SRI RAMAKRISHNA COLLEGE
OF ARTS AND SCIENCE (Autonomous)
Formerly SNR Sons College
Coimbatore-641 006

"Scheme of Examination along with Distribution of Marks and Credits" CBCS PATTERN

POST GRADUATE PROGRAMMES

M.Sc. MATHEMATICS Degree Course
(For the students admitted during the academic year **2019–2020** and onwards)

Study Components and Course Title	CIA	Comprehensive Exam		Compre-hensive Exam Total	Total	Credit
		Online	Descriptive Theory			
I SEMESTER						
19MMA101 ALGEBRA	**30**	**20**	**50**	**70**	**100**	**4**
19MMA102 REAL ANALYSIS	**30**	**20**	**50**	**70**	**100**	**4**
19MMA103 ORDINARY DIFFERENTIAL EQUATIONS	**30**	**20**	**50**	**70**	**100**	**4**
19MMA104 STATISTICAL METHODS	**30**	**20**	**50**	**70**	**100**	**3**
19MMA105 MATLAB (Theory & Practical)	**50**	**-**	**50**	**50**	**100**	**5**
Elective I:	**30**	**20**	**50**	**70**	**100**	**4**
19CME01- MACE-I	**-**	**-**	**-**	**100**	**100$**	**2$**
					600	24

II SEMESTER						
19MMA201 COMPLEX ANALYSIS	**30**	**20**	**50**	**70**	**100**	**4**
19MMA202 PARTIAL DIFFERENTIAL EQUATIONS	**30**	**20**	**50**	**70**	**100**	**4**
19MMA203 MECHANICS	**30**	**20**	**50**	**70**	**100**	**4**
19MMA204 LATEX (Theory & Lab)	**50**	**-**	**50**	**50**	**100**	**5**
Elective – II	**30**	**20**	**50**	**70**	**100**	**4**
INTERNSHIP DURING SUMMER VACATION FOR 20 DAYS	-	-	-	-	-	-
19CME02- MACE-II	**-**	**-**	**-**	**100**	**100$**	**2$**
					500	21
III SEMESTER						
19MMA301 TOPOLOGY	**30**	**20**	**50**	**70**	**100**	**4**
19MMA302 FLUID DYNAMICS	**30**	**20**	**50**	**70**	**100**	**4**
19MMA303 GRAPH THOERY	**30**	**20**	**50**	**70**	**100**	**4**
19MMA304 ADVANCED EXCEL (Theory & Practical)	**50**	**-**	**50**	**50**	**100**	**5**
19MMA305 INFERENTIAL STATISTICS	**30**	**20**	**50**	**70**	**100**	**3**
INTER DEPARTMENT COURSE – 19MMAM01 Introduction to R Software – **Mooc Course** (Self Study)	-	-	-	**100**	**100$**	**3$**
INTERNSHIP 19MMA306	-	-	-		**100***	**2*$**
					500	20

IV SEMESTER

19MMA401 FUNCTIONAL ANALYSIS	**30**	**20**	**50**	**70**	**100**	**4**
19MMA402 MATHEMATICAL METHODS	**30**	**20**	**50**	**70**	**100**	**4**
19MMA403 R & SPSS (Theory & Lab)	**50**	**-**	**50**	**50**	**100**	**5**
19MMA404 (NUMBER THEORY)	**30**	**20**	**50**	**70**	**100**	**4**
19MMA405 Project Work and Viva voce	**160**	**-**	**-**	**40**	**200**	**8**
					600	25

List of Elective papers (Can choose any one of the paper As electives)

Elective – I	**19MMAE01**	NUMERICAL METHODS
	19MMAE02	Fuzzy Logic and Fuzzy Sets
	19MMAE03	Control Theory
Elective – II	**19MMAE04**	Optimization Techniques
	19MMAE05	Differential Geometry
	19MMAE06	Neural Networks

Summary

Subject	Papers	Credit	Total	Papers	Marks	Total
Core (including Project work & Viva voce)	19	2*3 12*4 4*5 1*8	82	18 1	100 200	2000
Electives	2	4	8		100	200
Open Elective	1	3$				100$
MACE	2	4$				200$
Total			**90**			**2200**

$ - NOT INCLUDED IN TOTAL MARKS & CGPA calculations. * -No Comprehensive Examinations. Only Continuous Internal Assessment

Syllabus Coordinator
Prof. Vasanth kumar Boniface

BOS-Chairperson
Dr N Uma

Academic Council – Member Secretary
Dr D Jayasheela

19MMA101 – ALGEBRA

Semester	I
Credit	4
Paper Type	Core
Max. Marks	CIA -30 CE -70 TOT =100

COURSE OBJECTIVE

- Learn the elementary concepts and basic ideas involved in groups, cyclic groups, homomorphism andisomorphism.
- Develop the ability to form and evaluate group theory and itsactions.
- Understand the fundamental concepts of abstract algebra which include sylow theorems and relative this concept to the direct products and abelian groups.

UNIT I : INTRODUCTION TO GROUPS (11)

Dihedral groups - Symmetric groups - Matrix groups - Homomorphisms and Isomorphisms - Group actions. Subgroups: Definition and Examples - Centralizers and Normalizer, Stabilizers and Kernels.

UNIT II :CYCLIC GROUPS AND CYCLIC SUBGROUPS OF A GROUP(11)

Quotient Groups and Homomorphisms: Definitions and Examples - More on cosets and Lagrange's Theorem - The isomorphism theorems - Transpositions and the Alternating groups

UNIT III : GROUP ACTIONS (11)

Group actions and permutation representations - Groups acting on themselves by left multiplication - Cayley's theorem - Groups acting on themselves by conjugation - The class equation - Automorphisms.

UNIT IV : THE SYLOW THEOREMS (11)

TheSylow theorems - The simplicity of A_n.Further topics in group theory: p-groups, Nilpotent groups and Solvable groups.

UNIT V: DIRECT, SEMI-DIRECT PRODUCTS AND ABELIAN GROUPS (11)

Direct Products - The fundamental theorem of finitely generated abelian groups - Table of groups of small order - semi directproducts.

CourseOutcomes:

On successful completion of the course, the students will be ableto

CO 1 Apply the characteristics of Dihedral groups, Symmetric groups, Matrix groups and their Sub groups (K3)
CO 2 Compare the cosets of a Quotient group using Isomorphic theorems (K3)
CO 3 Derive the class equations using Group actions (K3)
CO 4 Analyze Sylow theorems and their Implications (K3)
CO 5 Compute the Direct products of Abelian groups (K3)

Total Periods : 55

TEXT BOOKS

"*Abstract Algebra*" (Third Edition) by **David S. Dummit**and **Richard M. Foote**, Wiley Student Edition (1999),

UnitI : Chapter 1: (Sections 1.2, 1.3. 1.4, 1.6,1.7) Chapter 2: (Sections 2.1, 2.2)
Unit II : Chapter 2: (Sections2.3) Chapter 3: (Sections 3.1, 3.2, 3.3, 3.5)
Unit III : Chapter 4: (Sections 4.1, 4.2, 4.3, 4.4)
Unit IV : Chapter 4: (Sections 4.5, 4.6) Chapter 6: (Sections 6.1, 6.2)
Unit V : Chapter 5: (Sections 5.1, 5.2, 5.3, 5.5)

REFERENCE BOOKS

1. "*Topics in Algebra*" by **I.N. Herstein,** John Wiley & Sons (Second Edition), New Delhi, 1975.
2. "*Lectures in Abstract Algebra*" Vol. I by**N. Jacobson, D. Van Nostrand Co.**, New York, 1976.

