BHARATHIAR UNIVERSITY, COIMBATORE.
M. Sc. MATHEMATICS DEGREE COURSE (AFFILIATED COLLEGES)
(For the candidates admitted from the academic year 2017-18 onwards)

SCHEME OF EXAMINATIONS – CBCS PATTERN

Sem.	Study Components	Course title	Ins. hrs/ week	Examinations				Credit
				Dur.Hrs	CIA	Marks	Total Marks	
I	Paper 1	Algebra	7	3	25	75	100	4
	Paper 2	Real Analysis	7	3	25	75	100	4
	Paper 3	Ordinary Differential Equations	6	3	25	75	100	4
	Paper 4	Numerical Methods	6	3	25	75	100	4
	Elect. Paper I		4	3	25	75	100	4
II	Paper 5	Complex Analysis	6	3	25	75	100	4
	Paper 6	Partial Differential Equations	7	3	25	75	100	4
	Paper 7	Mechanics	7	3	25	75	100	4
	Paper 8	Operations Research	6	3	25	75	100	4
	Elect. Paper II		4	3	25	75	100	4
III	Paper 9	Topology	7	3	25	75	100	4
	Paper 10	Fluid Dynamics	7	3	25	75	100	4
	Paper 11	Mathematical Statistics	6	3	25	75	100	4
	Paper 12	Graph Theory	6	3	25	75	100	4
	Elect. Paper III		4	3	25	75	100	4
IV	Paper 13	Functional Analysis	7	3	25	75	100	4
	Paper 14	Mathematical Methods	7	3	25	75	100	4
	Paper 15	Computer Programming (C++ Theory)	4	3	25	75	100	4
	Practical	Computer Programming (C++ Practical)	2	3	40	60	100	4
	Paper 16	Number Theory	6	3	25	75	100	4
	Elect. Paper IV		4	3	25	75	100	4
	Project						150*	6
		Total					2250	90

*** For Project report – 120 marks, Viva-voce – 30 marks.**

LIST OF ELECTIVES

1. Magnetohydro Dynamics
2. Control Theory
3. Differential Geometry
4. Fuzzy Logic and Fuzzy Sets
5. Cryptography
6. Neural Networks
7. Stochastic Differential Equations
8. MATLAB**
9. LaTex**

Note : The syllabus for all the above papers (except Paper IX – TOPOLOGY, Paper XV – Computer programming (C++ Theory), Elective 8: MATLAB, Elective 9: LaTex) be the same as prescribed for the academic year 2015-16. The syllabus for the papers, Paper IX – TOPOLOGY, Paper XV – Computer programming (C++ Theory) and the syllabus for all the Elective papers are furnished below.
** Theory – 2 hrs – 75 Marks (20 CIA +55 External)
Practical – 2 hrs – 25 Marks (10 CIA +15 External)

ELECTIVE PAPERS

ELECTIVE 1. MAGNETOHYDRO DYNAMICS

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.

Unit II:
Electromagnetic Equations with respect to moving axes – boundary conditions of electric and magnetic fields. Kinematics of fluid motion – equation of continuity – Stress tensor – Navier-stokes equations – boundary condition – Velocity Magneto fluid dynamic equations.

Unit III:
MHD approximation – equation of Magnetic diffusion in a moving conducting medium – Magnetic Reynolds number.

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

Unit V:
Incompressible viscous flows in the presence of magnetic field – Hartmann Flow – unsteady Hartmann flow – Magnetofluid dynamic pipe flow.

Books:
1. Crammer K.R. and Pai S.I, Magneto Fluid Dynamics for Engineers and Applied Physicists, McGraw Hill, 1973.
2. Ferraro, VCA and Plumpton: Introduction to Magneto Fluid Dynamics, Oxford, 1966.

ELECTIVE 2. CONTROL THEORY

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.

Unit IV:
Linear time varying systems – Perturbed linear systems – Nonlinear systems

Unit V:
STABILIZABILITY:
Stabilization via linear feedback control – Bass method – Controllable subspace – Stabilization with restricted feedback

Text Book:
Elements of Control Theory by K.Balachandran and J.P.Dauer, Narosa, New Delhi, 1999.

References:
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.
5. E.B. Lee and L. Markus, Foundations of optimal Control Theory, John Wiley, New York, 1967

ELECTIVE 3. DIFFERENTIAL GEOMETRY

Unit I:
Curves: Analytic representation - Arc Length – Osculation plane.

