ETHIRAJ COLLEGE FOR WOMEN
(AUTONOMOUS)
CHENNAI – 600 008

Department of Mathematics (SS)

M.Sc., Mathematics
SYLLABUS

CHOICE BASED CREDIT SYSTEM

To be offered from the academic year 2015 -2016

Department of Mathematics (Self-Supporting) is revising the M. Sc syllabus with effect from the academic year 2015- 2016 , (CBCS pattern)

PREAMBLE

As per the guidelines given by the University Grants Commission and the Tamil Nadu State Council for Higher Education , the M. Sc degree programme is designed in such a way that it has an extensive applications in both pure and applied Mathematics; an attitude towards problem formulation and solving ; an analytical skill and accuracy; an appreciation of the approaching of mathematical techniques and research aptitude to mathematics. Every effort has been made to present the subject in easy, clear, lucid and systematic manner. References at the end of each syllabus are given to cover more advanced extension of the topics presented.

REGULATIONS

1. ELIGIBILITY FOR ADMISSION:

Candidates for admission to the first year of the degree of M. Sc. course should have Bachelor's degree in Mathematics of University of Madras or some other University accepted by the syndicate as equivalent .

2. ELIGIBILITY FOR THE AWARD OF DEGREE:

The candidate shall be eligible for the award of degree only if she has undergone the prescribed course of study for a period of not less than two academic years, passed the examinations of all the four semesters prescribed, earning 90 credits.

3. DURATION OF THE PROGRAMME : 2 YEARS

Each academic year is divided into two semester sessions. The first academic year shall comprise the first and second semesters. The second academic year, the third and fourth semesters. Each semester will have a minimum of 90 working days and each day will have 5 working hours. Teaching is organized into a modular pattern of credit courses. Credit is normally related to the number of teaching hours of a particular subject. It is also related to the number of tutorial and practical hours.

4. COURSE OF STUDY :

The main subject of study for Master Degree shall consist of the following:

Part – I : Core Courses
Part - II : Electives
Part – III : Soft Skills

5. PASSING MINIMUM :

A candidate shall be declared to have passed in each paper of the main subject of study wherever prescribed, if she secured NOT LESS THAN 50 % of the marks prescribed for the examination.

6. CLASSIFICATION OF SUCCESSFUL CANDIDATES :

Part I, II & III

Successful Candidates passing the examination and securing the marks

1. 60% and above in aggregate shall be declared to have passed the Examination with first class
2. 50% and above but below 60% in the aggregate shall be declared to have passed the examination in the second class.
3. All other successful candidates shall be declared to have passed the examination in the third class.

Candidates who pass all the examination (Part I, II,& III) prescribed for the course in the FIRST ATTEMPT ITSELF ALONE are eligible for ranking .

7. QUESTION PAPER PATTERN

Template

Component	Nature of the question	Maximum marks
Section –A	Description/Problems	5 x 8 = 40
Section – B	Description/Problems	3 x 20 = 60

Section – A: Five questions to be answered out of eight questions covering all the five units. Each question carries eight marks.

Section – B: Three questions to be answered out of five questions covering all the five units. Each question carries twenty marks.

Department of Mathematics
PG Course Profile- 2015-2016

Sem	Code	Course Title	Core	Hours	L	T	P	Credits	C.A	S.E	Total
I	11SP15/1C/AL1	Algebra I	1	6	3	3	0	4	40	60	100
	11SP15/1C/RA1	Real Analysis-I	2	6	3	3	0	4	4	60	100
	11SP15/1C/ODE	Ordinary Differential Equations	3	6	3	3	0	4	40	60	100
	11SP15/1C/GTY	Graph Theory	4	6	3	3	0	4	40	60	100
	11SP15/1E1/OR1	Operations Research I	E1	4	2	2	0	3	40	60	100
	PG15/1S/PEW	Personality Enrichment Development Soft Skills	SS1	2				2			50
II	11SP15/2C/AL2	Algebra II	5	5	3	2	0	4	40	60	100
	11SP15/2C/RA2	Real Analysis-II	6	5	3	2	0	4	40	60	100
	11SP15/2C/PDE	Partial Differential Equations	7	5	3	2	0	4	40	60	100
	11SP15/2C/MTA	Mechanics and Tensor Analysis	8	5	3	2	0	4	40	60	100
	11SP15/2E2/OR2	Operations Research II	E2	4	2	2	0	3	40	60	100
	11SP15/2E/APM	Aptitude Mathematics	EDE (1)	4	2	2	0	3	40	60	100
	PG15/2S/LCE PG15/2S/FRE PG15/2S/GER	Language and Communication in English (Soft Skills)	SS2	2				2			50
		Internship						2	50	50	100
		Total		60				47			

Sem	Code	Paper Title	Core	Hours	L	T	P	Credits	C.A	S.E	Total
III	11SP15/3C/CA1	Complex Analysis I	9	5	3	2	0	4	40	60	100
	11SP15/3C/TOP	Topology	10	5	3	2	0	4	4	60	100
	11SP15/3C/DGY	Differential Geometry	11	5	3	2	0	4	40	60	100
	11SP15/3C/CVI	Calculus of Variations and Integral Equations	12	5	3	2	0	4	40	60	100
	11SP15/3E3/ST1	Statistics I	E3	4	2	2	0	3	40	60	100
	11SP15/3E/COM	Competitive Mathematics	EDE (2)	4	2	2	0	3	40	60	100
	11SP15/3S/MAS	Mathematical Sciences (Soft skill)	SS3	2	2	0	0	2			50
IV	11SP15/4C/CA2	Complex Analysis II	13	6	3	3	0	4	40	60	100
	11SP15/4C/FAN	Functional Analysis	14	6	3	3	0	4	40	60	100
	11SP15/4C/FSA	Fuzzy Set Theory and its Applications	15	6	3	3	0	4	40	60	100
	11SP15/4E4/ST2	Statistics II	E4	5	2	3	0	3	40	60	100
	11SP15/4E5/FAT	Formal Languages and Automata Theory	E5	5	2	3	0	3	40	60	100
	11SP15/4S/LAT	LATEX- A Document Preparation System (Soft skill)	SS4	2	0	0	2	2			50
	Total			60				44			
								Over all credits	91		

SEMESTER - I

ALGEBRA - I

Core - 1 **Course Code : 11SP15/1C/AL1**

Teaching Hours : 90 **Credits: 4** **LTP: 3 3 0**

OBJECTIVES :

To understand the concepts of advanced algebra. To get working knowledge on Class equation, Linear Transformations and different forms of matrices .

COURSE OUTLINE :

UNIT I : Group Theory

Sylow's Theorem (For Theorem 2:12.1 First proof only)

Chapter 2 : Sections 2.12 (Omit Lemma 2.12.1, 2.12.2 & 2.12.5)

(20 hrs)

UNIT II : Vector Spaces and Fields

Direct Products - Finite abelian groups - Modules.

Chapter 2 : Sections 2.13 and 2.14 (Theorem2.14.1only)
Chapter 4 : Section 4.5

(20 hrs)

UNIT III : Linear Transformations

Linear Transformations - Canonical forms - Triangular Forms.

Chapter 6 : Section 6.4

(15 hrs)

UNIT IV : Linear Transformations(contd.)

Nilpotent Transformations - Jordan form

Chapter 6 : Section 6.5 & 6.6 (15 hrs)

UNIT V : Linear Transformations(contd.)

Hermition , Unitary & Normal Transformations- Real Quadratic forms.

Chapter 6 : Sections 6.10 and 6.11. (20 hrs)

RECOMMENDED TEXT :

I.N. Herstein , Topics in Algebra (II Edition) , Wiley Eastern Limited, New Delhi, 1975

REFERENCE BOOKS:

1. M. Artin, Algebra, Prentice Hall of India, 1991
2. P.B.Bhattacharya, S.K.Jain And S.R.Nagpaul, Basic Abstract Algebra (II Edition) Cambridge University Press, 1997. (Indian Edition)
3. I.S. Luther and I.B.S Passi, Algebra, Vol - I Groups (1996): Vol II Rings, Narosa Publishing House, New Delhi, 1999.

Periodicals:

The Mathematics Intelligencer
Mathematic News Letter

Websites and e- learning sources

http//mathforum.org
http//www.opensource.org

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SEMESTER - I

REAL ANALYSIS - I

CORE - 2 **Course Code : 11SP15 / 1C / RA1**

Teaching hours : 90 **Credits : 4 L T P : 3 3 0**

OBJECTIVES :

To work comfortably with functions of bounded variation, Riemann - Stieltjes Integration, convergence of Double series,uniform convergence and its interplay between various limiting operations.

COURSE OUTLINE :

UNIT I : Functions Of Bounded Variation

Introduction - Properties of monotonic functions - Functions of bounded variation - total variation Additive property of Total variation -Total variation on [a, x] as a function of x - functions of bounded variation expressed as the difference of two increasing functions - continuous functions of bounded variation.

Chapter 6 : Section - 6.1 to 6.8 (18 hrs)

UNIT II : The Riemann - Stieltjes Integral

Introduction - Notation - The definition of the Riemann - Stieltjes integral - Linear properties - Integration by parts - Change of variable in a Riemann- Stieltjes integral - Reduction to a Riemann integral- Euler Summation formula - Monotonically increasing integrators-Upper and lower integrals - Riemann's conditions.

Chapter - 7: sections 7.1 to 7.11. (Omit 7.8 & 7.9)

(20 hrs)

UNIT III: The Riemann - Stieltjes Integral

Integrators of bounded variation - sufficient conditions for the existence of Riemann Stieltjes integrals Necessary conditions for the existence of Riemann Stieltjes integrals - Mean value theorems for Riemann - Stieltjes integrals - The integrals as a function of the interval-Second fundamental theorem of integral calculus -Second mean value theorem for Riemann integral, Lebesgue criterion for the existence of Riemann integrals.

Chapter 7: Sections 7.15 to 7.20, 7.22, 7.26

(20 hrs)

UNIT IV: Sequences Of Functions

Point - Wise Convergence of sequences of functions - Examples of sequences of real - valued functions - Definition of uniform convergence - Uniform convergence and continuity - The Cauchy condition for uniform convergence -Uniform convergence of infinite series of functions. Uniform convergence and Riemann - stieltjes integration -

Uniform convergence and differentiation- Sufficient condition for uniform convergence of a series

Chapter 9: Sections 9.1-9.6, 9.8, 9.10, 9.11 (18hrs)

UNIT V: Sequences Of Functions

Power series - Multiplication of power series - The Taylor's series generated by a function – Bernstein's theorem - Abel's limit theorem - Tauber's theorem.

Chapter 9: Sections 9.14, 9.15, 9.19, 9.20, 9.22, 9.23 (14 hrs)

RECOMMENDED TEXT :

Tom M. Apostol, 1974, Mathematical Analysis 2nd Edition, Addison Wesley publishing company Inc. New York.

REFERENCE BOOKS:

1.Bartle, R.G , Real Analysis, John Wiley and sons Inc, 1976.
2.Rudin.W, Principles of mathematical Analysis, 3rd Edition Mc.Graw Hill Company, NewYork, 1976.
3.A.L. Gupta and N.R. Gupta, Principles of Real Analysis, Pearson Education (India Print), 2003.

Periodicals:

The Mathematics Intelligencer
Mathematic News Letter

Websites and e- learning sources

http//mathforum.org
http//www.opensource.org

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Section – B	Description/Problems	3 x 20 = 60

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SEMESTER - I

ORDINARY DIFFERENTIAL EQUATIONS

Core - 3 **Course Code : 11SP15/1C/ODE**
Teaching hours : 90 **Credits : 4 L T P : 3 3 0**

OBJECTIVES :

To develop strong background on finding solutions to linear differential equations with constant and variable coefficients and also with singular points, to study existence and uniqueness of the solutions of first order differential equations.

COURSE OUTLINE :

UNIT I : Linear Differential Equations Of Higher Order

Introduction- Higher order equations - A Modelling problem - Linear Independence - Equations with Constant Coefficients.

Chapter 2 : sections 2.1 to 2.5 (15 hrs)

UNIT II:Linear Differential Equations Of Higher Order(Contd.)

Equations with variable coefficients - Wronskian - Variation of parameters - Some Standard Methods - Method of Laplace Transforms

Chapter2: sections 2.6 to 2.10 (15 hrs)

UNIT III: Solutions In Power Series

Introduction - Second order Linear Equations with Ordinary Points -Legendre Equation and Legendre Polynomials - Second Order Equation with Regular Singular Points - Properties of Bessel Functions

Chapter 3: sections 3.1 to 3.5 (25 hrs)

UNIT IV: Systems of Linear Differential Equations

Introduction - System of First Order Equations - Existence and Uniqueness Theorem - Fundamental Matrix -. Linear Systems with Constant Coefficients - Linear Systems with Periodic Coefficients

Chapter 4: Section 4.1, 4.2, 4.4, 4.5, 4.7, 4.8 (Omit 4.3 & 4.6) (20 hrs)

UNIT V: Existence and Uniqueness of Solutions

Introduction - Preliminaries - Successive Approximations - Picard's Theorem - Some Examples.

Chapter 5: Section 5.1 to 5.5 (15 hrs)

RECOMMENDED TEXT :

S.G. Deo , V. Lakshmikantham , V .Raghavendra Text Book of Ordinary Differential Equations (Second Edition) Tata Mc Graw Hill, New Delhi, 1974

REFERENCE BOOKS :

1.Earl A. Coddingtion, An introduction to ordinary differential equations, (3rd edition), Prentice Hall of India Ltd, New Delhi, 1987

2.Williams E. Boyce and Richard C. DI Prima, Elementary differential equations and boundary value problems, John wiley and sons, New York, 1967

3.George F. Simmons, Differential equations with applications and historical notes, Tata Mc Graw Hill, New Delhi, 1974.

4.N.N. Labedev. Special functions and their applications, prentice Hall of India, New Delhi 1965

5.W.T. Raid, Ordinary Differential equations, John wiley and sons, New York, 1974.

6.P. Hartman, Ordinary Differential Equations, John wiley and sons, New York,1974.

Periodicals:

The Mathematics Intelligencer .
Mathematics News letter.

Websites And E-Learning Sources:

http:// mathforum.org
http:// ocw.mit edu/ocw/web/mathematics,
http:// www.opensource.org, www.mathpages.com

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Section – B	Description/Problems	3 x 20 = 60

Section – A: Five questions to be answered out of eight questions covering all the Five units. Each question carries eight marks.

Section – B: Three questions to be answered out of five questions covering all the Five units. Each question carries twenty marks.

SEMESTER-I
GRAPH THEORY

Core : 4 **Course Code: 11SP15/1C/GTY**
Teaching hours : 90 **Credits : 4 L T P: 3 3 0**

OBJECTIVES: Graph Theory is a real life application subject. This paper enables the student to understand the subject deeply and apply the contents in various life situations like shortest path problem, time tabling problem etcetera. The students may pursue their studies in research also.

Course Outline:

UNIT 1: Graphs and Subgraphs: Graphs and simple graphs – Graph Isomorphism – The Incidence and Adjacency Matrices – Sub graphs – Vertex Degrees – Paths and Connection – Cycles
Chapter 1: Sections 1.1 – 1.7 (15 hrs)

UNIT 2: Trees, Connectivity: Trees, Cut edges and Bonds, Cut vertices, Connectivity, Blocks
Chapter 2: Sections 2.1, 2.2, 2.3
Chapter 3: Sections 3.1, 3.2 (20 hrs)

UNIT 3: Euler Tours And Hamilton Cycles, Matchings
Euler Tours, Hamilton Cycles, Matchings, Matchings and Coverings in Bipartite graphs
Chapter 4: Sections 4.1, 4.2,
Chapter 5: Sections 5.1, 5.2
(15 hrs)

UNIT 4: Edge Colourings, Vertex Colourings
Edge chromatic number, Vizing's theorem, Chromatic number, Brook's Theorem
Chapter 6: 6.1, 6.2
Chapter 8: Sections 8.1, 8.2 (20 hrs)

UNIT 5: Planar Graphs
Plane and planar graphs, Dual Graphs, Euler's formula, The five colour theorem and the four colour conjecture.
Chapter 9: Sections 9.1, 9.2, 9.3, 9.6(Omit 9.4 and 9.5) (20 hrs)

RECOMMENDED TEXT:

Graph theory and its applications- J.A. Bondy and U.S.R. Murty, 5th Print, 1982

REFERENCE BOOKS:

1.Introduction to Graph Theory – Doughlas B. West, Second edition, PHI learning pvt ltd, 2011.
2.A.Gibbons,*Algorithmic Graph Theory,*CambridgeUniversity Press, Cambridge, 1989.
3.S.A.Choudum, *A First Course in Graph Theory,* MacMillan India Ltd. 1987.

Periodicals:

The Mathematics Intelligencer
Mathematic News Letter

Websites and e- learning sources

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Section – B: Three questions to be answered out of five questions covering all the Five units. Each question carries twenty marks.

SEMESTER I
OPERATIONS RESEARCH I

Elective- E1 **Course Code : 11SP15/1E1/OR1**
Teaching Hours : 60 **Credits : 3 L T P: 2 2 0**

OBJECTIVES:
To understand the need of using Operations Research – a quantitative approach for effective decision making. To recognize, classify and use various models for solving a problem under consideration.

UNIT I: Integer Programming Problem
Introduction – Types of Integer Programming Problems – Enumeration and cutting plane concept – Gomory's All Integer cutting plane method – Gomory's mixed-integer cutting plane method.

Chapter7: Sections 7.1, 7.2, 7.3, 7.4 (15 hrs)

UNIT II : Dynamic Programming
Introduction – Dynamic Programming Terminology – Developing - Optimal Decision Policy - Dynamic Programming under Certainty – Shortest Route Problem(Model I) – Multiplicative Separable return function and single additive constraint(Model II)

Chapter 22: Sections 22.1 , 22.2, 22.3, 22.4 Model I and II (15 hrs)

UNIT III : Dynamic Programming:
Dynamic Programming under certainty – Additive separable return function and single additive constraint – additively separable return function and multiplicative constraint.

Chapter 22: section 22.4 Model III and IV (9 hrs)

UNIT IV : Classical Optimization Methods:
Introduction – Unconstrained optimization

Chapter 23: Sections 23.1, 23.2 (9 hrs)

UNIT V : Non-Linear Programming Methods:
Introduction – The General Non Linear Programming Problem – Quadratic Programming – Kuhn-Tucker Conditions – Wolfe's Modified Simplex method.
Chapter 24: Sections 25.1,24.2, 24.4 till Wolfe's Modified Simplex Method
(12 hrs)

RECOMMENDED TEXT

J.K Sharma, Operations Research Theory and Applications 4th edition Macmillan Publlishers India Ltd,2009.

REFERENCE BOOKS

1.Hamdy A. Taha Operations Research (9th Edition), Prentice Hall of India Private Limited, New Delhi,2013.
2.S.D. Sharma, Operations Research, Kedar Nath Ram Nath and Co., Meerut, 2010.
3.F.S Hiller and J. Liberman Introduction to Operations Research (7th edition),2010

Periodicals:
The Mathematicvs Intelligencer
Mathematics News letter.

Websites and e-Learning Sources
http://mathforum.org
http://OCW.mit.edu/ocwweb/Mathematics
http://www.opensource.org

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SEMESTER - II

ALGEBRA - II

Core - 5 **Course Code : 11SP15/2C/AL2**

Teaching hours : 75 **Credits : 4** **L T P: 3 2 0**

OBJECTIVES :

To impart important applications in the theory of numbers and to emphasize the aspects of field theory. To get introduced to fields having only a finite number of elements.

COURSE OUTLINE :

UNIT I: Fields

Extension fields .

Chapter 5: Section 5.1 (12 hrs)

UNIT II: Fields(contd.)

Roots of polynomials - More about roots

Chapter 5: Sections 5.3 and 5.5 (18 hrs)

UNIT III: Galois Theory

Elements of Galois Theory - Solvability by Radicals.

Chapter 5: Sections 5.6 and 5.7
(Omit Lemma 5.7.1, Lemma 5.7.2.,Theorem 5.7.1)

(18 hrs)

UNIT IV: Finite fields

Finite fields - Wedderburn's theorem on finite Division Rings.

Chapter 7: Section 7.1 and theorem 7.2.1(Omit Lemma 7.2.1,7.2.2 and Theorem 7.2.2) (12 hrs)

UNIT V: Finite fields(contd.)

Frobenius Theorem ,Integral Quaternions and Four square theorem

Chapter 7 : Sec 7.3 & 7.4 (15 hrs)

RECOMMENDED TEXT

I.N. Herstein, Topics in Algebra (II Edition) Wiley Eastern Ltd. , NewDelhi,1975.

REFERENCE BOOKS

1. M.Artin, Algebra, Prentice Hall of India, 1991
2. N.Jacobson, Basic Algebra, Vol I & II, Hindustan Publishing Company, NewDelhi,1974.

Periodicals:

The Mathematics Intelligencer .
Mathematics News letter.

Websites and e-Learning Sources

http:// mathforum.org,
http://ocw.mit.edu/ocwweb/mathematics.
http:// www.opensource.org. www. algebra.com

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SEMESTER - II
REAL ANALYSIS - II

CORE - 6
Teaching hours : 75

COURSE CODE : 11SP15/2C/RA2
Credits : 4 L T P : 3 2 0

OBJECTIVES

To introduce measure on the real line, To work comfortably with Fourier series and Integrals, in depth study in multivariable calculus

COURSE OUTLINE

UNIT I: Fourier Series

Introduction - Orthogonal systems of functions - The Theorem on best approximation - The fourier series of a function relative to an orthonormal system - Properties of fourier coefficients. The Riesz- Fischer theorem. The convergence and representation problems for trigonometric series - The Riemann - Lebesgue Lemma - The Dirichlet Integrals(definition only) - an integral representation for the partial sums of a Fourier series - Riemann's Localization theorem. Sufficient conditions for convergence of a Fourier series at a particular point.

Chapter 11: Section 11.1 to 11.12 (Omit sec-11.9) (Apostol) (15hrs)

UNIT II : Multivariable Differential Calculus

Introduction - The Directional Derivative- Directional Derivatives and continuity. The total derivative - The total derivative expressed in terms of partial derivatives- the matrix of linear function - The Jacobian Matrix - The Chain Rule- Matrix form of chain rule - The Mean Value theorem for differentiable functions - A sufficient condition for differentiable functions - A sufficient condition for differentiability - A sufficient condition for equality of mixed Partial derivatives - Taylor's formula for functions of R^n to R^1.

Chapter 12: Sections 12.1 to 12.14 (Apostol) (17 hrs)

UNIT III : Implicit Functions

Functions with non - zero jacobian determinants - The Inverse Function theorem - The Implicit Function theorem.

Chapter 13: Sections 13.1 to 13.4 (Apostol) (13 hrs)

UNIT IV: Measure Theory

Measures on the Real line: Lebesgue outer measure - Measurable sets - Regularity - Measurable functions - Borel and Lebesgue Measurability.

Chapter 2 : Section 2.1 to 2.4 (G.DeBarra) (15 hrs)

UNIT V: Integration Of Functions Of A Real Variable

Integration of non-negative functions - The general integral - Riemann and Lebesgue integrals

Chapter - 3 sec 3.1, 3.2 and 3.4 (G. De Barra) (15 hrs)

RECOMMENDED TEXTS :

1. G.De.Barra, 1981 Measure theory and Integration, Wiley Eastern Ltd. New Delhi.
2. Tom M.Apostol, 1974, Mathematical Analysis 2nd Edition, Addison wesley publishing company Inc. New York.

REFERENCE BOOKS :

1. Bartle, R.G. 1976, Real Analysis John Wiley and sons Inc
2. Rudin.W. 1976. Principles of mathematical Analysis, 3rd Edition Mc.Graw Hill company.NewYork.
3. A.L. Gupta and N.R. Gupta 2003. Principles of Real Analysis pearson Education (India Print)

Periodicals:

The Mathematics Intelligencer .
Mathematics News letter.

Websites And e-Learning Sources:

http://ocw.mit.edu/ocwweb/Mathematics
http://Mathforum.org

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SEMESTER - II

PARTIAL DIFFERENTIAL EQUATIONS

Core - 7 **Course Code : 11SP15/ 2C /PDE**
Teaching hours : 75 **Credits : 4** **L T P : 3 2 0**

OBJECTIVES :
To develop strong background on finding solutions to linear differential equations with constant and variable coefficients and also with singular points, to study existence and uniqueness of the solutions of first order differential equations, Cauchy problem, boundary value problems and method of separation of variables..

COURSE OUTLINE :

UNIT I : Mathematical models
Classification of second order equations, the classical equations, vibrating string, vibrating membrane, second order equation in two independent variables, canonical forms, equations with constant coefficients, general solution.

Chapter 2: Section 2.1-2.3
Chapter 3: Section 3.1-3.4 (15 hrs)

UNIT II: Cauchy problem
Cauchy problem, Cauchy Kowalewsky theorem, Homogeneous wave equation, initial Boundary value problems, finite string with fixed ends.

Chapter 4: Sections 4.1-4.6 (omit 4.5) (15 hrs)

UNIT III:Method of Separation of variables
Separation of variables, vibrating string problem, existing and uniqueness of solutions of the vibrating string problem, Heat conduction problem, existence and solutions of heat conduction problem

Chapter 6: Section 6.1-6.5 (15 hrs)

UNIT IV:Boundary value problems
Boundary value problems, maximum and minimum principles, uniqueness and continuity theorem, Dirichlet problem for a circle, a circular annulus.

Chapter8: Section 8.1-8.5 (15 hrs)

UNIT V: Green's function
Green's function, the Delta function, Methods of Green's function, Dirichlet problem for the Laplace&Helmholtz operators.

Chapter 10: Section 10.1-10.5 (15 hrs)

RECOMMENDED TEXT :

Tyn Myint-U and Lokenath Debnath, Partial Differential Equations for Scientists and Engineers(Third Edition), North Hollan, New York,1987.

REFERENCE BOOKS:

1.W.E. Williams, Partial Differential Equations, Oxford,1990
2.I.N. Sneddon,The use of integral forms, Tata Mcgraw Hill, NewDelhi,1985
3.M.M.Smirnov, Second order Partial Differential Equations,NewDelhi 1983.
4.Introduction toPartial Differential Equations by R.Dennemayer, New York1968.
5.M.D.RaiSinghania,AdvancedDifferentialEquations,S.Chand&CompanyLtd. NewDelhi,2001.

Periodicals:

The Mathematics Intelligencer.
Mathematics News letter.

Websites And e-Learning Sources:

http:// mathforum.org,http://ocw.mit
edu:// ocw.wweb/Mathematics,
http:// www.opensource.org,www. mathpages.com

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Component	Nature of the question	Maximum marks
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SEMESTER – II

MECHANICS AND TENSOR ANALYSIS

Core - 8 **Course Code: 11SP15/2C/MTA**
Teaching hours: 75 **Credits: 4** **LTP: 3 2 0**

OBJECTIVES:

To introduce the basic concepts of classical dynamics and tensor analysis and to make students get knowledge about mechanical systems and Hamiltonian theory.

COURSE OUTLINE:

UNIT - I : Mechanical System

Definitions and Basic Concepts-Virtual Work : Introduction, Principle of Virtual Work, Examples - Lagrange Equations: Introduction, Derivation and Simple Problems.

Chapter 1: Sections 1.1 to 1.3 (Definitions and Basic concepts), 1.4.
Chapter 2: Sections 2.1 & 2.2 (15 hrs)

UNIT - II : Hamilton's Equation

Hamilton's Principle : Introduction, Brachistochrone Problem, Geodesic Problem, Hamilton's Principle- Hamilton's equation: Derivation, Hamiltonian Function, Kepler's Problem, Principle of least action.

Chapter-4: Sections: 4.1, 4.2 & 4.3 (15 hrs)

UNIT - III : Hamilton Jacobi Theory

Introduction, Hamilton's Principle Function, Hamilton Jacobi equation, Jacobi Theorem, Conservative and Ignorable Co-ordinates - Formula for Canonical Transformation using generating functions.

Chapter 5: Section 5.1 & 5.2
Chapter 6: Section 6.2 (15 hrs)

UNIT IV: Tensor Theory

Invariance - Transformation of co-ordinates. Properties of admissible Transformation of Co-ordinates - Transformation by Invariance, Transformation by Co-variance and Contra variance. The tensor concept - Contra variant and co-variant Tensor - Tensor character of co-variant and contra variant laws- Algebra of Tensor - Quotient Laws - Symmetric and skew-Symmetric tensors- Relative tensors.

Chapter 2 : Sections18 -28 (15 hrs)

UNIT V: Tensor Theory

The Metric tensor - The fundamental and associated Tensors - Christoffel's Symbols - Transformation of Christoffel's. Symbols - Covariant differentiation of tensors -

Formulas for covariant Differentiation - Ricci's Theorem - Riemann Christoffel Tensor properties of Riemann - Christoffel Tensors.

Chapter 2: Sections 29 - 37 (15 hrs)

RECOMMENDED TEXTS

Unit I to Unit III: Donald. T. Greenwood, Classical Dynamics, Prentice Hall of India, New Delhi 1985.
Unit IV to Unit V: I.S. Sokolnikoff, Tensor Analysis, John Wiley and Sons, New York 1964

REFERENCE BOOKS

1. U.C. De, Absos Ali Shaikh and Joydeep Sengupta, Tensor Calculus, Narosa Publishing House, New Delhi, 2004.
2. D. Greenwood, Classical Dynamics, Prentice Hall of India, New Delhi, 1985.
3. J.L.Synge and A.Schild, Tensor Calculus, Toronto, 1949.
4. A.S.Eddington. The Mathematical Theory of Relativity, Cambridge University Press, 1930.
5. P.G.Bergman, An Introduction to Theory of Relativity, New York, 1942
6. C.E.Weatherburn, Riemannian Geometry and the Tensor Calculus, Cambridge, 1938.

Periodicals:

The Mathematics Intelligencer .
Mathematics News letter.

Websites And e-Learning Sources

http://mathforum.org,
http://OCW.mit.edu/ocwweb/Mathematics

Template

Component	Nature of the question	Maximum marks
Section –A	Description/Problems	5 x 8 = 40
Section – B	Description/Problems	3 x 20 = 60

Section – A: Five questions to be answered out of eight questions covering all the Five units. Each question carries eight marks.

Section – B: Three questions to be answered out of five questions covering all the Five units. Each question carries twenty marks.

SEMESTER II
OPERATIONS RESEARCH II

Elective- E2 **Course Code : 11SP15/2E2/OR2**
Teaching Hours : 60 **Credit: 3** **LT P: 2 2 0**

OBJECTIVES:
To understand the need of using Operations Research, a quantitative approach for effective decision making. To recognize, classify and use various models for solving a problem under consideration.

UNIT I: Probabilistic inventory control models
Continuous Demand Inventory control models without Set-up cost – Instantaneous Demand Inventory control model with set up cost.

Chapter 15 Sections 15.3, 15.4 (12 hrs)

UNIT II: Queueing Theory
Finite Calling Population models

Chapter 16 Section 16.8 (12 hrs)

UNIT III: Replacement Models
Introduction – Types of failure- Replacement of Items whose efficiency Deteriorates with time.

Chapter 17 Sections 17.1, 17.2, 17.3 (12 hrs)

UNIT IV : Decision Theory
Introduction – Steps of Decision Making Process – Types of Decision Making Environment – Decision Making under Certainty.

Chapter 11 Sections 11.1, 11.2, 11.3, 11.4 (12 hrs)

UNIT V: Decision Theory
Decision Making under risk - Decision Tree analysis

Chapter 11 Sections 11.5, 11.7 (12 hrs)

RECOMMENDED TEXT:

J.K Sharma, Operations Research Theory and Applications 4th edition Macmillan Publishers India Ltd,2009.

REFERENCE BOOKS

1.Hamdy A. Taha Operations Research (9th Edition), Prentice Hall of India Private Limited, New Delhi,2013.
2.S.D. Sharma, Operations Research, Kedar Nath Ram Nath and Co.,Meerut, 2003.
3.F.S Hiller and J. Liberman Introduction to Operations Research (7tedition),2010.

Periodicals:

The Mathematicvs Intelligencer
Mathematics News letter.

Websites and e-Learning Sources

http://mathforum.org
http://OCW.mit.edu/ocwweb/Mathematics
http://www.opensource.org

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Component	Nature of the question	Maximum marks
Section –A	Description/Problems	5 x 8 = 40
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SEMESTER - II

APTITUDE MATHEMATICS

(Offered to other PG departments)

EDE- 1 **Course Code : 11SP15 / 2E /APM**

Teaching hours : 60 **Credits : 3** **L T P : 2 2 0**

OBJECTIVES :

This course aims to develop general aptitude and logical reasoning and to equip with problem solving skills for competitive examinations.

COURSE OUTLINE:

UNIT I: Logical Reasoning

Problems of Ages, Problem of Time, Average, Grouping, Ranking, Arithmetic Reasoning, Discount, Odd man out

(15 hrs)

UNIT II: Business Applications

Permutations &Combinations, Stocks and Shares (10 hrs)

UNIT III: Quantitative Aptitude

Percentage, Profit and Loss, Ratio and Proportions (10 hrs)

UNIT IV: Arithmetic Reasoning

Time & work, Time & distance, Pipe & cisterns.

(10 hrs)

UNIT V:Statistics

Basic concepts in testing of hypothesis, Type I Error and Type II error, Level of significance, ANOVA classification-One way classification and Two way classification (Only Simple Problems) (15 hrs)

RECOMMENDED TEXTS :

UNIT II & III : P.R.Vittal, Business Mathematics,Margham Publications, 1999.
UNIT I & IV : R.S.Aggarwal, Quantitative Aptitude, S.Chand & Co, Ltd.,2007
UNIT V : P.Sivarama Krishna Das, C. Vijayakumari, Statistics ,Viji's Academy ,2010.

REFERENCE BOOKS:

1. U Mohan Rao ,Quantitative Aptitude , Scitech Publication,2010.
2. P.R.Vittal, Business Statistics, Margham Publications,2007.
3. P.R.Vittal, Allied Mathematics, Margham Publications,2009.

Websites and e-Learning Sources
http:// mathforum.org
http:// ocw.mit edu/ocwweb/mathematics,
http:// www.opensource.org, www.casact

Template

Component	Nature of the question	Maximum marks
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INTERNSHIP

Credits : 2 **Duration: 45 days**

Students have to undergo an internship programme during the summer vacations immediately after the second semester and are required to submit a project report.

Internal Valuation(Viva voce) carries 50 marks and external valuation carries 50 marks.

SEMESTER – III
COMPLEX ANALYSIS – I

Core – 9 **Course Code : 11SP15/3C/CA1**
Teaching hours : 75 **Credits : 4 LT P : 3 2 0**

Objectives:
To study Cauchy integral formula, local properties of analytic functions, general form of Cauchy's theorem and harmonic functions, power series expansions, partial functions and entire functions.

COURSE OUTLINE:

Unit I : Cauchy's Integral Formula
The index of a point with respect to a closed curve. The integral formula – higher derivatives. Local properties of Analytical functions: Removable singularities, Taylor's theorem – Zeros and poles – The Local mapping – The Maximum principle.

Chapter 4 : Section 2: 2.1 – 2.3
Section 3: 3.1 – 3.4 (15 hrs)

Unit II : The General Form of Cauchy's Theorem
Chains and cycles – Simple connectivity – Homology – The General statement of Cauchy's theorem – Proof of Cauchy's Theorem – Locally Exact Differentials – Multiply connected regions The calculus of Residues- The Residue Theorem – The argument Principle.

Chapter 4 : Section 4: 4.1 – 4.7
Section 5: 5.1 – 5.2 (15 hrs)

Unit III : Harmonic Functions
Definition and Basic properties – The mean value property – Poisson's formula – Schwartz's Theorem – The reflection principle

Chapter 4 : Section 6: 6.1 – 6.5 (15 hrs)

Unit IV: Series and Product Developments
Power series Expansions : The Weierstrass's theorem – The Taylor series – The Laurent series

Chapter 5 : Section 1: 1.1 – 1.3 (15 hrs)

Unit V:Partial Fractions And Factorization
Partial fractions – Infinite products – Canonical Products – The Gamma function.
Entire functions: Jenson's formula, Hadamard's theorem(Statement only)

Chapter 5 : Section 2: 2.1 -2.4
Section 3: 3.1,3.2 (15 hrs)

RECOMMENDED TEXT:

Lars.V.Ahlfors, Complex Analysis(3rd Edition)Mc Graw Hill Co., New York,1979.

REFERENCE BOOKS:

1. H.A. Prestly, Introduction of Complex Analysis, Clarendon Press, Oxford, 1990.
2. J.B. Conway, Functions of one complex variable, Springer-Verlag, International Student Edition,Narosa Publishing Co., 1996.
3. E.Hille, Analytic function theory(2 Vols.)Gonm & Co. 1959.
4. M.Heins, Complex function theory, Academic Press Newyork, 1968.
5. Tom Apostol, Introduction to Analytic Number Theory, Narosa Publications, New Delhi, 5th printing, 1998

Periodicals:

The Mathematicvs Intelligencer
Mathematics News letter

Websites and e-Learning Sources

http://mathforum.org,
http://OCW.mit.edu/ocwweb/Mathematics,
http://www.opensource.org

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Section –A	Description/Problems	5 x 8 = 40
Section – B	Description/Problems	3 x 20 = 60

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SEMESTER – III
TOPOLOGY

Core - 10 **Course Code : 11SP15/3C/TOP**
Teaching hours : 75 **Credits : 4 L T P: 3 2 0**

OBJECTIVES:
To understand about the topological spaces, connectedness and compactness.
To learn about Countability and Separation Axioms.

COURSE OUTLINE:

UNIT I : Topological Spaces and Continuous Functions
Topological spaces, Basis for a topology, The order Topology, The product Topology on X x Y, The subspace Topology.

Chapter 2 : Sections 12 - 16 (20 hrs)

UNIT II : Connectedness and Compactness
Connected spaces and Connected subspaces of the Real line.

Chapter 3 : Sections 23 and 24 (10 hrs)

UNIT III : Connectedness and Compactness(Contd.)
Compact spaces and Compact subspaces of the Real line.

Chapter 3 : Sections 26- 28 (15 hrs)

UNIT IV:Countability and Separation
The countability Axioms, The separation Axioms, Normal spaces.

Chapter 4 : Sections 30 -32 (15 hrs)

Unit V: Countability and Separation Axioms(Contd.)
The Urysohn Lemma, The urysohn Metrization Theorem, The Tietze Extension Theorem.

Chapter 4 : Sections 33, 34 and 35 (15 hrs)

RECOMMENDED TEXT:
James R. Munkres, Topology, Second Edition, 2002.

REFERENCE BOOKS:
1. G.F. Simmons, Introduction to Topology and Modern Analysis, McGraw Hill International Book Company, New York, 1963

2 . W.Rudin, Functional Analysis, Tata McGraw-Hill Publishing Company, New Delhi, 1973.
3. G. Bachman and L. Narici, Functional Analysis Academic Press, New York, 1966.
4. H.C. Goffman and G. Fedrick, First course in Functional Analysis, Prentice Hall of India, New Delhi, 1987.
5.E. Kreyszig, Introductory Functional Analysis with Application, John Wiley & Sons, New York, 1978.

Periodicals:
The Mathematics Intelligencer .
Mathematics News letter.

Websites and e-Learning Sources:
http://math-forum.org,
http://ocw.mit.edu/OCWweb/Mathematics,
http://www.opensource.org,
http://en.wikiepedia.org

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Section –A	Description/Problems	5 x 8 = 40
Section – B	Description/Problems	3 x 20 = 60

Section – A: Five questions to be answered out of eight questions covering all the Five units. Each question carries eight marks.

Section – B: Three questions to be answered out of five questions covering all the Five units. Each question carries twenty marks.

SEMESTER - III
DIFFERENTIAL GEOMETRY

Core - 11 **Course Code : 11SP15/3C/DGY**
Teaching hours: 75 **Credits : 4 L T P: 3 2 0**

OBJECTIVES:
This course introduces space curves and then intrinsic properties of Surface and Geodesics. Non- Intrinsic Properties of Surface.

COURSE OUTLINE:

UNIT I: Space Curves
Definition of Space Curve - Arc length - tangent, normal and binormal - Curvature and torsion - Contact between curves and surfaces

Chapter I: Section 2 to 6. (15 hrs)

UNIT II: Space Curves
Tangent surface, involutes, Evolutes - Intrinsic equation, Fundamental Existence Theorem for space curves - Helics.

Chapter I: Section 7 to 9. (15 hrs)

UNIT III: Intrinsic Properties of a Surface
Definition of a surface - Curves on a Surface - Surface of revolution - Helicoids.

Chapter II: Sections 1 to 4. (15 hrs)

UNIT IV: Intrinsic Properties Of A Surface
Metric - Direction Co-efficients - Families of curves - Isometric correspondence - Intrinsic properties.

Chapter II: Section 5 to 9 (10 hrs)

UNIT V: Geodesics
Geodesics - Canonical Geodesic equations - Normal property of Geodesics - Geodesic Parallels - Geodesic Curvature - Gauss - Bonnet Theorem - Gaussian Curvature.

Chapter II: Sections 10 to 17 (Omit 13) (20 hrs)

RECOMMENDED TEXT:
T.J. Willmore, An introduction to Differential Geometry, Oxford University Press (17^{th} Impression) New Delhi-2002 Indian Print.

REFERENCE BOOKS

1. Stuik, D.T. Lectures on Classical Differential Geometry Addision - Wesley Mass, 1950.
2. Mittal & Agarwal, Differential Geometry, Krishna Prakasham Media Pvt. Ltd., 27th edition (1999).

Periodicals:

The Mathematics Intelligencer .
Mathematics News letter.

Websites and e-Learning Sources:

http://ocw.mit.edu/ocwweb/Mathematics
http://Mathforum.org

Template

Component	Nature of the question	Maximum marks
Section –A	Description/Problems	5 x 8 = 40
Section – B	Description/Problems	3 x 20 = 60

Section – A: Five questions to be answered out of eight questions covering all the Five units. Each question carries eight marks.

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SEMESTER – III

CALCULUS OF VARIATIONS AND INTEGRAL EQUATIONS

Core - 12 **Course Code: 11SP15/3C/CVI**
Teaching hours: 75 **Credits: 4** **L T P : 3 2 0**

OBJECTIVES :
The Main aim of the course is to help the students to solve integral equations which is used in various real life applications.

UNIT I Variational Problems With Fixed Moving Boundaries
The Concept of Variation and its properties – Euler's equation – Variational problems for functional of form – Functionals dependent on higher order derivatives – Functional of form I(y(x))=$\int_{x_1}^{x_2} F(x, y, y')dx$. – Movable boundary for a functional dependent on two functions.

Chapter 1 : 1.1 to 1.4 & 2.1-2.2 (15 hrs)

UNIT II Sufficient Conditions For an Extremum
Field of Extremals-Jacobi Condition-Weistrass function-Legendre Condition-problems.

Chapter 3 : 3.1 to 3.4 (10 hrs)

UNIT III Integral Equations
Introduction – Definition– Special kinds of Kernals – Eigen values and eigen functions – Convolution integral – Reduction to a system of algebraic equations – Examples – Fredholm alternative – Examples .

Chapter 1 : 1.1 , 1.3 to 1.5 & Chapter 2 : 2.1 to 2.4 (15 hrs)

Unit – IV Method Of Successive Approximations and Fredholm Theory
Iterative scheme – Examples – Volterra integral equations – Examples – Some results about the resolvent kernel – The method of solution of Fredholm equation – Fredholm First theorm(statement only) – Examples- Fredholm Second & Third theorems(Statement only)

Chapter 3 : 3.1 to 3.5 & Chapter 4 : 4.2 to 4.5 (20 hrs)

UNIT V Applications To Ordinary Differential Equations

Introduction – Fundamental properties of Eigen values and Eigen functions for symmetric kernels- Hilbert Schmidt Theorem(Statement only)-Solution of a Symmetric Integral Equation-Examples-Abel Integral Equation-Examples.

Chapter 7 : 7.1 to 7.2,7.4-7.5

Chapter 8 : 8.1 to 8.2 (15 hrs)

RECOMMENDED TEXT

1. A. S. Gupta, Calculus of Variations with Applications, PHI, New Delhi, 2005. (for Units I and II)
2. Ram P. Kanwal, Linear Integral Equations, Theory and Techniques, Academic Press, New York, 1971. (for Units III, IV and V)

REFERENCE BOOKS

1. L. Elsgolts, Differential Equations and Calculus of Variations, Mir Publishers, Moscow, 1973.
2. M. D. Raisinghania, Integral Equations and Boundary Value Problems, S. Chand & Co., New Delhi, 2007.
3. Sudir K. Pundir and Rimple Pundir, Integral Equations and Boundary Value *Problems*, Pragati Prakasam, Meerut. 2005.

Periodicals:

The Mathematics Intelligencer .

Mathematics News letter.

Websites and e-Learning Sources:

https://www.classle.net/book/mathematics-calculus-variations-and-integral-equations

http://www.nptel.ac.in/courses/111104025/

http://textofvideo.nptel.iitm.ac.in/video.php?courseId=111104025

Template

Component	Nature of the question	Maximum marks
Section –A	Description/Problems	5 x 8 = 40
Section – B	Description/Problems	3 x 20 = 60

Section – A: Five questions to be answered out of eight questions covering all the Five units. Each question carries eight marks.

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SEMESTER – III
STATISTICS I

Elective – E3 **Course Code :11SP15/3E3/ST1**
Teaching hours: 60 **Credits: 3** **L T P : 2 2 0**

OBJECTIVES:
To give a systematic introduction to modern probability theory.
To present the possible applications of these theories.

COURSE OUTLINE:

UNIT I : Characteristic Functions
Properties of characteristic functions-The characteristic functions and their moments-Semi-invariants-The characteristic function of the sum of independent random variables-Determination of the distribution function by the characteristic functions-The characteristic function of multidimensional random vectors-Probability generating functions.

Chapter 4: Sections 4.1 to 4.7. (12 hrs)

UNIT II : Some Probability Distributions
One-point and two-point distributions-The Bernoulli scheme. The Binomial Distribution-The Polya and hypergeometric distributions-The Poisson distribution-The uniform distribution-The normal distribution-The gamma distribution-The Beta distribution-The Cauchy and Laplace distributions.

Chapter-5: Sections: 5.1,5.2, 5.4 to 5.10 (12 hrs)

UNIT III : Limit Theorems
Preliminary remarks-Stochastic convergence-Bernoulli's law of large numbers-The convergence of a sequence of distribution functions-The Riemann-Stieljies integral-The Levy-Cramer theorem.

Chapter 6: Section 6.1 to 6.6 (12 hrs)

UNIT IV: Limit Theorems(Contd.)
The De-Moivre-Laplace theorem-The Lapunov theorem-The Gnedenko theorem-Poisson's, Chebychev's and Khintchin's laws of large numbers-The strong law of large numbers.

Chapter 6: Sections 6.7 to 6.12. (12 hrs)

UNIT V: Markov Chains
Preliminary remarks-Homogeneous Markov chains-The transition matrix-The ergodic theorem-Random variables forming a homogeneous Markov chain.

Chapter 7: Sections 7.1 to 7.5 (12 hrs)

RECOMMENDED TEXTS:

M.Fisz, Probability Theory and Mathematical Statistics, John Wiley and sons, New York, 1963.

REFERENCE BOOKS:

1. R.B. Ash, Real Analysis and Probability, Academic Press, New York, 1972
2. K.L.Chung, A course in Probability, Academic Press, New York, 1974.
3. Y.S.Chow and H.Teicher, Probability Theory, Springer Verlag. Berlin, 1988 (2nd Edition)
4. R.Durrett, Probability : Theory and Examples, (2nd Edition) Duxbury Press, New York, 1996.
5. V.K.Rohatgi An Introduction to Probability Theory and Mathematical Statistics, Wiley Eastern Ltd., New Delhi, 1988(3rd Print).
6. S.I.Resnick, A Probability Path, Birhauser, Berlin,1999.
7. B.R.Bhat ,Modern Probability Theory (3rd Edition), New Age International (P)Ltd, New Delhi, 1999
8. J.P. Romano and A.F. Siegel, Counter Examples in Probability and Statistics, Wadsworth and Brooks / Cole Advanced Books and Software, California, 1968.

Periodicals:

The Mathematics Intelligencer .
Mathematics News letter.

Websites and e-Learning Sources:

http://mathforum.org,
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Template

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Section –A	Description/Problems	5 x 8 = 40
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SEMESTER - III

COMPETITIVE MATHEMATICS

(Offered to other PG departments)

EDE- 2 **Course Code: 11SP15/3E/COM**

Teaching hours :60 **Credits : 3 L T P : 2 2 0**

OBJECTIVES :

This course aims to Introduce the basics of LPP, Transportation and Assignments Problem's and the Fundamental concepts of Game Theory.

COURSE OUTLINE:

UNIT I : Linear Programming Problem

Formulation - Maximization Problems and Minimization problems - Solutions by GraphicalMethod,(simple problems).

(10 hrs)

UNIT II: Transportation Problem

Northwest Corner Rule - Least Cost Method - Vogel's Approximation Method - Modi Method (degeneracy included)

(15 hrs)

UNIT III: Assignment Problem

Hungarian Assignment Method (balanced problem and unbalanced problem)

(10 hrs)

UNIT IV: Game Theory

Two person Zero Sum game, The maximin-minimax principle, saddle point and value of the games, Games without saddle points, mixed strategies, Dominance property.

(15 hrs)

UNIT V: Sequencing

Introduction, Sequencing Problem, General Assumptions, Sequencing decision problems for n jobs on two machines and three machines.

(10 hrs)

RECOMMENDED TEXTS

R.K. Gupta , Linear Programming, Krishna Prakashan media pvt ltd., 2012.

REFERENCE BOOKS

1. S.K. Kalavathy, Operations Research, Vikas publishing house pvt ltd., 2008.
2. Hira & Gupta ,Operations Research , S. Chand & Sons publications, 1991.
3. V.K. Kapoor , S.C.Gupta, Problems and Solutions in Operations Research , S.Chand & Sons publications, 2012.

Periodicals:
The Mathematics Intelligencer .
Mathematics News letter.

Websites and e-Learning Sources:
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http:// www.opensource.org

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Section –A	Description/Problems	5 x 8 = 40
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SEMESTER - III
MATHEMATICAL SCIENCES

SOFT SKILLS -SS3 **Course Code: 11SP15/3S/MAS**
Teaching Hours: 30 **Credits: 2 L T P: 2 0 0**

OBJECTIVE:
Adequate subject matter has been provided to facilitate students to attempt objective type questions in competitive examination.

UNIT I: Analysis
Sequences and Series-Continuity- Differentiability- Cauchy-Riemann Equations-Singularities-Residues

(10 hrs)

UNIT-II: Algebra
Groups-Cyclic Groups-Class Equations-Sylow Theorems-Rings-Fields

(10 hrs)

UNIT-III: Differential Equations
First Order Ordinary Differential Equations-First Order Partial Differential Equation-Heat Equation-Wave Equations

(10 hrs)

RECOMMENDED TEXTS

1. N.P.Bali ,Real Analysis , Laxmi Publications, 2009.
2. Arumugam ,Complex Analysis , Scitech , 2007.
3. I.N.Herstein ,Topics in Algebra, John Wiley & Sons, 2nd Edition, 2012.
4. Rai Singhania , Advanced Differential Equations S. Chand Ltd., 1995.

REFERENCE BOOKS:

1. Robert G. Bartle, Introduction to Real Analysis John Wiley & Sons, 4th Edition.
2. Ponnusamy , First Course in Complex Analysis , Narosa Publishing House, 2nd Edition, 2005.
3. Joseph.A.Gallian , Contemporary Abstract Algebra, Cengage, India.
4. ShepleyRoss , Differential Equations John Wiley & Sons, 3rd Edition.

Periodicals:
The Mathematics Intelligencer.
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http://ocw.mit.edu/ocwweb/mathematics

http:// www.opensource.org

TEMPLATE

NATURE OF QUESTION	MAX MARKS
Objective Type	50 (50X1=50)

50 Questions to be answered each carrying 1 mark.

SEMESTER – IV
COMPLEX ANALYSIS – II

Core – 13 **Course Code : 11SP15/4C/CA2**
Teaching hours : 90 **Credits : 4 L T P : 3 3 0**

OBJECTIVE: To get introduced to Riemann – zeta functions and doubly periodic functions. To impart the knowledge on normal families and analytic continuation.

COURSE OUTLINE:

UNIT I: Riemann Zeta Function
The Product Development-Extension of ς (s) to the whole plane- The functional equation - The Zeroes of the Zeta function.

Chapter 5: Section 4: 4.1 - 4.4

(15 hrs)

UNIT II: Normal Families
Equicontinuity-Normality and Compactness-Arzela's theorem-Families of Analytic functions-The Classical Definition.

Chapter 5:Section 5: 5.1 to 5.5

(20 hrs)

UNIT III: The Riemann Mapping Theorem
The Riemann Mapping Theorem-Statement and proof-Boundary Behaviour-Use of the Reflection principle,A Closer Look At The Harmonic Functions,Functions with the Mean Value Property-Harnack's Principle,Simply Periodic Functions, Representation by Exponentials-The Fourier Development-Functions of Finite Order.

Chapter 6: Section 1: 1.1 to 1.3
Chapter 6: Section 3: 3.1 to 3.2
Chapter 7: Section 1: 1.1 to 1.3

(20 hrs)

UNIT IV: Doubly Periodic Functions
The Period Module-Unimodular Transformations-The Canonical Basis-General Properties of Elliptic Functions,The Weierstrass's Theory, The Weierstrass ρ-function-The functions ς (z) and σ(z)-The Differential Equation.

Chapter 7: Section 2: 2.1 to 2.4
Section 3: 3.1 to 3.3

(20 hrs)

UNIT V: Analytic Continuation

The Weierstrass Theory-Germs and Sheaves-Sections and Riemann Surfaces-Analytic Continuations along Arcs-Homotopic Curves-The Monodromy Theorem.

Chapter 8: Section 1: 1.1 to 1.6 (15 hrs)

RECOMMENDED TEXTS:

Lars.V.Ahlfors, Complex Analysis(3rd Edition)Mc Graw Hill Co., New York,1979.

REFERENCE BOOKS:

1. H.A. Prestly, Introduction of Complex Analysis, Clarendon Press, Oxford, 1990.
2. J.B. Conway, Functions of one complex variable, Springer-Verlag, International Student Edition,Narosa Publishing Co.,
3. E.Hille, Analytic function theory(2 Vols.)Gonm & Co. 1959.
4. M.Heins, Complex function theory, Academic Press Newyork, 1968.
5. Tom Apostol, Introduction to Analytic Number Theory, Narosa Publications, New Delhi.

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SEMESTER –IV
FUNCTIONAL ANALYSIS

Core - 14 **Course Code : 11SP15/4C/FAN**
Teaching hours : 90 **Credits : 4 L T P: 3 3 0**

OBJECTIVES :
To study the details of Banach and Hilbert spaces and to introduce Banach algebras.

COURSE OUTLINE:

UNIT I : Preliminaries
Normed linear spaces and some examples, Inner product space – definition and examples.

Chapter : 9 Section : 46 , Chapter : 10 Section : 52(upto example 2) (14 hrs)

UNIT II : Banach Spaces
Banach Spaces - Definition and examples - Holder's and Minkowski's inequalities (*)- Continuous transformations, equivalence of various norms in l^n_p - A locally Compact Normed linear space is finite dimensional (*) - The Hahn - Banach theorem.

Chapter : 9 Section : 46 – 48 (20 hrs)

UNIT III : Banach Spaces
Separable, Conjugate spaces of l^n_p and l^n_∞ (*) Natural imbedding (excluding weak topology)- Any finite dimensional normed linear space is reflexive - the open mapping theorem - the closed graph theorem – conjugate of an operator.

Chapter : 9 Section : 48 - 51 (20 hrs)

UNIT IV: Hilbert Space
Hilbert spaces - Definition and some examples - Orthogonal complements – Orthonormal sets, separable, Orthogonal dimension.

Chapter : 10. Section : 52(from theorem A) - 55 (20 hrs)

UNIT V: Hilbert Space

Conjugate Space - Adjoint Operator - Self adjoint Operators - Normal and unitary operators - Projections.

Chapter : 10 Section : 55 - 59 (16 hrs)

(*) These concepts introduced in the exercise part of relevant sections are to be treated as a part of the course content.

RECOMMENDED TEXTS:

G.F. Simmons, Introduction to Topology and Modern Analysis, McGraw Hill International Book Company, New York, 1963.

REFERENCE BOOKS:

1. W.Rudin, Functional Analysis, Tata McGraw-Hill Publishing Company, New Delhi, 1973.
2. G. Bachman and L. Narici, Functional Analysis Academic Press, New York, 1966.
3. H.C. Goffman and G. Fedrick, First course in Functional Analysis, Prentice Hall of India, New Delhi, 1987.
4. E. Kreyszig , Introductory Functional Analysis with Application, John Wiley & Sons, NewYork, 1978

Periodicals:

The Mathematics Intelligencer .
Mathematics News letter.

Websites And E- Learning Sources:

http://math-forum.org,
http://ocw.mit.edu/ocw web/Mathematics,
http://www.opensource.org,
http://en.wikiepedia.org

Template

Component	Nature of the question	Maximum marks
Section –A	Description/Problems	5 x 8 = 40
Section – B	Description/Problems	3 x 20 = 60

Section – A: Five questions to be answered out of eight questions covering all the Five units. Each question carries eight marks.

Section – B: Three questions to be answered out of five questions covering all the Five units. Each question carries twenty marks.

SEMESTER IV
FUZZY SET THEORY AND ITS APPLICATIONS

Core: 15 **Course Code: 11SP15/4C/FSA**
Teaching Hours: 90 **Credits: 4** **L T P: 3 3 0**

OBJECTIVE
To introduce fuzzy concepts and to offer fuzzy logic and fuzzy compositions and its applications

COURSE OUTLINE

UNIT I: Introduction To Fuzzy Set
Fuzzy sets- Basic Types And Basic Concepts, Paradigm Shift, Additional Properties Of Alpha Cut, Representation of fuzzy sets.

Chapter 1 & 2 Sections 1.3,1.4,1.5,2.1,2.2 (12 hrs)

UNIT II: Operation On Fuzzy Sets
Types of operations, Fuzzy Compliments t -norm , t- conorm.

Chapter 3: Sections 3.1,3.2,3.3,3.4 (24 hrs)

UNIT III : Fuzzy Arithmetic
Fuzzy numbers, Arithmetic Operations On Intervals, Arithmetic Operations On Fuzzy Numbers

Chapter 4: Sections:4.1, 4.2,4.3,4.4 (18 hrs)

UNIT IV:Fuzzy Logic
Classical logic, Multivalued logic, Fuzzy propositions, Fuzzy quantifiers

Chapter 8 Sections 8.1,8.2,8.3,8.4 (18 hrs)

UNIT V: Applications
Civil, Industrial & Mechanical Engineering. (18 hrs)

RECOMMENDED TEXT:
George j klir/ boyuan, fuzzy sets and fuzzy logic- theory and its applications, prince hall of India, New Delhi 2010.

REFERENCE BOOK:

1. Kauffmán, Fuzzy arithmetic,Van Nostrant Reinhold company, 2000.

Periodicals:

The Mathematics Intelligencer .
Mathematics News letter.

Websites and e-Learning Sources

http://mathforum.org,
http://OCW.mit.edu/ocwweb/Mathematics

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Component	Nature of the question	Maximum marks
Section –A	Description/Problems	5 x 8 = 40
Section – B	Description/Problems	3 x 20 = 60

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SEMESTER – IV

STATISTICS II

Elective – E4 **Course Code: 11SP15/4E4/ST2**

Teaching hours:75 **Credits: 3** **L T P : 2 3 0**

OBJECTIVES:

To give a systematic introduction to mathematical statistics.

To get introduced to the basic concepts and theorems of the subject.

COURSE OUTLINE:

UNIT I : Sample Moments and their Functions

The notion of a sample-The notion of a statistic-The distribution of the arithmetic mean of the independent normally distributed random variables-The chi –square distribution-The distribution of the statistic(sample mean, sample standard deviation).

Chapter 9: Sections 9.1 to 9.5. (15 hrs)

UNIT II : Sample Moments And Their Functions(Continued)

Student's t-distribution-Fisher's Z-distribution-The distribution of sample mean for some non-normal populations-The distribution of sample moments and sample correlation coefficients of a two-dimensional normal population-The distribution of regression coefficients.

Chapter-9: Sections 9.6 to 9.10 (15 hrs)

UNIT III : Significance Tests

The concept of a statistical test-Parametric tests for small samples-Parametric tests for large samples- The chi-square test.-Tests of the Kolmogorov and Smirnov type The Wald-Wolfovitz and Wilcoxon-Mann-Whitney tests-Independence tests by contingency tables.

Chapter 12: Sections 12.1 to 12.7 (15 hrs)

UNIT IV:The Theory Of Estimation

Preliminary notions-consistent estimates-Unbiased estimates-The sufficiency of an estimate-The efficiency of an estimate-Asymptotically most efficient estimates-Methods of finding estimates-Confidence intervals.

Chapter 13: Sections 13.1 to 13.8. (15 hrs)

UNIT V: Theory of Hypothesis Testing:

The power function and the OC function-Most powerful tests-Uniformly most powerful test-Unbiased tests

Chapter 16: Sections 16.2 to 16.5 (15 hrs)

RECOMMENDED TEXTS:

M.Fisz, Probability Theory and Mathematical Statistics, John Wiley and sons, New York, 1963.

REFERENCE BOOKS:

1. R.B. Ash, Real Analysis and Probability, Academic Press, New York, 1972
2. K.L.Chung, A course in Probability, Academic Press, New York, 1974.
3. Y.S.Chow and H.Teicher, Probability Theory, Springer Verlag. Berlin, 1988 (2nd Edition)
4. R.Durrett, Probability : Theory and Examples, (2nd Edition) Duxbury Press, New York, 1996.
5. V.K.Rohatgi An Introduction to Probability Theory and Mathematical Statistics, Wiley Eastern Ltd., New Delhi, 1988(3rd Print).
6. S.I.Resnick, A Probability Path, Birhauser, Berlin,1999.
7. B.R.Bhat ,Modern Probability Theory (3rd Edition), New Age International (P)Ltd, New Delhi, 1999
8. J.P. Romano and A.F. Siegel, Counter Examples in Probability and Statistics, Wadsworth and Brooks / Cole Advanced Books and Software, California, 1968

Periodicals:

The Mathematics Intelligencer .
Mathematics News letter.

Websites And E-Learning Sources:

http://mathforum.org,
http://OCW.mit.edu/ocwweb/Mathematics

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SEMESTER – IV
FORMAL LANGUAGES AND AUTOMATA THEORY

Elective-E 5 **Course Code : 11SP15/4E5/FAT**
Teaching hours: 75 hrs **Credits: 3** **L T P : 2 3 0**

OBJECTIVES:
To introduce the basic concepts of automata and formal language theory.

COURSE OUTLINE:

UNIT I: Finite Automata
Concepts of automata theory- Finite state systems-Non-Deterministic Finite Automata –Finite Automata with ϵ - moves.

Chapter 1: Section 1.1.
Chapter 2: Section2.1 to 2.4. (15 hrs)

UNIT II: Regular Expression and Properties of Regular sets
Properties of Regular Sets-Pumping lemma –Closure Properties – The Myhill-Nerode Theorem.

Chapter 2 : Section2.5.
Chapter 3 : Section 3.1,3.2,3.4 (omit3.3). (15 hrs)

UNIT III: Context- Free Grammars
Introduction-Derivation trees – Simplification of Context- free grammars – Normal Forms.

Chapter 4: Section4.1 to 4.6. (15 hrs)

UNIT IV: Pushdown Automata
Informal Description – Definition–Pushdown Automata and Context free languages.

Chapter 5: Section5.1 to 5.3. (15 hrs)

UNIT V: Properties of Context Free Languages
Pumping lemma- Closure properties.

Chapter 6: Section 6.1 & 6.2. (15 hrs)

RECOMMENDED TEXT:

Introduction To Automata Theory, Languages and Computation- John E. Hopcraft and Jeffrey D. Ullman, Narosa Publishing House, New Delhi, Second Edition .

REFERENCE BOOKS:

1. John E. Hopcraft and Jeffrey D. Ullman and Rajeev Motwani. : Introduction to Automata Theory, Languages and Computation, Narosa Publishing House, New Delhi.
2. Introduction to Formal Languages and Automata by Peter and Linz-Fourth Edition - Narosa Publishing House, New Delhi.
3. Introduction to AutomataTheory and Formal Languages, by Adesh and Pandy.

Periodicals:

Journal of Automata, Languages and Combinatorics Volume 14 Issue 3, June 2009.
International Journal of Foundations of Computer Science.

Websites and e-Learning Sources:

www.coursera.org/course/automata.
http://www.maa.org/press/periodicals/convergence/regular-languages-and-finite-automata.

Template

Component	Nature of the question	Maximum marks
Section –A	Description/Problems	5 x 8 = 40
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SEMESTER - IV

LATEX- A DOCUMENT PREPARATION SYSTEM

SOFT SKILL-SS4 **Course Code :11SP15/4S/LAT**
Teaching Hours : 30 **Credits : 2 LTP : 0 0 2**

OBJECTIVES:
To introduce the basic concepts of Latex , which is a typesetting software primarily used for technical journals, books and research works.

COURSE OUTLINE:
UNIT I
The Basics - Document class – Page style – Page numbering – Formatting lengths – Parts of a document – Dividing the document – Bibliography.

(10hrs)

UNIT II
The BIBTEX program – BIBTEX style files –Creating a bibliographic database - Table of contents, Index and Glossary , Keeping tabs - Tables . Floats-Cross References In Latex

(10hrs)

UNIT III
Typesetting Mathematics- The basics - Custom commands - More on mathematics - New operators –Symbols -Theorems in LATEX –Designer theorems, Several kinds of boxes. Footnotes, Marginpars, and Endnotes.

(10hrs)

REFERENCES BOOK:
1.LATEX: A document preparation system (2 nd edition) by Leslie.
2.A beginner.s introduction to typesetting with LATEX Peter Flynn.

Websitesand E-Learning Sources:
https://www.tug.org/twg/mactex/tutorials/ltxprimer-1.0.pdf

Template

Duration – 2 hours.

Practical examination will be conducted for 50 marks.