Dr N UMA
(Course Coordinator)

Dr NUMA
(BOS Chairman)

19MMA102 - REAL ANALYSIS

Semester	I
Credit	4
Paper Type	Core
Max. Marks	CIA:30 CE:70

COURSE OBJECTIVES

- This course will focus on the proofs of basic theorems of analysis.
- The way to establish the proofs, many new concepts will be introduced.
- Understanding the basic concepts and their properties are important for the development of the present and further courses.

UNIT - I RIEMANN STILTJES INTEGRAL 11

Definition and Existence of the Integral – properties of the integral – integration and differentiation – Integratio vector valued function – rectifiable curves.

UNIT - II SEQUENCES AND SERIES OF FUNCTIONS 11

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 11

Functions of several variables :Linear transformations –Differentiation - The contraction principle – The inverse function theorem – The implicit function theorem – Determinants – Derivatives of higher order – Differentiation of integrals.

UNIT – IV LEBESGUE MEASURE 11

Outer measure – Measurable sets and Lebesgue measure – Nonmeasurable set-Measurable functions – Littlewood's three principles.

UNIT - V LEBESGUE INTEGRAL 11

The Lebesgue integral of a bounded function over a set of finite measure – The integral of a nonnegative function – The general Lebesgue integral – Convergence in measure.

Course Outcomes

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

CO 1 – Determine the Riemann integrability and the Riemann-Stieltjes integrability of a bounded function and proved a selection of theorems concerning integration. (K3)

CO 2 – Recognize the difference between pointwise and uniform convergence of a sequence of functions. (K2)

CO 3 - Determine the continuity, differentiability, and integrability of functions defined on subsets of the real line. Illustrate the derivatives of higher order and differentiation of integral. (K3)

CO 4 – Analyze the Lebesgue measure and Lebesgue integral with related problems. (K3)

Total Periods : 55

TEXT BOOKS

1. Principles of Mathematical Analysis by W. Rudin, McGraw Hill, New York, 1976.
Unit I &II : Chapter 6 & 7.
Unit III : Chapter 9 (Pages 204 to 227)
2.Real Analysis by H.L. Royden, Third Edition, Macmillan, New York, 1988.
Unit IV : Chapter 3 (except Section – 4)
Unit V :Chapter 4 (Sections 2, 3 & 4 only)

Reference Books:

1.R.G.Bartle, Elements of Real Analysis, 2nd Edition, John Wily and Sons, New York, 1976.
2.W.Rudin, Real and Complex Analysis, 3rd Edition, McGraw-Hill, New York, 1986.

Mr.E.VIVEK
(Course Coordinator)

Dr.N.UMA
(BOS Chairman)

19MMA103 – ORDINARY DIFFERENTIAL EQUATION

Semester	I
Credit	4
Paper Type	Core
Max. Marks	CIA -30 CE -70 TOT =100

COURSE OBJECTIVE

- The main purpose of the course is to introduce students to the theory and methods of ordinary differential equations.
- Students should be able to implement the methods taught in the course to work associated problems, including proving results of suitable accessibility.
- This course is designed to prepare students to solve problems arising from many applications such as mathematical models of physical or engineering processes.

UNIT I: 11

Second order linear equations with ordinary points – Legendre equation and Legendre polynomials – Second order equations with regular singular points –Bessel equation.

UNIT II: 11

Systems of first order equations – existence and uniqueness theorem – Fundamental matrix.

UNIT III: 11

Non-homogeneous linear systems – linear systems with constant coefficients – linear systems with periodic co-efficients.

UNIT IV: 11

Successive approximation – Picard's theorem - Non-uniqueness of solution – Continuation and dependence on initial conditions, Existence of solutions in the large – Existence and uniqueness of solutions of systems.

UNIT V: 11

Fundamental results – Sturm's comparison theorem – Elementary linear oscillations. Comparison theorem of Hille-Winter – oscillations of x a(t)x 0 - Elementary non-linear oscillation.

CourseOutcomes

On successful completion of the course, the students will be ableto

CO 1 :Identify the difference between Legendre's equation and Bessel's equation (L3)
CO 2 :Explain the system of first order equations (L3)
CO 3 :Acquire the knowledge about Non-homogenous linear systems (L3)
CO 4 :Evaluate Successive Approximation problems (L3)
CO 5:Analyze the problems in Sturm's comparison theorem (L3)

Total Periods : 55

TEXT BOOK:

1. Ordinary Differential Equations and Stability Theory by S.G.Deo and V.Raghavendra.
Unit I -Chapter – 3 -Section 3.2 – 3.5
Unit II -Chapter – 4 -Section 4.2 – 4.4
Unit III -Chapter – 4 -Section 4.5 – 4.7
Unit IV -Chapter – 5 -Section 5.3 – 5.8
Unit V -Chapter – 6 -Section 6.1 – 6.6

REFERENCE BOOK

1.E.A.Coddington and N.Levinson , Theory of Ordinary Differential Equations, McGraw Hill, New York, 1955.
2.D.A.Sanchez, Ordinary Differential Equations and Stability Theory, W.H.Freeman& Co., San Francisco, 1968.

Mr VASANTH KUMAR BONIFACE
(Course Coordinator)

Dr N UMA
(BOS Chairman)

19MMA104 – STATISTICAL METHODS

Semester	I
Credit	3
Paper Type	Core
Max. Marks	CIA -30 CE -70 TOT =100

COURSE OBJECTIVE

- To gain knowledge about the concept of random variable, Expectations and special probability distribution.
- To learn the concept of Correlation & Regression
- To learn the concept of estimator & estimation.

UNIT-I (9)

Random variable- Discrete and Continuous random variable- distribution functions and Expectations of random variable.

UNIT-II (9)

Probability distributions- Binomial, Poisson and Normal distributions (No derivations) – Properties and Applications- Problems

UNIT-III (9)

Correlation-Karl Pearson correlation co-efficient-Spearman Rank correlation- Partial and Multiple correlation.

Regression-Simple linear regression-Regression equations-Regression co-efficients -Multiple linear regression.

UNIT-IV (9)

Parametric point estimation- Characteristics of good estimator – Consistency- sufficient condition for consistency- Unbiasedness- Cramer Rao inequality- Efficiency – Sufficiency– Rao- Blackwell Theorem.

UNIT-V (9)

Methods of estimation- method of moments and its properties – method of maximum likelihood and its properties-method of minimum Chi-Square and its properties.

CourseOutcomes

On successful completion of the course, the students will be ableto

CO 1 Acquire knowledge about variables & distribution function. (L2)
CO 2 Apply the concept of probability distribution. (L3)
CO 3 Analyze data using correlation & regression. (L3)
CO 4Understand the concept of estimator. (L2)
CO 5 Solve problems on MLE & Moments. (L3)

Total Periods : 45

TEXT BOOK

1. S.P.Gupta&V.K.Kapoor : "Fundamentals of Mathematical Statistics" 1st Edition 1969, Reprint 2016.

REFERENCE BOOKS

1. S.P.Gupta&V.K.Kapoor : " Statistical Methods" 1st Edition 2002, Reprint 2016.
2. P.R.Vittal : "Mathematical Statistics" 1st Edition 2002, Reprint 2015.

Mrs.J.SINTHIYA
(Course Coordinator)

Dr.N.UMA
(BOS Chairman)

19MMA105 – MATLAB (Theory & Practical)

Semester	I
Credit	5
Paper Type	Core
Max. Marks	CIA -50 (Practical) CE -50 TOT =100

COURSE OBJECTIVE

- To give an insight into theoretical concepts of MATLAB
- To understand the basic commands in MATLAB
- To gain programming knowledge in MATLAB

THEORY (45 Hrs)

Unit I: 9

Introduction: Basic of MATLAB, Input – Output - File types – Platform dependence– General commands.

Unit II: 9

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: 9

Programming in MATLAB: Scripts and Functions – Script files – Function files – Language specific features – Advanced data objects.

Unit IV: 9

Applications: Linear Algebra – Curve fitting and Interpolation – Data analysis and Statistics – Numerical Integration – Ordinary differential equations – Nonlinear Algebraic Equations.

Unit V: 9

Graphics: Basic 2-D plots – Using subplot to layout multiple graphs – 3-D Plots – Handle Graphics – Saving and Printing Graphs – Errors.

PRACTICALS (30 Hrs)

1. Equation of Straight line
2. Multiply, divide and exponentiation vectors
3. Matrices and vectors
4. Simple sine plot
5. Solution of a system of linear equations
6. Ordinary Differential Equation
7. Curve fitting and interpolation
8. Numerical Integration
9. 2-D plots
10. 3-D Plots

CourseOutcomes:

On successful completion of the course, the students will be ableto

CO 1 Apply the basic concepts of MATLAB and its commands (L_2)
CO 2 Plot simple graphs using arrays, inline functions and Built-in functions (L_2)
CO 3 Analyse script files and function files in MATLAB(L_3)
CO 4 Use suitable commands to solve the Ordinary Differential Equations and algebraic equations(L_3)
CO 5 Apply subplot and graphical commands to plot 2D and 3D graphs(L_3)

Total Periods : 75

Text Book:

1. Getting started with MATLAB – A Quick Introduction for Scientists and Engineers by RudraPratap, Oxford University Press, 2003.

Chapter I: Section 1.6
Chapter III: Sections 3.1 – 3.6.
Chapter IV: Sections 4.1 – 4.4
Chapter V: Sections 5.1 – 5.6.
Chapter VI & VII: Sections 6.1 – 6.5.

for

Mr. M MOHAMED RAJIK
(Course Coordinator)

Dr. N UMA
(BOS Chairman)

19MMAE01 – NUMERICAL METHODS

Semester	I
Credit	4
Paper Type	Elective
Max. Marks	CIA -30 CE -70 TOT =100

COURSE OBJECTIVE

- To understand appropriate numerical methods to solve algebraic and transcendental equations (Newton's method and Bairstow'smethod).
- To perform an error analysis for various numerical methods and derive appropriate numerical methods to solve definiteintegrals.
- To develop appropriate numerical methods to solve a system of linear equations and special kinds of differential equations such as elliptic, parabolic and hyperbolic differential equations.

UNIT I: SOLUTION OF NONLINEAR EQUATIONS: **11**

Newton's method – Convergence of Newton's method – Bairstow's Method for quadraticfactors.

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: **11**

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

UNIT III: SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS: **11**

Taylor series method – Euler and Modified Euler methods – Runge-kutta methods – Multistep methods – Milne's method – Adams Moulton method.

UNIT IV: BOUNDARY VALUE PROBLEMS AND CHARACTERISTIC VALUE PROBLEMS: **11**

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: **11**

(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.

CourseOutcomes:

On successful completion of the course, the students will be ableto

CO 1 Solve Non-Linear equations using Newtons method &Bairstow's method. (L2)
CO 2 Numerically differentiate & integrate the given function. (L3)
CO 3 Apply direct and iterative methods to solve a linear system. (L2)
CO 4 Analyze single step and multistep methods to solve ODE. (L3)
CO 5 Find the solutions of boundary value problems and Eigen values using numerical methods. (L3)
CO6 Use Finite difference method for solving PDEs (L3)

Total Periods : 55

Text Book:

1.APPLIED NUMERICAL ANALYSIS by C.F.Gerald and P.O.Wheatley, Fifth Edition, Addison Wesley, (1998).

Reference Books:

1.S.C. Chapra and P.C. Raymond: Numerical Methods for Engineers, Tata McGraw Hill, New Delhi, (2000)
2.S.S. Sastry: Introductory methods of Numerical Analysis, Prentice Hall of India, New Delhi, (1998).
3.P.Kandasamy et al., Numerical Methods, S.Chand&Co.Ltd., New Delhi(2003)

Mr.G.INFANT GABRIEL
(Course Coordinator)

Dr.N.UMA
(BOS Chairman)

19MMA201 – COMPLEX ANALYSIS

Semeste	II
Credit	4
Paper Type	Core
Max. Marks	CIA -30 CE -70 TOT =100

COURSE OBJECTIVE

- To lay the foundation for this subject, to develop clear thinking and analyzing capacity for furtherstudy.
- Cauchy's Theorem guaranteeing that certain integrals along closed paths are zero. This striking result leads to useful techniques for evaluating real integrals based on the 'calculus of residues'.
- Important results are the Mean Value Theorem, leading to the representation of some functions as power series (the Taylor series), and the Fundamental Theorem of Calculus which establishes the relationship between differentiation andintegration.

Unit I **(12)**

Complex Integration: Cauchy's integral formula– local properties of analytic functions – the calculus of residues.

Unit II: **(12)**

Harmonic Functions: Series and product development: power series expansions.

Unit III: **(11)**

Partial Fractions and Factorizations – Entire functions.

Unit IV: **(13)**

Conformal Mapping, Dirichlet Problem: Conformal mapping of polygons, A closer look at harmonic functions, The Dirichlet problem

Unit V: **(12)**

Elliptic Functions: Simply periodic functions, Doubly periodic functions.

Total Periods : 60

COURSE OUTCOMES

After the completion of the course the students will be able to

CO1: Compute definite integrals using residue calculus
CO2: Explain the basic algebraic manipulation with power series
CO3: Analyse the partial fraction of complex numbers
CO4: Use analytical functions in conformal mappings
CO5: Find the solutions of Elliptic and Periodic functions

Text Book:

Complex Analysis by Lars. V. Ahlfors, McGraw Hill, International Edition (Third Edition) 1979

Chapter 4: Sections 2.1 - 2.3, 3.1, 3.2, 3.4, 5.1 - 5.2
Chapter 4: Sections 6.1- 6.3; Chapter V: Sections 1.1 - 1.3
Chapter 5: Sections 2.1, 2.4, 3.1 - 3.2.
Chapter 6: Sections 2.1, 2.2, 3.1, 3.2, 4.1 and 4.2.
Chapter 7: Sections 1.1 - 1.3, 2.1 - 2.4.

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Mr MOHAMED RAJIK M

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Dr UMA N

19MMA202 – PARTIAL DIFFERENTIAL EQUATIONS

Semester	II
Credit	4
Paper Type	Core
Max. Marks	CIA -30 CE -70 TOT =100

COURSE OBJECTIVE

- The main objective of the course is to is to introduce the students to the theory and method of partial differential equations.
- Students should be able to implement the method taught in the course to work associated problems, providing results of suitable accessibility.
- This course is designed to prepare students to solve problems arising from many applications such as mathematical models of physical or engineering process.

UNIT I :**Non Linear Partial Differential Equation of the first order** (12)
Cauchy's method of characteristics – Compactable system of first order equations – Charpit's method – Special types of first order equations – Jacobi's method

UNIT II: **Partial Differential equations of second order** (11)
The origin of second order equations – linear partial differential equations with constant coefficients – equations with variable coefficients

UNIT III: **The solution of linear hyperbolic equations** (11)
Separation of variables – The method of Integral transforms – Non linear equations of the second order

UNIT IV: **Laplace equation** (13)
The occurrence of Laplace equations in physics – Elementary solution of Laplace equation – Families of Equi potential surfaces – Boundary value problems – Seperation of variables – Problems with axial symmetry

UNIT V: **The wave equation** (13)
The occurrence or wave equation in physics – Elementary solution of the one dimension wave equation – Vibrating Membranes – Application of the calculus of variations – Three Dimensional problems - The Diffusion equation – Elementary solution of the Diffusion equations - Separation of variables – The use of Integral Transform

Total Periods : 60

COURSE OUTCOMES

After the completion of the course the students will be able to

CO1: Identify the difference between Cauchy's method and Jacobi method
CO2:Acqquire the knowledge about partial differential equations with constant and variable coefficients
CO3: Explain the system of Integral Transforms
CO4: Evaluate Boundary value problems
CO5: Analyze the problems in wave equations

TEXT BOOK: Ian Sneddon – Elements of Partial Differential Equations – McGraw Hill International Book Company, New Delhi, 2006
Unit I: Chapter 2: Section - 7,8,9,10,13
Unit II: Chapter 3: Section – 1,4,5,6
Unit III: Chapter3: Section – 8,9,10,11
Unit IV: Chapter 4: Section – 1,2,3,4,5,6
Unit V: Chapter 5: Section – 1,2,4,5 Chapter 6: Section – 3,4,5

REFERENCE BOOKS:

1. M.D. Raisinghania"Advanced Differential Equations" S. Chand and Company Ltd., 9th Edition New Delhi, 2005.
2. K. SankaraRao, "Introduction to Partial Differential Equations", Second edition – Prentice – Hall of India, New Delhi 2011.
3. J.N. Sharma & K. Singh "Partial Differential Equations for Engineers & Scientists", Narosa Publishing House, 2006
4. Vairamanikam. K and Etal "Transforms and Partial Differential Equations", Scitech Publication India Pvt Ltd, 2nd Edition 2009.
5.Veerarajan.T "Transforms and Partial Differential Equations" , Tata McGraw Hill Publication New Delhi 2011
6. Nita H Shaw, "Ordinary and Partial Differential Equations", Phi Learning Pvt Ltd 2011

Prepared by

Mr VASANTH KUMAR BONIFACE

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Dr UMA N

19MMA203 – MECHANICS

Semester	II
Credit	4
Paper Type	Core
Max. Marks	CIA -30 CE -70 TOT =100

COURSE OBJECTIVE

- To create a solid foundation for understanding basic principles of mechanics and some classical problems
- To gain knowledge in Lagrangian and Hamiltonian formulations of classical mechanics
- To learn the importance and consequences of canonical transformations

UNIT-I: INDRODUCTORY CONCEPTS

Mechanical system – Generalized Coordinates – Constraints – Virtual Work – Energy and Momentum. (13)

UNIT-II: LAGRANGE'S EQUATIONS

Derivation of Lagrange's Equations – Examples – Integrals of Motion. (13)

UNIT-III: HAMITON'S EQUATIONS

Hamilton's Principle – Hamilton's Equations. (11)

UNIT-IV: HAMILTON – JACOBI THEORY

Hamilton's Principle function – Hamilton – Jacobi Equation – Separability. (11)

UNIT-V: CANONICAL TRANSFORMATIONS

Differential forms and Generating Functions – Lagrange and Poisson Brackets. (12)

COURSE OUTCOMES

After completion of the course, student will be able to

- Interpret a mechanical system using generalized coordinates.
- Derive the Lagrange's equations of a dynamical system
- Analyze a dynamical system by Hamilton's principle .
- Determine the principle function of a given integral of motion
- Verify whether the given transformation is canonical.

Total Periods : 60

Text Book:

D.T.Greenwood, Classical Dynamics, Dover Publication, New York, 1997. (Current Edition)

Unit-I: Chapter 1: Sections 1.1 – 1.5
Unit-II: Chapter 2: Sections 2.1 – 2.3
Unit-III: Chapter 4: Sections 4.1 – 4.2
Unit-IV: Chapter 5: Sections 5.1 – 5.3
Unit-V: Chapter 6: Sections 6.1, 6.3

Reference Books:

1. F. Gantmacher, Lectures in Analytic Mechanics, MIR Publishers, Moscow, 1975. (Current Edition)
2. I.M. Gelfand and S.V. Fomin, Calculus of Variations, Prentice Hall. (Current Edition)
3. S.L. Loney, An Elementary Treatise on Statics, Kalyani Publishers, New Delhi, 1979. (Current Edition)

Prepared by

Mr SIVACHANDRAN Y L

Approved by

Dr UMA N

19MMA204 – LATEX
(Theory & Practical)

Semester	II
Credit	5
Paper Type	Core
Max. Marks	CIA -50 (Practical) CE -50 (Theory) TOT =100

COURSE OBJECTIVE

- Explores the power of LaTeX for use at school, home, or the workplace for mathematical documents and other applications.

THEORY (45 Hrs)

UNIT I **(8)**

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

UNIT II **(8)**

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

UNIT III **(10)**

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 **(9)**

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

UNIT V **(10)**

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

PRACTICALS (30 Hrs)

1. Type a Document in different alignments (Left, Right, Center, Justify)
2. Type a Letter for applying a job
3. Type your own Bio-Data.
4. Construct a Table Structure in Latex.
5. Type a given Mathematical expression using differentiation, integration and trigonometry
6. Type a given mathematical expression using all inequalities
7. Type a given Article
8. Insert any picture in Latex file
9. Type a given question paper
10. Convert one latex file into power point presentation

Course Outcomes

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

CO1 Understand the various special formatting commands, including those for mathematics, text formatting, and tables.

CO2 Understand the various commands, environments, declarations and special characters in Latex.

CO3 Organize documents, page style and contents in Latex.

CO4 Construct table, graphs and figures in Latex.

CO5 Prepare documents containing mathematical formulas.

CO6 Prepare presentation using Latex.

Total Periods : 75

TEXT BOOK

1. 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.

Prepared by

Mrs SINTHIYA J

Approved by

Dr UMA N

* Each Programme carries 5 marks, in the specified list of 10 Practical programmes

19MMAE04 – OPTIMIZATION TECHNIQUES

Semester	II
Credit	4
Paper Type	Elective
Max. Marks	CIA:30 CE:70

COURSE OBJECTIVES

To make the students understand, analyse and apply the concepts of

- The LPP, Integer Programming Problem & Dynamic Programming
- The Network Routing Problem & Non- Linear Programming Problems.

UNIT - I

LPP – Artificial variables – Canonical form - Big – M Method – Two Phase method – Duality in simplex Method – Formulation of Dual – Dual simplex Method. **(10)**

UNIT - II

Integer Programming - Pure & Mixed IPP- Gomory's Cutting plane method for all IPP & Mixed IPP - Branch and Bound Method. **(10)**

UNIT - III

Dynamic Programming – Recursive Equation – Characteristics of DP – Solution of Discrete DPP – Some application – Solution of LPP by DP. **(11)**

UNIT – IV

Introduction to Network – Notations and Definitions – Minimial Spanning Tree problem – Shortest Route Problems – Dijkstra's Shortest path algorithm – Maximal Flow Problem – Minimum Cost Flow Problems **(12)**

UNIT - V

Introduction – Formulating a Non-Linear Programming Problem (NLPP) – General NLPP – Constrained Optimization with Equality Constraints - Constrained Optimization with Inequality Constraints – Kuhn-Tucker Condition (Necessary & Sufficient). **(12)**

Total Periods : 55

COURSE OUTCOMES

After the Completion of the course students should be able to

CO1 : Formulate and Solve LPP with artificial variables and apply the principle of duality
CO2 :Solve the Integer Programming Problem
CO3 :Apply Dynamic Programming Problem into various multi stage decision problem
CO4 :Construct the network for Routing Problems by Dijkstra's Algorithm
CO5 :Solve Non-Linear Programming Problem usingmKuhn-Tucker Condition

TEXT BOOK:

1. Operations Research: An Introduction to Management Science, by Kanti Swarup,P.K. Gupta, Man Mohan , Ninteenth Revised Edition, Sultan Chand & Sons Educational Publishers, New Delhi (2018).

Unit I: Chapter 3: 3.5, Chapter 4: 4.4, Chapter 5: 5.3, 5.7
Unit-II: Chapter 7: 7.1 – 7.7
Unit-III: Chapter 13: 13.1 - 13.7
Unit-IV: Chapter 24: 24.1 – 24.7
Unit-V: Chapter 27: 27.1 – 27.5

REFERENCE BOOK:

1. Operations Research: An Introduction, by H.A. Taha, Eighth Edition, Prentice Hall of India Private Limited, New Delhi (2006).

Prepared by

Dr HANNAH REVATHY F

Approved by

Dr UMA N

19MMA301 - TOPOLOGY

Semester	III
Credit	4
Paper Type	Core
Max. Marks	CIA -30 CE -70 TOT =100

COURSE OBJECTIVE

To enable the students to learn basic knowledge in Topology and Topological paces, to study the concepts of Compactness and Connectedness and to know the concept of Countability Axioms.

Unit I (12)

Topological Spaces – Definition – Basis for a Topology – The Order Topology – The Product Law - Normal Forms - Topology on X x Y – Closed Sets and Limit Points.

Unit II (11)

Continuous Functions – Continuity of a Function – Homeomorphisms – Rules for Constructing Continuous Functions – The Pasting Lemma – The Product Topology – The Metric Topology.

Unit III (11)

Connected Spaces – Connected Subspaces of the Real Line – Intermediate Theorem – Components and Local Connectedness.

Unit IV (13)

Compact Spaces – The Tube Lemma – Compact Subspaces of the Real Line – Extreme Value Theorem – The Lebesgue Number Lemma – Uniform Continuity Theorem – Limit Point Compactness – Local Compactness.

Unit V (13)

The Countability Axioms – The Separation Axioms –The Urysohn Lemma – Urysohn Metrization Theorem – Imbedding Theorem.

Total hours : 60

COURSE OUTCOMES

After completing the course, students should be able to

- Explain the concept of Basis for a topology. [L2]
- Compare the concepts of product topology and metric topology. [L3]
- Summarize the properties of connectedness in Topology [L3]
- Analyze the concepts of limit point compactness and local compactness. [L2]
- Apply Countability and separation axioms in proving Urysohn lemma and Urysohn Metrization theorem. [L2]

Text books

1. James R Munkers, *"Topology"* –Prentice Hall of India Pvt Ltd, 2nd edition, Reprint 2006.
   Chapter II : Sections 12– 15, 17 (except section 16)

Chapter II: Sections 18 –20
Chapter III : Sections 23 – 25
Chapter III : Sections 26 – 29
Chapter IV: Sections 30 –34 (except section 32)

References:

1. J.Dugundji, Allyn and Bacon, *"Topology"*, Prentice Hall of India Pvt. Ltd, New Delhi 1966.
2. George F.Simmons, Introduction to *"Topology and Modern Analysis"*, McGraw Hill Book Company, 1963.
3. Sze-Tsen Hu, *"Elements of General Topology"*, Holden – Day, Inc. 1965.

for

Prof Malarvizhi M
(Course Coordinator)

Dr JAYASHEELA D
(Academic Council-Member Secretary)

Dr UMA N
(BOS Chairman)

19MMA302 - FLUID DYNAMICS

Semester	III
Credit	4
Paper Type	Core
Max. Marks	CIA -30 CE -70 TOT =100

COURSE OBJECTIVE

To impart knowledge on the dynamics of Inviscid and Viscous fluid flow across specific surfaces using the fundamental concepts of conservation laws and Navier - Stokes Equations

Unit I (12)

Introductory notions – Velocity – Stream lines and Path lines – Stream Tubes and 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 (11)

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 (11)

Two Dimensional motion – Two Dimensional functions – Complex Potential – Basic Singularities – Source – Sink – Vortex – Doublet – Circle theorem - Flow past a Circular cylinder with Circulation – Blasius theorem – Lift force. (Magnus Effect)

Unit IV (13)

Viscous flows – Navier-Stokes equations – Vorticity and Circulation in a Viscous fluid – Steady flow through an arbitrary cylinder under pressure – Steady Couette flow between cylinders in Relative motion – Steady flow between Parallel planes.

Unit V (13)

Laminar Boundary Layer in Incompressible flow - Boundary Layer Concept –Boundary Layer equations – Displacement thickness - Momentum thickness – Kinetic Energy thickness – Integral equation of Boundary Layer – Flow parallel to Semi infinite flat plate –Blasius equation and its Solution in series.

Total hours : 60

COURSE OUTCOMES

After completing the course, students should be able to

- Explain the basic notions of fluid dynamics such as velocity, density, pressure , linear momentum and continuity equations. [L2]
- Derive the energy equation of an inviscid fluid flow [L3]
- Compare fluid flow across two dimensional surfaces with that of cylindrical surfaces [L3]
- Apply Navier- Stokes equations for the flow of viscous fluids [L2]
- Analyze flow of incompressible fluids using boundary layer concept [L2]

Text books

1. L.M. Milne Thomson , "*Theoretical Hydro Dynamics*", Macmillan Company, 5th Edition (1968).
Chapter I : Sections 1.0 – 1.3., 3.10-3.41 (except section 3.32)
Chapter III : Sections 3.42 – 3.53 (except section 3.44)

2. N. Curlea and H.J. Davies , "*Modern Fluid Dynamics*" (Volume I) ,D Van Nostrand Company Limited., London (1968).
Chapter III : Sections 3.1 – 3.7.5 (except sections 3.3.4, 3.4, 3.5.2,3.6)
Chapter V : Sections 5.1 – 5.3.3
Chapter VI: Sections 6.1 – 6.3.1 (except sections 6.2.2., 6.2.5)

References:

1. F. Chorlton, *"Textbook of Fluid Dynamics"*, CBS Publishers, New Delhi, 2004.
2. A. J. Chorin and A. Marsden, *"A Mathematical Introduction to Fluid Dynamics"*, Springer

Prof Sivachandran Y L	**Dr JAYASHEELA D**	**Dr UMA N**
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19MMA303 - GRAPH THEORY

Semester	III
Credit	4
Paper Type	Elective
Max. Marks	CIA -30 CE -70 TOTAL =100

COURSE OBJECTIVE

On successful completion of this course the student will gain knowledge about the graph theory concepts and their application in real life situations.

UNIT- I INTRODUCTION

(13)

Application of Graphs-Definitions-Fundamental Theorem-Subgraph-Theorem-Path and Circuits-Connectedness and Components-Cut point-Cut edges-Blocks-Theorems

UNIT - II EULERIAN GRAPHS, HAMILTONIAN GRAPHS AND TREE.

(11)

Eulerian Graphs-Definition-Fleury's Algorithms-Theorems -Hamiltonian graphs- HAMILTONIAN CYCLES Euler Tours & Hamilton Cycles Application: The Chinese Postman Problem –The Travelling Sales Man Problem Theorems-Properties of Trees-Distance and Centre in a tree-Characterization of Trees-Centre of Tree-Theorems.

UNIT- III EDGE COLOURINGS & INDEPENDENT SETS

(13)

Edge Chromatic Number-Vizings Theorem, Independent Sets-Ramsey's Theorem. Application: The Time Tabling Problem

UNIT –IV VERTEX COLOURINGS

(12)

Chromatic Number-Brooke's Theorem-Hajose' Conjecture-Chromatic Polynomials, Applications : A Storage Problem, Plane & Planar graphs-Dual Graphs - Kuratowski's theorem

UNIT – V PLANARITY

(11)

Introduction-Definition and Properties-Characterization of Planar Graphs-Thickness, Crossing and Outer Planarity

TOTAL PERIODS : 60

COURSE OUTCOMES

After completion of the course the students will be able to

- Explain the basic concepts of Graph Theory in depth [L2]
- Describe the features of Eulerian, Hamiltonian and Trees [L2]
- Apply the concepts of Edge Colourings and Independent Sets [L3]
- Analyse the concepts of Vertex Colourings [L2]
- Summarize the properties and /characteristics of the Planar Graphs [L3]

TEXT BOOK

1. S. Arumugam, S. Ramachandran, "Invitation to Graph theory", Scitech Publications, Chennai, 2001.(UNIT 1&5)
2. A. Bondy and U.S.R. Murthy, "Graph Theory with Applications", Macmillan Press Ltd.
   Unit 3 chapt 4; Sections –4.1, 4.2,4.3,4.4
   Unit 4 chapt 6; Sections –6.1, 6.2, 6.3, 7.1, 7.2,
   Unit 5 chapt 8; Sections – 8.1, 8.2, 8.3, 8.4, 8.6, 9.1, 9.2, 9.5

REFERENCE BOOKS

1. Narsingh Deo, "Graph Theory with Applications to Engineering and Computer Science", Prentice Hall of India(P) Ltd, New Delhi, 1997.
2. Harary, Graph theory-Addison Wesley, 1969.

Prof SANTHAKUMARI R	**Dr JAYASHEELA D**	**Dr UMA N**
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19MMA304-ADVANCED EXCEL
(THEORY & PRACTICAL)

Semester	3
Credit	5
Paper Type	Core
Max. Marks	CIA -50 (Practical) CE -50 TOT =100

COURSE OBJECTIVE

To enable the students to gain knowledge about Enter and edit data. Construct formulas, including the use of filters.

Unit-I 9

Getting Started with Excel: Introducing Excel-Exploring Data Types-Entering text and values into worksheets-Modifying cell contents-Applying number formatting.

Unit-II 9

Introducing Table: What is Table? – Creating table-changing the look of a table-working with table-Sorting and Filtering a table-Converting a table back into range.

Unit-III 8

Working with Formulas and Functions: Introducing Formulas and Functions-Understanding Formula Basics-Entering Formulas into your worksheets-Working with Formulas.

Unit-IV 9

Creating Charts and Graphics: Getting started making charts-what is chart-creating chart-Hands on getting and customizing charts-Working with charts-choosing a chart type.

Unit-V 10

Learning Advanced Charting: Selecting chart elements-User Interface Choices for modifying chart elements-Modifying the chart area-Modifying the Plot Area-Modifying with titles in a chart-Modifying the Axes.

Total Theory Hrs : 45 hrs

PRACTICALS: (30 Hrs)

1. Create a student table using Ms Excel
2. Create student mark table with 5 subjects and calculate Total, Average and Result using simple if function
3. Build a worksheet to perform correlation and regression coefficient using formula
4. Worksheet preparation for Electricity Bill Calculation
5. Draw Graphics to illustrate class performance
6. Worksheet preparation for Employee salary calculation
7. Calculation of EMI
8. Calculation of Future Value
9. Calculation of Present Value
10. Calculation of Annuity

COURSE OUTCOMES

After completion of the course the students will be able to

- Explain the basic concepts of open and navigate within workbooks and worksheets [L2]
- Describe the features of ranges in a worksheet [L2]
- Create and work with formulas and functions [L3]
- Analyse the concept of formatting rows and columns in a worksheet [L2]
- Use filter data into summarizing the worksheets [L2]

TEXT BOOK:

1. John Walkenbach "Microsoft Excel 2016 BIBLE", 'The Comprehensive Tutorial Resource', Jhon Willey & Sons.

REFERENCE BOOKS:

1. Scott Proctor, "Building Financial Models with Microsoft Excel", second Edition, Willey Finance.
2. Greg Harvey "Excel 2016 for Dummies", Jhon Willey & Sons.

E-RESOURCES:

1. www.it_ebooks.info
2. https://www.montclair.edu/media/montclairedu/oit/documentation/office2016/Introduction-to-Excel-2016.pdf
3. https://www.dit.ie/media/ittraining/msoffice/MOAC_Excel_2016_Core.pdf

Prof Mohamed Rajik M (Course Coordinator)	Dr JAYASHEELA D (Academic Council-Member Secretary)	Dr UMA N (BOS Chairman)

19MMA305 – INFERENTIAL STATISTICS

Semester	III
Credit	3
Paper Type	Core
Max. Marks	CIA -30 CE -70 TOT =100

COURSE OBJECTIVE

To teach the students about the concept of Testing of Hypothesis and Non-parametric test.

Unit I (8)

Test of Hypothesis Null and Alternative Hypothesis – Critical Region – Type-I & Type-II errors – Power of the test – Best Critical Region – Uniformly Most Powerful Test – Neymann Pearson Lemma – Simple Problems.

Unit II (8)

Test of significance – Standard error – Large sample test with regard to mean, difference of means, Proportion, Difference of Proportions, Standard Deviation and Difference of Standard Deviations – Simple problems.

Unit III (9)

Small Samples Test – t-Test – Singe Mean – Difference of Means – Paired t-Test for difference of Means – χ^2 test for Single Variance – Goodness of Fit – Exact Sample Test based on F test for Equality of two Population Variances – ANOVA – One way – Two way ANOVA – Simple Problems.

Unit IV (10)

Likelihood Ratio Test (LRT) – Properties of LRT – Test for the mean of a Normal Population – Test for two Means – Test for the Variance of a Normal Population – Test for two Variances – Simple Problems.

Unit V (10)

Non-Parametric Tests – Advantages and Disadvantages of Nonparametric Tests – Run Test, Kolmogorov Smirnov Test, median test, Mann Whitney U Test, Wilcoxon Signed Rank Test – Simple Problems.

Total hours : 45

COURSE OUTCOMES

After completing the course, students should be able to

- Gain knowledge about Hypothesis. [L1]
- Analyze data using Large Sample Test. [L2]
- Analyze data using Small Sample Test. [L2]
- Demonstrate the concept of Likelihood Ratio Test. [L2]
- Solve Problems on Non-parametric Test. [L2]

TEXT BOOK

1. S. C. Gupta & V. K. Kapoor: "Fundamentals of Mathematical Statistics" 1st Edition 1970, Reprint 2016.

REFERENCES:

1. P. R. Vittal: "Mathematical Statistics" 1st Edition 2002, Reprint 2016.
2. S. P. Gupta: "Statistical Methods" 1st Edition 1969, Reprint 2017.

Dr Ramya K (Course Coordinator)	Dr JAYASHEELA D (Academic Council-Member Secretary)	Dr UMA N (BOS Chairman)

19MMAM01 - INTRODUCTION TO R SOFTWARE
(Interdepartmental Course - Self Study)
NPTEL Online Course

Semester	III
Credit	3$
Paper Type	Self Study
Max. Marks	CE -100 TOTAL =100

COURSE OBJECTIVES

- This course is designed with the beginner in mind.
- In this course, students will learn how to use R for effective data analysis.

COURSE LAYOUT

Week 1: Basic fundamentals, installation and use of software, data editing, use of R as a calculator, functions and assignments.
Week 2: Use of R as a calculator, functions and matrix operations, missing data and logical operators.
Week 3: conditional executions and loops, data management with sequences.
Week 4: Data management with repeats, sorting, ordering, and lists.
Week 5: Vector indexing, factors, Data management with strings, display and formatting.
Week 6: Data management with display paste, split, find and replacement, manipulations with alphabets, evaluation of strings, data frames.
Week 7: Data frames, import of external data in various file formats, statistical functions, compilation of data.
Week 8: Graphics and plots, statistical functions for central tendency, variation, skewness and kurtosis, handling of bivariate data through graphics, correlations, programming and illustration with examples.

COURSE OUTCOMES

After the completion of the course the students will be able to
CO 1 Understand critical programming language concepts. [L1]
CO 2 Configure statistical programming software.[L2]
CO 3 Visualize data using R. [L2]
CO 4 Analyze data using statistics.[L2]
CO 5 Solve the problems using R. [L2]

BOOKS AND REFERENCES

- Introduction to Statistics and Data Analysis - With Exercises, Solutions and Applications in R By Christian Heumann, Michael Schomaker and Shalabh, Springer, 2016
- The R Software-Fundamentals of Programming and Statistical Analysis -Pierre Lafaye de Micheaux, RémyDrouilhet, Benoit Liquet, Springer 2013
- A Beginner's Guide to R (Use R) By Alain F. Zuur, Elena N. Ieno, Erik H.W.G. Meesters, Springer 2009.
- https://cran.r-project.org/doc/manuals/r-release/R-intro.pdf

Prof SINTHIYA J
(Course Coordinator)

Dr JAYASHEELA D
(Academic Council- Member Secretary)

Dr UMA N
(BOS Chairperson)

19MMA401 : FUNCTIONAL ANALYSIS

Semester	4
Credit	4
Paper Type	Core
Max. Marks	CIA -30 CE -70 TOT =100

COURSE OBJECTIVE

To enable the students to gain knowledge about

- Banach spaces, Hilbert spaces and operators
- Spectral theorem and Banach algebra

UNIT I: **(12)**

Banach spaces – The definition and some examples – Continuous linear transformations – The Hahn-Banach theorem –Dual spaces- The natural imbedding of N in N** - The open mapping theorem - Closed Graph theorem.

UNIT II: **(12)**

The conjugate of an operator – Uniform boundedness Principal - Hilbert spaces – The definition and some simple properties – Orthogonal complements and complements - Orthonormal sets and sequences – Maximal Orthonormal sets.

UNIT III: **(12)**

The Conjugate space H* - Representation of functional on Hilbert spaces -The adjoint of an operator – Self-adjoint operators – Normal and unitary operators – Projections.

UNIT IV: **(12)**

Matrices – Determinants and the spectrum of bounded operator – The spectral theorem.

UNIT V: **(12)**

The definition and some examples of Banach algebra – Regular and singular elements– Topological divisors of zero – The spectrum – The formula for the spectral radius.

Total Theory Hrs : 60 hrs

COURSE OUTCOMES

After completion of the course the students will be able to

CO1 : Explain Banach spaces using Linear transformations [L1]
CO2 : Illustrate the properties of Hilbert spaces using operators [L2]
CO3 : Examine the effect of operators on Hilbert spaces [L2]
CO4 : Analyse bounded operators through spectral theorem [L3]
CO5 : Analyse the elements of Banach algebra [L3]

TEXT BOOK:

1. G.F. Simmons, Introduction to Topology and Modern Analysis, McGraw–Hill Book Company, London, 1963.

Unit I:	Sections: 46 – 50.
Unit II:	Sections: 51 – 54.
Unit III:	Sections: 55 – 59.
Unit IV:	Sections: 60 – 63.
Unit V:	Sections: 64 – 68.

REFERENCE BOOKS:

1. C. Goffman and G. Pedrick, A First Course in Functional Analysis, Prentice Hall of India, New Deli, 1987.
2. G. Bachman and L. Narici, Functional Analysis, Academic Press, New York, 1966.
3. L.A. Lusternik and V.J. Sobolev, Elements of Functional Analysis, Hindustan Publishing Corporation, New Delhi, 1971.

Prof. VIVEK E	**Dr JAYASHEELA D**	**Dr UMA N**
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19MMA402 : MATHEMATICAL METHODS

Semester	4
Credit	4
Paper Type	Core
Max. Marks	CIA -30 CE -70 TOT =100

COURSE OBJECTIVE

To enable the students to gain knowledge about Integral equations, transforms and calculus of variation

UNIT I: INTEGRAL EQUATIONS (11)

Types of Integral equations – Integral Fredholm Alternative - Approximate method – Equation with separable Kernel - Volterra integral equations – Fredholm"s theory.

UNIT II: APPLICATION OF INTEGRAL EQUATIONS (13)

Application of Integral Equations to Ordinary Integral Equations and Singular Integral Equations - Initial value problems Boundary value problems – singular integral equations – Abel Integral equation

UNIT III: FOURIER TRANSFORMS (12)

Fourier Transforms, Fourier sine and cosine transforms – Fourier transforms of derivatives - convolution integral – Parseval's Theorem - Solution of Laplace Equations by Fourier transform.

UNIT IV: HANKEL TRANSFORMS (13)

Properties of Hankel Transforms – Hankel transformation of derivatives of functions - The Parseval"s relation – relation between Fourier and Hankel transforms - Axisymmetric Dirichlet problem for a half space - Axisymmetric Dirichlet problem for a thick plate.

UNIT V: CALCULUS OF VARIATIONS (11)

Variation and its properties – Euler"s(Euler Lagrange"s) equation – functionals dependent on the functions of several independent variables – variational problems in parametric form –applications.

Total Theory Hrs : 60 hrs

COURSE OUTCOMES

After completion of the course the students will be able to

CO1 : Explain the types of integral equations and their characteristics [L1]
CO2 : Apply integral equations to solve differential equations [L2]
CO3 : Solve Laplace equation using Fourier transforms [L2]
CO4 : Analyse Dirichlet problem using Hankel transforms [L3]
CO5 : Analyze the properties of variations using Euler's equation [L3]

TEXT BOOK:

1. Linear Integral Equations Theory and Technique by R.P.Kanwal, Academic Press, New York, 1971.

Unit I : Chapter 2: 2.4 - 2.7, 2.9 – 2.10, 2.16 – 2-(a).(c) 2.16.
Unit II : Chapter 5: 5.2 – 5.4 , 5.6 – 5.7, 5.10 – 5.12.

2. The Use of Integral Transforms by I.N.Sneddon, McGraw-Hill, NewYork, 1972.

Unit III : Chapter 2: 2.3- 2.5, Chapter 3: 3.3- 3.4.
Unit IV : Chapter 5: 5.1– 5.2, Chapter 8: 8.1– 8.2.

3. Differential Equations and Calculus of Variations by L.Elsgolts, Mir Publishers, Moscow, 1970.

Unit V : Chapter 6: 6.1-6.3, 6.4-6.7

Prof SIVACHANDRAN Y L
(Course Coordinator)

Dr JAYASHEELA D
(Academic Council-Member Secretary)

Dr UMA N
(BOS Chairman)

19MMA403 - R & SPSS
(Theory & Practical)

Semester	4
Credit	5
Paper Type	Core
Max. Marks	CIA -50 (Practical) CE -50 (Theory) TOT =100

COURSE OBJECTIVE

- To enable the students to gain knowledge about R Programming and SPSS.
- In this course the candidates shall undergo hands on training in R and SPSS software

Unit-I R Programming **9**

Introducing R – Downloading and Installing R –Running the R Program –Command Packages – Becoming Familiar with R-Some simple Math-Storing the Results Calculations-Reading and Getting Data into R- Reading Bigger Data Files-Viewing Named Objects-Types of Data Items- Examining Data Structure- Saving Your work in R.