Unit II:
Curvature torsion – Formulas of Frenet - Contact – Natural equations – Helices – General solutions of Natural equations.

Unit III:
Evolutes and Involutes - Elementary theory of surface: Analytic representation.

Unit IV:
First fundamental form – Normal, Tangent plane – Developable surfaces - Second fundamental form.

Unit V:
Meusnier's theorem – Euler's Theorem – Dupin's indicatrix – Some surfaces.
Text Book: D. Struik, Lectures on Classical Differential Geometry, Addison Wesley Publishing Company, 1961.

ELECTIVE 4. FUZZY LOGIC AND FUZZY SETS

Unit-1:
CRISP SETS AND FUZZY SETS:
Introduction-Crisp sets: An over view-The Notion of Fuzzy Sets-basic concepts of Fuzzy sets – Classical Logic: complement-Fuzzy Union-Fuzzy interaction – Combination of operations – general aggregation of operations.

Unit-2:
FUZZY RELATIONS:
Crisp and Fuzzy relations – Binary relations – Binary relations on a single set – Equivalence and similarity relations – Compatibility on Tolerance Relations-Orderings – Morphism – Fuzzy relations Equations.

Unit-3:
FUZZY MEASURES:
General discussion – Belief and plausibility Measures –Probability measures – Possibility and Necessity measures .

Unit-3:
FUZZY MEASURES:
Relationship among Classes of Fuzzy Measures.

Unit-5:
UNCERTAINTY AND INFORMATION:
Types of Uncertainty – Measures of Fuzziness-Classical Measures of Uncertainty – Measures of Dissonance-Measures of Confusion – Measures of Non-Specificity – Uncertainty and Information – Information and Complexity – Principles of Uncertainty and information.

Text Book:
1. George J. Klir and Tina A. Folger, Fuzzy Sets, Uncertainty and Information, Prentice-Hall of India Private Limited-Fourth printing-June 1995
(Treatment as in Chapeters 1 to 6)

Reference Book:
1. George J. Klir and Boyuan**,** Fuzzy Sets and Fuzzy Logic-Theory and Applications, Prentice-Hall of India Private Limited.

ELECTIVE 5. CRYPTOGRAPHY

Unit I:
Introduction – Encryption and Secrecy – The objective of Cryptography - Number Theory – Introduction – Modular Arithmetic.

Unit II:
Integer factorization problem – Pollard's rho factoring – Elliptic curve factoring – Discreate logarithm problem

Unit III:
Finite fields – Basic properties – Arithmetic of polynomials –Factoring polynomials over finite fields – Square free factorization

Unit IV:
Symmetric key encryption – Stream ciphers – Block Ciphers – DES

Unit V:
Public key cryptography – Concepts of public key cryptography – Modular arithmetic – RSA – Discrete logarithm – Elliptic curve cryptography

Reference Books:
1. Hans Delfs, Helmut Knebl, Introduction to Cryptography, Springer Verlag, 2002
2. Alfred J. Menezes, Paul C. Van Oorschot, Scott A. Vanstone, Handbook of Applied Cryptography, CRC Press, 2000
3. William Stallings, Cryptography and Network Security, Prentice Hall of India, 2000

ELECTIVE 6. NEURAL NETWORKS

UNIT I:
Mathematical Neuron Model- Network Architectures- Perceptron-Hamming Network-Hopfield Network-Learning Rules.

UNIT II:
Perceptron Architectures and Learning Rule with Proof of Convergence. Supervised Hebbian Learning-Linear Associator.

UNIT III:
The Hebb Rule-Pseudo inverse Rule-Variations of Hebbian Learning-Back Propagation-Multilayer Perceptrons.

UNIT IV:
Back propagation Algorithm-Convergence and Generalization - Performances Surfaces and Optimum Points-Taylor series.

UNIT V:
Directional Derivatives - Minima-Necessary Conditions for Optimality-Quadratic Functions-Performance Optimizations-Steepest Descent-Newton's Method-Conjugate Gradient.

Text Book: Martin T.Hagan, Howard B. Demuth and Mark Beale, Neural Network Design, Vikas Publishing House, New Delhi,2002.

Reference Books:
1. James A. Freeman, David M. Skapura, Neural Networks Algorithms, Applications and Programming Techniques, Pearson Education, 2003.
2. Robert J. Schalkoff, Artificial Neural Network, McGraw-Hill International Edition, 1997.

