K L UNIVERSITY
Department of Mathematics

Program design document for M. Sc.(Applied Mathematics)

Table of Contents

ANNEXURE-II

1.0 Introduction

The Department of Mathematics intends to commence M.Sc in Applied Mathematics due to its current day importance and to specialize in inter-discipline areas of study.

2.0 About the Program

Applied Mathematics deals with a wide range of disciplines in different areas, as science, technology, business and industry. Applied Mathematics aims to solve practical problems using Mathematical methods in models. Applied Mathematics can include mathematical disciplines such as mathematics of engineering, linear programming, continuous modelling, mathematical analysis, statistics etc.

3.0 Program Objectives

The objectives of the M.Sc program in Applied Mathematics are :

1.	Understand and analyze real life problems using modern mathematical concepts.
2.	Apply Advanced Mathematical Techniques to formulate, solve and analyze mathematical models of real life problems
3.	Identify and apply suitable computational mathematical tools and techniques to solve various complex Engineering problems
4.	Use knowledge and skills necessary for immediate employment or excellent foundation for planning to a Ph.D program in mathematics.
5.	Maintain a core of mathematical and technical knowledge that is adaptable to changing technologies and provides a solid foundation for life long learning.

4.0 Expected out comes of the program

Upon completion of the program, graduates will be able to

#1.	Demonstrate competence in using mathematical skills to model, formulate and solve real life applications.
#2.	Apply knowledge of Mathematics, science and Engineering to solve complex Engineering problems.
#3.	Acquire deep knowledge of different mathematical disciplines
#4.	Comprehend high levels of abstraction in mathematical concepts.
#5.	Use technology efficiently in mathematical modelling and numerical computations of real life applications.
#6.	Adapt mathematical techniques in their professional practices.
#7.	Pursue further studies towards Ph.D degree in mathematics.
#8.	Pursue a career in educational institutes.
#9.	Demonstrate the ability to conduct research independently.
#10.	Acquire required knowledge to excel in GATE, SLET and NET.

5.0 Admission Requirement

Applicants must posses a Bachelor's Degree in Mathematics, Physics and chemistry / Mathematics, Statistics and Computer Science / Mathematics , Physics and Computer Science with a minimum aggregate score of 60% with 5% relaxation to socially and economically backward students.

6.0 Intake

The program is designed with an intake of 40.

7.0 Man Power

The program is offered by department of mathematics. The non-teaching staff of FED will be used for the program.Faculty will be drawn from the department of mathematics as per the curriculum design and expertise available in the department.

8.0 Labs

The program includes three labs

1. Programming Lab
2. Mat Lab
3. SPSS Lab

9.0 Careers

The graduate students from this program will be absorbed in Junior, degree and Engineering colleges. Also they can join in R&D Departments of the industry and pursue PhD program in Mathematics.

10.0 Rules and regulations

The rules and regulations applicable to other M.Sc, program will also be applicable to M.Sc,(Applied Mathematics) also.

11.0 Curriculum Design

11.1 First Year (I Semester)

S.N0	Course Code	Subjects	Contact Hours/Week L-T-P	Credits
1	14AM501	Real Analysis	**3-1-0**	**4**
2	14AM502	Linear Algebra	**3-1-0**	**4**
3	14AM503	Discrete Mathematical structures	**3-1-0**	**4**
4	14AM504	Differential Equations and Applications	**3-1-0**	**4**
5	14AM505	Operations Research - 1	**3-1-0**	**4**
6	14AM506	Objected Oriented Programming through C++	**3-0-2**	**4**
Total				**24**

11.2 First Year (II Semester)

S. No	Course Code	Subjects	Contact Hours/Week L-T-P	Credits
1	14AM507	Complex Analysis	**3-1-0**	**4**
2	14AM508	Probability and Statistics	**3-1-0**	**4**
3	14AM509	Partial Differential Equations and Applications	**3-0-0**	**3**
4	14AM510	Transform Techniques	**3-0-0**	**3**
5	14AM511	Numerical Solutions of Differential Equations	**3-1-0**	**4**
6	14AM512	Operations Research - 2	**3-1-0**	**4**
7	14AM513	Seminar	**0-0-4**	**2**
Total				**24**

11.3 Second Year (I Semester)

S. No	Course Code	Subjects	Contact Hours/Week L-T-P	Credits
1	14AM514	Classical Mechanics	**3-1-0**	**4**
2	14AM515	Functional Analysis	**3-1-0**	**4**
3	14AM516	Mathematical Modeling	**3-0-2**	**4**
4		Elective – I	**3-1-0**	**4**
5	14AM517	Term Paper	**0-0-6**	**3**
6	14AM518	Seminar	**0-0-4**	**2**
Total				**21**

11.4 Second Year (II Semester)

S. No	Course Code	Subjects	Contact Hours/Week L-T-P	Credit
1	14AM519	Simulation and Modeling	**3-1-0**	**4**
2	14AM520	Special Functions and their Applications	**3-1-0**	**4**
3		Elective – II	**3-1-0**	**4**
4		Elective – III	**3-1-0**	**4**
5	14AM521	Project Work	**0-0-12**	**6**
Total				**22**

11.5 Elective Streams

Stream	Course Code	Name of the Course
Stream-1	14AM522	Fluid Dynamics
	14AM523	Magneto Hydrodynamics
	14AM524	Heat and Mass Transfer
Stream-2	14AM525	Software Reliability
	14AM526	Software Testing
	14AM527	Fault Tolerance Analysis
Stream-3	14AM528	Applied Statictics-1
	14AM529	Applied Statictics-2
	14AM530	Applied Stochastic Processes
Stream-4	14AM531	Mathematical Control Theory
	14AM532	Boundary Value Problems
	14AM533	Dynamical Systems
Stream-5	14AM534	Fuzzy Mathematics and Applications
	14AM535	Applied Algebra
	14AM536	Elements of Differential Topology

12.0 Areas of research

- Applied Mathematics
- Dynamical Systems
- Fluid Dynamics
- Special Functions
- Graph Theory
- Fuzzy Sets
- Topology
- Fixed Point Theory
- Operation Research
- Algebra

13. Syllabi

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DEPARTMENT OF MATHEMATICS
PROPOSED SYLLABUS FOR M.Sc. (Applied Mathematics)
W.E.F the Academic Year 2014-2015

Course Code : 14 AM 501	**L-T-P : 3-1-0**
Course Title : Real Analysis	**Credits : 4**
Prerequisite Course : Under graduate mathematics	**No of Lecture periods: 45**

SYLLABUS:

Basic Topology: Finite, Countable and uncountable sets, Metric spaces, Compact sets, Perfect sets, Connected sets.

Riemann Stieltje's integral: Definition and existence of the integral, Properties of the integral, integration and differentiation of integral with variable limits.

Improper integrals: Definitions and their convergence, Tests of convergence, Beta and Gamma functions and their properties.

Uniform convergence: Tests for uniform convergence, Theorems on limit and continuity of sum functions, Term by term differentiation and integration of series of functions.

Power series: Power series, convergence and their properties.

Text Book: Walter Rudin, Principles of Mathematical Analysis, McGraw Hill Book Co.

Reference:

1. S.C.Malik and Savita Arora, Mathematical Analysis, 2nd Edition, New Age International
2. Andrew M. Bruckner, Brian S. Thomson, Judith B. Bruckner , Real Analysis,2nd Edition, Prentice-Hall International.

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Course Code : 14 AM 502	**L-T-P : 3-1-0**
Course Title : Linear algebra	**Credits : 4**
Prerequisite Course : Under graduate mathematics	**No of Lecture periods: 45**

SYLLABUS:

System of linear equations: Matrices and elementary row operations , uniqueness of Echelon forms, Systems of linear equations, Moore-Penrose Generalized inverse.

Vector spaces: Vector spaces, Subspaces, Bases and dimension, Coordinates, linear transformations and its algebra and representation by matrices, Algebra of polynomials, determinant functions, Permutation and uniqueness of determinants, Additional properties, Elementary canonical forms, Characteristic values and vectors, Cayley Hamilton's theorem, Annihilating polynomial, Invariant subspaces. Simultaneous Triangularization, Simultaneous Diagonalization, Jordan form, Inner product spaces, Unitary and normal operators, Bilinear forms.

Text Book: Hoffman and Kunze : Linear Algebra, Prentice Hall of India, New Delhi

Reference Books:

1. V. Krishnamoorthy et al, An introduction to linear algebra, Affiliated East West Press, New Delhi
2. P.G. Bhattacharya, S.K. Jain and S.R. Nagpaul, First course in Linear Algebra, Wiley Eastern Ltd., New Delhi, K.B.Datta: Matrix and Linear Algebra, Prentice Hall of India, New Delhi

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Course Code : 14 AM 503	**L-T-P : 3-1-0**
Course Title : Discrete Mathematical structures	**Credits : 4**
Prerequisite Course : Under graduate mathematics	**No of Lecture periods: 45**

SYLLABUS:

Sets and propositions: Combinations of sets, Finite and Infinite sets, Uncountably infinite sets, Principle of inclusion and exclusion, Mathematical induction. Propositions, Fundamentals of logic, First order logic, Ordered sets.

Permutations, Combinations, Numeric functions, Generating functions.

Recurrence relations and recursive algorithms: Recurrence relations, Linear recurrence relations with constant coefficients, Homogeneous solutions, Particular solutions, Total solutions, Solution by the method of generating functions, Sorting algorithm.

Relations and functions: Properties of binary relations, Equivalence relations and partitions, Partial and total ordering relations, Transitive closure and Warshal's algorithm.

Boolean algebra: Chains, Lattices and algebraic systems, Principle of duality, Basic properties of algebraic systems, Distributive and complemented lattices, Boolean lattices and algebras, uniqueness of finite boolean algebras, Boolean expressions and functions.

Graphs and planar graphs: Basic terminology, Multigraphs and weighted graphs, Paths and circuits, Shortest paths in weighted graphs, Eulerian paths and circuits, Hamiltonian paths and circuits. Colourable graphs, Chromatic numbers, Five colour theorem and Four colour problem.

Trees and cut-sets: Trees, Rooted trees, Path lengths in rooted trees, Spanning trees and BFS & DFS algorithms, Minimum spanning trees and Prims & Kruskal's algorithms.

Text Book: Elements of Discrete Mathematics, McGraw Hill.

Reference:

1. Tremblay and Manohar, Discrete Mathematical Structures with applications to Computer Science, McGraw Hill Book Co., New Delhi
2. Mott, Kandel and Baker, Discrete Mathematics for Computer Scientists.

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Course Code : 14 AM 504	**L-T-P : 3-1-0**
Course Title : Differential Equations and Applications	**Credits : 4**
Prerequisite Course : Under graduate mathematics	**No of Lecture periods: 45**

SYLLABUS:

First order differential equations- Linear differential equations of higher order, Linear dependence and Wronskian, Basic theory for linear equations, Method of variation of parameters. Linear equations with variable coefficients.

Solution in power series- Legendre and Bessel equations, Systems of differential equations, Existence and uniqueness theorems, Fundamental matrix, Non-homogeneous linear systems, Linear systems with constant coefficients and periodic coefficients, Existence and uniqueness of solutions, Gronwall inequality, Successive approximation, Picard's theorem, Non-uniqueness of solutions, Continuous dependence on initial conditions, Existence of solutions in the large.

Text Books:

1. S.G.Deo and V. Raghavendra: Ordinary differential equations, Tata McGraw Hill Pub. Co., New Delhi.
2. Jaffer Ahsan , Differential equations and applications

References:

1. M. Rama Mohana Rao, Ordinary differential equations - Theory and applications. Affiliated East West Press, New Delhi
2. E.A.Coddington, Introduction to Ordinary differential equations, Prentice Hall.

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Course Code : 14 AM 505	**L-T-P : 3-1-0**
Course Title : Operations Research - 1	**Credits : 4**
Prerequisite Course : Under graduate mathematics	**No of Lecture periods: 45**

SYLLABUS:

Text Book:

References:

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Course Code : 14 AM 506	**L-T-P : 3-0-2**
Course Title : Object oriented Programming through C++	**Credits : 4**
Prerequisite Course : NIL	**No of Lecture periods: 45**

SYLLABUS:

Introduction to OOPS: Origins of C++, Object Oriented Programming, C++ fundamentals, Headers & Name Spaces, C++ Classes, Function overloading, Operator overloading, Inheritance, Constructors & Destructors.

Classes & Objects: Parameterized Constructors, Friend functions, Default function arguments. Structures, Unions, and Inline functions, passing objects to functions, Returning objects, Object assignment, Arrays of objects, Pointers to objects.

Function & Operator Overloading: Overloading constructors, Localizing variables, Function overloading & Ambiguity, Finding the address of an overloaded function, This Pointer, Operator overloading, References using reference to overload a unary operator, Overloading [] and (), Applying operator overloading.

Inheritance: Inheritance and the access specifiers, Constructors and Destructors in derived classes, Multiple Inheritance, Multilevel Inheritance, Diamond Inheritance, Hybrid Inheritance, Passing parameters to a basic class

Polymorphism and Virtual Functions: Pointer Objects, Pointer to Objects, Pointers and references to derived types, Virtual Functions, Pure virtual functions and abstract types, Early vs Late binding, Virtual Base Class.

The C++ 1/0 Class Library: C++ streams, The C++ Stream classes, Creating own inserter and extractors, Formatting I/O, Creating your own manipulator functions.

Files in C++: File I/O, Unformatted and Binary I/O. **Templates:** Generic Functions and classes.

Exceptions: Exception Handling, Fundamentals, options Un-caught exception (), Applying exception Handling, and RTTI, casting operators

Miscellaneous C+ + topics: Dynamic allocation using new and delete, static class members, constant member functions and mutable, volatile member functions, Using the asm keyword, linkage specification, The .* and ->* operators, Creating conversion functions, Copy constructors, Granting access, Namespaces, Explicit constructors.

The standard Template Library and the String Class: An overview of the STL (9)

Text Book: Herbert Schieldt ,The Complete Reference - Borland C++ Builder ,2007,4th ed., TMH

Reference Books:

1. E. Balaguruswamy, Object Oriented Programming using C++, 2nd ed., TMH
2. Deitel HM and Deitel PJ: C++ How to Program, Third Edition, PHI.

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Course Code : 14 AM 507	**L-T-P : 3-1-0**
Course Title : Complex Analysis	**Credits : 4**
Prerequisite Course : Real Analysis	**No of Lecture periods: 45**

SYLLABUS:

Complex variable, Functions of a complex variable, Continuity, Differentiability, Analytic functions, Complex integration, Cauchy's theorem. Cauchy's integral formula, Morera's theorem, Taylor's theorem, Cauchy's inequality, Liouville's theorem, Zeros of an analytic function, Singularities. Laurent's theorem, Residue, Cauchy's residue theorem, Contour integration, Argument principle, Rouche's theorem, Fundamental theorem of algebra, Poisson's integral formula, Analytic continuation, Branches of a many valued function, Riemann surface.

The maximum modulus theorem, mean values of f(z), Conformal representation, Bilinear transformation, Transformation by elementary functions, Uniqueness of conformal transformation, Representation of a polygon on a half plane, Representation of any region on a circle.

Text Book:

R.V. Churchill & Brown, Complex variables and applications, McGraw Hill

Reference:

Copson, E.T. Theory of complex variables, Oxford University Press.

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Course Code : 14 AM 508	**L-T-P : 3-1-0**
Course Title : Probability and Statistics	**Credits : 4**
Prerequisite Course : Under graduate mathematics	**No of Lecture periods: 45**

SYLLABUS:

Probability: Sample space, Notion of probability, Axioms of probability, Empirical approach to probability, Conditional probability, Independent events, Bayes' Theorem, Random variable, Probability distributions with discrete and continuous random variables, Joint probability mass function, Marginal distribution function, Joint density function.

Probability Distributions: Mathematical expectation, Moment generating function, Chebyshev's inequality, Weak law of large numbers , Bernoulli trials, Binomial, Negative binomial, Geometric, Poisson, Normal, rectangular, Exponential, Gaussian, Beta and Gamma distributions and their moment generating functions, Fit of a given theoretical model to an empirical data.

Testing of Hypothesis: Theory of estimation, Characteristics of estimation, Minimum variance unbiased estimator, Method of maximum likelihood estimation. Sampling and large sample tests, Introduction to testing of hypothesis, Tests of significance for large samples, Chi-square test, Analysis of variance, t and F tests.

Correlation and Regression: Scatter diagram, Linear and polynomial fitting by the method of least squares, Linear correlation and linear regression, Rank correlation, Correlation of bivariate frequency distribution.

Text Book:

1. Irwin Miller and Marylees Miller, Mathematical Statistics, 7th Edition, Pearson

References:

1. Gupta and Kapur , Fundamentals of Mathematical Statistics, S.Chand & Co.,
2. Rohtgi, An Introduction to Probability theory and Mathematical Sciences, Wiley Eastern.

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Course Code : 14 AM 509	**L-T-P : 3-0-0**
Course Title : Partial Differential Equations and Applications	**Credits : 3**
Prerequisite Course : Ordinary differential equations	**No of Lecture periods: 45**

Syllabus

Formulation, Linear and quasi-linear first order partial differential equations, Paffian equation, condition for inerrability, Lagrange's method for linear equations, First order non-linear equations, Method of Charpit, Method of characteristics.

Equations of higher order: Method of solution for the case of constant coefficients, Equations of second order reduction to canonical forms, Characteristic curves and the Cauchy problem, Riemann's method for the solution of linear hyperbolic equations, Monge's method for the solution of non-linear second order equations, Method of solution by separation of variables.

Laplace's equations: Elementary solutions, Boundary value problems, Green's functions for Laplace's equation, Solution using orthogonal functions.

Wave equations: One dimensional equation and its solution in trigonometric series, Riemann -Volterra solution, Vibrating membrane.

Diffusion equations: Elementary solution, Solution in terms of orthogonal functions.

Text Book:

1. Sneddon, Elements of Partial Differential Equations, McGraw Hill, New York.

Reference:

1. P.Prasad, Partial Differential Equations, Wiley Eastern.

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Course Code : 14 AM 510	**L-T-P : 3-0-0**
Course Title : Transform Techniques	**Credits : 3**
Prerequisite Course : Differential equations	**No of Lecture periods: 45**

Syllabus

Laplace Transform: Definition - Functions of exponential order and examples, Transforms of elementary, transcendental and special functions, Transforms of derivatives and integrals and periodic function, unit step function and impulse function, The inverse transform, Convolution theorem, Solution of differential equations by the use of the transform, Laplace inverse integral, Solution of Laplace equation (in two dimensions), one dimensional heat equation and one dimensional wave equation.

Fourier transform: The Fourier transform, Inverse Fourier transform, Fourier transform properties, Convolution integral, Convolution theorem, Correlation, Correlation theorem, Parseval's theorem, Wave from sampling, Sampling theorem, Frequency sampling theorem.

Z transform: Z transform, Inverse Z transform, Z transform properties, Solution of linear difference equations by using Z-transform.

Discrete Fourier Transform: Fourier transform of sequences, Discrete Fourier transform, Transfer function.

Fast Fourier Transform: Intuitive Development, Theoretical development of Base 2, FFT algorithm.

Text Book:

1. Churchill, Operational Mathematics, McGraw Hill, Tokyo.

Reference:

1. Hildebrand, Methods of Applied Mathematics, Prentice Hall Inc., New Jercy.
2. E.O.Brigham, The Fast Fourier Transforms, Prentice Hall.
3. E.J.Jerry, Theory and applications of Z transform method.

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Course Code : 14 AM 511	**L-T-P : 3-1-0**
Course Title : Numerical Solutions of Differential Equations	**Credits : 3**
Prerequisite Course : Numerical methods	**No of Lecture periods: 45**

Syllabus

Solution of Ordinary differential equations: Initial value problems; Single step methods, Taylor's, Euler's, Runge-Kutta methods, Error analysis; Multi-step methods: Adam-Bashforth, Nystorm's, Adams-Moulton methods, Milne's predictor-corrector methods. System of IVP's and higher order IVP's.

Finite Difference Methods: Finite difference approximations for derivatives, Boundary value problems with explicit boundary conditions, Implicit boundary conditions, Error analysis, stability analysis, Convergence analysis.

Cubic splines and their application for solving two point boundary value problems.

Partial Differential Equations: Finite difference approximations for partial derivatives and finite difference schemes for Parabolic equations, Schmidt's two level, Multilevel explicit methods, Crank-Nicolson's two level, Multilevel implicit methods, Dirichlet's problem, Neumann problem, Mixed boundary value problem, Hyperbolic Equations: Explicit methods, Implicit methods, One space dimension, Two space dimensions, ADI methods. Elliptic equations, Laplace equation, Poisson equation, Iterative schemes, Dirichlet's problem, Neumann problem, mixed boundary value problem, ADI methods.

Text Book: M.K.Jain, Numerical Solution of Differential Equations, Wiley Eastern, Delhi

Reference: G.D.Smith, Numerical Solution of Partial Differential Equations, Oxford University Press.

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Course Code : 14 AM 512	**L-T-P : 3-1-0**
Course Title : Operations Research - 2	**Credits : 4**
Prerequisite Course : Operations Research - 1	**No of Lecture periods: 45**

SYLLABUS:

Text Book: H.M. Wagner, Principles of OR with Application to Managerial Decisions, Prentice Hall.

References:

1 F.S. Hiller and G.J. Lieberman, Introduction to Operations Research, Addison Wesley.
2 G. Hadley, Linear Programming, Addison Wesley.
3 J.W. Prichard and R.H. Eagle, Modern Inventory Management, John Wiley.
4 M.K. Starr and R.J. Tersine, North Holland, Material Management in Inventory Systems,
5 H.A. Taha, Operations Research - An Introduction, Macmillan, N.Y.

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PROPOSED SYLLABUS FOR M.Sc. (Applied Mathematics)

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Course Code : 14 AM 514	**L-T-P : 3-1-0**
Course Title : Classical Mechanics	**Credits : 4**
Prerequisite Course : Under graduate physics	**No of Lecture periods: 45**

SYLLABUS:

Classical mechanics:

Lagrangian Formulation: Mechanics of a particle, mechanics of a system of particles, constraints, generalized coordinates generalized velocity, generalized force and potential. D'Alembert's principle and Lagranges equations, some applications of Lagrangian formulation

Hamilton's principle, derivation of Lagrange's equations from Hamilton's principle, extension of Hamilton's principle to non-holonomic systems, Advantages of variational principle formulation, conservation theorems and symmetry properties

Hamiltonian formulation: Legendre transformations and the Hamilton equations of motion, cyclic coordinates and conservation theorems, derivation of Hamilton's equations from a variational principle, the principle of least action.

The equation of canonical transformation, examples of canonical transformation, Poisson and Lagrange brackets and their invariance under canonical transformation. Jacobi's identity; Poisson's Theorem. Hamilton Jacobi Equations for Hamilton's principal function, The harmonic oscillator problem as an example of the Hamilton – Jacobi method.

Two Dimensional Motion : Motion of rigid bodies, Eulur's dynamical equations for the motion of a rigid body about an axis, theory of small oscillations.

Text Books:

1. Classical mechanics by H. Goldstein, 2nd edition, Narosa Publishing House.
2. Mathematical theory of Elasticity, by I.S.SOKOLNIKOFF

Reference Book:

1. Classical Mechanics by K Sankara Rao, PHI.

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Course Code : 14 AM 515	**L-T-P : 3-1-0**
Course Title : Functional Analysis	**Credits : 4**
Prerequisite Course : Differential equations	**No of Lecture periods: 45**

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Text book:

Reference Book:

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Course Code : 14 AM 516	**L-T-P : 3-0-2**
Course Title : Mathematical Modeling	**Credits : 4**
Prerequisite Course : Differential equations	**No of Lecture periods: 45**

SYLLABUS

Mathematical Modelling Through Ordinary Differential Equations of First Order: Mathematical Modelling Through Differential Equations, Linear Growth and Decay Models, Non-Linear Growth and Decay Models, Compartment Models, Mathematical Modelling in Dynamics Through Ordinary Differential Equations of First Order, Mathematical Modelling of Geometrical Problems Through Ordinary Differential Equations of First Order.

Mathematical Modelling Through Systems of Ordinary Differential Equations of the First Order: Mathematical Modelling in Population Dynamics, Mathematical Modelling of Epidemics Through Systems of Ordinary Differential Equations of First Order, Compartment Models Through Systems of Ordinary Differential Equations, Mathematical Modelling in Economics Through Systems of Ordinary Differential Equations of First Order, Mathematical Models in Medicine, Arms Race, Battles and International Trade in Terms of Systems of Ordinary Differential Equations, Mathematical Modelling in Dynamics Through Systems of Ordinary Differential Equations of First Order.

Mathematical Modelling Through Ordinary Differential Equations of Second Order: Mathematical Modelling of Planetary Motions, Mathematical Modelling of Circular Motion and Motion of Statellites, Mathematical Modelling Through Linear Differential Equations of Second Order, Miscellaneous Mathematical Models Through Ordinary Differential Equations of the Second Order.

Mathematical Modelling Through Difference Equations: The Need for Mathematical Modelling Through Difference Equations: Some Simple Models, Basic Theory of Linear Difference Equations with Constant Coefficients, Mathematical Modelling Through Difference Equations in Economics and Finance, Mathematical Modelling Through Difference Equations in Population Dynamics and Genetics, Mathematical Modelling Through Difference Equations in Probability Theory, Miscellaneous Examples of Mathematical Modelling Through Difference Equations.

Mathematical Modeling through Partial Differential Equations: Situations Giving Rise to Partial Differential Equations Models, Mass-Balance Equations: First Method of Getting PDE Models, Momentum-Balance Equations: The Second Method of Obtaining Partial Differential Equation Models, Variational Principles: Third Method of Obtaining Partial Differential Equation Models, Probability Generating Function, Fourth Method of Obtaining Partial Differential Equation Models, Model for Traffic Flow on a Highway, Nature of Partial Differential Equations, Initial and Boundary Conditions.

(Chapters 1 to 6 of Text Book 1)

Text Books: 1) Mathematical Modelling by J.N.Kapur, Wiley Eastern Ltd.

2) Numerical Solutions of Differential Equations by M.K.Jain, Wiley Eastern Ltd.

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Course Code : 14 AM 519	**L-T-P : 3-1-0**
Course Title : Simulation and Modeling	**Credits : 4**
Prerequisite Course : Probability and Statistics	**No of Lecture periods: 45**

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Text books:

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Course Code : 14 AM 520	**L-T-P : 3-1-0**
Course Title : Special Functions and Their Applications	**Credits : 4**
Prerequisite Course : Differential Equations	**No of Lecture periods: 45**

SYLLABUS

The Gamma and Beta Functions: The Gamma function ,A series for $\Gamma'(z)/\Gamma(z)$,Evaluation of $\Gamma'(1)$, the Euler product for $\Gamma(z)$,the difference equation $\Gamma(z+1)=z\Gamma(z)$,evaluation of certain infinite products , Euler 's integral for $\Gamma(z)$, the Beta function , the value of $\Gamma(z)\,\Gamma(1-z)$, the factorial function , Legendre 's duplication formula , Gauss multiplication theorem , a summation formula due to Euler .

Bessel functions : Definition of J_n (x) , Bessel's differential equation , Differential recurrence relation, A pure recurrence relation, A generating function, Bessel's integral, Index half an odd integral, modified Bessel function, orthogonality property for J_n (x).

Legendre's polynomials: Definition of P_n (x) , Differential recurrence relations, the pure recurrence relation, Legendre's differential equation, the Rodrigue's formula , orthogonality property , special properties of P_n (x), more generating functions, Laplace's first Integral form , Expansion of x^n

Hermite polynomials: Definition of H_n (x),Recurrence relations , the Rodrigue's formula ,other generating functions ,integrals, the Hermite polynomials as ${}_2F_0$, orthogonality , expansion of polynomial s, more generating functions.

Laguerre polynomials: The Laguerre polynomial definition , generating functions, , recurrence relations, the Rodrigue's formula, the differential equation , orthogonality, expansion of polynomials , special properties ,other generating functions , the simple Laguerre polynomials.

Text Book:

Special functions by E.D. Rainville, MacMillan company, New York, 1960.

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Course Code : 14 AM 532	**L-T-P : 3-1-0**
Course Title : Boundary value problems	**Credits : 4**
Prerequisite Course : Differential Equations	**No of Lecture periods: 45**

SYLLABUS

Elementary Topology on Metric spaces: Mappings on metric spaces, Existence and uniqueness theorem via the principle of contraction. Continuation of solutions, Dependence of solutions on initial conditions and on parameters. **(Chapter 2 of text book l)**

General theory for linear first order system of equations, solution space, The non-homogeneous equation. The nth order linear homogeneous equation, The nth order non-homogeneous equation, The adjoint vector equation, The adjoint nth order equation, The relationship between scalar and vector adjoints.

(Chapter 3 of text book l)

Linear equation with constant coefficients, Real distinct eigen values, The general solution. Direct solutions, Real solutions associated with complex eigen values. **(Chapter 4, Section: 4.1, 4.2, 4.3, of text book l)**

The two point boundary value problem: The two point homogeneous boundary value problem, the adjoint boundary value problem, The non-homogeneous boundary value problem and Green's matrix. The nth order boundary value problem, The nth order adjoint boundary value problem, the nth order non-homogeneous boundary value problems and Green's function. Self-adjoint boundary value problem

(Chapter 6 of text book l)

Linear Control System: Controllability, Observability, Controllability and Polynomials, linear feed back, state observers, Relization of constant systems. **(Chapter 4 of text book 2)**

Text books:

1. Theory of Ordinary differential equations, Randal H.Cole Appleton-Century-Crafts, New York (1968)

2. Introduction to Mathematical Control Theory, S.Barnett, R.G.Camarol, Clarendon Press, 1985.

Reference book:

1. Theory of Ordinary differential equations by E.A. Coddington and Normal Levinson, Tata Mcgraw Hill Inc., New York (1980)

K L University
DEPARTMENT OF MATHEMATICS
PROPOSED SYLLABUS FOR M.Sc. (Applied Mathematics)
W.E.F the Academic Year 2014-2015

Course Code : 14 AM 534	**L-T-P : 3-1-0**
Course Title : Fuzzy Mathematics and Applications	**Credits : 4**
Prerequisite Course : Discrete Mathematics Structures & Linear Algebra	**No of Lecture periods: 45**

SYLLABUS

CRISP SET THEORY: Introduction; Relations between Sets; Operations on Sets; Characteristic Functions; Cartesian Product of Crisp Sets; Crisp Relations on Sets.

FUZZY SET THEORY: Introduction; Concept on a Fuzzy Set; Relations between Fuzzy Sets; Operations of Fuzzy Sets; Properties of the Standard Operations; Certain numbers Associated with a Fuzzy Set; Certain Crisp Sets Associated with a Fuzzy Set; Certain Fuzzy Sets Associated with a Given Fuzzy Set; Extension Principle.

FUZZY RELATIONS: Introduction; Fuzzy Relations; Operations on Fuzzy Relations; α-Cuts of a Fuzzy Relation; Composition of Fuzzy Relations; Projections of Fuzzy Relations; Cylindrical Extensions; Cylindrical Closure; Fuzzy Relation on a Domain.

FUZZY LOGIC: Introduction; Three-valued Logics; *N*-valued Logics $N \geq 4$; Infinite- valued Logics; Fuzzy Logics; Fuzzy Propositions and Their Interpretations in Terms of Fuzzy Sets; Fuzzy Rules and Their Interpretations in Terms of Fuzzy Relations.

SWITCHING FUNCTIONS AND SWITCHING CIRCUITS: Introduction; Switching Functions; Disjunctive Normal Form; Relation between Switching Functions and Switching Circuits; Equivalence of Circuits; Simplification of Circuits.

APPLICATIONS

FUZZY METHODS IN CONTROL THEORY: Introduction; Introduction to Fuzzy Logic Controller; Fuzzy Expert Systems; Classical Control Theory vs. Fuzzy Control; Illustrative Examples; Working of an FLC through Examples; Details of the Components of FLC; Mathematical Formulation of an FLC; Real-life Examples.

Text Books : 1. M. Ganesh, Introduction to Fuzzy Sets and Fuzzy Logic, PHI, 2001.
2. G. J. Klir and B. Yuan , Fuzzy Sets and Fuzzy Logic theory and applications, PHI, 1997.

References: 1. T.J.Ross, Fuzzy Logic with engineering Applications, McGraw-Hill Inc,1995.
2. H.J.Zimmerman, Fuzzy sets, Decision making and expert systems, Kluwer, Boston,1987.

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DEPARTMENT OF MATHEMATICS
PROPOSED SYLLABUS FOR M.Sc. (Applied Mathematics)
W.E.F the Academic Year 2014-2015

Course Code : 14 AM 535	**L-T-P : 3-1-0**
Course Title : Applied Algebra	**Credits : 4**
Prerequisite Course : Under Graduate Mathematics	**No of Lecture periods: 45**

Syllabus

Sets and Functions: Sets and subsets, Boolean algebra, Functions , Inverses, Functions on S to S, Sums, products, and powers, Peano axioms, Finite induction, Pigeonhole principle; division algorithm.

Binary Relations and Graphs: Introduction, Relation matrices, Algebra of relations, Partial orderings, Equivalence relations and partitions, Modular numbers; morphisms, Cyclic unary algebras, Directed graphs, Graphs, Directed graphs, II

Monoids and Groups: Binary algebras, Cyclic monoids,; submonoids, Groups, Morphisms; direct products, Examples of groups; postulates, Subgroups, Abelian groups, Groups acting on sets, Permutations, Lagrange's theorem, Normal subgroups.

Binary Group Codes: Introduction, Encoding and decoding, Block codes, Matrix encoding techniques, Group codes, Decoding tables, Hamming coding.

Optimization and Computer Design: Introduction, Optimization, Computerizing optimization, Logic design, NAND gates and NOR gates, The minimization problem, Procedure for deriving prime implicants, Consensus taking, Flip-flops, Sequential machine design

Finite State Machines: Introduction, Binary devices and states, Finite- state machines, Covering and equivalence, Equivalent states, A minimization procedure, Truing machines, Incompletely specified machines, Relations between states- a minimization procedure.

Text Book:

1. Garrett Birkhoff & Thomas C. Bartee, Modern Applied Algebra, MacGraw-Hill Company, New York, 1970.

References:

1.William J. Gilbert, W. Keinth Nicholson, Modern algebra with applications, second edition, A John Wiley & sons, Inc., publication.

2. Rudolf Lidl and Gunter Pilz, Applied abstract algebra, Second edition, Springer-Verlag, 1997.

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DEPARTMENT OF MATHEMATICS
PROPOSED SYLLABUS FOR M.Sc. (Applied Mathematics)
W.E.F the Academic Year 2014-2015

Course Code : 14 AM 536	**L-T-P : 3-1-0**
Course Title : Elements of Differential Topology	**Credits : 4**
Prerequisite Course :	**No of Lecture periods: 45**

Syllabus

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DEPARTMENT OF MATHEMATICS
PROPOSED SYLLABUS FOR M.Sc. (Applied Mathematics)
W.E.F the Academic Year 2014-2015

Course Code : 14 AM 531	**L-T-P : 3-1-0**
Course Title : Mathematical Control Theory	**Credits : 4**
Prerequisite Course : Differential Equations	**No of Lecture periods: 45**

SYLLABUS

Introduction Problems of mathematical control theory , Specific models . **(Chapter 0 of Ref.1)**
Controllability and observability for Linear systems Linear differential equations , The controllability matrix , Rank condition , Kalman decomposition and Observability **(chapter1 of Part I of Text book 1)**
Controllability and observability for non-Linear systems Nonlinear differential equations , Controllability and linearization , Lie brackets , The openness of attainable sets and Observability . **(chapter1 of Part II of Text book. 1)**
Stability of Linear systems Stable linear systems , Stable polynomials . The Routh theorem , Stability, observability, and Liapunov equation , Stabilizability and controllability **(Chapter 2 of Part I of Text book 1)**
Stability of non-Linear systems The main stability test , Linearization , The Liapunov function method , La Salle's theorem Necessary conditions for stabilizability**. (Chapter 2 of Part II of Text book 1)**
Optimal controllability Bellman's equation and the value function , The linear regulator and stabilization, Impulse control problems, An optimal stopping problem . Iterations of convex mappings . **(Chapters 1&2 of Part III of Text book 1)**

Text Books:

1. Mathematical Control Theory: An Introduction - Jerzy Zabczyk
2. Mathematical control theory:- E.D.Sontag, Texts in applied mathematics, No.6, Springer Verlag,1990.

Reference Books:

1. Mathematical Control Theory by John Baillieul, Springer