BHARATHIAR UNIVERSITY

Coimbatore – 641046

DEPARTMENT
OF
APPLIED MATHEMATICS

M.Sc. Mathematics with Computer Applications

(For the Candidates admitted during the year **2018-2020**)

BHARATHIAR UNIVERSITY: COIMBATORE – 641 046

DEPARTMENT OF APPLIED MATHEMATICS (DAM)

M.SC., MATHEMATICS WITH COMPUTER APPLICATIONS

ELIGIBILITY CONDITIONS FOR STUDENTS

(For the Candidates admitted during the year **2018-2020**)

Eligibility Conditions for Admission to the Programme: M.Sc. Mathematics with Computer Applications

A candidate who has passed the Degree Examination **in B.Sc. Mathematics (or) B.Sc. Mathematics (CA)** of this University or an examination of some other University accepted by the Syndicate as equivalent there to shall be eligible for admission to the **Master Degree in Mathematics (CA)** of this University.

BHARATHIAR UNIVERSITY: COIMBATORE – 641 046

DEPARTMENT OF APPLIED MATHEMATICS (DAM)

M.Sc., MATHEMATICS WITH COMPUTER APPLICATIONS

VISION:

- To provide a quality education in Mathematics with Computer Applications to widen the horizon of knowledge and to encourage high level research.

MISSION:

- To impart with strong mathematical background, abstract understanding, analytical and computational skills, which enable to face the changing scenario and to handle any industrial and research problem.
- To develop knowledge and a passion for science towards the needs concerning the society.

PROGRAM EDUCATIONAL OBJECTIVES:

Master of Science in Mathematics (CA) curriculum for full-time is designed to engross the post graduates having attitude and knowledge to

- cultivate a mathematical attitude and nurture the interests.
- impart training with a view to create competent and motivated academicians.
- equip with more technological skills and scientific computing techniques based on mathematical methods.

PROGRAMME OUTCOMES:

The post graduates will have the ability to

- understand the concepts of Analysis, Algebra, Differential equations, able to solve the problems using Numerical methods and also with C++.
- identify and solve the problems in Partial differential equations, Mechanics and able to write programs using the software Matlab.
- understand the concepts of Topology, Functional analysis and Fluid dynamics and their applications in the industrial areas.
- self-learning and updating with advanced technological challenges of Computer Science and Mathematics at the local level and to remain globally competitive.

DEPARTMENT OF APPLIED MATHEMATICS (DAM)
M.Sc., MATHEMATICS WITH COMPUTER APPLICATIONS

Scheme of Examination

Semester	Subject Code	Title of the paper	Class Hours	University Examination			
				Internal	External	Total Marks	Credit
I	18AMAA13A	Algebra	5	25	75	100	4
	18AMAA13B	Real Analysis	5	25	75	100	4
	18AMAA13C	Ordinary Differential Equations	5	25	75	100	4
	18AMAA13D	Programming in C++	3	12	38	50	2
	18AMAA13P	Practical I : Programming in C++	3	12	38	50	2
	18AMAA1EA	Elective – I	4	25	75	100	4
		Supportive – I (Offered from other Departments)	2	12	38	50	2
II	18AMAA23A	Complex Analysis	5	25	75	100	4
	18AMAA23B	Partial Differential Equations	5	25	75	100	4
	18AMAA23C	Mechanics	5	25	75	100	4
	18AMAA23D	Java Programming	3	12	38	50	2
	18AMAA23P	Practical II : Java Programming	3	12	38	50	2
	18AMAA2EB	Elective II	4	25	75	100	4
		Supportive – II (Offered from other Departments)	2	12	38	50	2
III	18AMAA33A	Topology	5	25	75	100	4
	18AMAA33B	Fluid Dynamics	5	25	75	100	4
	18AMAA33C	Mathematical Methods	5	25	75	100	4
	18AMAA33D	Matlab	3	12	38	50	2
	18AMAA33P	Practical III :Matlab	3	12	38	50	2
	18AMAA3EC	Elective- III	4	25	75	100	4
		Supportive – III (Offered from other Departments)	2	12	38	50	2
IV	18AMAA43A	Functional Analysis	5	25	75	100	4
	18AMAA43B	Nonlinear Differential Equations	5	25	75	100	4
	18AMAA43C	Latex and Mathematica	3	12	38	50	2
	18AMAA43P	Practical IV : Latex and Mathematica	3	12	38	50	2
	18AMAA4ED	Elective- IV	4	25	75	100	4
	18AMAA47V	Project	8	---	---	200	8
Total						**2250**	**90**

As per UGC (Credit Framework for Online Learning Courses through **SWAYAM**) Regulation 2016, it is encouraged the use of SWAYAM (Study Web of Active Learning by Young and Aspiring Minds) platform. Based on the availability of relevant courses on SWAYAM, students shall choose online courses from **Course era, NPTEL, MOOC, Udacity**, etc. as extra credit (without marks) courses.
On submission of the valid course certificate before the completion of the programme, it can be added to the mark sheets.

ELECTIVE COURSES

S.No.	Title of the paper
1	Numerical Methods
2	Number Theory and Cryptography
3	Fuzzy Sets and Fuzzy Logic
4	Control Theory
5	Stochastic Processes
6	Mathematical Statistics
7	Fundamentals of Actuarial Mathematics
8	Magneto hydrodynamics
9	Discrete Mathematics

SUPPORTIVE COURSES FOR OTHER DEPARTMENT STUDENTS

Subject Code	Title of the paper	Class Hours	University Examination			
			Internal	External	Total Marks	Credit
181GS01	Numerical Methods	2	12	38	50	2
182GS45	Differential Equations and Transforms	2	12	38	50	2

M.Sc., Core and Elective theory Examination having the following Marks:

CORE AND ELECTIVE PAPERS : MAXIMUM MARKS– 100

INTERNAL MARKS: 25	
*Test	15 Marks
Assignment	5 Marks
Seminar	5 Marks

* Best two from Continuous Internal Assessment (CIA) I , II and III.

EXTERNAL MARKS : 75

SECTION– A : (5x2=10 Marks) (Question No. 1 to 5)

(Answer all FIVE questions. ONE Question from each unit)

SECTION– B : (5x5=25 Marks) (Question No. 6 to 12)

(Answer any FIVE questions out of SEVEN questions. ONE Question necessarily from each unit to be asked)

SECTION– C: (5x8=40 Marks) (Question No. 13 to 19)

(Answer any FIVE questions out of SEVEN questions. ONE Question necessarily from each unit to be asked)

CORE PAPERS : MAXIMUM MARKS– 50

INTERNAL MARKS: 12	
*Test	6 Marks
Assignment	3 Marks
Seminar	3 Marks

* Best two from Continuous Internal Assessment (CIA) I , II and III.

EXTERNAL MARKS : 38

SECTION-A (5x2=10 Marks)

(Answer all FIVE questions. ONE Question from each unit)

SECTION-B (5x4=20 Marks)

(Answer any FIVE questions out of SEVEN questions. ONE Question necessarily from each unit to be asked)

SECTION-C (1x8=8 Marks)

(Answer any ONE question out of TWO questions. ONE Question from first three units to be asked and ONE Question from last two units to be asked)

M.Sc., Practical Examination having the following Marks:

PRACTICAL: MAXIMUM MARKS– 50

INTERNAL MARKS : 12	
Test-I	3 Marks
Test-II	3 Marks
Model	6 Marks
Total	12 Marks
EXTERNAL MARKS : 38	
Practical	30 Marks
Record	8 Marks
Total	38 Marks

SUPPORTIVE PAPERS : MAXIMUM MARKS– 50

INTERNAL MARKS: 12	
*Test	6 Marks
Assignment	3 Marks
Seminar	3 Marks

* Best two from Continuous Internal Assessment (CIA) I , II and III.

EXTERNAL MARKS: 38

SECTION-A (5x2=10 Marks) (Question No. 1 to 5)

(Answer All questions)

SECTION-B (4x7=28 Marks) (Question No. 6 to 11)

(Answer any FOUR questions out of SIX questions)

PROJECT: MAXIMUM MARKS– 200

Project Mark : 200	
Project Report	80 Marks
Internal	60 Marks
External -Viva -Voce	60 Marks

Title of the subject : **ALGEBRA** No. of Credits: **4**

Code No. : **18AMAA13A** No. of Teaching Hours: **5**

Course Objectives:

The student should be made to

- Introduce the general concepts in Algebra and related theorems.
- To learn the elementary theorems of group and ring theory.

UNIT I: GROUP THEORY

Permutation Groups – Another counting principle – Sylow's theorem.

UNIT II: RING THEORY

Euclidean rings – A particular Euclidean ring – Polynomial rings – Polynomials over the rational field.

UNIT III: FIELDS

Extension Fields – Roots of polynomials.

UNIT IV: FIELDS

Elements of Galois Theory.

UNIT V: LINEAR TRANSFORMATIONS

Characteristic roots – Trace and Transpose – Hermitian, unitary and normal Transformations.

TEXT BOOK:

1. "Topics in Algebra" (Second Edition) by **I.N. Herstein**, John Wiley & Sons, New Delhi, 1975.

REFERENCE BOOKS:

1. "A First Course in Abstract Algebra" by **J.B.Fraleigh**, Narosa Publishing House, New Delhi,1988.
2. "Algebra" by **M. Artin**, Prentice-Hall", Englewood Cliff, 1991.
3. "Algebra" by **T.W. Hungerford**, Springer, New York, 1974.

Course Outcomes:

On successful completion of the course, the students will be able to

CO 1 - Understand concept of Cauchy's theorem, Sylow's theorem, Rings, fields, linear transformations, trace & transpose.

CO2 - Apply the sylow theorems to describe the structure of certain finite groups.

Title of the subject: **REAL ANALYSIS** No. of Credits: **4**
Code No.: **18AMAA13B** No. of Teaching Hours: **5**

Course Objectives:
The student should be made to

- Have a detailed study of continuity, uniform continuity, differentiability Riemann Stieltjes integral and the calculus on $\mathbb{R}_n$.
- Know about convergence of sequences and Lebesgue Measure and Integration.

UNIT I: RIEMANN STIELTJES INTEGRAL
Definition and Existence of the Integral – properties of the integral – Integration and differentiation – Integration of vector valued function – rectifiable curves.

UNIT II: UNIFORM CONVERGENCE AND CONTINUITY
Uniform convergence and integration–Uniform convergence and differentiation – equicontinuous families of functions – The Stone Weirstrass theorem.

UNIT III: FUNCTIONS OF SEVERAL VARIABLES
Linear transformation – contraction principle-Inverse function theorem-Implicit function theorem-determinants-derivatives of higher order-differentiation of integrals.

UNIT IV: MEASURE ON THE REAL LINE
Introduction - Lebesgue outer measure - measurable sets - Borel sets - regular measure - Lebesgue measurable function – Borel measurable function.

UNIT V: INTEGRATION OF NON-NEGATIVE FUNCTIONS
Lebesgue integral- Fatou's lemma- Lebesgue monotone convergence theorem - Lebesgue Dominated convergence theorem – Riemann and Lebesgue integrals.

TEXT BOOKS:

1. "Principles of Mathematical Analysis" (Second Edition) by **W.Rudin**, McGraw-Hill, New York, 1976.
2. "Measure Theory and Integration" by **G.D.Barra**, Ellis Harwood Publishing company, Chichester, 1981.

REFERENCE BOOK:

1. "Real Analysis" (Third Edition) by **H.L.Roydon**, Macmillan Company, New York, 1988.

Course Outcomes:
On successful completion of the course, the students will be able to
CO 1 - Understand the concept of analysis which is the motivating tool in other area such as Applied Mathematics.

Title of the subject : **ORDINARY DIFFERENTIAL EQUATIONS** No. of Credits: **4**

Code No. : **18AMAA13C** No. of Teaching Hours: **5**

Course Objectives:

The student should be made to

- Introduce the basic theory of ordinary differential equations and apply to dynamical problems of practical interest.

UNIT I: LINEAR EQUATIONS WITH CONSTANT COEFFICIENTS

The second order homogeneous equations – Initial value problems – Linear dependence and independence - A formula for the Wronskian – The non-homogeneous equation of order two.

UNIT II: HOMOGENEOUS AND NON-HOMOGENEOUS EQUATIONS OF ORDER 'n'

Initial value problems – A special method for solving the non–homogeneous equation – Algebra of constant coefficient operators.

UNIT III: LINEAR EQUATIONS WITH VARIABLE COEFFICIENTS

Initial value problems for the homogeneous equation - Solutions of the homogeneous equation - The Wronskian and linear independence - Reduction of the order of a homogeneous equation - Homogeneous equation with analytic coefficients – The Legendre equation.

UNIT IV: LINEAR EQUATIONS WITH REGULAR SINGULAR POINTS

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

UNIT V: EXISTENCE AND UNIQUENESS OF SOLUTIONS TO FIRST OREDER EQUATIONS

Equation with variables separated – Exact equations – The method of successive approximations – The Lipschitz condition – Convergence of the successive approximations.

TEXT BOOK:

1. "An Introduction to Ordinary Differential Equations" by **E.A.Coddington**, Prentice Hall of India Ltd., New Delhi, 1957.

REFERENCE BOOK:

1. "Theory of Ordinary Differential Equations" by **E.A.Coddington and N. Levinson**, McGraw-Hill Publishing Company, New York, 1955.

Course Outcomes:

On successful completion of the course, the students will be able to

CO 1 – Gain knowledge about Second order linear equations, Legendre equation and Bessel equations etc., which provides the essential motivation in Applied Mathematics.

Title of the subject : **PROGRAMMING IN C++** No. of Credits: **2**
Code No.: **18AMAA13D** No. of Teaching Hours: **3**

Course Objectives:
The student should be made to

- Provide an insight to theoretical computer science and to get across to the notion of effective computability using programming in C++.

UNIT I: PRINCIPLES OF OBJECT-ORIENTED PROGRAMMING
Software crisis – Software evolution – A look at procedure-oriented programming – Object-oriented programming paradigm – Basic concept of object-oriented programming – Inheritance – Polymorphism – Benefits of OOP – Object-oriented languages – Applications of OOP.

UNIT II: TOKENS, EXPRESSIONS AND CONTROL STRUCTURE
Introduction – Tokens – Keywords – Identifiers and constants – Basic data types – User defined data types - Derived data types – Symbolic constants – Type compatibility – Declaration of variables – Dynamic insulation of variables – Reference variables – Operations in C++ - Scope resolution operator – Member dereferencing operators – memory management operators – Manipulators – Type cast operator – Expressions and their types– Special assignment expressions – Implicit conversions – Operator overloading – Operator precedence – Control structures.

UNIT III: FUNCTIONS IN C++
Introduction – The main function – Function prototyping – Call by reference – return by reference inline functions – default arguments – constant arguments – function overloading – friend and virtual functions – Math library functions. Managing Console I/O operations: Introduction – C++ streams – C++ stream classes – Unformatted I/O operations – Formatted I/O operations – Managing output with manipulators.

UNIT IV: CLASSES AND OBJECTS
Introduction – C Structures revisited – Specifying a class – Defining member functions – A C++ program with class – Making an outside function inline – Nesting of member functions – Private member functions – Arrays within a class – Memory allocation for objects – Static data members – Static member functions – Arrays of objects – Objects as function arguments - Friendly functions - Returning objects - Constant member functions.

UNIT V: OPERATOR OVERLOADING AND TYPE CONVERSIONS
Introduction – Defining operator overloading – Overloading unary operators – Overloading binary operators – Overloading binary operators using friends – Manipulating of strings using operators – Rules of overloading operators. Inheritance and Extending classes: Introduction – defining derived classes – Single inheritance – Making a private member inheritable – Multilevel inheritance – Multiple inheritance – Hierarchical inheritance – Hybrid inheritance.

TEXT BOOK:

1. "Object Oriented Programming with C++" by **E.Balaguruswamy**, Tata McGraw-Hill, New Delhi, 1999.

REFERENCE BOOKS:

1. "The C++ Programming Language" by **B.Stroustrup**, Addison Wesley, Canada, 1999.
2. "C++ – The Complete Reference" by **H.Schildt**, Tata McGraw-Hill, New Delhi, 1998.

Course Outcomes:

On successful completion of the course, the students will be able to
CO 1 – Understand the basic concepts of Oops.
CO 2 – Know fundamentals of C++ programming language.

Title of the subject : **PRACTICAL I: PROGRAMMING IN C++** No. of Credits: **2**
Code No. : **18AMAA13P** No. of Teaching Hours: **3**

Course Objectives:

The student should be made to

- Provide an effective computability, using programming in C++.

Course Content:

1. Transpose of a Matrix
2. Obtaining Eigen value and Eigen vector of a matrix
3. Solving a Transcendental equation using Newton Raphson Method
4. Solving a set of Simultaneous Equations by Gauss Elimination Method
5. Solving a set of Simultaneous Equations by Gauss Jacobi Method
6. Integration using Trapezoidal Rule
7. Solving First order ODE using Second order Runge-Kutta Method

Course Outcomes:

On successful completion of the course, the students will be able to
CO 1 – Know fundamentals of C++ programming language with the means of writing efficient, maintainable and portable code in Numerical Problems.

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Title of the subject : **COMPLEX ANALYSIS** No. of Credits: **4**
Code No. : **18AMAA23A** No. of Teaching Hours: **5**

Course Objectives:

The student should be made to

- Understand the fundamental concepts of complex variable theory.
- Acquire the skill of contour integration to evaluate complicated real integrals by residue calculus.

UNIT I : ANALYTIC FUNCTION

Introduction to the concept of analytic function: Limits and continuity – Analytic functions – Polynomials – Rational functions.

CONFORMALITY

Arcs and closed curves – Analytic functions in regions – Conformal mapping – Length and area – Linear transformations: The linear group –The cross ratio –Elementary conformal mappings: Elementary Riemann surfaces.

UNIT-II : FUNDAMENTAL THEOREMS

Line integrals rectifiable arcs – Line integrals as functions of arcs – Cauchy's theorem for a rectangle - Cauchy's theorem in a disk. The index of a point with respect to a closed curve – The integral formula – Higher derivatives. Removable singularities- Taylor's theorem – Zeros and poles – The local mapping – The maximum principle - Chains and cycles.

UNIT-III : THE CALCULUS OF RESIDUES

The residue theorem –The argument principle –Evaluation of definite integrals.

HARMONIC FUNCTIONS

Definition and basic properties – The mean-value property –Poisson's formula.

UNIT-IV : POWER SERIES EXPANSIONS

Weierstrass theorem – The Taylor series – The Laurent series.

PARTIAL FRACTIONS AND FACTORIZATION

Partial fractions – Infinite products – Canonical products.

UNIT-V: MAPPING

The Riemann mapping theorem: Statement and proof – Boundary behavior – Use of the reflection principle – Analytic arcs – Conformal mapping of polygons: The behavior at an angle– The Schwarz – Christoffel formula – Mapping on a rectangle.

TEXT BOOK:

1. "Complex Analysis" (Third Edition), by **L.V.Ahlfors** McGraw-Hill, New York, 1979.

REFERENCE BOOKS:

1. "Functions of One Complex Variables" by **J.B.Conway**, Springer-Verlag, New York Inc.,1973.
2. "Foundations of Complex Analysis" by **S.Ponnusamy**, Narosa Publishing House, New Delhi, 2004.

Course Outcomes:

On successful completion of the course, the students will be able to

CO 1 - Work with functions (polynomials, reciprocals, exponential, trigonometric, hyperbolic, etc.) of single complex variable and describe mappings in the complex plane.

CO2 - Examine the theory and illustrate the applications of the calculus of residues in the evaluation of integrals.

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Title of the subject: **PARTIAL DIFFERENTIAL EQUATIONS** No. of Credits: **4**
Code No. : **18AMAA23B** No. of Teaching Hours: **5**

Course Objectives:

The student should be made to

- Solve nonlinear Partial Differential equations by different methods.
- Understand some physical problems in Engineering that results in partial differential equations.

UNIT I: NONLINEAR PARTIAL DIFFERENTIAL EQUATIONS OF THE FIRST ORDER

Cauchy's method of characteristics–Compatible systems of first order equations –Charpit's method-Special types of first order equations –Jacobi's method.

UNIT II: PARTIAL DIFFERENTIAL EQUATIONS OF SECOND ORDER

The origin of second-order equations – Linear partial differential equations with constant coefficients – Equations with variable coefficients –Characteristic curves of second–order equations- Characteristics of equations in three variables.

UNIT III: HYPERBOLIC EQUATION

The solution of linear hyperbolic equations – Separation of variables – The method of integral transforms – Nonlinear equations of the second order.

UNIT IV: LAPLACE'S EQUATION

The occurrence of Laplace's equation in physics- elementary solution of Laplace's equation – Families of equipotential surfaces - boundary value problems – Separation of variables- Problems with axial symmetry.

UNIT V: THE WAVE EQUATION

The occurrence of wave equation in physics – Elementary solutions of the one-dimensional wave equation – vibrating membranes: Applications of the calculus of variations – Three dimensional problems. The diffusion equations: Elementary solutions of the diffusion equation – Separation of variables- The use of integral transforms.

TEXT BOOK:

1. "Elements of Partial Differential Equations" by **I.N.Sneddon**, McGraw-Hill Book Company, Singapore, 1957.

REFERENCE BOOK:

1. "Partial Differential Equation for Engineers and Scientists" by **J.N.Sharma and K.Singh**, Narosa publishing House, Chennai, 2001.

Course Outcomes:

On successful completion of the course, the students will be able to

CO 1 - Solve linear partial differential equations, by using elementary methods.

CO2 – Analyze and solve complex problems using partial differential equations as functional and analytical tools.

CO3 - Apply problem-solving with partial differential equations to diverse situations in physics engineering and other mathematical contexts.

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Title of the subject : **MECHANICS** No. of Credits: **4**

Code No. : **18AMAA23C** No. of Teaching Hours: **5**

Course Objectives:

The student should be made to

- Present the state of the area of mechanical system with its generalized coordinates and constraints.
- Analyze equations of Lagrange and Hamilton.

UNIT I: **INDRODUCTORY CONCEPTS**

The mechanical system – Generalized coordinates – Constraints – Virtual work – Energy and momentum.

UNIT II: **LAGRANGE'S EQUATIONS**

Derivations of Lagrange's equations- Examples –Integrals of the motion.

UNIT III: **HAMILTON'S EQUATIONS:**

Hamilton's principle – Hamilton's equations.

UNIT IV: **HAMILTON – JACOBI THEORY**

Hamilton's principal function –The Hamilton – Jacobi equation – Separability.

UNIT V: **CANONICAL TRANSFORMATIONS**
Differential forms and generating functions – Lagrange and Poisson brackets.

TEXT BOOK:
1. "Classical Dynamics" by **D.T.Greenwood**, Prentice Hall of India, New Delhi, 1979.

REFERENCE BOOK:
1. "Classical Mechanics" by **H.Goldstein**, **C. Poole** and **J.Safko**, Pearson Education, Inc., New Delhi, 2002.

Course Outcomes:
On successful completion of the course, the students will be able to
CO1 - Understand the concepts of stress mechanical system and its generalized coordinates.
CO2 - Know the analysis made on equations which are derived from the equation of continuity.

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Title of the subject : **JAVA PROGRAMMING** No. of Credits: **2**

Code No.: **18AMAA23D** No. of Teaching Hours: **3**

Course Objectives:
The student should be made to
- Understand fundamentals of object oriented programming paradigm with thread and Applet concepts.

UNIT I : OBJECT ORIENTED PROGRAMMING
Basic concepts of object oriented programming – benefits & applications of OOP. JAVA evolution: Java features – Java and C – Java and C++ - Java and Internet.
OVERVIEW OF JAVA LANGUAGE:
Introduction - implementation of java program – creating, compiling, running the program, JVM.

UNIT II: DECISION MAKING , BRANCHING AND LOOPING

Data Types– operators and Expressions – Strings, Arrays– Branching: Decision making with if statement, if…else statement, nesting if…else statements, the else if ladder, switch statement.

LOOPING: The while statement, do statement, for statement- additional features of for loop: nesting of for loops; jumps in loops – jumping out of a loop; skipping a part of loop; labeled loops

UNIT III: CLASSES AND OBJECTS

Introduction; adding variables, creating and adding methods, constructors, overloading; Inheritance – defining a subclass, multilevel inheritance, hierarchical inheritance, overriding methods, visibility control, rules of thumb.

UNIT IV: PACKAGES AND MULTI-THREADED PROGRAMMING

Creating threads, extending the thread class- implementing the run( ) method, starting new thread stopping and blocking a thread- life cycle of a thread – new born state, running state, blocked state, dead state.

UNIT V: APPLET

Basics – Architecture – Passing parameters to Applets – Skeleton – simple Applet – AWT.

TEXT BOOK:

1. "Programming with JAVA a Primer"(Fourth edition) by **E.Balagurusamy** , Tata McGraw-Hill, New Delhi, 2010.

REFERENCE BOOKS:

1. "The JAVA Programming Language" by **K.Arnold, J.Gosslings and D.Holmes**, Addison Wesley Professional, New Jersey, 2005.
2. "The Complete Guide to JAVA Database Programming" by **M.Siple**, Tata McGraw-Hill, New York,1998.
3. "JAVA For you" by **P.Koparkar**, Tata McGraw-Hill, New Delhi, 2001.
4. "The Complete Reference - Java 2.0" (Fourth Edition) by **H.Schildt**, Tata McGraw-Hill, Berkeley, 2001.

Course Outcomes:

On successful completion of the course, the students will be able to
CO1 – Use the characteristic of an OOPS.
CO1 – Familiar with multithreaded programming and simple Applet.

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Title of the subject : **PRACTICAL II: JAVA PROGRAMMING** No. of Credits: **2**
Code No. : **18AMAA23P** No. of Teaching Hours: **3**

Course Objectives:
The student should be made to

- Enhance problem solving and programming skills in java with extensive programming projects

Course Content:

1. Mathematical Operations
2. Matrix Manipulation
3. Student Mark list using Multilevel Inheritance
4. Employee details using Multiple Inheritance
5. Packages
6. Constructors
7. Thread
8. Thread using run able interface
9. Applet
10. Displaying different shapes using Applet

Course Outcomes:
On successful completion of the course, the students will be able to

CO1 - Use the characteristics of an object-oriented programming language.

CO2- Program using Java features such as composition of objects, Operator overloading, inheritance, polymorphism etc.

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Title of the subject: **TOPOLOGY** No. of Credits: **4**
Code No.: **18AMAA33A** No. of Teaching Hours: **5**

Course Objectives:
The student should be made to

- Introduce the fundamental concepts of topology and investigate properties of topological spaces.

UNIT I: TOPOLOGICAL SPACES
Basis for a Topology – The Order Topology– The product Topology on X x Y- The Subspace Topology- Closed Sets and Limit Points.

UNIT II : CONTINUOUS FUNCTIONS
The Product Topology – The Metric Topology.

UNIT III : CONNECTEDNESS AND COMPACTNESS
Connected Spaces – Connected sets in R-Components and Path Components – Local Connectedness – Compact Spaces – Limit Point Compactness– Local Compactness.

UNIT IV: COUNTABILITY AND SEPARATION AXIOMS
Countability Axioms–Separation Axioms-Urysohn's Lemma–Urysohn Metrization Theorem.

THE TYCHONOFF THEOREM:
The Tychonoff Theorem – Completely Regular spaces – The Stone-Cech Compactification.

UNIT V: COMPLETE METRIC SPACES
Compactness in Metric Spaces- A space-Filling Curve – Pointwise and Compact Convergence –The Compact –Open Topology.

TEXT BOOK:
1. "Topology A First Course" by **J.R.Munkres**, Prentice Hall of India, New Delhi, 2000.

REFERENCE BOOKS:

1. "Topology" by **J.Dugundji,** Allyn and Bacon, Boston, 1966.
2. "Introduction to Topology and Modern Analysis" by **G.F.Simmons**, McGraw-Hill Book Company, New York, 1963.
3. " General Topology" by **J.L.Kelley,** Van Nostrand Reinhold Co., New York,1995.
4. "General Topology" by **R.Engelking**, Polish Scientific Publishers, Warszawa, 1977.
5. "Elements of General Topology" by **S.T.Hu,** Holden – Day, Inc., San Francisco, 1965.

Course Outcomes:
On successful completion of the course, the students will be able to
CO 1 –Know the various topological properties of sets.
CO 2 – Know the properties of continuous functions on different topological spaces.
CO 3 –Connected and compact topological spaces and its properties.
CO 4 –Various theorems on normal spaces and complete metric spaces.

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Title of the Subject : **FLUID DYNAMICS** No.of Credits **: 4**
Code No. **: 18AMAA33B** No. of Teaching hours**: 5**

Course Objectives:
The student should be made to
- Introduce fundamental aspects of fluid flow behavior.

UNIT I : BERNOULL'S EQUATION
Introductory Notions – Velocity- Stream Lines and Path Lines- Stream Tubesand Filaments- Fluid Body- Density- Pressure - Differentiation following the Fluid-Equation of continuity- Boundary conditions-Kinematical and physical- Rate of change of linear momentum- Equation of motion of an inviscid fluid.

UNIT II: EQUATIONS OF MOTION
Euler's momentum Theorem-Conservative forces-Bernoulli's theorem in steady motion - energy equation for inviscid fluid- circulation - Kelvin‟s theorem - vortex motion – Helmholtz equation.

UNIT III: TWO DIMENSIONAL MOTION
Two Dimensional Potential Functions- Complex Basic singularities-Source-Sink-Vortex-Doublet-past a circle theorem-Flow circular cylinder with circulation-Blasius theorem- Lift force(Magnus effect)

UNIT IV: VISCOUS FLOWS
Navier-Stokes equations- some exact solutions of Navier Stokes equations- Flow between parallel flat plates- Couette flow- Plane Poiseuille flow- Steady flow in pipes: Flow through a pipe- The Hagen Poiseuille flow.

UNIT V: LAMINAR BOUNDARY LAYER IN INCOMPRESSIBLE FLOW
Boundary Layer concept – Boundary Layer equations – Boundary Layer along a flat plate – The Blasius solution – Shearing stress and boundary layer thickness – Displacement thickness, momentum thickness- Momentum integral theorem for the boundary layer – The Von-Karman Integral relation – The Von-Karman Integral relation by momentum law.

TEXT BOOKS:

1. "Theoretical Hydrodynamics" (Fifth Edition) by **L.M.Milne Thomson**, Macmillan Company, London, 1968.

2. "Modern Fluid Dynamics" by **N.Curle and H.J.Davies**, Vol-I, David Van Nostrand Company, London, 1968 .

3. "Foundations of Fluid Mechanics" by **S.W.Yuan**, Prentice –Hall, New Delhi, 1976.

REFERENCE BOOKS:

1. "Textbook of Fluid Dynamics" by **F.Chorlton**, CBS Publishers & Distributors, New Delhi, 2004.
2. "Fluid Mechanics with Problems and Solutions and an Aerodynamics Laboratory" by **E.Krause**, Springer, Berlin, 2005.
3. "Introduction to Fluid Mechanics" by **R.W.Fox and A.T.McDonald**, Wiley, New York, 1985.

Course Outcomes:
On successful completion of the course, the students will be able to
CO1 - Identify how properties of fluids change with temperature and their effect on Pressure and fluid flow.
CO2- Use the general energy equation to calculate changes in fluid flow for circular and Non-Circular pipes for in-compressible fluids.

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Title of the Subject**: MATHEMATICAL METHODS** **No. of credits : 4**
Code No. **: 18AMAA33C** **No. of Teaching hours : 5**

Course objectives:
The student should be made to
- Introduce the basic concepts and theorems on transforms.
- Know about types of integral equations and its applications.
- Study about calculus of variations.

Unit-I : INTEGRAL EQUATIONS
Introduction: Integral equations with separable kernels - Reduction to a system of algebraic equations, Fredholm alternative, an approximate method, Fredholm integral equations of the first kind, method of successive approximations - Iterative scheme, Volterra integral equation, some results about the resolvent kernel, classical Fredholm theory - Fredholm's method of solution - Fredholm's first, second, third theorems.

Unit-II : APPLICATIONSOF INTEGRAL EQUATIONS

Application to ordinary differential equation - Initial value problems, boundary value problems - Singular integral equations - Abel integral equation.

Unit-III: CALCULUSOF VARIATIONS

Themethod of variations in problems with fixed boundaries:Variation and its properties - Euler's equation - Functionals of the form $\int F(x,y1,y2,..., yn,y1',y2',...yn')dx$, Functionals dependent on higher order derivatives – Functionals dependent on the functions of several independent variables - Variational problems in parametric form - Some applications.

Unit-IV: SUFFICIENT CONDITIONS FOR AN EXTREMUM

Field of extremals - The function E(x,y,p,y') -Transforming the Euler equations to the canonical form.

Unit-V: DIRECT METHODS IN VARIATIONAL PROBLEMS

Direct methods - Euler's finite difference method – The Ritz method - Kantorovich's method.

TEXT BOOKS:

1. "Linear Integral Equations - Theory and Technique" by **R.P.Kanwal**, Second Edition, Birkhauser, Boston, 1997.
2. "Differential Equations and the Calculus of Variations" by **L.Elsgolts**, MIR Publishers, Moscow, 1970.

REFERENCES BOOKS:

1. "Integral Equations and Applications" by **C.Corduneanu**, Cambridge University Press, Cambridge, 1991.
2. "Calculus of Variations, with Applications to Physics and Engineering" by **R.Weinstock**, McGraw-Hill Book Co., Inc., New York, 1952.

Course Outcomes:

On successful completion of the course, the students will be able to

CO 1- Know about Fourier and Laplace's transforms.

CO 2- Familiar with Volterra and Fredholm integral equations.

CO 3-Describe the functionals of the integral forms.

Title of the Subject: **MATLAB** No. of credits: 2
Code No. : **18AMAA33D** No of Teaching hours: 3

Course objectives:
The student should be made to

- This course provides basic fundamentals on MATLAB, primarily for numerical computing.
- To learn the characteristics of script files, functions and function files, two-dimensional plots and three-dimensional plots.
- To enhance the programming skills with the help of MATLAB and its features which allow to learn and apply specialized technologies.

UNIT I
Introduction - Basics of MATLAB, Input – Output, File types – Platform dependence – General commands.

UNIT II
Interactive Computation: Matrices and Vectors – Matrix and Array operations – Creating and Using Inline functions – Using Built-in Functions and On-line Help – Saving and loading data – Plotting simple graphs.

UNIT III
Programming in MATLAB: Scripts and Functions – Script files – Functions files-Language specific features – Advanced Data objects.

UNIT IV
Applications – Linear Algebra - Solving a linear system – Finding Eigen values and Eigen vectors – Matrix Factorizations.

UNIT V
Applications – Data Analysis and Statistics – Numerical Integration – ordinary differential equations – Nonlinear Algebraic Equations.

TEXT BOOK:
1. "Getting Started with MATLAB-A Quick Introduction for Scientists and Engineers" by **Rudra Pratap**, Oxford University Press, New Delhi, 2006.

REFERENCE BOOKS:
1. "Introduction to MATLAB 7" by **D.M.Etter and D.C.Kuncicky**, Prentice Hall, New Jersey, 2005.

2. "Introduction to Matlab 7 for Engineers" by **W.J.Palm**, McGraw-Hill Education, New York, 2005.

Course Outcomes:

On successful completion of the course, the students will be able to

CO 1 - It lays foundation for doing matrix manipulations, plotting of functions and data, implementation of algorithms, and creation of user interfaces.

CO 2 - It helps in integrating computation, visualization and programming in an easy to use environment where problems and solutions are expressed in familiar mathematical notations.

CO 3 - This software is a more flexible programming tool for users in order to create large and complex application programs.

CO 4 - It consists of set of tools that facilitates for developing, managing, debugging and profiling M-files, and MATLAB's applications.

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Title of the Subject: **PRACTICAL III:MATLAB** No. of credits: 2

Code No. : **18AMAA33P** No of Teaching hours: 3

Course objectives:

The student should be made to

- To enhance the programming skills with the help of MATLAB and its features which allow to learn and apply specialized technologies.

Programmes

1.Plotting a function.

2.Polar plot.

3.Addition of two matrices.

4.Finding the determinant of a matrix.

5.Finding Eigen values and Eigen vectors of a matrix.

6.Straight line fit.

7.Exponential curve fitting.

8.Solving a first-order linear ODE.

9.Solving a second-order nonlinear ODE.

10.Solving nonlinear algebra equations.

Course Outcomes:

On successful completion of the course, the students will be able to

CO 1 - This software is a more flexible programming tool for users in order to create large and complex application programs.

CO 2 – It consists of set of tools that facilitates for developing, managing, debugging and profiling M-files, and MATLAB's applications.

Title of the subject **: FUNCTIONAL ANALYSIS** No. of Credits**: 4**
Code No.**: 18AMAA43A** No. of Teaching Hours**: 5**

Course Objectives:
The student should be made to

- Introduce the basic concepts and theorems of functional analysis and its applications.

UNIT I: ALGEBRAIC SYSTEMS
Linear spaces and dimension of spaces, linear transformations and linear operators, algebras, normed linear spaces, definition of Banach spaces with examples.

UNIT II: BANACH SPACES
Continuous linear transformations, The Hahn-Banach theorem, The natural imbedding of space N into space N**, open mapping theorem, closed graph theorem, conjugate of an operator, BanachSteinhaus's uniform boundedness theorem.

UNIT III: HILBERT SPACES
Inner product spaces, definition and properties, Schwarz inequality and theorems, orthogonal complements, orthonormal sets, Bessel's inequality, complete orthonormal sets, conjugate space H***.**

UNIT IV: OPERATORS ON HILBERT SPACES
Adjoint of an operator, self-adjoint operators, normal and unitary operators, projections.

UNIT V: FINITE DIMENSIONAL SPECTRAL THEORY
Matrices ,determinants and the spectrum of an operator, the spectral theorem.

TEXT BOOK:

1. "Introduction to Topology and Modern Analysis" by **G.F.Simmons**, Tata McGraw -Hill, New Delhi, 2004

REFERENCE BOOKS:

1. "Functional Analysis: A First Course" by **M.T.Nair**, PHI-Learning (Formerly: Prentice-Hall of India), New Delhi, 2002.

2. "Functional Analysis" by **G.Bachman and L.Narici,** Academic Press, New York, 1966.
3. "First Course in Functional Analysis" by **H.C.Goffman and G.Fedrick**, Prentice Hall of India, New Delhi, 1987.

Course Outcomes:
On successful completion of the course, the students will be able to
CO 1 – Familiar with continuous linear transformations and related theorems.
CO 2 – Know about the Banach and Hilbert spaces and their properties.
CO 3 –Describe the spectral theorem.

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Title of the Subject: NONLINEAR DIFFERENTIAL EQUATIONS No. of credits: 4
Code No. : 18AMAA43B No. of Teaching hours: 5

Course objectives:
The student should be made to
- To discuss nonlinear differential equations and the solution behavior without finding the solutions explicitly.
- Nonlinear systems occur widely in the real world and may produce oscillations or wild chaotic fluctuations even when influenced by a constant external force.
- To develop clear thinking and analyzing capacity for advanced research.

Unit I:
First order systems in two variables and linearization: The general phase plane – Some population models – Linear approximation at equilibrium points – Linear systems in matrix form.

Unit II:
Averaging Methods: An energy balance method for limit cycles – Amplitude and frequency estimates – Slowly varying amplitudes ; Nearly periodic solutions - Periodic solutions: Harmonic balance – Equivalent linear equation by harmonic balance – Accuracy of a period estimate.

Unit III:
Perturbation Methods: Outline of the direct method – Forced oscillations far from resonance Forced oscillations near resonance with weak excitation – Amplitude equation for undamped pendulum – Amplitude perturbation for the pendulum equation – Lindstedt's method- Forced oscillation of a self – excited equation – The Perturbation method and Fourier series.

Unit IV:
Linear systems: Structure of solutions of the general linear system – Constant coefficient system – Periodic coefficients –Floquet theory – Wronskian.

Unit V:

Stability: Poincare stability – Solutions, paths and norms – Liapunov stability- Stability of linearsystems – Comparison theorem for the zero solutions of nearly-linear systems.

TEXT BOOK:

1. "Nonlinear Ordinary Differential Equations" by **D.W.Jordan and P.Smith**, Clarendon Press, Oxford, 1977.

REFERENCES BOOKS:

1. "Differential Equations" by **G.F.Simmons**, Tata McGraw-Hill, New Delhi, 1979.
2. "Ordinary Differential Equations and Stability Theory" by **D.A.Sanchez**, Dover, New York,1968.
3. "Notes on Nonlinear Systems" by **J.K.Aggarwal**, Van Nostrand Reinhold, New York, 1972.

Course Outcomes:

On successful completion of the course, the students will be able to

CO 1 – Understand the correspondence between some population models and mathematical equations via interpretation of population behaviour using equilibrium points.

CO 2 – Solve the nonlinear differential equations and analyse their solution behaviour using averaging methods, perturbation theory, Lindstedt's method and other different techniques.

CO 3 – Master the concepts of stability in different perspectives by practicing many problems.

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Title of the subject **: LATEX AND MATHEMATICA** No. of Credits**: 2**
Code No. **: 18AMAA43C** No. of Teaching Hours**: 3**

Course Objectives:

The student should be made to

- Format words, lines, and paragraphs, design pages, create lists, tables, references, and figures in LATEX.
- Creating a table of contents and lists of figures and tables; as well as how to cite books, create bibliographies, and generate an index.
- Enter queries through free-form input and the Wolfram Language, create notebooks, perform symbolic and numeric calculations, create interactive Manipulates and analyzing data

Unit – I

Commands and Environments:Command names and arguments-Environments-Declarations-Special Characters, Document layout and organization – Document class, Page style, Parts of the document. Displayed text: Changing font- Centering and indenting, Lists, Theorem–like declarations, Boxes, Tables, footnotes and marginal notes.

Unit – II

Mathematical formulas : Mathematical environments, Main elements of math mode, Mathematical symbols, Additional elements, Fine–tuning mathematics, Drawing pictures with LATEX.

Unit – III

Introduction To Mathematica : Running Mathematica - Numerical calculations – Building up calculations – Using the Mathematica system – Algebraic calculations - Symbolic mathematics - Numerical mathematics.

Unit – IV

Advanced Mathematics In Mathematica**:** Numbers - Mathematical functions – Algebraic manipulation – Manipulating equations - Calculus.

Unit – V

Series, limits and residues - Linear algebra.

TEXT BOOKS:

1. "A Guide to LATEX" (Third Edition) by **H.Kopka** and **P.W.Daly**, Addison Wesley, London, 1999.
2. "The Mathematica Book" (Fourth Edition) by **S.Wolfram**, Cambridge University Press, Cambridge, 1999.

REFERENCES BOOKS:

1. "Math into LATEX" by **G.Gratzer**, Birkhauser, Boston, 1996.
2. " Mathematica by example" (Fifth Edition) by **M.L.Abell and J.P.Braselton**, Acamedic press, London, 2017.

Course Outcomes:

On successful completion of the course, the students will be able to

CO 1- Use LaTeX and various templates acquired from the course to compose Mathematical documents, presentations, and reports

CO 2 - Use integrals to formulate and solve application problems in science and engineering

CO 3 - Solve mathematical problems using analytical methods.

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Title of the subject **: PRACTICAL IV:LATEX AND MATHEMATICA** No. of Credits**: 2**
Code No. **: 18AMAA43P** No. of Teaching Hours**: 3**

Course Objectives:
The student should be made to

- LaTeX is a document typesetting system that is used to produce high quality scientific documents, like articles, books, dissertations and technical reports.
- Information about numbers and precision in the Wolfram Language, algebraic manipulation, equation solving, calculus functions, symbolic calculation, numerical computation, interpolation and data fitting, probability and statistics.

LAB LIST

LaTex

1. Test the basic operations of running the LaTex program
2. To display the text
3. Theorem-like declarations
4. Constructing tables
5. To display Mathematical formulas
6. To display matrices
7. To create single picture and diagrams

MATHEMATICA

1. Numerical Calculations
2. Mathematical Functions
3. Algebraic Calculations
4. Symbolic Mathematics
5. Symbolic Mathematics – Solving Equations
6. Numerical Mathematics
7. Functions
8. Lists
9. Graphics-Two Dimensional Plots
10. Graphics – Three Dimensional Plots
11. Input and Output in Notebooks
12. Input and Output forms.

Course Outcomes:
On successful completion of the course, the students will be able to

CO 1-Use various methods to either create or import graphics into a LaTeX document.

CO2- Apply the core numeric functions of the Wolfram Language, Control and customize numerical algorithms, Monitor numerical methods while they are running.

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NUMERICAL METHODS

Course Objectives:

The student should be made to

- Various topics in Numerical Analysis such as solutions of nonlinear equations in one variable, interpolation and approximation, numerical differentiation and integration, direct methods for solving linear systems, numerical solution of ordinary differential equations.
- Understand the basic concepts to solve the Numerical problems.

UNIT I: SOLUTION OF NONLINEAR EQUATIONS

Newton's method – Convergence of Newton's method – Bairstow's Method for quadratic factors.

NUMERICAL DIFFERENTIATION AND INTEGRATION

Derivatives from Differences tables – Higher order derivatives – Divided difference, Central- Difference formulas – Composite formula of Trapezoidal rule – Romberg integration – Simpson's rules.

UNIT II: SOLUTION OF SYSTEM OF EQUATIONS

The Elimination method – Gauss and Gauss Jordan methods–LU Decomposition method – Matrix inversion by Gauss-Jordan method – Methods of Iteration – Jacobi and Gauss Seidal and Relaxation method – Systems of Nonlinear equations.

UNIT III: SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS

Taylor series method – Euler and Modified Euler methods – Runge Kutta methods (Second and Fourth order) – Multistep methods – Milne's method – Adams Moulton method.

UNIT IV: BOUNDARY VALUE PROBLEMS AND CHARACTERISTIC VALUE PROBLEMS

The shooting method – solution through a set of equations – Derivative boundary conditions – Characteristic value problems – Eigen values of a matrix by Iteration – The power method.

UNIT V: NUMERICAL SOLUTION OF PARTIAL DIFFERENTIAL EQUATIONS

(Solutions of Elliptic, Parabolic and Hyperbolic partial differential equations) Representation as a difference equation – Laplace's equation on a rectangular region – Iterative methods for Laplace equation – The Poisson equation – Derivative boundary conditions – Solving the equation for time-dependent heat flow (i) The Explicit method (ii) The Crank Nicolson method – solving the wave equation by Finite Differences.

TEXT BOOK:

1. "Applied Numerical Analysis" (Fifth Edition) by **C.F.Gerald and P.O.Wheatly**, Addison Wesley, London, 1998.

REFERNCE BOOKS:

1. "Numerical Methods for Engineers" by **S.C.Gupta** and **P.C.Raymond**, Tata McGraw Hill, New Delhi, 2000.
2. "Numerical Analysis" (Fourth Edition) by **R.L.Burden** and **J.D.Faires**, P.W.S.Kent Publishing Company, Boston, 1989.
3. "Introductory methods of Numerical Analysis" by **S.S.Sastry**, Prentice Hall of India, New Delhi, 1998.
4. "Numerical Methods" by **P.Kandasamy, K.Thilagavathy** and **K.Gunavathi**, S. Chand & Company Ltd., New Delhi, 2003.

Course Outcomes:

On successful completion of the course, the students will be able to

CO 1- Apply numerical methods to obtain approximate solutions to mathematical problems.

CO 2 - Know the basics of numerical methods to solve nonlinear equations, system of equations, Ordinary differential equations and Partial differential equations.

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NUMBER THEORY AND CRYPTOGRAPHY

Course Objectives:

The student should be made to

- Provide an introduction to basic number theory.
- Know about Computational aspects in cryptography.

UNIT I : DIVISIBILITY AND CONGRUENCE

Divisibility – Primes - Congruence's – Solutions of Congruence's – Congruence's of Degree one.

UNIT II: SOME FUNCTIONS OF NUMBER THEORY

Arithmetic functions –The Mobius inverse formula – The multiplication of arithmetic functions.

UNIT III: SOME DIAPHANTINE EQUATIONS

The equation ax + by= c – positive solutions – Other linear equations – The equation $x^2 + y^2 = z^2$ -The equation $x^4 + y^4 = z^4$ Sums of four and five squares – Waring's problem – Sum of fourth powers – Sum of Two squares.

UNIT-VI: CRYPTOGRAPHY

Some simple crypto systems - Enciphering matrices

UNIT-V: PUBLIC KEY CRYPTOGRAPHY

The idea of public key cryptography - RSA - Discrete log - Knapsack

TEXT BOOKS:

1. "An Introduction to the Theory of Numbers" (Third edition) by **I.Niven** and **H.S.Zuckerman**, Wiley Eastern Ltd., New Delhi, 1989.
2. "A Course in Number Theory and Cryptography" (Second Edition) by **N.Koblitz**, Springer-Verlag, New York, 2002.

REFERENCE BOOKS:

1. "Elementary Number Theory" by **D.M.Burton**, Universal Book Stall, New Delhi 2001.
2. "A Classical Introduction to Modern Number Theory" by **K.Ireland and M.Rosen**, Springer Verlag, New York, 1972.
3. "Introduction to Analytic Number Theory" by **T.M.Apostol**, Narosa Publishing House, Chennai,1980.
4. "Cryptography and Network Security: Principles and Practice" (Fifth Edition) by **W.Stallings**, Pearson, New Jersey, 2010.

Course Outcomes:

On successful completion of the course, the students will be able to

CO 1 - Apply mathematical concepts and principles to perform numerical and symbolic computations.

CO 2 - Use technology appropriately to investigate and solve mathematical and statistical problems.

FUZZY SETS AND FUZZY LOGIC

Course Objectives:

The student should be made to

- Understand the basic knowledge of fuzzy sets and fuzzy logic.
- To gain knowledge in fuzzy relations and fuzzy measures.
- Be exposed to basic fuzzy system Applications.

Unit I : CRISP SETS AND FUZZY SETS

Crisp Sets, Fuzzy Sets (basic types), Fuzzy Sets (basic concepts); Representation of fuzzy sets; Decompositions theorems; Extension principle for fuzzy sets. Operations on fuzzy sets (Fuzzy compliment, Intersection and union); Combinations of operations.

Unit II: FUZZY RELATIONS

Crisp and fuzzy relations- Projections; Binary fuzzy relations; Binary relations on a single set, Fuzzy equivalence relations, Fuzzy compatibility relations, Fuzzy ordering relations, Fuzzymorphism, Sup-i compositions of binary fuzzy relations, Inf-w_i compositions of fuzzy relations.

Unit III: FUZZY MEASURES

Possibility theory, Fuzzy measure, Evidence theory, possibility theory, Fuzzy sets and possibility theory.

Unit IV: FUZZY LOGIC

Fuzzy logic, Classical logic, Multivalued logic, Fuzzy propositions, Fuzzy quantifiers, Linguistic Hedges, Inference from conditional fuzzy propositions, Inference from Conditional and Qualified Propositions, Inference from Quantified Propositions.

UNIT V: APPLICATIONS

Natural, life and Social Sciences - Engineering - Medicine - Management and decision making – Computer Sciences.

TEXT BOOKS:

1. **"**Fuzzy Sets and Fuzzy Logic**"** by **G.J.Klir and B.Yuan**, Prentice Hall of India, New Jersey, 1988.

2. "Fuzzy Sets, Uncertainty and Information" by **G.J.Klir and T.A.Folger**, Prentice-Hall of India, Noida, 2015.

REFERENCE BOOKS:

1. "Fuzzy Set Theory and Its Applications" by **H.J.Zimmerman**, Kluwer Academic publishers, Boston, 1985.
2. "Fuzzy Sets and Systems: Theory and Applications*"* by **D.Dubois** and **H.M.Prade**, Academic Press, New York, 1994.
3. "Fuzzy Logic with Engineering Applications*"* by **T.J.Ross**, John wiley & sons, Chichester, 2010.
4. "An Introduction to Fuzzy Logic and Fuzzy Sets*"* by **J.J.Buckley** and **E.Eslami**, Springer-Verlag Heidelberg, 2002.

Course Outcomes:

On successful completion of the course, the students will be able to

CO 1- Know about fuzzy sets and operations.

CO 2- Familiar with fuzzy relations and the properties of these relations.

CO 3- Apply a new thinking methodology to real life problems including engineering ones.

CONTROL THEORY

Course objectives:

The student should be made to

- To learn the basic principles underlying the analysis and designing of control systems often being a continuously operating dynamical system using a control action in an optimum manner.

- Familiar with the control theory concepts and properties including observability, controllability, stability and stabilizability.

Unit-I: OBSERVABILITY

Linear Systems – Observability Grammian – Constant coefficient systems –Reconstruction kernel – Nonlinear Systems.

Unit-II: CONTROLLABILITY

Linear systems – Controllability Grammian – Adjoint systems – Constant coefficient systems–Steering function – Nonlinear systems.

Unit-III: STABILITY

Stability – Uniform stability – Asymptotic stability of linear systems - Linear time-varying systems – Perturbed linear systems – Nonlinear systems.

Unit-IV: STABILIZABILITY

Stabilization via linear feedback control – Bass method – Controllable subspace – Stabilization with restricted feedback.

Unit-V: OPTIMAL CONTROL

Linear time varying systems with quadratic performance criteria – Matrix Riccati equation – Linear time invariant systems – Nonlinear Systems.

TEXT BOOK:

1. "Elements of Control Theory" by **K.Balachandran and J.P.Dauer**, Narosa Publishing House, New Delhi, 1999.

REFERENCES BOOKS:

1. "Linear Differential Equations and Control" by **R.Conti**, Academic Press, London, 1976.
2. "Functional Analysis and Modern Applied Mathematics" by **R.F.Curtain** and **A.J. Pritchard**, Academic Press, New York, 1977.
3. "Controllability of Dynamical Systems" by **J.Klamka**, Kluwer Academic Publisher, Dordrecht, 1991.

4. "Mathematics of Finite Dimensional Control Systems" by **D.L.Russell**, Marcel Dekker, New York, 1979.

Course Outcomes:

On successful completion of the course, the students will be able to

CO 1 - The concept of controllability and observability are two important properties of state models which are to be studied prior designing a controller since they are dual aspects of the same problem.

CO 2 - The field of control theory consists of linear and nonlinear control systems together With some mathematical techniques for analyzing and designing of appropriate control policies.

CO 3 - To deal with the problem of finding a control law for a given system, the use of Optimal control theory provides a mathematical optimization method such that a certain optimality criterion is achieved.

CO 4 - Understanding and learning how control theory underpins modern technologies and provides an insight in mathematical analysis.

STOCHASTIC PROCESSES

Course Objectives

The student should be made to

- This course covers Markov processes, Renewal processes and branching processes with an emphasis on model building

UNIT I: MARKOV AND STATIONARY PROCESSES

Specification of Stochastic Processes – Stationary Processes – Poisson Process Generalizations – Birth and Death Processes – Markov Chain – Erlang Process

UNIT II:RENEWAL PROCESSES

Renewal processes in discrete and continuous time – Renewal equation – Stopping time – Wald's equation – Renewal theorems – Delayed and Equilibrium renewal– processes Residual and excess life times – Renewal reward process – Alternating renewal process – Regenerative stochastic process

UNIT III: MARKOV RENEWAL AND SEMI – MARKOV PROCESSES

Definition and preliminary results – Markov renewal equation – Limiting behaviour -First passage time.

UNIT IV: BRANCHING PROCESSES

Generating functions of branching processes – Probability of extinction – Distribution of total number of progeny – Generalization of classical Galton – Watson process – Continuous time Markov branching process – Age dependent branching process –Bellman - Harris process

UNIT V: MARKOV PROCESSES WITH CONTINUOUS STATE SPACE

Brownian motion – Weiner process – Kolmogorov equations - First passage time distribution for Weiner process – Ornstein – Uhlenbeck process

TEXT BOOK :

5. "Stochastic Processes"(Second Edition) by **J.Medhi**, New Age International, New Delhi, 2001.

REFERENCES:

1. "Elements of Applied Stochastic Processes"(Second Edition) by **U.N.Bhat**, John Wiley and Sons, Chichester ,1984.
2. "The theory of Stochastic Process" by **D.R.Cox and H.D.Miller**, Methuen, London, 1965.
3. "Stochastic Processes" (Second Edition) by **S.M.Ross**, Wiley, New York, 1996.
4. "A First Course in Stochastic Processes" "(Second Edition) by **S.Karlin and H.M. Taylor**, Academic press, New York, 1975.

Course Outcomes:

On successful completion of the course, the students will be able to

CO 1 – Know the basics knowledge about stochastic process.

CO 2 - Acquire more detailed knowledge about Markov Process with discrete and continuous state space.

MATHEMATICAL STATISTICS

Course Objectives:

The student should be made to

- Understand knowledge of probability and the standard statistical distributions.

UNIT I: SAMPLING DISTRIBUTIONS AND ESTIMATION THEORY

Sampling distributions – Characteristics of good estimators – Method of Moments – Maximum Likelihood Estimation – Interval estimates for mean, variance and proportions.

UNIT II: TESTING OF HYPOTHESIS

Type I and Type II errors - Tests based on Normal, t, Chi-square and F distributions for testing of mean, variance and proportions – Tests for Independence of attributes and Goodness of fit.

UNIT III: CORRELATION AND REGRESSION

Method of Least Squares - Linear Regression – Normal Regression Analysis – Normal Correlation Analysis – Partial and Multiple Correlation - Multiple Linear Regression.

UNIT IV: DESIGN OF EXPERIMENTS

Analysis of Variance – One-way and two-way Classifications – Completely Randomized Design – Randomized Block Design – Latin Square Design.

UNIT V: MULTIVARIATE ANALYSIS

Covariance matrix – Correlation Matrix – Normal density function –Principal components – Sample variation by principal components – Principal components by graphing.

TEXT BOOKS:

1. "Mathematical Statistics" (Fifth Edition) by **J.E.Freund**, Prentice Hall of India, New Jersey, 1992.
2. "Applied Multivariate Statistical Analysis" (Fifth Edition) by **R.A.Johnson** and **D.W. Wichern**, Prentice Hall, New Jersey, 2002.

REFERENCE BOOK:

1. "Fundamentals of Mathematical Statistics"(Eleventh Edition) by **S.C.Gupta** and **V.K.Kapoor,** Sultan Chand & Sons, New Delhi, 2003.

Course Outcomes:

On successful completion of the course, the students will be able to

CO 1 - Solve mathematical and statistical problems.

CO 2- Explain the concepts of sampling distributions.

CO 3- Understand the concept of testing of hypothesis and derives the likelihood and associated functions of interest for simple models.

FUNDAMENTALS OF ACTUARIAL MATHEMATICS

Course Objectives:

The student should be made to

- Define and use standard actuarial functions involving several lives
- Experience in life insurance premiums

UNIT I: ANNUITIES

Certain- present Values- Amounts - Deferred Annuities –Perpetuities - Present Value of an Immediate Annuity Certain – Accumulated Value of Annuity – Relation between Sn and an – Present Value of Deferred Annuity Certain – Accumulated Value of a term of n-years – Perpetuity – Present Value of an Immediate Perpetuity of 1p.a. – Present Value of a Perpetuity due of 1 p.a. – Deferred Perpetuity with Deferment Period of m years – Mortality Table – The Probabilities of Survival and Death.

UNIT II: LIFE INSURANCE PREMIUMS

General considerations - Assurance Benefits – Pure Endowment Assurance – Endowment Assurance – Temporary Assurance or Term Assurance - Whole Life Assurance – Pure Endowment Assurance – Endowment Assurance – Double Endowment Assurance – Increasing Temporary Assurance – Increasing Whole Life Assurance – Commutation Functions Dx, Cx, Mx and Rx – Expressions for Present Values of Assurance Benefits in terms of Commutation Functions – Fixed Term (Marriage) Endowment – Educational Annuity Plan.

UNIT III: LIFE ANNUITIES AND TEMPORARY ANNUITIES

Commutation Functions Nx – To Find the Present Value of an Annuity Due of Re.1 p.a. for Life – Temporary Immediate Life Annuity – Expression for ax: n – Deferred Temporary Life Annuity – Variable Life Annuity – Increasing Life Annuity – Commutation Function Sx – Increasing Temporary Life Annuity – Tables of Life Annuity and Temporary Life Annuity – Variations in the Present Values of Annuities – Life Annuities Payable at Frequent Intervals.

UNIT IV: NET PREMIUMS FOR ASSURANCE PLANS

Natural Premiums – Level Annual Premium – Symbols for Level Annual Premium under Various Assurance Plans – Mathematical Expressions for level Annual Premium under Level Annual Premium under Various Plans for Sum Assure of Re. 1 – Net Premiums – Consequences of charging level Premium – Consequences of withdrawals – Net Premiums for Annuity Plans – Immediate Annuities – Deferred Annuities.

UNIT V: PREMIUM CONVERSION TABLES

Single Premium Conversion tables – Annual Premium Conversion Tables – Policy Values – Two kinds of Policy values – Policy value in symbols – Calculation of Policy Value for Unit Sum Assure – Numerical Example : Retrospective Method and Comparison with Prospective

Value – Derivative of Theoretical Expressions for Policy Value, tVx by the Retrospective Method and Prospective Method – Other Expressions for Policy Value – Surrender Values – Paid up Policies – Alteration of Policy Contracts.

TEXT BOOK:

1."Mathematical Basis of Life Assurance" by **S.P.Dixit and C.S.Modi**, Insurance Institute of India, Mumbai, 1998.

REFERENCE BOOKS:

1. "Fundamentals of Actuarial Mathematics" (Second Edition) by **S.D.Promislow**, John Wiley and sons, Chichester, 2011.

Course Outcomes:

On successful completion of the course, the students will be able to
CO 1- Know the basic knowledge about Actuarial Mathematics.
CO 2- Acquire more knowledge about Premium Conversion.

MAGNETO HYDRODYNAMICS

Course Objectives:

The student should be made to

- Introduce the Definition of electromagnetism, MHD basis, one and two fluid equations, equilibrium and stability; equations of kinetic theory; derivation of fluid equations and stabilities.

Unit I: ELECTROMAGNETISM

Fundamental Laws – Electrostatic Energy – Electrodynamics – Ampere's Law – Lorentz force on a moving charge – Magnetostatic Energy – Faraday's Law of Induction – Poynting stresses – Electromagnetic Equations with respect to moving axes – boundary conditions of electric and magnetic fields

Unit II: KINEMATICS OF FLUID MOTION

Equation of continuity – Stress tensor – Navier stokes equations – boundary condition – Velocity Magneto fluid dynamic equations – MHD approximation – equation of Magnetic diffusion in a moving conducting medium – Magnetic Reynolds number

Unit III: MAGNETO HYDROSTATICS

Alfven's theorem Law of isorotation - Magneto hydrostatics – Force-free field
-Alfven waves in incompressible MHD.

Unit IV: INCOMPRESSIBLE VISCOUS FLOWS IN THE PRESENCE OF MAGNETIC FIELD

Hartmann Flow– Unsteady Hartmann flow – Magnetofluid dynamic pipe flow

Unit V: STABILITY

Instability of linear pinch – Sausage and flute types –Method of small oscillations – gravitational instability

TEXT BOOKS:

1. **"**Magnetofluid Dynamics for Engineers and Applied Physicists" by **K.R.Crammer** and **S.I.Pai**, McGraw Hill, New York, 1973.
2. **"**Introduction to Magneto Fluid Dynamics"(Second Edition) by **V.C.A.Ferraro** and **C**.**Plumpton,** Clarendon Press, Oxford ,1966.

REFERENCE BOOK:

1. "Ideal Magneto hydrodynamics" by **J.P.Freidberg**, Plenum Press, New York ,1987.

Course Outcomes:

On successful completion of the course, the students will be able to

CO1- Describe and explain the domains of validity of one-fluid MHD.

CO2- Demonstrate the basic properties of MHD.

DISCRETE MATHEMATICS

Course Objectives:

The student should be made to

- Simplify and evaluate basic logic statements including compound statements, implications, inverses, converses and contrapositives using truth tables and the properties of logic.
- Apply the operations of sets by using Venn diagrams.
- Solve problems using the principle of inclusion-exclusion.

UNIT I: LOGIC

Propositions – Logical Connectives - Compound statements – Conditional and Biconditional Propositions – Truth tables – Tautologies and Contradictions – Logical equivalence and implications – Demorgan's Law – Normal forms – PDNF and PCNF – Predicate Calculus – Free and bound variables – Quantifiers – Universe of discourse – Theory of inference– Rules of universal specification and generalization – Arguments – Validity of Arguments.

UNIT II: SET THEORY

Basic concepts – Notations –Algebra of sets – The power sets – Ordered pairs and Cartesian products–Relation and its types – Properties –Relational Matrix and the graph of relation – Partitions–Equivalence relations – Poset-Hasse diagram – Lattices and their properties – Sublattice – Boolean Algebra – Homomorphism.

UNIT III: FUNCTIONS Definitions of functions and its Classification – Types –Examples – Composition of functions – Inverse functions – Binary and unary operations – Characteristic function of a set – Hashing functions – Recursive functions – Permutation functions.

UNIT IV: GRAPH THEORY

Graph Introduction – Basic terminology – Representation of graphs –connectivity – Eulerian and Hamiltonian graphs – Planar graphs- Directed graphs-Application of Graphs. Binary tree – traversals of a binary tree – Expansion trees.

UNIT V: GRAMMARS AND LANGUAGES

Definitions – Types of Grammars – Productions – Regular Grammar and Languages– Finite state Automata (FSA) – Deterministic and Non-Deterministic FSA – Conversion of NDFSA to DFSA.

TEXT BOOK:

1. "Discrete Mathematical Structures with applications to Computer Science" by **J.P Trembley** and **R.Manohar**, Tata Mc Graw-Hill, New Delhi, 2003.

REFERNCE BOOKS:

1. "Discrete and Combinatorial Mathematics : an Introduction" (Fourth Edition) by **R. P.Grimmaldi**, Perarson Education, Asia, Delhi, 2002.
2. Introduction to Automata Theory, "Languages and Computation" by **J.E.Hopcroft, R.Motwani** and **J.D.Ullman**, Pearson Edition, Delhi, 2008.
3. "Applied discrete structures for Computer Science" by **A.Doerr** and **K.Levasseur**, Galgotia publications, New Delhi, 2000.

Course Outcomes:

On successful completion of the course, the students will be able to

CO 1 - express a logic sentence in terms of predicates, quantifiers, and logical connectives.

CO2 – apply the rules of inference.

CO 3 - use tree and graph algorithms to solve problems.

Supportive-I

Title of the Subject **: NUMERICAL METHODS** **N**o. of Credits **: 2**
Code No. **: 18GS01** No. of Teaching hours**: 2**

Course Objectives:
The student should be made to

- Solve the non-linear equations.
- Understand the concepts of interpolation, differentiation and integration.

UNIT I SOLUTION OF NUMERICAL ALGEBRAIC AND TRANSCENDENTAL EQUATIONS
The Bisection Method – Method of Successive approximation -Regula falsi Method- Newton's Raphson Method - Convergence of Newton's Method and rate of Convergence.

UNIT II SOLUTION OF SIMULTANEOUS LINEAR ALGEBRAIC EQUATION
Gauss elimination method-Gauss Jordan method – Jacobi Iterative method - Gauss Seidal method - Comparison of Gauss elimination and Gauss Seidal Iteration Method.

TEXT BOOKS:

1. "Numerical Methods in Science and Engineering" by **M.K.Venkataraman**, The National Publishing company, Chennai, 1990.
2. "Numerical Methods" by **P. Kandasamy ,K.Thilagavathy, K.Gunavathi,** Sultan Chand & Company Ltd., New Delhi, 2003.

Course Outcomes:
On successful completion of the course, the students will be able to
CO 1- Describe and implement common methods for root-finding.
CO 2 - Demonstrate techniques for the solution of linear simultaneous equations.

Supportive-II

Title of the Subject :**DIFFERENTIAL EQUATIONS**

AND TRANSFORMS No.of Credits **: 2**

Code No.**:18GS45** No. of Teaching hours**: 2**

Course Objectives:
The student should be made to

- Learn to solve first-order differential equations.
- Learn to use Laplace transform methods to solve differential equations.
- Understand how the Fourier series is extended to a periodic signals in the form of Fourier transform

UNIT I: LAPLACE TRANSFORM

Laplace transform-conditions for existence-Transforms of elementary functions-Basic properties-Transform of derivatives and Integrals. Statement of Fourier integral theorem - Fourier transform pair-Sine and Cosine transforms-Properties. Z-Transform-Elementary properties.

UNIT II: DIFFERENTIAL EQUATIONS

Definition of Differential Equations – degree – order - Solutions of Differential equation – Exact Differential equations: Sufficient Condition - Practical rule for solving an exact differential equation - rules for finding integrating factors – Equations of the first order, but of higher degree- equations solvable for y - equations solvable for x - Clairaut's form.

TEXT BOOKS:

1. "Calculus-Volume II" by **S.Narayanan** and **T.K.Manicavachagam Pillay,** S.Viswanathan Printers and Publishers, Chennai 1996.
2. "Engineering Mathematics –II" by**G.Balaji**, G. Balaji Publishers, Chennai, 2011.
3. "Transforms and Partial Differential Equations" by **Dr.A.Singaravelu**, Meenakshi Agency, Chennai, 2015.

Course Outcomes:
On successful completion of the course, the students will be able to
CO 1- Solve basic application problems described by first order differential equations.
CO 2- Find the Laplace transform of a function using the definition.
CO 3- Calculate the Fourier transform of elementary functions from the definition.

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