ELECTIVE 7. STOCHASTIC DIFFERENTIAL EQUATIONS

Unit I
Introduction: Stochastic Analogs of Classical Differential Equations, Filtering Problems, Stochastic Approach to Deterministic Boundary Value Problems, Optimal Stopping, Stochastic Control and Mathematical Finance. Some mathematical preliminaries: Probalitity Spaces, Random Variables and Stochastic Processes and an Important Example: Brownian Motion.

Unit II
Ito Integrals: Construction of the Ito integral , Some Properties of the Ito Integral and Extensions of the Ito Integral.

Unit III
The Ito formula and the Martingale Representation Theorem: The 1- dimentional Ito Formula, the Multi dimensional Ito Formula and the Martingale Reprsentation Theorem.

Unit IV
Stochastic Differential Equations: Examples and Some Solution Methods, An Existence and Uniqueness Result and Weak and Strong Solutions.

Unit V
The Filtering problem: Introduction, The 1- dimentional Linear Filtering Problem and the Multi- dimentional Linear Filtering Problem.

Text Book:
"Stochastic Differential Equations - An Introduction with Applications", by **Bernt Oksendal**, (Sixth Edition), Springer-Verlag, Heidelberg, 2003.
Unit I : Chapter 1 and 2
Unit II : Chapter 3
Unit III: Chapter 4
Unit V : Chapter 5

Unit IV: Chapter 6

ELECTIVE 8. MATLAB

Unit – I
Introduction - Basics of MATLAB, Input – Output, File trypes – 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 – Curve fitting and Interpolation – Data analysis and Statistics – Numerical Integration – Ordinary differential equations – Nonlinear Algebraic Equations.

Unit – V
Graphics: Basic 2-D Plots – Using subplot to Layout multiple graphs - 3 – D Plots – Handle Graphics – Saving and printing Graphs – Errors.

Treatment as in:
RUDRA PRATAP, Getting Started with MATLAB – A Quick Introduction for Scientists and Engineers, Oxford University Press, 2003.
Reference Books:
1. William John Palm, Introduction to Matlab 7 for Engineers, McGraw-Hill Professional, 2005.
2. Dolores M. Etter, David C. Kuncicky , Introduction to MATLAB 7, Prentice Hall, 2004

ELECTIVE 9. LATEX

Unit I:
Text formatting, TEX and its offspring, What's different in LATEX 2ϵ, Distinguishing LATEX 2ϵ , Basics of a LATEX file.

Unit II:
Commands and Environments–Command names and arguments, Environments, Declarations, Lengths, Special Characters, Fragile Commands, Exercises.

Unit III:
Document Layout and Organization – Document class, Page style, Parts of the document, Table of contents, Fine – Tuning text, Word division.
Displayed Text - Changing font, Centering and indenting, Lists, Generalized lists, Theorem–like declarations, Tabulator stops, Boxes.

Unit IV:
Tables, Printing literal text, Footnotes and marginal notes. Drawing pictures with LATEX.

Unit V:
Mathematical Formulas – Mathematical environments, Main elements of math mode, Mathematical symbols, Additional elements, Fine–tuning mathematics.

Treatment as in:
A Guide to LATEX by H. Kopka and P.W. Daly, Third Edition, Addison – Wesley, London, 1999.
Unit I : Chapter 1 : Sections : 1.1-1.3, 1.4.1, 1.5.
Unit II : Chapter 2 : Sections : 2.1-2.7.
Unit III : Chapter 3 : Sections : 3.1-3.6, 4.1-4.7
Unit IV : Chapter 4 : Sections : 4.8-4.10, 6.1.
Unit V : Chapter 5: Sections : 5.1-5.5.

REFERENCE BOOK:
Fundamentals of Latex for Mathematicians, Physicists and Engineers
By
Velusamy Kavitha and Mani Mallika Arjunan
LAP LAMBERT Academy Publishing, Germany, 2013.

PAPER IX - TOPOLOGY

Unit I: Topological spaces – Basis for a Topology – The Order Topology – Product Topology on $X \times Y$ – Subspace Topology - Closed sets and Limit Points – Continuous Functions.

Unit II: Metric Topology- Connected Spaces – Connected sets in the real line – Components and path components - Local connectedness

Unit III: Compact Spaces – Compact sets in the real line- Limit Point Compactness –Local compactness.

Unit IV: Countability Axioms – Separation Axioms - Urysohn's Lemma – Urysohn Metrization Theorem .