Unit-II Statistics and Probability **9**

Data: Descriptive Statistics and Tabulation-Summarizing Samples-Cumulative Statistics-Summary Statistics-Making Contingency Tables- Cross Tabulation.

Data: Distribution –Stem and Leaf Plot-Histograms-Density Function-Types of Data Distribution (Normal Distribution, Binomial and Poisson Distribution).

Unit-III Correlation, Regression and Hypothesis Testing **8**

Simple Hypothesis Testing- Correlation and Covariance- Simple Correlation – Covariance-Significance Testing in Correlation Tests. Regression –Multiple Regression.

Unit-IV SPSS **9**

An overview of SPSS-SPSS windows Processes-Creating an d Editing a Data File-Name & Type-Labels & Values-Missing and Columns-Entering and Editing Data.

Introduction to Managing Data-Listing Cases-Replacing Missing Values-Computing New Variables-Recoding Variables-Selecting Cases-Sorting Cases and Merging Files.

Unit-V Diagrammatic Representation and ANOVA **10**

Graphs and Charts: Creating and Editing –Bar Charts- Line Charts-Pie Chart- Box Plots – Histogram –Scatter Plots-Bivariate Correlation-Significance-Direction of Causality-t-Test-One way ANOVA and Two way ANOVA.

Total Theory Hrs : 45 hrs

PRACTICALS: (30 Hrs)

1. Draw Simple and Multiple Bar Diagram.
2. Draw Box Plots and Dot Chart.
3. Draw Pie Diagram and Histogram
4. Binomial, Poisson and Normal Distribution.
5. Correlation and Regression.
6. Multiple Regression
7. t-test

8. Chi-square test and F Test
9. One Way ANOVA
10. Two Way ANOVA.

[Each programme carries 5 marks, in the specified list of 10 practical programmes]

Program 1 to 5 using R and 6- 10 using SPSS.

COURSE OUTCOMES

After completion of the course the students will be able to

CO1: Explain the basic concepts of R Programming [L1]
CO2: Solve Problems on Descriptive Statistics and Probability Distributions [L2]
CO3: Analyse data using Correlation and Regression [L3]
CO4: Explain the basic concepts of SPSS [L1]
CO5: Apply and Analyse Data using Diagrammatic Representation and ANOVA.[L3]

TEXT BOOK:

1. Dr. Mark Gardener, "Beginning R the Statistical Programming Language", Second Edition -2018, Willey India Pvt.Ltd.
2. Darren George, Paul Mallery, "SPSS for Windows Step by Step", Eleventh Edition, Published by Dorling Kindersley Pvt.Ltd.
3. Sandip Rakshit, "Statistics with R Programming", McGraw Hill Publications, Kindle Edition – 2018.

REFERENCE BOOKS:

1. Alian F.Zuur,Eena N.Leno and Erik H.W.G.Meesters, "A Beginner's Guide to R", Springer Dordrecht Heidelberg London , New York.
2. Sabine Landau and Brain S. Everitt, "A Handbook of Statistical Analysis using SPSS", Chapman & Hall/CRC Press LLC.2004.
3. EMC Educational Services, "Data Science and Big Data Analytics: Discovering, Analyzing, Visualizing and Presentation of Data", Second Edition – 2015, Wiley India Pvt. Ltd.New Delhi-110002.

E-RESOURCES:

1. https://opentextbc.ca/introductorybusinessstatistics/chapter/descriptive-statistics-and-frequency-distributions-2/
2. https://courses.lumenlearning.com/suny-natural-resources-biometrics/chapter/chapter-1-descriptive-statistics-and-the-normal-distribution/
3. https://basketsoftgo.tistory.com/m/16?category=0
4. https://books.goalkicker.com/RBook/
5. https://www.r-statistics.com/2009/10/free-statistics-e-books-for-download/

Prof. Mani N	**Dr JAYASHEELA D**	**Dr UMA N**
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19MMA404 : NUMBER THEORY

Semester	4
Credit	4
Paper Type	Core
Max. Marks	CIA -30 CE -70 TOT =100

COURSE OBJECTIVE

To enable the students to gain knowledge about fundamental concepts and applications of number theory

UNIT I: **10 Hours**

Divisibility and Euclidean algorithm.

UNIT II: **13 Hours**

Congruences-Euler's theorem-Wilson's Theorem-Solutions of congruences-Congruences of Degree 1- Chinese Remainder Theorem-The function $\Phi(n)$-Congruences of higher degree

UNIT III: **12 Hours**

Prime power moduli-Prime modulus-Quadratic residues.- Quadratic reciprocity.

UNIT IV: **12 Hours**

The Jacobi symbol – Greatest integer function - Arithmetic functions – The Moebius Inversion formula

UNIT V: **13 Hours**

Multiplication of arithmetic functions- Linear Diophantine equations – The equation $x^2 + y^2 = z^2$ - The equation $x^4 + y^4 = z^2$.

Total Hours :60

COURSE OUTCOMES

After completion of the course the students will be able to

CO1: Explain divisibility of numbers using Euclidean algorithm [L1]
CO2: Solve congruence between integers using modular arithmetic [L2]
CO3: Analyze quadratic residues of integers through prime modulus [L3]
CO4: Apply Mobius inversion formula in a number series [L2]
CO5: Analyze the Solution of simple linear Diophantine equations [L3]

TEXT BOOK:

An Introduction to Theory of Numbers by Ivan Nivan and HerbertsZucherman. Third Edition, 1972, Wiley Eastern Limited, New Delhi.

Unit I – Chapter I : Section 1.1 -1.3
Unit II – Chapter II : Section 2.1 -2.5
Unit III – Chapter II : Section 2.6 – 2.7, Chapter III : Section 3.1-3.2
Unit IV – Chapter III : Section 3.3
Unit V – Chapter IV : Section 4.1 – 4.4, Chapter V : Section 5.1-5.6

REFERENCE BOOKS:

1.T.M. Apostol, Introduction to Analytic Number Theory, Springer Verlag, 1976.
2.Kennath and Rosan, Elementary Number Theory and its Applications, Addison Wesley Publishing Company, 1968.
3.George E. Andrews, Number Theory, Hindustan Publishing, New Delhi, 1989.

Prof SIVACHANDRAN Y L
(Course Coordinator)

Dr JAYASHEELA D
(Academic Council-Member Secretary)

Dr UMA N
(BOS Chairman)

19MMA405 – PROJECT WORK AND VIVA VOCE

Semester	IV
Credit	8
Paper Type	SKILL BASED
Max. Marks	CIA -160 CE -40 TOTAL- 200

COURSE OBJECTIVE

To enable the students to do preliminary research work in their area of interest

AREA OF RESEARCH IN MATHEMATICS

1. Algebra
2. Real Analysis
3. Complex Analysis
4. Optimization Techniques
5. Graph Theory
6. Differential Equations
7. Fluid Dynamics
8. Numerical Analysis
9. Topology
10. Mathematical Statistics
11. Number Theory
12. Mechanics
13. Integral Equations
14. Discrete Mathematics
15. Mathematical Biology
16. Fuzzy Logic
17. Artificial Neural Networks
18. Control theory
19. Data Analytics
20. Functional Analysis

COURSE OUTCOMES

After the completion of the course the students will be able to

CO1 : Review and summarize published research articles (L3)
CO2: Analyze the current research topics (L3)
CO3: Prepare dissertation report (L3)

Prof MOHAMED RAJIK M
(Course Coordinator)

Dr JAYASHEELA D
(Academic Council-Member Secretary)

Dr UMA N
(BOS Chairman)