St. JOHN'S COLLEGE OF ARTS & SCIENCE
(Accredited with B++ by NAAC & Approved by UGC under section 2(f) & 12(B) status)
(Affiliated to Manonmaniam Sundaranar University, Tirunelveli)
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ELECTIVE COURSES – MSC MATHEMATICS

Title of the Course		**1.5.2: ANALYTIC NUMBER THEORY**						
Paper Number		ELECTIVE - II						
Category	Elective	Year	**I**	Credits	3	Course Code		
		Semester	**I**					
Instructional Hours per week		Lecture	Tutorial		Lab Practice		Total	
		4	2		--		**6**	
Prerequisite		Knowledge of differential and integral calculus of real functions in several variables, convergence of series, (uniform) convergence of sequences of functions, basics of complex analysis						
Objectives of the Course		To understand Dirichlet multiplication, a concept which helps clarify interrelationship between various arithmetical functions and also some equivalent forms of the prime number theorem.						
Course Outline		**UNIT-I :** The Fundamental Theorem of Arithmetic. Chapter 1 : Section 1.1 - 1.8 Exercise Problems :Chapter 1 : 1 - 11.						
		UNIT-II : Arithmetic Functions. Chapter 2: Sections 2.1 - 2.8. Exercise problems:Chapter 2: 1 - 6.						
		UNIT-III : Multiplicative Functions and Dirichlet Multiplication. Chapter 2: Sections 2.9 – 2.14. Exercise problems: Chapter 2: 21 - 23, 25, 26.						
		UNIT-IV : Averages of Arithmetical Functions. Chapter 3: Sections 3.1 - 3. 9. Exercise problems: Chapter 3: 1 - 4.						
		UNIT-V: Partial sums of Dirichlet Product, Chebyshev's Functions – Equivalent forms of Prime Number Theorem. Chapter 3: Sections: 3.10, 3.11, Chapter 4: Sections 4.1 – 4.4. Exercise problems: Chapter 4: 3, 4, 5, 8.						
Recommended Text		*Introduction to Analytic Number Theory* – Tom M. Apostol - Springer, International Student Edition.						
Reference Books		1. *Problems in Analytic Number Theory*, M. Ram Murty, Springer(2001) 2. *Steps into Analytic Number Theory*, Paul Pollack, Akash Singha Roy, Springer (2021)						

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

CLO 1: Study the basic concepts of elementary number theory

CLO 2: Explain several arithmetical functions and construct their relationships

CLO 3: Apply algebraic structure in arithmetical functions

CLO 4: Demonstrate various identities satisfied by arithmetical functions

CLO 5: Determine the application to μ(n) & ʌ(n) and several equivalent form of prime number theorem

	POs						PSOs		
	1	2	3	4	5	6	1	2	3
CLO1	3	2	3	3	2	2	3	2	2
CLO2	3	3	2	2	3	3	3	2	2
CLO3	3	3	2	3	2	2	3	3	2
CLO4	2	2	3	3	3	2	2	2	3
CLO5	3	3	2	2	3	2	2	3	2

Title of the Course		**1.5.3: FUZZY SETS AND THEIR APPLICATIONS**						
Paper Number		ELECTIVE - II						
Category	Elective	Year	**I**	Credits	**3**	Course Code		
		Semester	**I**					
Instructional Hours per week		Lecture		Tutorial		Lab Practice	Total	
		5		1		--	**6**	
Prerequisite		Knowledge of graphs, relations, composition						
Objectives of the Course		To study about Fuzzy sets and their relations, Fuzzy graphs, Fuzzy relations, Fuzzy logic and laws of Fuzzy compositions						
Course Outline		**UNIT-I :** Fundamental Notions. Chapter I: Sec. 1 to 8						
		UNIT-II : Fuzzy Graphs. Chapter II: Sec. 10 to 18						
		UNIT-III : Fuzzy Relations. Chapter II: Sec. 19 to 29						
		UNIT-IV: Fuzzy Logic. Chapter III:Sec.31 to 40(omit Sec.37,38)						
		UNIT-V: The Laws of Fuzzy Composition. Chapter IV: Sec.43 to 49						
Recommended Text		A.Kaufman, *Introduction to the theory of Fuzzy subsets*, Vol.I, Academic Press, New York, (1975).						
Reference Books		1. H.J.Zimmermann, *Fuzzy Set Theory and its Applications*, Allied Publishers, Chennai, (1996) 2. George J.Klir and Bo Yuan, *Fuzzy sets and Fuzzy Logic-Theory and Applications*, Prentice Hall India, New Delhi, (2001).						

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

CLO1: Understand the definition of Fuzzy sets and its related concepts

CLO2: Define Fuzzy Graphs and explain the concepts

CLO3: Explain the concepts in Fuzzy sets and its relations

CLO4: Discuss about Fuzzy logic

CLO5: Analyze the compositions of Fuzzy sets.

MSU / 2021-2022 /PG-College /M.Sc. (Mathematics)/SEMESTER - III /Course No. 16 / Elective-2.2

Title of the Course **: CALCULUS OF VARIATIONS AND INTEGRAL EQUATIONS** (90 Hours)

Course Objective : To identify Constraints, Linear Equations and various theorems.

Course Outcomes(COs)

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

	Course outcome	Cognitive Level
CO 1	Demonstrate competence with the basic ideas Maxima and Minima	K-2
CO 2	Explain about Constraints and Lagrange's Multipliers Hamilton's principles-Lagrange equations	K-3
CO 3	Demonstrate Relation between differential and integral equations	K-3
CO 4	Appreciate the significance of Fredholm equations with separable kernels	K-3
CO 5	Acquired the knowledge of Iterative methods for solving equations of second kind	K-3

K-1: Remembering; K-2: Understanding; K-3: Applying; K-4: Analyzing; K-5: Evaluating; K-6:Creating.

L	T	C	P
6	0	4	0

Course Description

Unit I: Calculus of Variations and Applications Maxima and Minima – The simplest case – Illustrative examples-The variational notation-the more general case. (18 hours)

Unit II: Constraints and Lagrange's Multipliers – Variable endpoints - Sturm Liouville problems-Hamilton's principles - Lagrange equations (18 hours)

Unit III: Integral Equations – Introduction –Relation between differential and integral equations – The Green's function - Alternative definition of Green's function. (18 hours)

Unit IV: Linear Equations in cause and effect - The influence function – Fredholm equations with separable kernels – Illustrative Examples. (18 hours)

Unit V: Hilbert Schmidt theory – Iterative methods for solving equations of second kind-Fredholm theory. (18 hours)

Text Book: Methods of Applied Mathematics, Francis B. Hildebrand, sections 2.1to 2.11, 3.1 to 3.9 and 3.11.

Mapping:

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO 1	3	3	2	3	3	3	3	3	2	3
CO 2	3	3	3	3	3	3	3	2	2	3
CO 3	2	3	2	3	2	3	3	3	3	3
CO 4	2	3	3	3	2	3	3	3	2	3
CO 5	2	3	3	3	2	3	3	2	2	3

Strongly Correlated-3; Moderately Correlated-2; Weakly Correlated-1; No Correlation-0

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="8">1.4.1: GRAPH THEORY AND APPLICATIONS</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="8">ELECTIVE - I</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Elective</td><td>Year</td><td>I</td><td rowspan="2">Credits</td><td rowspan="2">3</td><td rowspan="2">Course Code</td><td rowspan="2"></td></tr>
<tr><td>Semester</td><td>I</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per week</td><td>Lecture</td><td colspan="2">Tutorial</td><td colspan="2">Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>5</td><td colspan="2">1</td><td colspan="2">--</td><td colspan="2">6</td></tr>
<tr><td colspan="2">Prerequisite</td><td colspan="8">Basic Set Operations in Mathematics</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="8">To understand and apply the fundamental concepts in Graph Theory, to apply Graph Theory based tools in solving practical problems and to improve the proof writing skills.</td></tr>
<tr><td colspan="2" rowspan="5">Course Outline</td><td colspan="8">UNIT-I : Basic Result: Subgraphs – Degrees of Vertices – Paths and Connectedness – Automorphism of a simple graph – Line graphs – Operations on graphs – Graph Products.
Chapter 1: Sec 1.1 to 1.9.</td></tr>
<tr><td colspan="8">UNIT-II : Connectivity: Vertex Cuts and Edge Cuts – Connectivity and Edge Connectivity – Blocks.
Chapter 3: Sec 3.1 to 3.4.</td></tr>
<tr><td colspan="8">UNIT-III : Trees: Definition, Characterization and simple properties - Centres and centroids - counting the number of Spanning Trees -Cayley’s formula
Chapter 4: Sec 4.1 to 4.5.</td></tr>
<tr><td colspan="8">UNIT-IV : Independent Sets and Matchings: Vertex – Independent Sets and Vertex Coverings – Edge Independent Sets – Matchings and Factors – Matching in Bipartite Graphs – Perfect Matching and the Tutte Matrix
Chapter 5: Sec 5.1 to 5.6.</td></tr>
<tr><td colspan="8">UNIT-V: Eulerian and Hamiltonian Graphs: Eulerian Graphs-Hamiltonian Graphs-Hamilton’s “Around the World” Game
Graph Colorings: Vertex colorings-Applications of Graph Colorings-Critical Graphs-Brooks’ Theorem.
Chapter 6: Sec 6.1 to 6.3,
Chapter 7: Sec 7.1 to 7.3 (up to Brooks theorem).</td></tr>
<tr><td colspan="2">Recommended Text</td><td colspan="8">R.Balakrishnan and K.Ranganathan, TextBook of Graph Theory, Springer Publications, 2012.</td></tr>
<tr><td colspan="2">Reference Books</td><td colspan="8">1. H.J.A Bondy and U.S.R.Murty. Graph Theory with Applications. North Holland, New York, Amsterdam, Oxford, 2008.
2. West, D. B., Introduction to Graph Theory, Pearson Education, 2011.
3. Robin J. Wilson, Graph Theory, Pearson Education, Asia 2002.
4. P. J. Cameron, J. H. Van Lint, Graph Theory, Coding Theory and Block Designs, London Mathematical Society Lecture Note Series (19), Cambridge University Press, Reprint in April 2013.
5. Kenneth H. Rosen, Discrete Mathematics and Its Applications, McGraw Hill, 2007</td></tr>
</table>

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

CLO 1: Demonstrate the concept of different structures and types about graphs and explain its applications.

CLO 2: Determine the properties of trees and applications in network and study the concepts of connections in graphs.

CLO 3: Acquire the knowledge about Euler Tours, Hamilton Cycles and Matchings in Graphs.

CLO 4: Analyze the concept of edge colouring ,independent sets and cliques in Graphs

CLO 5: Explain the concept of vertex colourings.

	POs						PSOs		
	1	2	3	4	5	6	1	2	3
CLO1	3	2	3	3	2	2	3	2	2
CLO2	2	3	3	2	3	2	3	3	2
CLO3	2	3	3	2	2	3	3	2	2
CLO4	2	3	3	2	3	3	3	3	3
CLO5	3	3	2	2	2	2	3	3	2

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="8">1.4.3: MATHEMATICAL STATISTICS</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="8">ELECTIVE - III</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Elective</td><td>Year</td><td>I</td><td rowspan="2">Credits</td><td rowspan="2">3</td><td rowspan="2">Course Code</td><td rowspan="2"></td></tr>
<tr><td>Semester</td><td>II</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per week</td><td>Lecture</td><td colspan="2">Tutorial</td><td colspan="2">Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>5</td><td colspan="2">1</td><td colspan="2">--</td><td colspan="2">6</td></tr>
<tr><td colspan="2">Prerequisite</td><td colspan="8">UG level Combinatorics and basic set theory</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="8">To understand mathematical statistics, acquire basic knowledge about various distributions, understand mathematical expectations, marginal and conditional distributions, the gamma and chi-square distributions, the t & F distributions and their applications, moment generating function technique and the Central Limit Theorem.</td></tr>
<tr><td colspan="2" rowspan="5">Course Outline</td><td colspan="8">UNIT-I : The probability set function – Random Variables – Probability density function – Distribution function – Mathematical expectation – Special mathematical expectations – Chebyshev’s Inequality.</td></tr>
<tr><td colspan="8">UNIT-II : Conditional probability – Marginal and conditional distributions – Stochastic independence Some special distributions: The Binomial distribution – The Poisson distribution</td></tr>
<tr><td colspan="8">UNIT-III : The Gamma and chi-square distributions –The normal distribution – The Bivariate normal distribution. Distributions of functions of random variables –Sampling theory – Transformations of variables of the discrete type – Transformations of variables of the continuous type.</td></tr>
<tr><td colspan="8">UNIT-IV : The □, t and F distributions – Distributions of order statistics–The moment generating function technique. The distributions of $□^2$ and $\frac{□□^2}{□^2}$ – Expectations of functions of random variables.</td></tr>
<tr><td colspan="8">UNIT-V: Limiting distributions -Stochastic convergence – Limiting moment generating functions – The central limit theorem – Some theorems on limiting distributions.</td></tr>
<tr><td colspan="2">Recommended Text</td><td colspan="8">Robert V. Hogg and Allen T. Craig, Introduction to Mathematical Statistics (fourth edition) Chapter 1,2 (except 1.1,1.2,1.3,1.8 & 2.3), Chapter 3,4 (except 4.5) and Chapter 5.</td></tr>
<tr><td colspan="2">Reference Books</td><td colspan="8">1. M. Fisz, Probability theory and Mathematical Statistics, John Wiley & sons, New York, 1963.
2. E.J. Dudewiczn and S.N. Mishra, Modern Mathematical Statistics, John Wiley & sons, New York, 1988.
3. V.N. Rohatgi, An introduction to Probability theory and Mathematical statistics, Wiley Eastern Limited, New Delhi, 1988</td></tr>
</table>

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

CLO 1: Discuss the sets, functions of sets ,random variables and certain expectations
CLO 2: Discuss binomial and related distributions
CLO 3: To study various kinds of distributions
CLO 4: Discuss additional distributions and order statistics and statistical applications
CLO 5: To learn the convergence in distribution of a sequence of random variables

	POs						PSOs		
	1	2	3	4	5	6	1	2	3
CLO1	3	3	2	3	3	3	3	3	2
CLO2	3	3	3	3	3	3	3	2	2
CLO3	2	3	2	3	2	3	3	3	3
CLO4	2	3	3	3	2	3	3	3	2
CLO5	2	3	3	3	2	3	3	2	2

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="8">2.5.2: OPERATIONS RESEARCH</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="8">ELECTIVE - IV</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Elective</td><td>Year</td><td>I</td><td rowspan="2">Credits</td><td rowspan="2">3</td><td rowspan="2">Course Code</td><td rowspan="2"></td></tr>
<tr><td>Semester</td><td>II</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per week</td><td>Lecture</td><td colspan="2">Tutorial</td><td colspan="2">Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>4</td><td colspan="2">1</td><td colspan="2">--</td><td colspan="2">5</td></tr>
<tr><td colspan="2">Prerequisite</td><td colspan="8">Knowledge of probability distributions and statistics</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="8">To analyse different situations in the industrial/ business scenario involving limited resources and finding the optimal solution within constraints.</td></tr>
<tr><td colspan="2" rowspan="5">Course Outline</td><td colspan="8">UNIT-I : Transportation Models and its Variants: Definition of the Transportation Model – Non-Traditional Transportation Model– Transportation Algorithm – The Assignment Model.
Chapter 5: Sections 5.1, 5.2, 5.3, 5.4. Exercise problems.</td></tr>
<tr><td colspan="8">UNIT-II :Network Analysis: Network Definitions – Minimal Spanning Tree Algorithm –Shortest Route Problem – Maximum Flow Model – CPM –PERT.
Chapter 6: Sections 6.2 to 6.7. Exercise problems.</td></tr>
<tr><td colspan="8">UNIT-III : Integer Linear Programming: Introduction – Applications –Integer Programming Solutions – Algorithms.
Chapter 9: Sections 9.1 to 9.3. Exercise problems.</td></tr>
<tr><td colspan="8">UNIT-IV : Inventory Theory: Basic Elements of an Inventory Model –Deterministic Models: Single Item Stock Model With And Without Price Breaks –Multiple Items Stock Model With Storage Limitations – Probabilistic Models :Continuous Review Model-Single Period Models.
Chapter 11 – Sections 11.1 to 11.3, Chapter 16 –Sections 16.1 to 16.3.Exercise problems.</td></tr>
<tr><td colspan="8">UNIT-V: Queuing Theory: Basic Elements of Queuing Model– Role of Poisson and Exponential Distributions – Pure Birth and Death Models –Specialised Poisson Queues - (M/G/1): GD/∞/∞)-Pollaczek - Khintechine Formula.
Chapter 17: Sections 17.2, 17.3, 17.4, 17.6, 17.7. Exercise problems.</td></tr>
<tr><td colspan="2">Recommended Text</td><td colspan="8">Operations Research (Sixth Edition), Hamdy A. Taha, Prentice Hall of India Private Limited, New Delhi.</td></tr>
<tr><td colspan="2">Reference Books</td><td colspan="8">1. Operations Research, H.K Pathak, Dr. Pradeep K. Joshi and C.Sharma,Shree Shiksha Sahitya Prakashan Publication, Reprint 2022-23.
2. Operations Research: Principles and Applications, Second Edition, G. Srinivasan, Eastern Economy Edition, PHI</td></tr>
</table>

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

CLO 1: Be able to build and solve Transportation and Assignment problems using appropriate method

CLO 2: Learn the constructions of network and optimal scheduling using CPM and PERT

CLO 3: Ability to construct linear integer programming models and solve linear integer programming models using branch and bound method

CLO 4: Understand the need of inventory management.

CLO 5: To understand basic characteristic features of a queuing system and acquire skills in analyzing queuing models

	POs						PSOs		
	1	2	3	4	5	6	1	2	3
CLO1	3	2	3	3	2	2	3	2	2
CLO2	3	3	2	2	3	3	3	2	2
CLO3	3	3	2	3	2	2	3	3	2
CLO4	2	2	3	3	3	2	2	2	3
CLO5	3	3	2	2	3	2	2	3	2

Title of the Course		**2.5.3: NEURAL NETWORKS**						
Paper Number		ELECTIVE - IV						
Category	Elective	Year	**I**	Credits	**3**	Course Code		
		Semester	**II**					
Instructional Hours per week		Lecture		Tutorial		Lab Practice	Total	
		4		1		--	**5**	
Prerequisite		Familiarity with linear algebra, multivariate calculus and probability theory						
Objectives of the Course		To know the main fundamental principles and techniques of neural network systems and investigate the principal neural network models and applications. Acquire in-depth knowledge in Nonlinear dynamics. Apply neural networks to classification and generalization problems.						
Course Outline		**UNIT-I:Neuron Model and Network Architectures:**Mathematical Neural Model-Network Architectures-Perceptron-Hamming Network-Hopfield Network-Learning Rules.						
		UNIT-II :Perceptron Architectures: Perceptron Architectures and Learning Rules with proof of convergence-Supervised Hebbian Learning-Linear Associator.						
		UNIT-III : Supervised Hebbian Learning: The Hebb Rule-Pseudo inverse rule-Variation of Hebbian Learning-Back Propagation-Multilayer Perceptrons.						
		UNIT-IV: Back Propagation: Back Propagation algorithm-convergence and Generalization-Performances surfaces and optimum points-Taylor series.						
		UNIT-V: Performance surface and performance optimizations: Directional derivatives-Minima-Necessary conditions for optimality-Quadratic functions-Performance optimizations-Steepest Descent Newton's method-Conjugate Gradient.						

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Declaration

I hereby declare that the details and information given above are complete and true to the best of my knowledge and belief.

Dr. V.Y. DASAPPAN M.A., M.Phil.,Ph.D.
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KANYAKUMARI DISTRICT

Principal