Unit V: The Tychonoff Theorem – Completely regular spaces – The stone-Cech Compactification.

Treatment as in:

Topology by James R. Munkres, Prentice Hall of India Private Limited, New Delhi, 1987.
Unit I: Chapter 2: Sections 2.1 – 2.7
Unit II: Chapter 2: 2.9, Chapter 3: Sections 3.1-3.4
Unit III: Chapter 3: Sections 3.5 – 3.8
Unit IV: Chapter 4: Sections 4.1 - 4.4
Unit-V: Chapter 5: Sections 5.1 – 5.3

PAPER XV: COMPUTER PROGRAMMING(C++ THEORY)

Unit I:
Basic Concept of Object-Oriented Programming – Benefits of OOP – Object-Oriented Languages –Applications of OOP. Tokens, Expressions and Control Structure: Introduction – Tokens – Keywords –Identifiers and Constants – Basic Data Types – User Defined Data Types – Storage Classes –Derived Data Types –Symbolic Constants – Type Compatibility – Declaration of Variables – Dynamic Initialization 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 Over Loading – Operator Precedence – Control Structures.

Unit II:
Functions in C++: Introduction – The Main Function – Function Prototyping – Call by Reference – Return by Reference – Inline Functions – Default Arguments – const Arguments – Recursion – Function Over Loading – 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 III:
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 – const Member Functions.

Constructors and Destructors: Introduction – Constructors – Parameterized Constructors– Multiple Constructors in a Class – Constructors with Default Arguments – Dynamic Initializations of Objects – Copy Constructor –const Objects – Destructors.

Unit IV:
Operator Overloading: Introduction – Defining Operator Overloading – Overloading Unary Operators – Overloading Binary Operators – Overloading Binary Operators Using Friends – Manipulating of Strings Using Operators – Some Other Operator Overloading Examples – Rules for Overloading Operators.

Inheritance - Extending Classes: Introduction – Defining Derived Classes – Single Inheritance – Making a Private Member Inheritable – Multilevel Inheritance – Multiple Inheritance – Hierarchical Inheritance – Hybrid Inheritance – Virtual Base Classes – Abstract
Classes – Constructors in Derived Classes – Member Classes: Nesting of Classes.

UNIT-V:
Working with Files: Introduction – Classes for File Stream Operations - Opening and Closing a File – Detecting End-of-File – More about open( ): File Modes – File Pointers and their Manipulations – Sequential Input and Output Operations – Updating a File: Random Access – Error Handling During File Operations.

Treatment as in:

Object–Oriented Programming with C++ by E. Balaguruswamy, Tata McGraw-Hill Publishing Company Limited, Sixth Edition.

Unit I : 1.4 – 1.6 and 3.1 – 3.25
Unit II : 4.1 – 4.12 and 10.1 – 10.6
Unit III : 5.1 – 5.17, 6.1 – 6.7 and 6.10 – 6.11
Unit IV : 7.1 – 7.8 and 8.1 – 8.12
Unit V : 11.1 – 11.9

PRACTICAL - COMPUTER PROGRAMMING (C++ PRACTICAL)

1. friend FUNCTION usage:

Create two classes to store the value of distances in meters-centimetres and feet-inches. Write a program that can create the values of the class objects and add one object with another. Use a friend function to carry out addition operation. The result may be stored in any object depending on the units in which results are required. The display should be in the order of meters & centimetre and feet & inches depending on the order of display.

2. OVERLOADING OBJECTS:

Create a class that contains one float data member. Overload all the four arithmetic operators so that operate on the objects of the class.

3. OVERLOADING CONVERSIONS:

Design a class **Polar** which describes a point in a plane using polar co-ordinates **radius** and **angle**. Use the overloaded + operator to add two objects of **Polar**. Note that we cannot add polar values of two points directly. This requires first the conversion of points into rectangular co-ordinates and finally converting the result into polar co-ordinates. You need to use following trigonometric formulae: $x = r * \cos(a)$; $y = r * \sin(a)$; $a = atan(y/x)$; $r = sqrt(x * x + y * y)$.

4. OVERLOADING VECTOR:

Define a class for Vector containing scalar values. Apply overloading concepts for Vector Addition, Multiplication of a Vector by a scalar quantity, replace the values in a Position Vector.

