web Links

https://mathworld.wolfram.com/ComplexAnalysis.html
https://www.wolframalpha.com/examples/mathematics/complex-analysis/

You Tube Video Links

https://www.youtube.com/watch?v=zfKkJPjT14s

https://www.youtube.com/watch?v=qTDDFMAt7j4

https://www.youtube.com/watch?v=5enkh_z5mwE

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ACTIVITY PLANNER:

List of activities for Employability / Skill Development / Entrepreneurship Skill Development

(Course faculty may conduct any, all or any other activities as well)

MCQ test: On analyticity of f(z), Cauchy- Riemann equations, harmonic functions construction of analytic functions which improves the skill needed for preparation of SET/CSIR exams.

Audio Visual Presentation: On applications of conformal/isogonal mapping, Students are able to choose an appropriate mapping to transform image from one plane into another.

Participatory Learning: Group activity on evaluating complex integration using Cauchy's integral formula and Cauchy's formula for nth derivative, inculcates problems solving skill**.**

Worksheets: Problems on identifying various types of singularities, expanding f(z) as Taylor's and Laurent's series.

Case Study Analysis: On Cauchy's Residue theorem, Contour integration, instils research skill in students and extend the concepts for higher learning.

COURSE OUTCOMES:

On completion of the course, students will be able to

CO No.	COURSE OUTCOME	PSOs ADDRESSED	COGNITIVE LEVEL
CO1	Prove Cauchy- Riemann equations and construct analytic functions.	1,2	E
CO2	Determine the image of any closed region from z-plane to w-plane under the given transformation.	1,2,4	E
CO3	Prove Cauchy's integral formulae and solve problems in complex integration.	1,2,4,5	E
CO4	Determine Taylor series or Laurent series of an analytic function in a given region.	1,2,4	E
CO5	Evaluate complex contour integration using Cauchy's Residue Theorem and extend it to learn advanced concepts for higher studies.	1,2,4,5	E

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CORE XIII - OPTIMISATION TECHNIQUES

COURSE CODE: 16UMAT308	YEAR/SEMESTER:III/VI	MAXIMUM MARKS: 100
COURSE TYPE: THEORY	CREDITS: 4	TOTAL TEACHING HOURS: 60

GENERAL OBJECTIVE:

To provide an insight into the basic principles of Operations Research, various models and apply the different optimization techniques in global business/decision making environments.

COURSE OBJECTIVES (Co):

Co No.	Course Objective
Co1	To understand the concepts of LPP, formulate any situation into LPP and obtain the solution through graphical, simplex / Big M method.
Co2	To recognize transportation problem as a LPP, find basic feasible solution of the transportation problem byvarious methods and determine the optimal solution byMODI method.
Co3	To know the mathematical formulation of an assignment problem as a special case of LPP and solve an assignment problem usingHungarian method.
Co4	To understand the basic terminology of a sequencing problem and useJohnson's rule for solving n jobs through 2,3 and m machines.
Co5	To understand the characteristics of game theory,classify pure/mixed strategies and solve games usingmaximin, minimax principle, dominance property, graphical method and matrix oddment method.
Co6	To enable the students tounderstand the concepts of network theory, apply CPMto estimate the critical path,project duration, floats and PERT procedure to determine expected project duration in probabilistic situations.
Co7	To describe the essential features of a queue,analyze and derive(M/M/1): (∞/FCFS), (M/M/S): (∞/FCFS) models and deduce their performance measures.

UNIT I
Linear Programming
Introduction, Mathematical Formulation, Basic feasible, Unbounded and Infeasible solutions,Graphical method (maximization and minimization models), Canonical and standard forms of LPP, Simplex method, Big M method.

(12 hours)

UNIT II
Transportation Problem

Introduction, Mathematical formulation, Methods of solving a TPP - North West Corner method, Least Cost method, Vogels Approximation method, MODIMethod, Degeneracy, Unbalanced Transportation problems, Maximization problems.

Assignment Problem

Introduction, Mathematical formulation,Hungarian method, Unbalanced assignment models, Maximization and restrictions in assignment models, Travelling salesman problem.

(12 hours)

UNIT III

Sequencing Problems

Introduction, Processing of - n jobs on 2 machines, n jobs on 3 machines, n jobs on m machines.

Game Theory

Introduction, Maxmin , Minimax principle, Two person zero sum game with saddle point and without saddle point , Matrix oddment method for nxn games, Dominance property, Solving 2 x n and m x 2 game by graphical method.

(12 hours)

UNIT IV

Network Analysis

Introduction, Basic concepts, Construction of networks, Critical path method, Programme evaluation review technique (without cost considerations).

(12 hours)

UNIT V

Queueing Models

Introduction, Characteristics of queuing models, Kendal's notation, Derivation of Models(M/M/1): (∞/FCFS), (M/M/S): (∞/FCFS), simple problems.

(12 hours)

TEXT BOOK

- Prof.V.Sundaresan, K.S.Ganapathy Subramanian and K.Ganesan (2000), Resource Management Techniques, A.R.Publications, Chennai.

REFERENCE BOOKS

- KantiSwaroop,Gupta P.K. and Manmohan (1999), Problems in Operation Research, Sultan Chand & Sons, New Delhi.
- P.R.Vittal (2003), Operations Research, Margham Publications.
- S.D. Sharma (2001), Operations Research: Theory and Applications, Macmillan, New Delhi.

e-RESOURCES

Web Links

https://wps.prenhall.com/wps/media/objects/14127/14466190/online_modules/taylor_ims11_module_B.pdf
https://www.bbau.ac.in/dept/UIET/EME-601%20Operation%20Research.pdf

You Tube Video Links

https://www.youtube.com/watch?v=WrAf6zdteXI

https://www.youtube.com/watch?v=xGkpXk-AnWU

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(Course faculty may conduct any, all or any other activities as well)

Assignments : Formulation of LPP and obtain the optimal solution using graphical, simplex and Big M method.

Class presentation: On applications of transportation and assignment problems in obtaining the solution of some real-world problems.

Participatory learning: Students discuss on selection of an appropriate order in which a number of tasks can be assigned to a finite number of service facilities so as to optimize the outputs in terms of time, cost or profit using principles of sequencing models.

Quiz: Features of game theory, methods of solving games, applications in relevant fields.

Case study Analysis: Construction of networks, estimation of expected project duration for real time projects from varied fields using PERT/CPM techniques..

Group discussion: On queuing models to improve service delivery in public service sectors and minimise the queue waiting time thus enhancing customer satisfaction**.**

COURSE OUTCOMES:

On completion of the course, students will be able to

CO No.	COURSE OUTCOME	PSOs ADDRESSED	COGNITIVE LEVEL
CO1	Formulate real life situations into a linear programming problem, analyze and obtain the optimal solution.	**1,2,4**	**C**
CO2	Select the appropriate transportation/ assignment techniques and obtain the optimum solution in allocation of resources/jobs.	**1,2,4**	**E**
CO3	Determine the minimum total elapsed time for processing jobs on machines using sequencing models and derive optimal strategies in a competitive environment using the characteristics of game theory.	**1,2,4**	**E**
CO4	Estimate the expected duration of a project in any global environment by implementing CPM/PERT techniques.	**1,2,4,5**	**E**
CO5	Explain the characteristics of queueing theory, obtain the probability distribution function of single server/multiserver queueing models and derive performance measures.	**1,2,3,4,5**	**E**

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CORE XIV - GRAPH THEORY

COURSE CODE: 14UMAT 326	YEAR/SEMESTER: III / VI	MAXIMUM MARKS: 100
COURSE TYPE: THEORY	CREDITS: 4	TOTALTEACHING HOURS: 60

GENERAL OBJECTIVE:

To introduce the fundamental concepts of graph theory, types of graphs, their properties and understand their applications in network theory.

COURSE OBJECTIVES (Co):

Co No.	Course Objective
Co1	To introduce the concepts of graphs, subgraphs, adjacency/incidence matrices and operations on graphs.
Co2	To provide the basic concepts of walk, trail, path and able to distinguish between them.
Co3	To impart the knowledgeof trees, concepts of trees and characterisation of trees
Co4	To understand the Konigsberg problemusing the concepts of Eulerian and Hamiltonian graphs
Co5	To acquire the knowledge of plane/ planar graphs and their characterization with suitable examples.

UNIT I

Graphs and Sub graphs

Definition and examples, Degrees, Sub graphs, Graph Isomorphism, Matrices, Adjacency and Incidence matrix, Operations on Graphs.

(12 hours)

UNIT II

Connectedness

Walks, Trails and Paths, Connectedness and Components, Blocks.

(12 hours)

UNIT III

Trees

Introduction, Characterisation of Trees, Centre of a tree, Spanning tree, Connectivity.

(12 hours)

UNIT IV

Eulerian and Hamiltonian Graphs

Introduction, Eulerian graphs, Hamiltonian graphs.

(12 hours)

UNIT V

Planarity

Definition and properties, Characterization of planar graphs, Thickness, Crossings and Outer Planarity (only Definitions).

(12 hours)

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TEXT BOOK

- S.Arumugam&S.Ramachandran (2002), Invitation to Graph Theory, Scitech Publications Pvt. Ltd., Chennai.
  UNIT I: Chapter 2: 2.1, 2.2, 2.3, 2.4, 2.8, 2.9.
  UNIT II: Chapter 4: 4.1, 4.2, 4.3.
  UNIT III: Chapters 6 & 4: 6.0, 6.1, 6.2, 4.4.
  UNIT IV: Chapter 5: 5.0. 5.1,5.2.
  UNIT V: Chapter 8: 8.0, 8.1, 8.2, 8.3.

REFERENCE BOOKS

- John Clark Holton (1991), A first look at Graph Theory, World Scientific Publishing Co. Ltd., New Jersey.
- J. A. Bondy and U.S.R Murthy (1976), Graph theory with Applications, Macmillan Press Ltd., USA.

e-RESOURCES

Web Links

WWW.d3gt.com

www.slideshare.net/SakibMuhaimin/tree-and-graph

www.slideshare.net/ShakibSararArnab1/hamilton-path-and-euler-path

www.javatpoint.com/planar-and-non-planar-graphs

You Tube Video Links

www.youtube.com/watch?v=82zlRaRUsaY
www.youtube.com/watch?v=f1JTtMP6NGw
www.youtube.com/watch?v=Z3u63IgE-Hw
www.youtube.com/watch?v=wnYtITkWAYA

ACTIVITY PLANNER:

List of activities for Employability / Skill Development / Entrepreneurship Skill Development

(Course faculty may conduct any, all or any other activities as well)

Assignments: On Graphs and Subgraphs- Representing the relationship between the objects as graphs(chemical molecules of compounds, electric circuits etc.,)to understand the significance of graph theory in real life situations
MCQs: Finding the degree, adjacency and incidence matrices for special types of graphs.
Quiz: On Connectedness of graphs, advanced concepts of Connectedness (in higher learning).**Class presentation:** Applications of connectivity in routing, network and image processing, etc.,

Seminar: Applications on the concepts of Eulerian and Hamiltonian graphs applicable to real life problems say Konigsberg bridge problem.
Net surfing: Students surf the net and find the applications on the concepts of planarity in research and areas of higher studies.
Cross Word: Reinforcing Graph Theory vocabulary.

COURSE OUTCOMES:
On completion of the course, student's will be able to

CO No.	COURSE OUTCOME	PSO's ADDRESSED	COGNITIVE LEVEL
CO1	Explain the concepts of vertices, edges, degrees, graph isomorphism, adjacency, incidence matrices, operations on graphs and prove related theorems.	**1,2**	**E**
CO2	Prove results pertaining to walks, trails, paths and connected graphs.	**1,2**	**E**
CO3	Construct the hierarchical structure of graphs and employ the concept of spanning trees to find the minimal path.	**1,2,3,4**	**C**
CO4	Explain the properties of Hamiltonian, Eulerian graphs and apply it in diversified fields globally.	**1,2,4,5**	**E**
CO5	Analyse the concepts of planarity in 3D graphs and prove related theorems.	**1,2**	**An, E**

- **PSO – Programme Specific Outcome; Co – Course Objective; CO – Course Outcome; R- Remember; U- Understand; Ap – Apply; An – Analyse; E- Evaluate; C – Create**

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CORE XV- MATHEMATICAL MODELLING

COURSE CODE: 16UMAT306	YEAR/SEMESTER: III/VI	MAXIMUM MARKS: 100
COURSE TYPE: THEORY	CREDITS: 4	TOTAL TEACHING HOURS: 60

GENERAL OBJECTIVE:
To acquaint students with the principles of formulation, analysis, solution of mathematical models and to study the impact of environmental changes for sustainable development.

COURSE OBJECTIVES (Co):

Co No.	Course Objective
Co1	To understand the modelling using differential equations of first order in linear growth and decay models.
Co2	To provide an in-depth knowledge in modelling of non-linear growth and decay, dynamic models using differential equations of first order.
Co3	To provide an insight into applications of simultaneous differential equations inmodelling of prey predator,competition,epidemic models.
Co4	To obtain the components of velocity, acceleration and explain modelling of planetary motions using keplar's law
Co5	To highlight theapplications of mathematical modelling in economics and actuarial sciences.

UNIT I
Linear Growth and Decay Models
Mathematical Modelling through Differential Equations, Linear Growth and Decay Models - Population Growth Models, Effects of Immigration and Emigration on Population Size, Interest Compounded Continuously, Decrease of Temperature, Diffusion, Change of Price of a Commodity.

(12 hours)

UNIT II
Non-Linear Growth and Decay Models
Non-Linear Growth and Decay Models- Logistic Law of Population Growth, Compartment Models- A Simple Compartment Model, Mathematical Modelling in Dynamics through Ordinary Differential Equations of First Order- Simple Harmonic Motion, Motion under Gravity in a Resisting Medium. (12 hours)

UNIT III
Population Dynamics
Mathematical Modelling in Population Dynamics- Prey- Predator Models, Competition Models, Mathematical Modelling of Epidemics Through Systems of Ordinary Differential Equations of First Order-A Simple Epidemic Model, A Susceptible-Infected-Susceptible (SIS) Model, SIS Model with Constant Number of Carriers, Simple Epidemic Model with Carriers.

(12 hours)

UNIT IV
Planetary Motions

Mathematical Modelling of Planetary Motions- Need for the study of Motion Under Central Forces, Components of Velocity and Acceleration Vectors along Radial and Transverse Directions, Motion Under Central Forces, Motion Under the Inverse Square Law, Kepler's Law of Planetary Motions.

(12 hours)

UNIT V
Economics and Finance
The Harrod Model, The Cobweb Model, Samuelson's Interaction Models,Application to Actuarial Science.

(12 hours)

TEXT BOOKS

- J N Kapur (1988), Mathematical Modelling, Wiley Eastern Limited, New Delhi.
  Unit I: Chapter 2: 2.1, 2.2 - 2.2.1, 2.2.3, 2.2.4, 2.2.6, 2.2.7, 2.2.8.
  Unit II: Chapter 2: 2.3-2.3.1, 2.4 - 2.4.1, 2.5- 2.5.1, 2.5.2.
  Unit III: Chapter 3: 3.1-3.1.1, 3.1.2, 3.2: 3.2.1-3.2.4.
  Unit IV: Chapter 4: 4.1: 4.1.1- 4.1.5.
  Unit V: Chapter 5: 5.3: 5.3.1- 5.3.4.

REFERENCES

- J N Kapur (1985), Mathematical Models in Biology and Medicine, EWP, New Delhi.

e-RESOURCES

Web Links

https://www.ams.org/open-math-notes/omn-advanced-search
https://slideplayer.com/slide/12326543/
https://www.amsi.org.au/ESA_Senior_Years/PDF/GrowthDecay3e.pdf
ttps://arxiv.org/ftp/arxiv/papers/1504/1504.07964.pdf

You Tube Video Links

https://www.youtube.com/watch?v=MIOj-W-jY-k
https://www.youtube.com/watch?v=3h-TfH1wrfI
https://www.youtube.com/watch?v=y8vUgTdmG34

ACTIVITY PLANNER:

List of activities for Employability / Skill Development / Entrepreneurship Skill Development

(Course faculty may conduct any, all or any other activities as well)

Assignment: Solving challenging problems related to linear growth and decay models.
Class Seminar: On Logistic law of population growth model.
Virtual discussion: On phase plane analysis of prey predator and competition model.

Knowledge sharing sessions On application of differential equations in modelling planetary motions using Kepler's law.
Group Discussion: Students analyse and discuss on the interrelatedness of situations or events in the environment based on the Logistic law of population growth model.
Case study Analysis:-students **t**ake up real time biological systems formulate mathematical model, analyse and solve using differential equations.
Paper Presentations on developing mathematical models in real world situations and solving them using appropriate mathematical tools.

COURSE OUTCOMES:
On completion of the course, students will be able to

CO No.	COURSE OUTCOME	PSOs ADDRESSED	COGNITIVE LEVEL
CO1	Formulate and solve population dynamic, demand and supply problems using differential equations.	**1,2,4**	**C**
CO2	Construct compartment models, models based on principles of dynamics and obtain their solution using differential equations of first order.	**1,2,4**	**C**
CO3	Explain prey predator, competitive, epidemic models and predict the effect of environment changes and sustainable development.	**1,2,3**	**E**
CO4	Design a mathematical model using Kepler's law and solve problems in spatial science.	**1,2,3,5**	**C**
CO5	Develop and solve mathematical models in Economics and Finance in national/global environment.	**1,2,3,4,5**	**C**

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