5. OVRELOADING MATRIX:

Create a class **MAT** of size m * n. Define all possible matrix operations for **MAT** type objects. Verify the identity: *(A-B)^2 = A^2+B^2 – 2*A*B.*

6. INHERITANCE:

Create three classes: **alpha, beta** and **gamma**, each containing one data member. The class **gamma** should be inherited from both **alpha** and **beta**. Use a constructor function in the class **gamma** to assign values to the data members of all the classes. Write a program to print the value of data members of all the three classes.

7. FILE HANDLING:

Write a program to create a disk file containing the list of names and telephone numbers in two columns, using a class object to store each set of data. Design an interactive menu to access the file created and to implement the following tasks:

(a) Determine the telephone number of the specified person.
(b) Determine the name if a telephone number is known.
(c) Update the telephone number, whenever there is a change.

ELECTIVE PAPER 8 - MATLAB PRACTICAL PROBLEMS

(Students has to attend two questions – one from each group)

Group - A

A1. Write aprogram using MATLAB to generate Fibonacci series.

A2. Using MATLAB, write a program to solve the system of simultaneous equations with two variables by matrix method.

A3. Write a program using MATLAB to calculate Mean, Median, Standard Deviation, Variance, Maximum Value, Minimum Value, Range, Skewness and Kurtosis for a set of 'n' numbers.

A4. Write aprogram using MATLAB to find the Eigen Values and Eigen Vectors of a given matrix.

Group –B

B1. Using MATLAB, solve the following first order linear differential equation using Euler's method: $dy/dx = -y$, $y(0) = 1$. Draw the graph and compare the exact solution.

B2. Using MATLAB, obtain the straight line fit and estimate the value of Y when X=25, for the following data:

X	5	10	20	50	100
Y	15	33	53	140	301

B3. Using MATLAB, write a program to plot the function $f(t) = t * \sin t$, $0 \le t \le 10\pi$.

B4. Draw a Pie chart using MATLAB, for the following data:

Continent	South America	North America	Africa	Europe	Asia
Population(in %)	6	8	13	12	61

ELECTIVE PAPER 9 - LaTeX PRACTICAL PROBLEMS

(Students has to attend two questions - one from each group)

Group - A

A1. Type the following paragraph in LaTeX, using the {quote} environment. Format the paragraph with the following: Text height - 9.5inches, Text width - 6.3 Inches, Left margin – 0.1 Inch, Right margin – 0.12 Inch, Top margin - 0.6 Inch, Line space – 1.5 Inches. Also, include a Footnote.

Today (<Current Date>) the rate of exchange between the American dollar and Indian rupee is $1 = Rs. 65, an increase of 10% over the last year.

A2. Produce a document in LaTeX, using two-columns. Insert a title centred for the two columns.

A3. Produce a title page in LaTeX, with the following:

(i) Title of the page, (ii) Name and Addresses of two authors, (iii) Footnotes for the corresponding author; e-mail address and telephone numbers of each author, (iv) Date.

A4. Create a document in LaTeX to produce the bibliographic information, using the {bibliography} environment.

Group – B

B1. Create the following table using LaTeX:

S.No.	Register Number	Name of the Student	Percentage of Marks	Rank
1	xxxxxx	xxxxxx	xxxxx	xxxx
2	xxxxxx	xxxxxxx	xxxx	xxxx
3	xxxxxx	xxxxxx	xxxx	xxxxx

B2. Using LaTeX, generate the following formula:

$$a_0 + \cfrac{1}{a_1 + \cfrac{1}{a_2 + \cfrac{1}{a_3 + \cfrac{1}{a_4}}}} + \begin{pmatrix} a & b \\ c & d \end{pmatrix} + \sum_{\alpha=0}^{\infty} (\beta^{\alpha} + \Gamma^{\alpha})$$

B3. Using LaTeX, generate the following with {eqnarray} environment:

$$\begin{aligned} (x+y)(x-y) &= x^2 - xy + xy - y^2 \\ &= x^2 - y^2 \qquad (1.1) \\ (x+y)^2 &= x^2 + 2xy + y^2 \qquad (1.2) \end{aligned}$$

$$\begin{aligned} x_n u_1 + \cdots + x_{n+t-1} u_t &= x_n u_1 + (a\, x_n + c) u_2 + \cdots \\ &\quad + a^{t-1} x_n + c(a^{t-2} + \cdots + 1)\, u_t \\ &= (u_1 + a\, u_2 + \cdots + a^{t-1} u_t)\, x_n + h\,(u_1, \ldots, u_t) \end{aligned}$$

B4. Using LaTeX, draw the following diagram: