Sadakathullah Appa College

(Autonomous)

(Reaccredited by NAAC at an 'A' Grade. An ISO 9001:2015 Certified Institution)

Rahmath Nagar, Tirunelveli- 11.

Tamil Nadu.

PG DEPARTMENT OF MATHEMATICS

CBCS SYLLABUS

Learning Outcomes-based Curriculum Framework for

MATHEMATICS (M.Sc.)

(Applicable for the students admitted from June 2021 as per the Resolutions of the Academic Council Meeting held on 20.03.2021)

CONTENTS

POSTGRADUATE DEPARTMENT OF MATHEMATICS

CBCS SYLLABUS

M.Sc. Mathematics (2021-2024)

COURSE STRUCTURE

I SEMESTER				II SEMESTER		
COURSE	**H/W**	**C**		**COURSE**	**H/W**	**C**
DSC – I	5	4		DSC –V	5	4
DSC – II	5	4		DSC –VI	5	4
DSC – III	5	4		DSC –VII	5	4
DSC – IV	4	4		DSC –VIII	4	4
DSE-I	4	3		DSE-II	4	3
Practical-I	4	2		Practical - II	4	2
IDC – I	2	2		SEC	2	2
Library Hour	1			Library Hour	1	
TOTAL	**30**	**23**		**TOTAL**	**30**	**23**
III SEMESTER				**IV SEMESTER**		
DSC-IX	5	4		DSC –XIII	5	4
DSC –X	5	4		DSC –XIV	5	4
DSC –XI	5	4		DSC –XV	4	4
DSC –XII	4	4		Project	8	4
DSE –III	4	3		DSE -IV	4	3
Practical-III	4	2		Practical-IV	4	2
IDC -II	2	2				
Library Hour	1					
TOTAL	**30**	**23**		**TOTAL**	**30**	**21**

DISTRIBUTION OF HOURS, CREDITS, NO. OF PAPERS & MARKS				
SUBJECT	**HOURS**	**CREDITS**	**NO. OF PAPERS**	**MARKS**
DSC+Project	79	64	16	1650
Practical	16	8	4	200
DSE	16	12	4	400
IDC	4	4	2	100
SEC-MOOC*	2	2	1	50
Library Hour	3			
TOTAL	**120**	**90**	**27**	**2400**

POSTGRADUATE DEPARTMENT OF MATHEMATICS

M.Sc. Mathematics (2021-2024)

COURSE STRUCTURE

SEM	Course	Title of the Courses	Sub. Code	H/W	L	T	P	C	Marks		
									I	E	T
I	DSC-I	Groups, Rings and Fields	21PCMA11	5	4	1	-	4	40	60	100
	DSC-II	Real Analysis I	21PCMA12	5	4	1	-	4	40	60	100
	DSC-III	MATLAB	21PCMA13	5	4	1	-	4	40	60	100
	DSC-IV	Ordinary Differential Equation	21PCMA14	4	3	1	-	4	40	60	100
	DSE-I	Differential Geometry	21PEMA11A	4	3	1	-	3	40	60	100
		Discrete Mathematics	21PEMA11B								
		Classical Mechanics	21PEMA11C								
	P-I	MATLAB Practical	21PCMA1P1	4	-	-	4	2	40	60	100/2
	IDC-I	Discrete Structure –I	21PIMA11	2	2	-	-	2	40	60	100/2
		Library Reading hour		1	-	-	-	-	-	-	--
II	DSC-V	Topology	21PCMA21	5	4	1	-	4	40	60	100
	DSC-VI	Real Analysis II	21PCMA22	5	4	1	-	4	40	60	100
	DSC-VII	Graph Theory	21PCMA23	5	4	1	-	4	40	60	100
	DSC-VIII	LaTeX	21PCMA24	4	3	1	-	4	40	60	100
	DSE-II	Calculus of Variations and integral equations	21PEMA21A	4	3	1	-	3	40	60	100
		Java programming	21PEMA21B								
		Combinatorics	21PEMA21C								
	P-II	LaTeX Practical	21PCMA2P1	4	-	-	4	2	40	60	100/2
	SEC	SWAYAM-NPTEL Course	21PSMA21	2	2	-	-	2	25	75	100/2
		Library Reading hour	-	1	-	-	-	-	-	-	-
III	DSC-IX	Linear Algebra	21PCMA31	5	4	1	-	4	40	60	100
	DSC-X	Measure Theory	21PCMA32	5	4	1	-	4	40	60	100
	DSC-XI	Research Methodology	21PCMA33	5	4	1	-	4	40	60	100
	DSC-XII	Optimization Technique	21PCMA34	4	3	1	-	4	40	60	100
	DSE-III	Mathematical Statistics	21PEMA31A	4	3	1	-	3	40	60	100
		Analytical Number Theory	21PEMA31B								

		Fuzzy set theory	21PEMA31C								
	P-III	Optimization Technique in Java Programming	21PCMA3P1	4	-	-	4	2	40	60	100/2
	IDC-2	Discrete Structure – II	21PIMA21	2	2	-	-	2	40	60	100/2
		Library Reading hour	-	1	-	-	-	-	-	-	-
IV	DSC-XIII	Complex Analysis	21PCMA41	5	4	1	-	4	40	60	100
	DSC-XIV	Functional Analysis	21PCMA42	5	4	1	-	4	40	60	100
	DSC-XV	R- Programming	21PCMA43	4	3	1	-	4	40	60	100
	P	Project	21PCMAP41	8	-	-	-	4	-	-	150
	DSE-4	Partial Differential Equation	21PEMA41A	4	3	1	-	3	40	60	100
		Numerical Analysis	21PEMA41B								
		Representation theory of finite group	21PEMA41C								
	P-IV	R-Programming Practical	21PCMA4P1	4	-	-	4	2	40	60	100/2
			Total	**120**				**90**			**2400**

*** L–Lecture Hours * T–Tutorial Hours * P–Practical Hours**

M.Sc. Mathematics
Programme Learning Outcomes

PLO	Upon completion of M.Sc. Degree Programmes, the graduates will be able to:
PLO 1	**Disciplinary Knowledge** • Acquire in-depth scientific knowledge in the core areas of study.
PLO 2	**Creative Thinking and Practical Skills / Problem Solving Skills** • Enrich skills of observation to draw logical inferences from scientific experiments /programming and skills of creative thinking to develop novel ideas. • Hone problem solving skills in theoretical, experimental and computational areas and to apply them in real life situations.
PLO 3	**Sense of inquiry and Skilled Communicator / Research, Innovation and Entrepreneurship** • Develop the capability for raising appropriate questions relating to the current/emerging issues encountered in the scientific field and to plan, execute and express the results of experiments / investigations through technical writings as well as through oral presentations. • Design innovations for exploring the unexplored areas in diverse fields to accomplish socially relevant and economically beneficial innovative research projects. • Become a skilled entrepreneur for launching start-up / business ventures to improve the economy of the nation.
PLO 4	**Ethical Awareness / Team Work / Environmental Conservation and Sustainability** • Equip them for conducting work as an individual / as a member, or as a leader in diverse teams upholding values such as honesty and precision, and thus preventing unethical behaviours such as fabrication, falsification, misrepresentation of data, plagiarism etc. to ensure academic integrity. • Realise that environment and humans are dependent on one another and to know about the responsible management of our ecosystem for survival, and for the well-being of the future generation as well.
PLO 5	**Digital Literacy/Self-Directed Learning/Usage of ICT/Lifelong Learning** • Get access to digital resources, to use them judiciously for updation of knowledge and also to engage in remote/ independent learning. • Inculcate the habit of learning continuously through the effective adoption of ICT to update knowledge in the emerging areas in Sciences for inventions/discoveries so that the knowledge transferred from laboratory to land would yield fruitful results for the betterment of global society.

Programme Specific Outcomes

PSO	Upon completion of M.Sc. Mathematics Degree Programme, the students will be able to:	PLOs Mapped
PSO 1	Understand the fundamental axioms in Mathematics and develop ideas.	PLO - 1,2
PSO 2	Demonstrate mathematical and computational skills to model, formulate and solve real life applications.	PLO - 1,2,3,4
PSO 3	Motivate themselves towards research studies in Mathematics.	PLO - 1,2,3,4,5
PSO 4	Provide a systematic understanding of the concepts and theories of Mathematics and their applications in the real world to an advanced level.	PLO - 2,3,4
PSO 5	Enhance their career prospects in a huge array of fields by recognizing the need for engaging in lifelong learning through continuing education and research.	PLO - 1,2,3,4,5

Semester – I

Course Title	Groups, Rings and Fields
Total Hrs.	75
Hrs./Week	5
Sub.Code	21PCMA11
Course Type	DSC-I
Credits	4
Marks	100

General Objective:

To give an in-depth knowledge about the fundamental algebraic structures such as groups, rings and fields subsequently to introduce Galois Theory.

Course Objectives:

CO No.	The learners will be able to
CO-1	Understand the class equation of the group and the converse of Lagrange's theorem.
CO-2	Identify the finite abelian groups for a given order.
CO-3	Classify the polynomial rings and discuss the polynomial's irreducibility.
CO-4	Explain the roots of the polynomial in extension fields.
CO-5	Familiarize themselves with the fundamental theorem of Galois Theory and the structure of the finite fields.

Unit – I :

A Counting Principle - Another Counting Principle - Sylow's Theorem (2^{nd} proof only).

Unit – II:

Direct Products - Finite Abelian groups.

Unit – III:

Euclidean Rings - A Particular Euclidean Ring - Polynomial Rings -Polynomials over the rational fields.

Unit – IV :

Extension Fields – Roots of Polynomials - More About Roots.

Unit – V :

The Elements of Galois Theory (Fundamental Theorem of Galois theory statement only) and Finite fields.

Textbook:

I.N. Herstein, Topics in Algebra, Wiley India (P.) Ltd, 2^{nd} Edition, 2013.

UNIT-I: Chapter 2 (Section 2.5, 2.11, 2.12)

UNIT-II: Chapter 2 (Section 2.13, 2.14)

UNIT-III : Chapter 3 (Section 3.7 to 3.10)

UNIT-IV : Chapter 5 (Section 5.1 ,5.3 and 5.5)

UNIT-V : Chapter 5 (Section 5.6) and Chapter 7 (Section 7.1)

Reference Books:

1. Joseph A. Gallian, Contemporary Abstract Algebra, Narosa Publishing House, Fourth Edition.

2. V.K. Khanna & S.K. Bhamri, A course in Abstract Algebra, Fourth Edition, Vikas Publishing House.

Course Outcomes

CO No.	Upon completion of the course, the students will be able to	PSOs Addressed	Cognitive Level
CO-1	Summarize the class equation of Groups and the converse of Lagrange's theorem.	1,3,5	Understanding
CO-2	Apply the direct product of groups to list out the finite abelian groups for the given order.	1,3,5	Applying
CO-3	Analyze the structure of Euclidean Ring and irreducibility of the polynomial.	1,2,5	Analyzing
CO-4	Evaluate the extension of the field and its degrees.	1,2,4,5	Evaluating
CO-5	Elaborate upon the Galois Field of the irreducible polynomial.	1,5	Creating

Relationship Matrix

Semester	Course Code	Title of the Course	Hours	Credits
I	21PCMA11	Groups,Rings & Fields	75	4

Course Outcomes (COs)	Programme LearningOutcomes (PLOs)					Programme Specific Outcomes (PSOs)				
	PLO1	PLO2	PLO3	PLO4	PLO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO-1	✓	✓	✓	✓	✓	✓		✓		✓
CO-2	✓	✓	✓	✓	✓	✓		✓		✓
CO-3	✓	✓	✓	✓	✓	✓	✓			✓
CO-4	✓	✓	✓	✓	✓	✓	✓		✓	✓
CO-5	✓	✓	✓	✓	✓	✓				✓
	Number of matches (✓) = 40 Relationship = High **Low (If the No. of matches are less than 25)** **Medium (If the No. of matches are between 25 and 33)** **High (If the No. of matches are more than 33)**									

Semester – I

Course Title	**Real Analysis I**
Total Hrs	**75**
Hrs/Week	**5**
Sub.Code	**21PCMA12**
Course Type	**DSC-II**
Credits	**4**
Marks	**100**

General Objective:

To interpret the real number system, its properties and to relate the sequences and series with their examples.

Course Objectives:

CO No.	The learners will be able to
CO-1	Know the fundamental definitions of basic topology.
CO-2	Distinguish the numerical sequences and series.
CO-3	Acquire clear ideas about series of non-negative terms.
CO-4	Familiarize themselves with the Continuity and Discontinuities of functions.
CO-5	Discern the differentiation of vector valued functions.

Unit – I

Basic topology:Finite, countable and uncountable sets – Metric spaces –compact sets.

Unit – II

Numerical sequences and Series: Convergent sequences – Subsequences – Cauchy sequences –Upper and lower limits – Some special sequences.

Unit – III

Series – Series of Non negative terms – The number e – The Root and Ratio tests – Power series – Summation by parts – Absolute convergence –Addition and Multiplication of Series – Rearrangements.

Unit – IV

Continuity: Limits of functions – Continuous functions – Continuity and compactness – Continuity and connectedness.

Unit – V

Differentiation: The Derivative of a Real Function – Mean Value Theorems – The Continuity of Derivatives – L'Hospital's Rule – Derivatives of Higher order –Taylor's Theorem – Differentiation of vector-valued functions.

Textbook:

Walter Rudin - Principles of Mathematical Analysis – 3rd Edition, McGraw Hill International Editions.

Unit I : Chapter 2 (Section 2.1-2.42)

Unit II : Chapter 3 (Section 3.1-3.20)

Unit III : Chapter 3 (Section 3.21-3.55)

Unit IV : Chapter 4 (Section 4.1-4.24)

Unit V : Chapter 5 (Full)

Reference Books:

1. **H.L.Roydon& P.M.Fitz patrick**- "Real Analysis" –Fourth Edition, PHI Learning Private Limited 2012.
2. **D.Somasundaram, B.Choudhary**- "First Course in Mathematical Analysis.

Course Outcomes

CO No.	Upon completion of the course, the students will be able to	PSOs Addressed	Cognitive Level
CO-1	Define the concepts of metric spaces and compact sets.	1,2,4	Remembering
CO-2	Explain the different types of sequences and its properties.	1,2,3,4	Understanding
CO-3	Classify the types of series such as convergent, bounded and monotone.	1,2,4	Analyzing
CO-4	Analyze the limit functions, continuous functions and compactness of a set.	1,2,3,4	Analyzing
CO-5	Evaluate the derivatives of real functions and vector valued functions.	1,2,3,5	Evaluating

Relationship Matrix

Semester	Course Code		Title of the Course			Hours				Credits
I	21PCMA12		Real Analysis I			75				4
Course Outcomes (COs)	Programme Learning Outcomes (PLOs)					Programme Specific Outcomes (PSOs)				
	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO-1	✓	✓	✓	✓		✓	✓		✓	
CO-2	✓	✓	✓	✓	✓	✓	✓	✓	✓	
CO-3	✓	✓	✓	✓		✓	✓		✓	
CO-4	✓	✓	✓	✓	✓	✓	✓	✓	✓	
CO-5	✓	✓	✓	✓	✓	✓	✓	✓		✓
	Number of matches (✓) = 41 Relationship = High									

Semester – I

Course Title	**MATLAB**
Total Hrs.	**75**
Hrs./Week	**5**
Sub.Code	**21PCMA13**
Course Type	**DSC-III**
Credits	**4**
Marks	**100**

General Objective:

To understand the matrix based language allowing most computational Mathematics and numerical computation with MATLAB Software.

Course Objectives:

CO No.	The learners will be able to
CO-1	Understand the elementary concepts to execute the MATLAB program.
CO-2	Demonstrate the process of plot simple graphs.
CO-3	Identify the solutions for numerical integrations.
CO-4	Discover the results of higher order differential equations.
CO-5	Comprehend the tangent of curves by its visualization.

Unit – I

Introduction – What is MATLAB - The Basics of MATLAB – Matrices and Vectors – Matrix and Array operations.

Unit – II

Interactive computations:Character strings – A special note on array operations – Command Line Function – Using Built in Functions and Online Help – Saving and Loading Data – Plotting simple graphs.

Unit – III

Programming in MATLAB : Scripts and Functions – Script Files – Function Files - Language- specific Features.

Unit – IV

Application: Linear Algebra – Curve Fitting and Interpolation – Data Analysis and Statistics – Numerical Integration – Ordinary Differential Equation : A first order linear ODE and A second order non-linear ODE.

Unit – V

Applications : Non-linear Algebraic Equations. Graphics :Basic 2-D Plots – Using subplot for Multiple Graphs – 3-D Plots.

Textbook:

Rudra Pradap, Getting started with MATLAB – A quick introduction for Scientist and Engineer, Oxford University, Press 2003.

Unit I: Chapter 1 (Section 1.1,1.6) and Chapter 3 (Section 3.1,3.2)
Unit II: Chapter 3 (Section 3.3 – 3.8)
Unit III: Chapter 4 (Section 4.1 – 4.3)

Unit IV: Chapter 5 (Section 5.1- 5.4, 5.5 (5.5.1 ,5.5.2 only))
Unit V: Chapter 5 (Section 5.6) and Chapter 6 (Section 6.1 – 6.3)

Reference Book:

Delores M. Etter, David C. Kuncicky and Holly Moore, Introduction to MATLAB, Dorling Kindersley (India) Pvt Ltd, New Delhi (2009).

Course Outcomes

CO No.	Upon completion of the course, the students will be able to	PSOs Addressed	Cognitive Level
CO-1	Define the way to interpret matrix,vectors etc in MATLAB Software.	1,2	Remembering
CO-2	Explain the process of defining command line functions.	1,2,4	Understanding
CO-3	Analyze the nested function and its means to apply MATLAB Program.	1,2,4	Analyzing
CO-4	Evaluate the eigen values and eigen vectors of the matrix.	1,3,5	Evaluating
CO-5	Elaborate upon the various dimensional function images in graphs.	1,2,3,5	Creating

Relationship Matrix

Semester	Course Code		Title of the Course			Hours				Credits
I	21PCMA31		MATLAB			75				4
Course Outcomes (COs)	Programme Learning Outcomes (PLOs)					Programme Specific Outcomes (PSOs)				
	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO-1	✓	✓	✓	✓		✓	✓			
CO-2	✓	✓	✓	✓		✓	✓		✓	
CO-3	✓	✓	✓	✓		✓	✓		✓	
CO-4	✓	✓	✓	✓	✓	✓		✓		✓
CO-5	✓	✓	✓	✓	✓	✓	✓	✓		✓
	Number of matches (✓) = 37 Relationship = High									

Semester –I

Course Title	**Ordinary Differential Equations**
Total Hours	**60**
Hours / Week	**4**
Code	**21PCMA14**
Course type	**DSC-IV**
Credits	**4**
Marks	**100**

General Objective:

To discuss several methods for finding power series solutions to differential equations of first and second order and regular singular points.

Course Objectives:

CO No.	The learners will be able to
CO 1	Analyze the methods of variation of parameters to find out the solution of homogeneous equation.
CO 2	Apply power series to solve first and second order differential equations.
CO 3	Remember the ordinary and regular singular point.
CO 4	Understand the properties of Legendre polynomial and Bessel Function.
CO 5	Evaluate the homogeneous linear differential equations with constant coefficient.

UNIT I

Introduction -The general solution of the homogeneous equation – The use of a known solution to find another – The Homogeneous equation with constant coefficients - The method of undetermined coefficients- The method of variation of parameters.

UNIT II

Introduction: A review of power series - Series solutions of first order equations - Second Order Linear equations and Ordinary points.

UNIT III

Regular singular points - Regular singular point (continued) - Gauss Hyper Geometric equation.

UNIT IV

Legendre Polynomials- Properties of Legendre Polynomials - Bessel functions. The Gamma Function.

UNIT V

Properties of Bessel Functions - Linear Systems – Homogeneous linear equations with constant coefficients.

Textbook :

George F. Simmons, Differential Equations with Applications and Historical Notes, Tata McGraw Hill Publishing Company Limited, New Delhi, Second Edition 2003.

UNIT I : Chapter 3 (Section 14 -19)
UNIT II : Chapter 5 (Section 25 to 28)

UNIT III : Chapter 5 (Section 29,30)
UNIT IV : Chapter8 **(**Section 44 to 46)
UNIT V : Chapter 10 (Section 55, 56)

Reference Books:

1. Earl A. Coddington, An Introduction to Ordinary Differential Equations, Prentice-Hall of India, New Delhi, 1992.

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

Course Outcomes

CONo.	**Upon completion of the course, the students will be able to**	PSOs Addressed	Cognitive Level
CO 1	Understand the general solution for homogeneous equation with constant coefficient.	1,2	Understanding
CO 2	Applying the power series method and to find the solution of first and second order differential equation .	1,3	Applying
CO 3	Analyze the Gauss hyper geometric series to solve the problems.	1,3,5	Analyse
CO 4	Evaluate the properties of Bessel and gamma function.	1,3	Evaluating
CO 5	Explain the concept of Linear system of equation with constant coefficient.	1,4,5	Creating

Relationship Matrix

Semester	**Course Code**		**Title of the Course**			**Hours**		**Credits**		
I	**21PCMA14**		**Ordinary Differential Equations**			**60**		**4**		
Course Outcomes (COs)	**Programme Learning Outcomes (PLOs)**					**Programme Specific Outcomes (PSOs)**				
	PLO 1	**PLO 2**	**PLO 3**	**PLO 4**	**PLO 5**	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**	**PSO 5**
CO-1	✓	✓	✓	✓		✓	✓			
CO-2	✓	✓	✓	✓	✓	✓		✓		
CO-3	✓	✓	✓	✓	✓	✓		✓		✓
CO-4	✓	✓	✓	✓	✓	✓		✓		
CO-5	✓	✓	✓	✓	✓	✓			✓	✓
	Number of matches (✓) = 36 Relationship = High									

Semester I

Course Title	Differential Geometry
Total Hrs	60
Hrs / Week	4
Sub. Code	21PEMA11A
Course Type	DSE-I-A
Credits	3
Marks	100

General Objective:

To introduce the concept of a parameterized surface with the help of examples, compute the curvature and torsion of space curves, gain knowledge about the metric of a surface and get a clear idea to find out a geodesic curvature on various surfaces.

Course Objectives: :

CO No.	The learners will be able to
CO – 1	Understand the basic concept of tangent, normal and binormal vectors in space curve.
CO – 2	Determine the contact between curves and surfaces.
CO – 3	Comprehend the idea of surface of revolution and anchor ring in an easiest way.
CO – 4	Assimilate the notion of Geodesics and its properties.
CO – 5	Execute the problems using the normal property of Geodesics.

UNIT I

The theory of space curves – Definitions, Arc length – Tangent – Normal and Binormal - Curvature and Torsion .

UNIT II

Contact between curves and surfaces – Tangent Surface – Involutes and evolutes .

UNIT III

Definition of a surface – Curves on a surface –Surface of Revolution - Helicoids.

UNIT IV

Metric – Direction Coefficients - Families of curves - Geodesics.

UNIT V

Canonical geodesic equation, Normal Property of geodesics (Christoffel symbols notincluded), Geodesic curvature.

Text Book:

T.J.Willmore- An Introduction to Differential Geometry, Oxford University Press, (17th Impresssion), New Delhi, 2002, (Indian Print)

Unit I: Chapter 1: Section: 1.1 – 1.4, problem:chapter1:1-4

Unit II:Chapter 1: Section: 1.5- 1.7, problem:chapter1:9-12

Unit III:Chapter 2: Section: 2.1, 2.2, 2.4,Example Problem only.

Unit IV:Chapter 2: Section: 2.5-2.7, 2.10, problem: chapter 2:1-4

Unit V:Chapter 2: Section: 2.11, 2.12,2.15, problem: chapter 2:8,10-12

Reference Book:

D. Somasundaram, Differential Geometry: A First Course.

Course Outcomes(CO)

CO No.	Upon completion of the course, the students will be able to	PSOs Addressed	Cognitive Level
CO - 1	Understand the problem using tangent, normal and binormal vectors.	1,2	Understanding
CO – 2	Analyse the contact between curves and surfaces.	1,2,4	Analyzing
CO – 3	Apply the concept of helicoid, right helicoid and pitch in various applications.	1,2,4,5	Applying
CO – 4	Use the differential geometry techniques to specific research problems in Mathematics.	1,2,3	Applying
CO – 5	Evaluate the Geodesic condition and its properties.	1	Evaluating

Relationship Matrix

Semester	Course Code	Title of the Course	Hours	Credits
I	21PEMA11A	Differential Geometry	60	3

Course Outcomes (COS)	Programme Learning Outcomes (PLOs)					Programme Specific Outcomes (PSOs)				
	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO - 1	✓	✓	✓	✓		✓	✓			
CO - 2	✓	✓	✓	✓		✓	✓		✓	
CO - 3	✓	✓	✓	✓	✓	✓	✓		✓	✓
CO - 4	✓	✓	✓	✓	✓	✓	✓	✓		
CO - 5	✓	✓				✓				
	Number of Matches(✓) = 33 Relationship = Medium									

Semester – I

Course Title	**DiscreteMathematics**
Total Hrs	**60**
Hrs/Week	**4**
Sub.Code	**21PEMA11B**
Course Type	**DSE-I-B**
Credits	**3**
Marks	**100**

General Objective:

To apply logical reasoning to solve a variety of real life problems and analyze the basic discrete structures and algorithms.

Course Objectives:

CO No.	The learners will be able to
CO-1	Know about the proportional logic and equivalence.
CO-2	Understand the pigeonhole principle in basics of counting.
CO-3	Discuss the relation and their properties with n-ary.
CO-4	Acquire the proper idea about Boolean functions and their representations.
CO-5	Obtain the concept in minimization of circuits.

Unit – I

Propositional Logic–Propositional equivalence.

Unit – II

The Basics of counting–The Pigeonhole principle.

Unit – III

Relation and their properties–n-ary relations and their applications.

Unit – IV

Boolean functions –Representing Boolean functions.

Unit – V

Logic Gates–Minimization of circuits.

Textbook:

DiscreteMathematicsanditsApplications(SixthEdition)–KennethH.Rosen, WCB/McGraw Hill Publications.

Unit I : Section :1.1,1.2 Problems: Section 1.1(1-38),Section 1.2(1-35)
Unit II: Sections:5.1,5.2 Problems: Section 5.1(1-40),Section 5.2(1-22)
Unit III: Section: 7.1,7.2 Problems: Section 7.1(All exercise problems), Section 7.2(1-27)
Unit IV: Section: 10.1,10.2
Unit V :Section: 10.3,10.4

Reference Books:

1. J.P.Tremblay and R.Manohar,*Discrete Mathematical Structures with Applications to Computer Science*,McGraw-Hill International Edition,2008.
2. Kolman-Busby-Ross,*Discrete Mathematical Structures*, (Sixth Edition).

Course Outcomes

CO No.	Upon completion of the course, the students will be able to	PSOs Addressed	Cognitive Level
CO-1	Understand the fundamental concepts of proportional logic and its equivalents in a systematic way.	1,2,4	Understanding
CO-2	Analyze the pigeonhole principle in basics of counting.	1,2,3,5	Analyzing
CO-3	Analyse n-ary relations and their properties.	1,2,4,5	Analyzing
CO-4	Evaluatethe Boolean functions and their properties.	1,2,5	Evaluating
CO-5	Generalize the concepts of logic gates and minimization of circuits.	1,2,4	Creating

Relationship Matrix

Semester	Course Code	Title of the Course	Hours	Credits
I	21PEMA11B	Discrete Mathematics	60	3

Course Outcomes (COs)	Programme Learning Outcomes (PLOs)					Programme Specific Outcomes (PSOs)				
	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO-1	✓	✓	✓	✓		✓	✓		✓	
CO-2	✓	✓	✓	✓	✓	✓	✓	✓		✓
CO-3	✓	✓	✓	✓	✓	✓	✓		✓	✓
CO-4	✓	✓	✓	✓	✓	✓	✓			✓
CO-5	✓	✓	✓	✓		✓	✓		✓	
	Number of matches (✓) =40 Relationship = High									

Semester –I

Course Title	**Classical Mechanics**
Total Hrs.	**60**
Hrs./Week	**4**
Sub.Code	**21PEMA11C**
Course Type	**DSE-I-C**
Credits	**3**
Marks	**100**

General Objective:

Obtain the knowledge to demonstrate the fundamental concepts in mechanics of a system of particles, motion of rigid body, Lagrangian and Hamiltonian formulation in simple technique.

Course Objectives:

CO	The learners will be able to
CO-1	Understand the concepts of linear, angular and energy conservation theorem for a particle and a system of particle.
CO-2	Apply their knowledge in Maxwell equation.
CO-3	Analyse the variational principles and Lagrange's equation.
CO-4	Analyze the equation of motion using two body central force problem.
CO-5	Derive the equation of motion for circular orbit.

UNIT I

Survey of the Elementary Principles: Mechanics of a particle - Mechanics of a system of particles – Constraints - D'Alembert's principle and Lagrange's Equations.

UNIT II

Velocity-dependent potentials and the dissipation functions - Simple applications of the Lagrangian formulation - single particle in space (Cartesian co-ordinates, plane polar co-ordinates)-Atwood's machine-bead sliding on rotating wire.

UNIT III

Variational Principles and Lagrange's Equations: Hamilton's principle - Some techniques of the calculus of variations - Derivation of Lagrange's equations from Hamilton's principle - Extension of Hamilton's principle to nonholonomic systems - Advantages of a variational principle formulation – Conservation theorems and symmetry properties.

UNIT IV

The Two-Body Central Force Problem: Reduction to the equivalent one-body problem - The equations of motion and first integrals - The equivalent one-dimensional problem, and classification of orbits – The virial theorem – The differential equation for the orbit, and integrable power-law potentials.

UNIT V

Conditions for closed orbits (Bertrand's theorem) - The Kepler problem: Inverse Square law of force -The motion in time in the Kepler problem - The Laplace-Runge-Lenz vector-scattering in a central force field.

TEXT BOOK:

Herbert Goldstein- Classical Mechanics-Second Edition-Narosa Publishing House Pvt.Ltd

Unit I: Chapters 1 (Section 1.1 to 1.4)

Unit II: Chapters 1 (Section 1.5 to 1.6)

Unit III: Chapters 2 (Section 2.1 to 2.6)

Unit IV: Chapters 3 (Section 3.1 to 3.5)

Unit V: Chapters 3 (Section3.6 to 3.10)

Reference Books:

Classical Mechanics by R.Douglas Gregory, Cambridge University Press, 2006.

Course Outcomes

CO	Upon completion of the course, the students will be able to	PSOs Addressed	Cognitive Level
CO-1	Understand the concept of linear, angular and energy conservation theorem for a particle and a system of particle.	1,5	Understanding
CO-2	Evaluate the Lagrangian equation using Hamilton's principle.	1,3,5	Evaluating
CO-3	Apply their skills in Hamilton's principle for various coordinate systems.	1	Applying
CO-4	Determine central force field in real life application.	1,2,4	Evaluating
CO-5	Analyzsis conic and orbital motion using kepler law of planetary motion.	1,2,4,5	Analyzing

Relationship Matrix

Semester	Course Code		Title of the Course			Hours				Credits
I	21PEMA11C		Classical Mechanics			60				3
Course Outcomes (COs)	Programme Learning Outcomes (PLOs)					Programme Specific Outcomes (PSOs)				
	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO-1	✓	✓	✓	✓	✓	✓				✓
CO-2	✓	✓	✓	✓	✓	✓		✓		✓
CO-3	✓	✓				✓				
CO-4	✓	✓	✓	✓		✓	✓		✓	
CO-5	✓	✓	✓	✓		✓	✓		✓	
	Number of matches (✓) = 32 Relationship = Medium									

Semester – I

Course Title	**MATLAB Practical**
Total Hrs.	**60**
Hrs./Week	**4**
Sub.Code	**21PCMA1P1**
Course Type	**Practical-I**
Credits	**2**
Marks	**100/2**

General Objective:

To learn the fundamentals of MATLAB software and to workout Mathematical calculations.

Course Objectives:

CO No.	The learners will be able to
CO-1	Understand the simple calculations to work on MATLAB.
CO-2	Know to create and print simple plots.
CO-3	Utilize the tools to create custom plots.
CO-4	Grasp the concepts of matrix computation and manipulations.
CO-5	Make calculations in equations and polynomials easily.

1. Write a MATLAB coding to some simple calculation in MATLAB.
2. Write a MATLAB coding to creating and working with arrays of numbers.
3. Write a MATLAB coding to creating and printing simple plots.
4. Write a MATLAB coding to creating, saving and executing a script file.
5. Write a MATLAB coding to creating and executing a function file.
6. Write a MATLAB coding to working with arrays and matrices.
7. Write a MATLAB coding to create a simple inline function and anonymous function and compute its value.
8. Write a MATLAB coding to symbolic computations
9. Write a MATLAB coding to find the addition, subtraction and multiplication of any two matrix.
10. Write a MATLAB coding to delete and display the rows and columns of a Matrix.
11. Write a MATLAB coding to distinguish Matrix functions and array functions.
12. Write a MATLAB coding to find the determinant, inverse and Eigen value of given matrix.
13. Write a MATLAB coding to importing and exporting data.
14. Write MATLAB coding to solve a linear system of three equations.
15. Write a MATLAB coding to find the roots of the polynomial.
16. Write aMATLAB coding to draw a line.
17. Write a MATLAB coding to draw a curve.
18. Write a MATLAB coding to plot the various graphs.
19. Write a MATLAB coding to solve the partial fraction.

20. Write a MATLAB coding to display 2-D plots
21. Write a MATLAB coding to display specialized 2-D plots
22. Write a MATLAB coding to display 3-D plots
23. Write a MATLAB coding to display specialized 3-D plots
24. Write a MATLABcoding to interpolated surface plots

Course Outcomes

CO No.	Upon completion of the course, the students will be able to	PSOs Addressed	Cognitive Level
CO-1	Identify the experiment with matrix manipulations.	1,2	Understanding
CO-2	Identify the eigen values and vectors of higher order matrices.	1,2,3,5	Applying
CO-3	Analyze the complicated equation by partial fractions.	1,2,4	Analyzing
CO-4	Evaluate the difference between the image of 2D and 3D surfaces.	1,2,4	Evaluating
CO-5	Discuss the roots of the linear and non-linear ordinary differential equations.	1,2,3,5	Creating

Relationship Matrix

Semester	Course Code	Title of the Course	Hours	Credits
I	21PCMA1P1	MATLAB Practical	60	4

Course Outcomes (COs)	Programme Learning Outcomes (PLOs)					Programme Specific Outcomes (PSOs)				
	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO-1	✓	✓	✓	✓		✓	✓			
CO-2	✓	✓	✓	✓	✓	✓	✓	✓		✓
CO-3	✓	✓	✓	✓		✓	✓		✓	
CO-4	✓	✓	✓	✓		✓	✓		✓	
CO-5	✓	✓	✓	✓	✓	✓	✓	✓		✓
	Number of matches (✓) = 38 Relationship = High									

Semester – I

Course Title	**Discrete Structure I**
Total Hrs.	**30**
Hrs./Week	**2**
Sub.Code	**21PIMA11**
Course Type	**IDC-I**
Credits	**2**
Marks	**100/2**

General Objective:

To introduce the methods of analytical, critical thinking, deductive reasoning and logical and mathematical tools.

Course Objectives:

CO No.	The learners will be able to
CO-1	Understand the elements of propositional logic such as statements and operations.
CO-2	Represent the logic statements in Mathematics by predicates and quantifiers.
CO-3	Recognize nested quantifiers and interference rules for propositional statements.
CO-4	Define a set operation and its relation.
CO-5	Describe an equivalence relation on a set to discuss the partition of a given set.

Unit – I : Propositional Logic - Propositional Equivalence.
Unit – II : Predicate Logic - Normal Forms.
Unit – III : Nested Quantifiers - Rules of Inferences.
Unit – IV : Set Operations - Representation and Properties of Relations.
Unit – V : Equivalence Relations - Partially Ordering.

Textbook:

Kennath H Rosen, Discrete Mathematics & its Applications with Combinatorics and Graph Theory, Tata Mcgraw- Hill Publishing Company Limited, sixth Edition.

UNIT-I: Chapter 1 (Section 1.1, 1.2)
UNIT-II: Chapter 1 (Section 1.3)
UNIT-III : Chapter 1 (Section 1.4, 1.5)
UNIT-IV : Chapter 2 (Section 2.2) and Chapter 7 (Section 7.1, 7.3)
UNIT-V : Chapter 7 (Section 7.5,7.6)

Reference Book:

Susanna S. Epp, Discrete Mathematics with Applications, Brooks/Cole, Fourth Edition, 2011.

Course Outcomes

CO No.	Upon completion of the course, the students will be able to	PSOs Addressed	Cognitive Level
CO-1	Describe the components such as statements and operations of propositional logic.	2,4	Understanding
CO-2	Apply predicate logic and quantifiers to express the logic statements in Mathematics.	2,4,5	Applying
CO-3	Give examples of various operations on a set.	1,2	Applying
CO-4	Interpret the complicated arguments by applying the rules of inferences of propositions and quantified statements.	2,4	Evaluating
CO-5	Estimate the partially ordered sets and equivalence relations.	1,2,3	Creating

Relationship Matrix

Semester	Course Code		Title of the Course			Hours			Credits	
I	21PIMA11		Discrete Structure I			30			2	
Course Outcomes (COs)	Programme Learning Outcomes (PLOs)					Programme Specific Outcomes (PSOs)				
	PLO1	PLO2	PLO3	PLO4	PLO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO-1	✓	✓	✓	✓			✓		✓	
CO-2	✓	✓	✓	✓	✓		✓		✓	✓
CO-3	✓	✓	✓	✓		✓	✓			
CO-4	✓	✓	✓	✓			✓		✓	
CO-5	✓	✓	✓	✓	✓	✓	✓	✓		
	Number of matches (✓) = 34 Relationship = High									

SEMESTER II

Course Title	**Topology**
Total Hours	**75**
Hours / Week	**5**
Code	**21PCMA21**
Course type	**DSC-V**
Credits	**4**
Marks	**100**

General Objective:

To reformulate the concepts of Metric Spaces to topological spaces, develop analytical thinking and gain knowledge in countability axioms and separation axioms.

Course Objectives:

CO No.	The learners will be able to
CO 1	Understand the basic definitions and theorems related to topology.
CO 2	Formulate new topological spaces such as product space and quotient space.
CO 3	Discuss the concepts of connected, compact and the locally connectedness in topological spaces.
CO 4	Analyze the local compactness and countability axiom.
CO 5	Familiarize themselves with the concepts of Urysohn lemma.

UNIT I

Topological spaces – Basis for a Topology – Order Topology – The product Topology on X ×Y – The Subspace Topology – Closed sets and Limit points.

UNIT II

Continuous functions – The Product Topology - The Quotient Topology.

UNIT III

Connected spaces, components and local connectedness - compact spaces.

UNIT IV

Local compactness - The Countability axioms - The Separation axioms.

UNIT V (e-PG Pathashala)

Normal Spaces – Urysohn lemma – Urysohn metrization theorem.

Textbook:

J.R. Munkres – Topology-2nd Edition, Eastern Economy Edition – Prentice- Hall of India Pvt Ltd, New Delhi.

UNIT I: Chapter 2 (12 to 17).
UNIT II: Chapter 2(18, 19, 22).

UNIT III: Chapter 3 (23, 25, 26).
UNIT IV: Chapter 3 (29), Chapter 4 (30, 31).
UNIT V: Chapter 4 (32, 33, 34)

Reference Book:

1. G.F.Simmons, Introduction to Topology and Modern Analysis. Tata McGraw-Hill Publishing Company Ltd, New Delhi.
2. https://youtu.be/azbVpX5y8k82. https://youtu.be/azbVpX5y8k8.

Course Outcomes:

CO No.	Upon completion of the course, the students will be able to	PSOs Addressed	Cognitive Level
CO 1	Understand the ways to construct topology from bases and subbases.	1,2	Understanding
CO 2	Analyze the continuous and Homeomorphism functions among topological spaces.	1,2,3,5	Analyzing
CO 3	Apply the properties of connectedness, local connectedness and compactness.	1,3,4,5	Applying
CO 4	Estimate the importance of first countable and second countable space.	1,3	Evaluation
CO 5	Analyse the Urysohn lemma and the Urysohn metrization theorem.	1,3,5	Analyzing

Relationship Matrix

Semester	Course Code		Title of the Course			Hours				Credits
II	**21PCMA21**		**Topology**			**75**				**4**
Course Outcomes (COs)	**Programme Learning Outcomes (PLOs)**					**Programme Specific Outcomes (PSOs)**				
	PLO 1	**PLO 2**	**PLO 3**	**PLO 4**	**PLO 5**	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**	**PSO 5**
CO-1	✓	✓	✓	✓		✓	✓			
CO-2	✓	✓	✓	✓	✓	✓	✓	✓		✓
CO-3	✓	✓	✓	✓	✓	✓		✓	✓	✓
CO-4	✓	✓	✓	✓	✓	✓		✓		
CO-5	✓	✓	✓	✓	✓	✓		✓		✓
	Number of matches (✓) = 39 Relationship = High									

Semester – II

Course Title	**Real Analysis II**
Total Hrs	**75**
Hrs/Week	**5**
Sub.Code	**21PCMA22**
Course Type	**DSC-VI**
Credits	**4**
Marks	**100**

General Objective:

To recognize the basic properties of the field in real numbers and formulate the proofs and structures of mathematical arguments.

Course Objectives

CO No.	The learners will be able to
CO-1	Understand the importance of Riemann –Stieltjes integral and its properties.
CO-2	Study about the sequence and series of functions.
CO-3	Apply the uniform convergence in differentiation and integration.
CO-4	Gain the knowledge of power series, exponential and logarithmic functions.
CO-5	Know the significance of contraction principle, Inverse and Implicit function theorem.

Unit – I

The Riemann–Stieltjes Integral: Definition and Existence of the Integral – Properties of the Integral–Integration and differentiation.

Unit – II

Sequences and Series of Functions:Discussion of main problem–Uniform convergence–Uniform convergence and continuity–Uniform convergence and integration.

Unit – III

Uniform convergence and Differentiation - Equicontinuous Families of functions.

Unit – IV

Some Special Functions:Power Series–The Exponential and Logarithmic Functions–The trigonometric Functions–The Algebraic Completeness of the Complex Field-Fourier series.

Unit – V

Functions of Several Variables: Differentiation– The Contraction principle – The Inverse function Theorem–The Implicit function theorem.

Textbook:

Walter Rudin–"Principles of Mathematical Analysis" – 3rd Edition, McGraw Hill International Editions.

Unit I: Chapter 6(section 6.1-6.22)
Unit II: Chapter 7 (section 7.1-7.16)
Unit III: Chapter 7(section 7.17-7.25)
Unit IV: Chapter 8(section 8.1-8.12)

Unit V: Chapter 9 (section 9.10-9.29)

Reference Books:

1. **H.L.Roydon& P.M.Fitz patrick**-"Real Analysis" – Fourth Edition, PHI Learning Private Limited 2012.
2. **D.Somasundaram, B.Choudhary** "First Course in Mathematical Analysis", Narosa Publishing house 1996.

Course Outcomes

CO No.	Upon completion of the course, the students will be able to	PSOs Addressed	Cognitive Level
CO-1	Understand the importance of Riemann Stieltjes Integral and its properties.	1,2,4	Understanding
CO-2	Develop the uniform convergence for sequence of function.	1,2,3,4	Applying
CO-3	Analyse the conditions related to equicontinuous families of functions.	1,2,3,4	Analyzing
CO-4	Evaluate the power series concepts such as Exponential, Logarithmic and Trigonometric functions.	1,2,3,4	Evaluating
CO-5	Discuss the derivatives of functions in several variables using contraction principle and the inverse function theorem.	1,2,5	Creating

Relationship Matrix

Semester	Course Code	Title of the Course					Hours			Credits
II	21PCMA22	Real Analysis II					75			4
Course Outcomes (COs)	Programme Learning Outcomes (PLOs)					Programme Specific Outcomes (PSOs)				
	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO-1	✓	✓	✓	✓		✓	✓		✓	
CO-2	✓	✓	✓	✓	✓	✓	✓	✓	✓	
CO-3	✓	✓	✓	✓	✓	✓	✓	✓	✓	
CO-4	✓	✓	✓	✓	✓	✓	✓	✓	✓	
CO-5	✓	✓	✓	✓	✓	✓	✓			✓
	Number of matches (✓) =42 Relationship = High									

Semester – II

Course Title	**Graph Theory**
Total Hrs	**75**
Hrs/Week	**5**
Sub. Code	**21PCMA23**
Course Type	**DSC-VII**
Credits	**4**
Marks	**100**

General Objective:

To understand the fundamental concepts in graph theory so as to solve day-to-day life problems besides improving the proof writing skills.

Course Objectives:

CO No.	The learners will be able to
CO-1	Understand the basic concepts of trees and their properties.
CO-2	Identify the Eulerian and Hamiltonian graphs.
CO-3	Understand and prove the theorems/lemmas in matching and factorization.
CO-4	Analyze the necessary condition for planar graphs.
CO-5	Recall the edge colouring of graphs.

UNIT I

Trees: Bridges – Trees. Connectivity: Cut vertices - Connectivity.

UNIT II

Traversability: Eulerian graphs – Hamiltonian graphs.

UNIT III

Matchings and Factorizations: Matchings – Factorization

UNIT IV

Planarity: Planar graphs –Embedding Graphs on surfaces. Coloring: Vertex coloring.

UNIT V

Edge coloring – The Heawood Map coloring theorem, Distance: The centre of a graph.

Textbook:

Gary Chartrand and Ping Zhang – Introduction to Graph Theory, Edition 2006. Tata McGraw-Hill Publishing Company Limited, New Delhi.

UNIT I: Chapter 4 (4.1, 4.2), Chapter 5 (5.1, 5.3).
UNIT II: Chapter 6 (6.1, 6.2),

UNIT III: Chapter 8 (8.1, 8.2,)
UNIT IV: Chapter 9 (9.1, 9.2), Chapter 10(10.2).
UNIT V: Chapter 10 (10.3, 10.4), Chapter 12 (12.1).

Reference Book:

J.A. Bondy and U.S.R. Murty – Graph Theory with applications, Department of Combinatorics and Optimization, Elsevier Science Publishing 1976.

Course Outcomes

CO No.	Upon completion of the course, the students will be able to	PSOs Addressed	Cognitive Level
CO-1	Understand the concept of vertex and edge connectivity.	1, 5	Understanding
CO-2	Apply the various characterization of Eulerian and Hamiltonian graphs.	1, 3, 4	Applying
CO-3	Analyse Hall's Marriage theorem to justify that if the graphs have a perfect matching.	1, 4, 5	Analyzing
CO-4	Evaluate the interpretation of non-planar graphs in higher dimension surfaces.	1, 5	Evaluating
CO-5	Discuss the edge colouring of graphs and centre of a graph.	1, 2, 4, 5	Creating

Relationship Matrix

Semester	Course Code		Title of the Course			Hours			Credits	
II	21PCMA23		Graph Theory			75			4	
Course Outcomes (COs)	Programme Learning Outcomes (PLOs)					Programme Specific Outcomes (PSOs)				
	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO-1	✓	✓	✓	✓	✓	✓				✓
CO-2	✓	✓	✓	✓	✓	✓		✓	✓	
CO-3	✓	✓	✓	✓	✓	✓			✓	✓
CO-4	✓	✓	✓	✓	✓	✓				✓
CO-5	✓	✓	✓	✓	✓	✓	✓		✓	✓
	Number of matches(✓) = 39 Relationship = High									

Semester – II

Course Title	**LaTeX**
Total Hrs.	**60**
Hrs./Week	**4**
Sub.Code	**21PCMA24**
Course Type	**DSC-VIII**
Credits	**4**
Marks	**100**

General Objective:

To familiarize themselves with the LaTeX software for document preparation.

Course Objectives

CO No.	The learners will be able to
CO-1	Write the coding to prepare journal format and beamer presentation.
CO-2	Understand the advanced typesetting of Mathematics with AMS-LaTeX.
CO-3	Know the automatic generation of table of contents, bibliographies and indexes.
CO-4	Have the skills to control over large documents containing sections, cross-references, tables and figures.
CO-5	Create chapters with subheadings and reference chapters or sections in the text.

Unit – I

Introduction: Basics of a LaTeX file- **Texts, Symbols and Commands:** Commands names and arguments –Environments – Declarations – Lengths - Special Characters – **Document Layout and Organization:** Document Class – Page Style – Parts of the document – Table of Contents.

Unit – II

Displaying Text: Changing font style – Centering and indenting – Lists – Generalized Lists – Theorem like-declarations - **Text in Boxes:** Boxes – Footnotes and Marginal notes – **Tables:** Tabular stops – Tables.

Unit – III

Mathematical Formulas: Mathematical environments – Main elements of math mode – Mathematical symbols – Additional Elements – Fine tuning Mathematics – **Floating tables and figures:** Float placement – Postponing floats – style parameters for floats – float captions – float examples – References to figures and tables in text – Some float packages.

Unit – IV

Graphics Inclusion and Color: The graphics packages – Adding color – **Drawing with Latex:** The picture environment – Extended pictures.

Unit – V

Math Extensions with AMS-LaTeX: Invoking AMS-LaTeX – Standard features of AMS-LaTeX- Further AMS-LaTeX Packages – The AMS fonts **Presentation Material:** Slide production with slides class- Slide production with seminar - Slide Production with the proper class - Electronic documents for screen viewing – Special effects with PDF.

Textbook:

Helmut Kopka and Patrick W. Daly – Guide to LaTeX (Fourth Edition) Addison Wesley

UNIT I: Chapter 1 (Section 1.5 Only), Chapter 2 (Section 2.1 to 2.5) and Chapter 3 (Section 3.1 to 3.4)
UNIT II: Chapter 4 (Section 4.1 to 4.5), Chapter 5 (Section 5.1 to 5.2) and Chapter 6 (Section 6.1 to 6.2)
UNIT III: Chapter 7 (Section 7.1 to7.5) and Chapter 9 (Section 9.1 to 9.7)
UNIT IV: Chapter 8 (Section 8.1 to 8.2) and Chapter 16 (Section 16.1 to 16.2)
UNIT V: Chapter 15(Section 15.1 to 15.4) and Chapter 17 (Section 17.1 to 17.5)

Reference Book:

LaTeX Beginner's Guide, Stefan Kottwitz, Published by Packt Publishing Ltd.32 Lincoln Road Old on Birmingham.

Course Outcomes

CO No.	Upon completion of the course, the students will be able to	PSOs Addressed	Cognitive Level
CO-1	Understand the basics such as text, symbols and commands of LaTeX software.	1,4	Understanding
CO-2	Apply the interpretation of boxes, nested boxes and minipages.	1,2,4,5	Applying
CO-3	Analyze the techniques in LaTeX for preparing floating tables and figures.	1,4	Analyzing
CO-4	Apply the picture environment to draw graphs and the various kinds of images.	1,2,4,5	Applying
CO-5	Elaborate upon the knowledge in preparing presentation materials by understanding the Math Extensions with AMS-LaTeX.	1,3,4,5	Creating

Relationship Matrix

Semester	Course Code	Title of the Course	Hours	Credits
II	21PCMA24	LaTeX	60	4

Course Outcomes (COs)	Programme Learning Outcomes (PLOs)					Programme Specific Outcomes (PSOs)				
	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO-1	✓	✓	✓	✓		✓			✓	
CO-2	✓	✓	✓	✓	✓	✓	✓		✓	✓
CO-3	✓	✓	✓	✓		✓			✓	
CO-4	✓	✓	✓	✓	✓	✓	✓		✓	✓
CO-5	✓	✓	✓	✓	✓	✓		✓	✓	✓
	Number of matches (✓) = 39 Relationship = High									

Semester II

Course Title	**Calculus of Variations and Integral Equations**
Total Hrs	**60**
Hrs / Week	**4**
Sub. Code	**21PEMA21A**
Course Type	**DSE-II-A**
Credits	**3**
Marks	**100**

General Objective:

To obtain knowledge for finding maxima and minima of functionals and to give exact analytical techniques to find the shortest distance between two given points on a surface and get clear idea about the relationship between differential equation and Integral equations.

Course Objectives:

CO No.	The learners will be able to
CO 1	Understand the concept of Euler's equation in different form.
CO 2	Know the concept with variational problems.
CO 3	Differentiate the relation between differential and integral equations.
CO4	Execute the successive approximation method in simple way.
CO 5	Gain knowledge about Fredholm equation of first, second and third kind.

UNIT I

Calculus of Variations and Applications: Maxima and minima - The simplest case - Illustrative examples - Natural boundary conditions and transition conditions.

UNIT II

Constraints and Lagrange multipliers - Variable end points - Sturm-Liouville problems - Lagrange's equations.

UNIT III

Integral Equations: Introduction - Relation between differential and integral equations - Illustrative example.

UNIT IV

The Green's function – Abel's Theorem – Bessel's function - Fredholm equations with separable kernels - Illustrative example.

UNIT V

Iterative methods for solving equations of the second kind –Neumann Series - Fredholm theory.

Textbook:

Francis B.Hildebrand, Methods of Applied Mathematics, Second Edition, Prentice Hall, INC. Englewood Cliffs, New Jersey.

UNIT I: Chapter 2 (Section 2.1 to 2.4)
UNIT II: Chapter 2 (Section 2.7 to 2.9 & 2.11)
UNIT III: Chapter 3 (Section 3.1 to 3.2)

UNIT IV: Chapter 3 (Section 3.3, 3.6 & 3.7)

UNIT V: Chapter 3 (Section 3.9, 3.10, 3.11)

Reference Books:

1. Calculus of Variations by I. M. Gelfand and S.V. Fomin, Prentice Hall. Inc.,1963.
2. Integral Equations and their applications, M. Rahman, WIT Press, Boston, 2007.

Course Outcomes -

CO No.	Upon completion of the course, the students will be able to	PSOs Addressed	Cognitive Level
CO 1	Understand the concept of maxima and minima of functionals.	1,2,4	Understanding
CO 2	Identify the problems using Strum Liouville problems and Lagrange's equations.	1,2	Applying
CO 3	Analyse the relation between differential and integral equations, convert it from one to another.	1,4,5	Analyzing
CO 4	Explain the difference between Fredholm equations and Volterra equations.	1	Evaluating
CO 5	Discuss the Fredholm theory concept and evaluate the problems.	1,3,4	Creating

Relationship Matrix

Semester	Course Code	Title of the Course					Hours	Credits		
II	21PEMA21A	Calculus of Variations and Integral Equations					60	3		
Course Outcomes (COS)	Programme Learning Outcomes (PLOs)					Programme Specific Outcomes (PSOs)				
	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO – 1	✓	✓	✓	✓		✓	✓		✓	
CO – 2	✓	✓	✓	✓		✓	✓			
CO – 3	✓	✓	✓	✓	✓	✓			✓	✓
CO – 4	✓	✓				✓				
CO – 5	✓	✓	✓	✓	✓	✓		✓	✓	
	Number of Matches(✓) = 32 Relationship = Medium									

Semester – II

Course Title	**Java Programming**
Total Hrs	**60**
Hrs/Week	**4**
Sub. Code	**21PEMA21B**
Course Type	**DSE-II-B**
Credits	**4**
Marks	**100**

General Objective:

To apply Java programming to solve simple problems in scientific fields, including mathematics, statistics and economics.

Course Objectives:

CO No.	The learners will be able to
CO 1	Gain knowledge about basic Java language syntax and semantics to write Java programs.
CO 2	Understand the fundamentals of object-oriented programming in Java, including defining classes, objects, invoking methods etc and exception handling mechanisms.
CO 3	Understand the principles of inheritance, packages and interfaces.
CO 4	Secure the flow of a program by Exception handling.
CO 5	Know the basic concepts of applet architecture.

UNIT I

An Overview of Java Language: Object oriented programming–A first simple program–A second short program–Two control statements–Using blocks of code – Lexical issues–The java class libraries.

UNIT II

Data types, variables & Arrays: The primitive types – Integers – Floating –point types – Characters – Booleans – A closer look at Literals – Variables – Type conversion and casting – Arrays.

UNIT III

Control statements: Java's selection statements – Iteration statements –Jump statements. Introducing Classes: Class fundamentals – Declaring objects –Assigning object Reference Variables – Introducing methods – Constructors–The this keyword –Garbage collection–The finalize ( ) method.

UNIT IV

Inheritance: Inheritance Basics – using super –creating a multi-level hierarchy – when constructors are called – method overriding –The object class. Packages and Interfaces: Packages - Access protection – importing packages–Interfaces.

UNIT V

Exception handling: Exception handling fundamentals – Exception types –Uncaught Exceptions– Using try and catch-Multiple catch clauses– Nested try statements – throw –

throws – finally. The Applet class: Two types of Applets – Applet basics – Applet architecture.

Textbook:

Herbert Schildt- JAVA–2, The Complete reference (7th edition), Tata McGraw Hill 2001.

Unit I: Chapter 2 (full)

Unit II: Chapter3 (2 to 9, 11)

Unit III: Chapter 5 (full)

Unit IV: Chapter 6 (1 to 8), Chapter 8(1-5)

Unit V: Chapter 9(1 -5) 21 (1-3)

Reference Book:

Harry H Chaudhary-- Introduction to Java programming, Second Edition. OD Publishing, LLC, USA, Second Edition

Course Outcomes

CO No.	Upon completion of the course, the students will be able to	PSOs Addressed	Cognitive Level
CO-1	Understand the Java features in program structure.	1, 2 ,4	Understanding
CO-2	Build the concept of array and multi-dimensional array.	2, 4, 5	Applying
CO-3	Simplify the fundamentals of object-oriented programming in Java, including defining classes, objects, invoking methods and exception handling mechanisms.	2,4, 5	Analyzing
CO-4	Analyze the concepts of packages and interfaces.	3, 4, 5	Analyzing
CO-5	Explain the error handling techniques using exception handling.	2, 4, 5	Creating

Relationship Matrix

Semester	Course Code		Title of the Course			Hours			Credits	
II	21PEMA21B		Java Programming			60			3	
Course Outcomes (COs)	Programme Learning Outcomes (PLOs)					Programme Specific Outcomes (PSOs)				
	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO-1	✓	✓	✓	✓		✓	✓		✓	
CO-2	✓	✓	✓	✓	✓		✓		✓	✓
CO-3	✓	✓	✓	✓	✓		✓		✓	✓
CO-4	✓	✓	✓	✓	✓			✓	✓	✓
CO-5	✓	✓	✓	✓	✓		✓		✓	✓
	Number of matches (✓) = 39 Relationship = High									

Semeter - II

Course Title	**Combinatorics**
Total Hrs.	**60**
Hrs./Week	**4**
Sub.Code	**21PEMA21C**
Course Type	**DSE-II-C**
Credits	**3**
Marks	**100**

General Objective:

To comprehend the theory of various types of distinct objects and generating functions

Course Objectives:

CO	The learners will be able to
CO-1	Recall the permutations and combinations theory
CO-2	Discuss the distribution of distinct objects into non distinct cells
CO-3	Understand the recurrence relation application in Tower of Hanoi problem
CO-4	Realize the number of arrangements of N objects by the Principle of inclusion and exclusion
CO-5	Apply the Polya's Theory to solve the puzzles problem

UNIT I

Permutations and combinations - distributions of distinct objects ~ distributions of non distinct objects - Stirlings formula.

UNIT II

Generating functions. - generating function for combinations - enumerators for permutations - distributions of distinct objects into non-distinct cells - partitions of integers – the Ferrer's graphs - elementary relations.

UNIT III

Recurrence relation - linear recurrence relations with constant coefficients solutions by the technique of generating functions - a special class of nonlinear difference equations - recurrence relations with two indices.

UNIT IV

The principle of inclusion and exclusion - general formula - permutations with restriction on relative positions - derangements - the rook polynomials - permutations with forbidden positions.

UNIT V

Polya's theory of counting - equivalence classes under a permutation group Burnside theorem - equivalence classes of functions - weights and inventories of functions - Polya' s fundamental theorem – generation of Polya's theorem.

Textbooks:

Introduction of Combinatorial Mathematics, C.L. Liu, McGraw Hill,1968.

Unit I: Chapter 1

Unit II: Chapter 2

Unit III: Chapter 3

Unit IV: Chapter 4

Unit V: Chapter 5

Reference Books:

1. Combinatorial Theory, Marshall Hall Jr.,John Wiley & Sons, second edition.

2. Combinatorial Mathematics, H.J. Rayser, Carus Mathematical Monograph,No.14.

Course Outcomes

CO	Upon completion of the course, the students will be able to	PSOs Addressed	Cognitive Level
CO-1	Understand the derivation of Stirling formula	1,2	Understanding
CO-2	Analyse the Ferrers Graphs construction from the partition of integers	1,2,3	Analysing
CO-3	Apply recurrence relation to calculate the determinant of a matrix	1,2,4	Understanding, Applying
CO-4	Apply the principle of inclusion and exclusion to solve the puzzles	1,3,5	Understanding, Applying
CO-5	Analyse the Generalization of Polyas theory	1,2,3	Understanding, Analysising

Relationship Matrix

Semester	Course Code		Title of the Course			Hours			Credits	
II	21PEMA21C		Combinatorics			60			3	
Course outcome so	Programme Learning Outcomes (PLOs)					Programme Specific Outcomes (PSOs)				
	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO-1	✓	✓	✓			✓	✓			
CO-2	✓	✓	✓	✓	✓	✓	✓	✓		
CO-3	✓	✓	✓	✓		✓	✓		✓	
CO-4	✓	✓	✓		✓	✓		✓		✓
CO-5	✓	✓	✓			✓	✓			
	Number of matches (✓) = 32 Relationship = Medium									

Semester – II

Course Title	**LaTeX Practical**
Total Hrs.	**60**
Hrs./Week	**4**
Sub.Code	**21PCMA2P1**
Course Type	**Practical-II**
Credits	**4**
Marks	**100/2**

General Objective:

To produce high quality scientific documents such as articles, books, technical reports, thesis, etc. by using LaTeX software.

Course Objectives:

CO No.	The learners will be able to
CO 1	Understand the basic concepts of Typesetting in LaTeX.
CO 2	Improve their skills in LaTeX through various packages.
CO 3	Analyze the concepts of floating tables.
CO 4	Compose a LaTeX program using picture environment.
CO 5	Create various art designs using LaTeX Programs.

1. Write a LaTeX coding for Basic Mathematical Equation.
2. Write a LaTeX coding for Mathematical Equation with Mathematics Formulae.
3. Write a LaTeX coding for Mathematical Equation with Delimiters.
4. Write a LaTeX coding for Chess Board.
5. Write a LaTeX coding for Rangoli.
6. Write a LaTeX coding for Lotus.
7. Write a LaTeX coding for Natural Scene with Home.
8. Write a LaTeX coding for Tamil letters.
9. Write a LaTeX coding for your name in Colour & Tamil letters.
10. Write a LaTeX coding for Different types of Graphs in Graph Theory
11. Write a LaTeX coding for Time Table.
12. Write a LaTeX coding for Class Schedule Time Table.
13. Write a LaTeX coding for Draw different types of Boxes.
14. Write a LaTeX coding for preparing a paper in Journal.
15. Write a LaTeX coding for Beamer presentation with lists.

Course Outcomes

CO No.	Upon completion of the course, the students will be able to	PSOs Addressed	Cognitive Level
CO-1	Understand the basic structures of an article.	1,2,4,5	Understanding
CO-2	Apply their skills to class files of some journals.	1,3,4,5	Applying
CO-3	Analyze the page styles using the text in boxes.	1,4	Analyzing
CO-4	Explain the concepts to write documents containing mathematical formulas.	1,4,5	Evaluating
CO-5	Discuss the concepts as how to draw graphs.	1,4,5	Creating

Relationship Matrix

Semester	Course Code		Title of the Course			Hours				Credits
II	21PCMA2P1		LaTeX Practical			60				4
Course Outcomes (COs)	Programme Learning Outcomes (PLOs)					Programme Specific Outcomes (PSOs)				
	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO-1	✓	✓	✓	✓	✓	✓	✓		✓	✓
CO-2	✓	✓	✓	✓	✓	✓		✓	✓	✓
CO-3	✓	✓	✓	✓		✓			✓	
CO-4	✓	✓	✓	✓	✓	✓			✓	✓
CO-5	✓	✓	✓	✓	✓	✓			✓	✓
	Number of matches (✓) = 40 Relationship = High									

Semester – II

Course Title	**SWAYAM-NPTEL ONLINE CERTIFICATION COURSE**
Total Hrs.	**30**
Hrs./Week	**2**
Sub.Code	**21PSMA21**
Course Type	**SEC**
Credits	**2**
Marks	**100/2**

SWAYAM-NPTEL ONLINE CERTIFICATION COURSES

GUIDELINES AND INSTRUCTIONS

1. National Programme on Technology Enhanced Learning (NPTEL) provides e-learning through online web and video courses in Engineering, Science and Humanities streams through its portal https://swayam.gov.in/ncdetails/NPTEL.
2. Enrollment to all the courses is FREE.
3. Enrollment to courses and Examination Registration can be done ONLINE only. The link is available on NPTEL Website http://nptel.ac.in/
4. SWAYAM– NPTEL Online Certification Courses are mandated for the students in the PG Programmes from the Academic year 2021-2022.
5. Candidates must have completed Examination Registration successfully within the prescribed time to receive hall tickets and to write examinations.
6. Any Eight – Week, Two-Credit Course in any discipline to offer for two hours a week be chosen by the respective Departments in the second semester of the Postgraduate Programmes.
7. The SWAYAM–NPTEL Online Certification Courses offered during the December – April Semester be chosen by the Departments. The courses may be handled by the Department Mentor or by any teacher in the respective Departments.
8. The allocation of marks for the online examination conducted by the respective IITs is 25:75 for each course.

9. A candidate should obtain a minimum of 40 marks on 100 marks (a minimum of 10 marks for Assignment and 30 marks in the final examination) to pass the Online Courses.
10. If a student fails in the Online Examination conducted by the respective IITs he/she would be permitted to write a Supplementary Examination for 75 marks by the Controller of Examinations of our College.
11. Those who registered for the Online Courses, obtained Assignment marks, appeared for the Online Examination and failed in the courses alone are eligible to apply for the Supplementary Examinations conducted by the College.
12. If a candidate fails in the Supplemenary Examinations conducted by the College, the norms followed for taking an Arrear Examination will be adopted.
13. A provision is given to candidates to reappear for Supplementary/Arrear Examinations in the same semester to facilitate them to receive their Degrees.
14. The Question paper in Multiple Choice Question Pattern for 75 marks shall be framed by the respective faculty/ by an External Examiner for conducting the Supplementary Examinations.
15. The Supplementary Examinations would be conducted for three hours.
16. Course Completion Certificate will not be issued by the respective IITs for the candidates who clear the Online Courses through the Supplementary Examinations conducted by the College. The two credits the candidate earns, if passed, would be added in the Consolidated Statement of Marks issued by the Controller of Examinations.

Semester – III

Course Title	**Linear Algebra**
Total Hrs.	**75**
Hrs./Week	**5**
Sub.Code	**21PCMA31**
Course Type	**DSC-IX**
Credits	**4**
Marks	**100**

General Objective:

To prove elementary facts concerning eigen values and eigen vectors, also identify and solve the problems using linear transformations.

Course Objectives:

CO No.	The learners will be able to
CO-1	Relate the column space of matrix transformation with three possibilities of system Ax=b having unique solution, infinitely many solution and No solution
CO-2	Find the kernel, range, rank and nullity of a Linear Transformation
CO-3	Analyze the linear functions defined on a finite dimensional vector space.
CO-4	Find the relation between characteristic polynomial and Annihilating polynomial.
CO-5	Determine the matrix which is diagonalizable, Triangulizable.

UNIT I

Linear Equations: Fields- systems of Linear Equations- Matrices and Elementary Row Operations – Row reduced Echelon Matrices – Matrix multiplication – Invertible Matrices. **Vector Spaces:** Vector Spaces – Subspaces-Bases and Dimension.

UNIT II

Linear Transformations: Linear Transformation – The Algebra of Linear Transformations- Isomorphism –Representation of Transformations by Matrices.

UNIT III

Linear Transformations: Linear functional – The double dual – The transpose of Linear Transformation. **Determinants:** Commutative Rings – Determinant functions –Permutations and Uniqueness of Determinants.

UNIT IV

Determinants: Additional Properties of Determinants. **Elementary Canonical Forms:** Introductions – Characteristic Values – Annihilating Polynomials- Invariant Subspaces.

UNIT V

Elementary Canonical Forms : Simultaneous Triangulations ; Simultaneous Diagonalizations – Direst Sum Decomposition – Invariant Direct sums.

Textbook:

Kenneth Hoffman and Ray Kunze – Linear Algebra Second Edition Prentice-Hall, Inc., Englewood Cliffs, New Jersey.

UNIT I: Chapter 1 (Section 1.1 to 1.6) and Chapter 2 (Section 2.1 to 2.3)

UNIT II: Chapter 3 (Section 3.1 to 3.4)

UNIT III: Chapter 3 (Section 3.5 to 3.7) and Chapter 5 (Section 5.1 to 5.3)
UNIT IV: Chapter 5 (Section 5.4) and Chapter 6 (Section 6.1 to 6.4)
UNIT V: Chapter 5 (Section 6.5 – 6.7)

Reference Book

I.N. Herstein - Topics in Algebra (Second Edition) - Wiley India (P.)Ltd, New Delhi.

Course Outcomes

CO No.	Upon completion of the course, the students will be able to	PSOs Addressed	Cognitive Level
CO 1	Understand the basic techniques for solving the system of linear equations and properties of vector spaces.	1,2,5	Understanding
CO 2	Experiment with the matrix associated with the linear transformation.	1,2,5	Applying
CO 3	Analyze the formation of the determinant function.	1,3,4,5	Analyzing
CO 4	Evaluate the nature of the characteristic roots for the justification of the diagonalizable operator.	1,3,4,5	Evaluating
CO 5	Discuss the vector space decomposition of the operator by minimal polynomial.	1,3,4,5	Creating

Relationship Matrix

Semester	Course Code		Title of the Course			Hours			Credits	
III	21PCMA31		Linear Algebra			75			4	
Course Outcomes (COs)	Programme Learning Outcomes (PLOs)					Programme Specific Outcomes (PSOs)				
	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO-1	✓	✓	✓	✓	✓	✓	✓			✓
CO-2	✓	✓	✓	✓	✓	✓	✓			✓
CO-3	✓	✓	✓	✓	✓	✓		✓	✓	✓
CO-4	✓	✓	✓	✓	✓	✓		✓	✓	✓
CO-5	✓	✓	✓	✓	✓	✓		✓	✓	✓
	Number of matches (✓) = 43 Relationship = High									

Semester – III

Course Title	**Measure Theory and Integration**
Total Hrs.	**75**
Hrs./Week	**5**
Sub.Code	**21PCMA32**
Course Type	**DSC-X**
Credits	**4**
Marks	**100**

General Objective:

To understand the concept of an Outer Measure of a set and its properties to realize the Riemann Integral's Extension

Course Objectives:

CO No.	The learners will be able to
CO-1	Introduce the new concepts of Lebesgue Measure
CO-2	Develop the Lebesgue integrable from Riemann Integral
CO-3	Understand the characterization of Measurable functions
CO-4	Discuss about the measure on arbitrary spaces.
CO-5	Realize the importance of Outer measurability in Extended space.

Unit – I

Lebesgue Measure: Introduction - Outer Measure – Measurable Sets and Lebesgue Measure–A non Measurable set.

Unit – II

Measurable Functions - LittleWood's three principles. TheLebesgue Integral: Riemann Integral – The Lebesgue Integral of a bounded function over a set of finite measure.

Unit – III

The Integral of a non negative function - The general LebesgueIntegral. Differentiation and Integration: Differentiation of monotone functions.

Unit – IV

Functions of bounded variation - Differentiation of an integral – Absolute continuity. Measure and Integration: Measure Spaces- Measurable functions.

Unit – V

Integration - General convergence Theorems - Signed Measures – TheRadon Nikodym Theorem. Measure and Outer Measure: OuterMeasure and Measurability – The Extension Theorem.

Textbook:

H.L.Royden – Real Analysis, Dorling Kindersley (India) Pvt. Ltd - Third Edition, Pearson Education.

Unit I: Chapter 3 (Section 1 to 4)
Unit II: Chapter 3(Section 5,6) and Chapter 4(Section 1,2)
Unit III: Chapter 4 (Section 3,4) and Chapter 5(Section 1)
Unit IV: Chapter 5 (Section 2 to 4) and Chapter 11(Section 1,2)
Unit V: Chapter 11 (Section 3 to 6) and Chapter 12(Section 1,2)

Reference Book:

Debarra G, Measure Theory and integration, New Age International Publishers (Second Edition) New Delhi.

Course Outcomes

CO No.	Upon completion of the course, the students will be able to	PSOs Addressed	Cognitive Level
CO-1	Define the theory of Outer measure associated with real line.	1,2	Remembering
CO-2	Demonstrate the Riemann Integral Theory to learn about Lebesgue Integral.	1,2,4	Understanding
CO-3	Experiment with the properties of Absoulte Continuity with the different types of functions such as Integrable and Measurable functions.	1,2,4	Applying
CO-4	Analyze the measure of arbitrary space.	1,3	Analyzing
CO-5	Assess the Radon Nikodym Theorem to learn the properties of Outer measure of Arbitrary space.	1,2,3,5	Evaluating

Relationship Matrix

Semester	Course Code	Title of the Course	Hours	Credits
III	21PCMA32	Measure Theory and Integration	75	4

Course Outcomes (COs)	Programme Learning Outcomes (PLOs)					Programme Specific Outcomes (PSOs)				
	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO-1	✓	✓	✓	✓		✓	✓			
CO-2	✓	✓	✓	✓		✓	✓		✓	
CO-3	✓	✓	✓	✓		✓	✓		✓	
CO-4	✓	✓	✓	✓	✓	✓		✓		
CO-5	✓	✓	✓	✓	✓	✓	✓	✓		✓
	Number of matches (✓) = 36 Relationship = High									

Semester – III

Course Title	**Research Methodology**
Total Hrs.	**75**
Hrs./Week	**5**
Sub.Code	**21PCMA33**
Course Type	**DSC-XI**
Credits	**4**
Marks	**100**

General Objective:

To expand the learner's knowledge in basic method of research and build his credibility for good foundations.

Course Objectives :

CO No.	The learners will be able to
CO 1	Understand the process of research and its significance.
CO 2	Realize the important concepts relating to research design.
CO 3	Compare the different phases of teaching methods.
CO 4	Formulate the ways for effective presentation by using ICT tools.
CO 5	Discuss the importance of cognitive and physical development.

Unit – I

General introduction to research methodology: Meaning and objective of scientific research – Motivation of Research -Types and significance of research, Methods of scientific research, Research process and criteria for good research, Stages of research.

Unit – II

Defining the Research Problem:Selecting the problem – Necessity of Defining the Problem – Technique Involved in Defining a Problem – An Illustration. Research Design: Meaning of Research Design – Need for Research Design – Features of Good Design – Important Concepts Relating to Research Design – Basic Principles of Experimental Designs.

Unit – III

Objectives of Teaching - Phases of Teaching - Methodology of Teaching**:** Lecture method – Discussion method – Inquiry method – Discovery method - Problem Solving method, Project method of teaching, Seminar method.

Unit IV

Integrating ICT in Teaching: Instruction system - Individual instruction - Ways for Effective presentation with power point –Evaluation – Need, Importance and Characteristics: Principles of evaluation – Approaches to evaluation -Continuous and Comprehensive Evaluation.

Unit V

Later Adolescent Psychology: Physical development during adolescence – Cognitive development during adolescence – Emotional development during adolescence – Social development. Teaching Late Adolescents: Characteristics of late adolescents – Problems of adolescents – Teaching Strategies for late adolescents – Important tips for teaching late adolescents.

Textbooks:

1. C.R. Kothari, Research Methodology – Methods and Techniques, Second revised Edition, New Age International Publishers, 2004.
2. Study material for the course of Research and Teaching Methodology.(Reference from R.B 1, 2, 3)

Unit I: TB 1- Chapter 1Full
Unit II: TB 1- Chapter 2 & 3
Unit III: TB 2 –Chapter 5 (5.1 – 5.3)
Unit IV: TB 2 - Chapter 5 (5.4 ,5.5)
Unit V: TB 2 - Chapter 5 (5.6 ,5.7 (5.7.1 – 5.7.4))

Reference Books:

1. Sampath K., Pannerselvam A & Santhanam S (1984), Introduction to Educational Technology, New Delhi: Sterling Publishers.
2. Sharma S R (2003), Effective classroom teaching modern methods, tools & techniques. Jaipur: Mangal Deep.
3. Vedanayam, E.G. (1989) Teaching Technology for College Teachers New York: Sterling Publishers.
4. G. M. - Teaching Methodology, Independently Published, 2018.
5. J. C. Aggarwal – Principles, Methods & Techniques of Teaching, Vikas Publishing House, 2nd Revised Edition.

Course Outcomes

CO No.	Upon completion of the course, the students will be able to	PSOs Addressed	Cognitive Level
CO 1	Understand the components of research articles.	3,5	Understanding
CO 2	Choose between the physical and cognitive development during adolescence.	3,4,5	Applying
CO 3	Analyse the different method of teaching to perform the effective way.	3,5	Analyzing
CO 4	Evaluate the teaching and learning process.	2,3,5	Evaluating
CO5	Elaborate upon the research articles.	1,3,5	Creating

Relationship Matrix

Semester	Course Code		Title of the Course					Hours		Credits
III	21PCMA33		Research Methodology					75		4
Course Outcomes (COs)	Programme Learning Outcomes (PLOs)					Programme Specific Outcomes (PSOs)				
	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PSO1	PSO 2	PSO 3	PSO 4	PSO 5
CO-1	✓	✓	✓	✓	✓			✓		✓
CO-2	✓	✓	✓	✓	✓			✓	✓	✓
CO-3	✓	✓	✓	✓	✓			✓		✓
CO-4	✓	✓	✓	✓	✓		✓	✓		✓
CO-5	✓	✓	✓	✓	✓	✓		✓		✓
	Number of matches (✓) = 38 Relationship = High									

Semester III

Course Title	**Optimization Technique**
Total Hrs	**60**
Hrs / Week	**4**
Sub. Code	**21PCMA34**
Course Type	**DSC-XII**
Credits	**4**
Marks	**100**

General Objective:

Operation research model is an idealized representation of the real-life situation and represents one or more aspects of reality and also, identify the situation and make good decision in real life. Queueing models are used for minimizing the waiting time and idle time together with the costs associated herewith.

Course Objectives:

CO No.	The learners will be able to
CO 1	Understand the simplex method to solve the LPP in TORA
CO 2	Familiarize the concept of Integer Programming problems.
CO 3	Make good decision in day to day life.
CO 4	Identify the shortest distance and evaluating projects using CPM and PERT.
CO 5	Understand the strength and weakness of Queueing models.

UNIT I

The Simplex Method: LP Solution space in Equation form – Simplex Iterations withTORA – Artificial starting solution. Simplex Method Application – Degeneracy.

UNIT II

Integer Programming: Introduction – Pure and Mixed Integer Programming Problems – Gomory's All I.P.P Method – Construction of Gomory's constraints – Fractional Cut Method – All Integer LPP.

UNIT III

Decision Analysis: Introduction - Decision making Problem - Decision making Process - Decision making Environment - Decision making under uncertainty - Decision making under risk.

UNIT IV

Network Scheduling by PERT / CPM: Introduction – Network: Basic Components – Logical Sequencing – Rules of Network Construction – Concurrent Activities – Critical Path Analysis – Probability Construction in PERT.

UNITV

Queuing theory: Elements of Queuing Model – Role of Exponential distribution -single and Multi Server Models.

Theory: Problem = 60: 40

Textbooks:

1. **Kanti Swarup, P.K. Gupta and Man Mohan**, Operation Research, Eleventh Edition,Sultan Chand & Sons, New Delhi.

2. HAMDY A. TAHA, Operations Research An Introduction, 7th Edition, MacMillanPublishing Company, New York.

UNIT I: TB - 2: Chapter 2 (2.2, 2.3)
UNIT II: TB - 1Chapter 7 (7.1 - 7.5)
UNIT III: TB - 1 Chapter 16 (16.1 – 16.6)
UNIT VI: TB - 1Chapter 25 (25.1 – 25.7)
UNIT V: TB - 2 Chapter 17 (17.2, 17.3, 17.6.1- 17.6.5)

Reference Book:

Prem Kumar Gupta, D S Hira, Operations Research – S Chand and Company Limited

Course Outcomes

CO No.	Upon completion of the course, the students will be able to	PSOs Addressed	Cognitive Level
CO 1	Understand the simplex method to solve the LPP in TORA	1,2,4	Understanding
CO 2	Identify the problems and find out the best optimal solution using Gomory's All I.P.P Method.	1,2,4	Applying
CO 3	Take part in critical thinking in the decision process.	1,2,4,5	Analyzing
CO 4	Calculate the simple models of CPM.	1,2	Evaluating
CO 5	Discuss the problems in Queuing theory for the Research field.	2,3,5	Creating

Relationship Matrix

Semester	Course Code	Title of the Course				Hours		Credits		
III	21PCMA34	Optimization Technique				60		4		
Course Outcomes (COS)	Programme Learning Outcomes (PLOs)					Programme Specific Outcomes (PSOs)				
	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO – 1	✓	✓	✓	✓		✓	✓		✓	
CO – 2	✓	✓	✓	✓		✓	✓		✓	
CO – 3	✓	✓	✓	✓		✓	✓		✓	✓
CO – 4	✓	✓	✓	✓		✓	✓			
CO – 5	✓	✓	✓	✓	✓		✓	✓		✓
	Number of Matches(✓) = 36 Relationship = High									

Semester – III

Course Title	Mathematical Statistics
Total Hrs	60
Hrs/Week	4
Sub. Code	21PEMA31A
Course Type	DSC-III-A
Credits	3
Marks	100

General Objective:

Demonstrate knowledge of probability, fixed sample and large sample statistical properties and the standard statistical distributions.

Course Objectives:

CO No.	The learners will be able to
CO 1	Understand the concept of stochastic processes model of a system.
CO 2	Know about the parameters and statistics in distribution.
CO 3	Optimize analytical measurement problem in sampling theory.
CO 4	Estimate the location and scale parameters of a distribution in order statistics.
CO 5	Evaluate the distribution of random variables in a limiting distribution.

UNIT I

Conditional Probability and Stochastic Independence: Conditional Probability –Marginal and Conditional distributions – The correlation coefficient – Stochastic Independence.

UNIT II

Some Special Distributions: The Binomial, The Poisson distribution - The Gamma distribution & chi-square distribution –The normal distribution –The Bivariate distribution.

UNIT III

Distributions of functions of Random variables: Sampling Theory –Transformation of variables of the discrete type – Transformation of variables of the continuous type-The t and F distribution.

UNIT IV

Extensions of the Change of variable Technique – Distribution of order statistics –The moment generating function technique – Distributions of and nS^2/σ^2 and $\overline{X}$.

UNIT V

Limiting Distributions: Limiting Distributions – Stochastic convergence – Limiting moment generating functions – The central limit theorem – Some theorems on Limiting Distributions.

Textbook:

Robert V. Hogg and Allen T. Craig – Introduction to Mathematical Statistics **-** Pearson Education Asia, Chapters2, 3, 4 and 5.

Unit I: Chapter2 (Section 2.1to2.3)

Unit II: Chapter 3(Section 3.1, 3.2, 3.3, 3.4)

Unit III: Chapter4 (Section 4.1to 4.4)

Unit IV: Chapter 4(Section 4.5 to 4.8)

Unit V: Chapter5 (Section5.1 to 5.5)

Reference Books:

1. **Lee. J. Bain, Max Engel-Hardt–** Introduction to probability and Mathematical Statistics. Duxbury Learning, Second Edition
2. **Richard J Larsen, Morris L. Marx-** Introduction to Mathematical statistics and its Applications, fifth Edition, Prentice Hall.

Course Outcomes

CO No.	Upon completion of the course, the students will be able to	PSOs Addressed	Cognitive Level
CO 1	Remember the concept of conditional probability to estimate the number of possible outcomes with different conditions	1, 2, 4	Remembering
CO 2	Understandthe basic distribution theory to learn about special distributions.	1, 2	Understanding
CO 3	Analyse the change in transformations of variables in discrete and continuous type.	2, 4	Analyzing
CO 4	Evaluate the distributions of $\overline{X}$ and $\frac{nS^2}{\sigma^2}$ by applying moment generating function technique.	3, 4, 5	Evaluating
CO 5	Discuss the concept of central limit theorem to find the value of the probability.	3, 5	Creating

Relationship Matrix

Semester	Course Code		Title of the Course			Hours			Credits	
III	21PEMA31A		Mathematical Statistics			60			4	
Course Outcomes (COs)	Programme Learning Outcomes (PLOs)					Programme Specific Outcomes (PSOs)				
	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO-1	✓	✓	✓	✓		✓	✓		✓	
CO-2	✓	✓	✓	✓		✓	✓			
CO-3	✓	✓	✓	✓			✓		✓	
CO-4	✓	✓	✓	✓	✓			✓	✓	✓
CO-5	✓	✓	✓	✓	✓			✓		✓
	Number of matches (✓) = 34 Relationship = High									

Semester – III

Course Title	**Analytical Number Theory**
Total Hrs	**60**
Hrs/Week	**4**
Sub. Code	**21PEMA31B**
Course Type	**DSE-III-B**
Credits	**3**
Marks	**100**

General Objective:

Understand the concept of number theory using analytical tools besides enhancing the focus on studying distribution of prime numbers.

Course Objectives:

CO No.	The learners will be able to
CO 1	Understand the arithmetic functions and their utility in analytic theory of numbers.
CO 2	Remember the concept of Fundamental Theorem of Arithmetic.
CO 3	Analyse the existence of primes by Dirichlet's multiplication.
CO 4	Evaluate the average order of $\mu(n)$ and $\lambda(n)$
CO 5	Understand the concept of some Elementary theorems on the distribution of primes.

UNIT I

The Fundamental Theorem of Arithmetic: Introduction – Divisibility - Greatest Common Divisor – Prime Numbers –Fundamental Theorem of Arithmetic.

UNIT II

The Fundamental Theorem of Arithmetic: The Euclidean Algorithm – The greatest common divisor of more than two numbers. Arithmetical Function and Dirichlet multiplication: Introduction – The Mobius Function μ(n) – The Euler Totient Function φ(n).

UNIT III

Arithmetical Function and Dirichlet multiplication: Multiplicative functions – Multiplicative functions and Dirichlet multiplication –The inverse of a completely multiplicative functions – Liouville's function λ(n) .

UNIT IV

Averages of Arithmetical Functions: The average order of d(n)–The average order of the divisor functions σα(n) –The average order of φ(n) –An application to the distribution of lattice points visible from origin –The average order of μ(n) and of ʌ(n).

UNIT V

Some Elementary Theorems on the distribution of Prime Numbers: Introduction– Chebyshev's function ψ (n) and υ (n) – Relations connecting υ(x) and π(x)

Textbook:

Tom M. Apostol – Introduction to Analytical Number Theory.

Unit I: Chapter 1 Section :(1.1-1.5).
Unit II: Chapter 1 Section: (1.7 & 1.8) and Chapter 2 Section: (2.1-2.3)
Unit III: Chapter 2 Section: (2.9– 2.12)
Unit IV: Chapter 3 Section :(3.5 -3.9)
Unit V: Chapter 4 Section :(4.1 -4.3)

Reference Books:

1. W. A. Coppel –Number Theory: An Introduction to Mathematics, Springer Publication Second Edition,
2. William J. Levenque –Topics in Number Theory, Volume I and II, Reading Mass, Addison-Wesley Publication 1956

Course Outcomes

CO No.	Upon completion of the course, the students will be able to	PSOs Addressed	Cognitive Level
CO-1	Understand the fundamental theorem of Arithmetic to decompose the numbers.	1, 4	Understanding
CO-2	Apply Euler phi functions formula to find out the generators of a finite group.	2,3	Applying
CO-3	Examine the Big O notation to express bound on arithmetic functions.	2, 3	Analyzing
CO-4	Evaluate the distribution of lattice points visible from origin.	4, 5	Evaluating
CO-5	Elaborate upon the Chebyshev's function Ψ (n) and υ (n).	2, 4, 5	Creating

Relationship Matrix

Semester	Course Code	Title of the Course				Hours	Credits			
III	21PEMA31B	Analytical Number Theory				60	3			
Course Outcomes (COs)	Programme Learning Outcomes (PLOs)					Programme Specific Outcomes (PSOs)				
	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PSO1	PSO 2	PSO 3	PSO 4	PSO 5
CO-1	✓	✓	✓	✓		✓			✓	
CO-2	✓	✓	✓	✓	✓		✓	✓		
CO-3	✓	✓	✓	✓	✓		✓	✓		
CO-4	✓	✓	✓	✓	✓				✓	✓
CO-5	✓	✓	✓	✓	✓		✓		✓	✓
	Number of matches (✓) = 35 Relationship = High									

SEMESTER –III

Course Title	Fuzzy Set Theory
Total Hrs	60
Hrs/Week	4
Sub. Code	21PEMA31C
Course Type	DSE-III-C
Credits	3
Marks	100

General Objectives:

To teach the fundamental concepts in Fuzzy Set theory and develop problems solving skills on lattices of Fuzzy number, characteristics of fuzzy logic, fuzzy norms besides the proof technique.

Course Objectives:

CO	The learners will be able to
CO-1	Understand the basic concepts of fuzzy sets.
CO-2	Apply their knowledge to grasp the relations between fuzzy sets and crisp sets in application.
CO-3	Categorize the logical disjunction in fuzzy logic and union of fuzzy sets by t-conorms.
CO-4	Acquire the knowledge in Fuzzy Arithmetic.
CO-5	Evaluate different methods for construction of fuzzy sets.

Unit I: Fuzzy sets:

Fuzzy sets-Basic types-Basic concepts-Characteristics-Significance of the paradigm shift-Additional properties of α-cuts.

Unit II: Fuzzy Sets versus CRISP Sets:

Representation of Fuzzy sets- Extension principle of Fuzzy sets- Operation on Fuzzy sets- Types of Operation- Fuzzy complements.

Unit III: Operations on Fuzzy Sets:

Fuzzy intersection- t norms, Fuzzy unions- t Conorms- Combinations of Operations-Aggregation operations.

Unit IV: Fuzzy Arithmetic:

Fuzzy numbers- Linguistic variables- Arithmetic operation on intervals-Lattice of Fuzzy numbers.

Unit V: Constructing Fuzzy sets:

Methods of Construction: An overview – Direct methods with one expert-Direct method with multiple experts-Indirect methods with multiple experts and one expert-Construction from sample data.

Text Book:

G.J. Klir and Bo Yuan, Content and treatment as in the book Fuzzy set and Fuzzy logic: Theory and Applications, Prentice Hall of India Ltd, New Delhi, 2005.

Unit-I Chapter 1: Sections 1.3 to 1.5 and Chapter 2.1.
Unit II: Chapter2: Sections 2.2 to 2.3, Chapter 3: Sections 3.1, 3.2
Unit III: Chapter 3: Section 3.3 to 3.6
Unit IV: Chapter 4: Section 4.1 to 4.4
Unit V: Chapter 10: Section 10.1 to 10.7.

Reference Books:

1. H.J. Zimmermann , Fuzzy Set Theory and its Applications, Allied Publishers, Chennai,1996
2. V. Novak, Fuzzy Sets and their Applications, Adam Hilger, Bristol, 1969.

Course Outcomes:

CO	Upon completion of the course, the students will be able to	PSOs Addressed	Cognitive Level
CO-1	Understand the properties of α-cuts by fuzzy set theory.	1,5	Understanding
CO-2	Identify the difference between the crisp and fuzzy sets by using extension principle.	1,3.	Remembering
CO-3	Apply the concept of operation of fuzzy sets.	1,4,5	Applying
CO-4	Analyze the notion of lattices of Fuzzy numbers by fuzzy Arithmetic.	1,2,3.	Analyzing
CO-5	Evaluate the construction of Fuzzy sets by different methods.	1,2,5	Evaluating

Relationship Matrix

Semester	Course Code	Title of the Course	Hours	Credits
III	21PEMA31C	Fuzzy Set Theory	60	3

Course Outcomes (COs)	Programme Learning Outcomes (PLOs)					Programme Specific Outcomes (PSOs)				
	PLO1	PLO2	PLO3	PLO4	PLO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO-1	✓	✓	✓	✓	✓	✓				✓
CO-2	✓	✓	✓	✓	✓	✓		✓		
CO-3	✓			✓	✓	✓			✓	✓
CO-4	✓	✓	✓	✓		✓	✓	✓		
CO-5	✓		✓	✓		✓	✓			✓
	Number of matches = 33 Relationship = Medium									

Semester III

Course Title	**Optimization Technique in Java Programming Practical**
Total Hrs	**60**
Hrs / Week	**4**
Sub. Code	**21PCMA3P1**
Course Type	**Practical-III**
Credits	**2**
Marks	**100/2**

General Objective:

Acquire knowledge for read and write files in Java and to design applications with threads in Java and get clear idea about the extend Java class in Optimization Problems. Also, understand the concept how to write Java code in one platform and run it in another platform.

Course Objectives:

CO No.	The learners will be able to
CO 1	Understand the concept for problem solving in Mathematics.
CO 2	Formulate programs using Java programming standard class library.
CO 3	Evaluate the optimization problem using the concept of inheritance.
CO 4	Understand how to write, compile and execute the Java programs.
CO 5	Read and write data using Java streams.

1. Write a JAVA program using simple arithmetic calculation.
2. Write a JAVA program using one dimensional array.
3. Write a JAVA program using classes and objects.
4. Write a JAVA program for payroll using interface.
5. Write a JAVA program for matrix addition & multiplication.
6. Write a JAVA program to find NCR value using Recursion.
7. Write a JAVA program to find the volume of sphere & cone.
8. Write a JAVA program to solve the quadratic equation.
9. Write a JAVA program to find the factorial of a number.
10. Write a JAVA program to find the simple interest.
11. Write a JAVA program to display calendar details.
12. Write a JAVA program to find the area and perimeter of triangle, circle.
13. Write a JAVA program to draw lines, rectangles and ovals in Applet.
14. Write a JAVA program to implement smiley face using Applet.
15. Write a JAVA program to create animation using Applet.
16. Write a JAVA program to create a frame window in Applet.

Course Outcomes

CO No.	Upon completion of the course, the students will be able to	PSOs Addressed	Cognitive Level
CO – 1	Understand the construction of the Java programming language.	1,3,4	Understanding
CO – 2	Identify the knowledge to write, compile anddebug programs in Java programming.	1,2,4	Applying
CO – 3	Evaluate the problems using the knowledge of programming and operating system.	1,2,4	Analyzing
CO – 4	Evaluate the Java based software code of medium – to – high complexity level.	1,2,5	Evaluating
CO – 5	Elaborate upon the knowledge in Java programming and evaluate the program in simple way.	1,2	Creating

Relationship Matrix

Semester	Course Code	Title of the Course					Hours	Credits		
III	21PCMA3P1	Optimization Technique In Java Programming Practical					60	2		
Course Outcomes (COS)	Programme Learning Outcomes (PLOs)					Programme Specific Outcomes (PSOs)				
	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO – 1	✓	✓	✓	✓	✓	✓		✓	✓	
CO – 2	✓	✓	✓	✓		✓	✓		✓	
CO – 3	✓	✓	✓	✓		✓	✓		✓	
CO – 4	✓	✓	✓	✓	✓	✓	✓			✓
CO – 5	✓	✓	✓	✓		✓	✓			
	Number of Matches(✓) = 36 Relationship = High									

Semester – III

Course Title	**Discrete Structure II**
Total Hrs.	**30**
Hrs./Week	**2**
Sub.Code	**21PIMA21**
Course Type	**IDC-II**
Credits	**2**
Marks	**100/2**

General Objective:

To solve the counting problems by using counting principles and to understand the fundamental concept of probability.

Course Objectives:

CO No.	The learners will be able to
CO-1	Discuss the two basic counting principles and the pigeonhole principle.
CO-2	Understand the selection and arrangement of objects of a set of particular size.
CO-3	Explain the fundamental concepts of probability.
CO-4	Understand the Baye's theorem.
CO-5	Understand the Karnaugh maps for the sum-of-product expansion.

Unit I

Basics of Counting –Pigeonhole Principle.

Unit II

Permutations and Combinations - Inclusion and Exclusion Principle..

Unit III

Probability - Baye's Theorem .

Unit IV

Boolean Functions and its Representation.

Unit V

Simplifications of Boolean Functions.

Textbooks:

1. Kennath H Rosen, Discrete Mathematics & its Applications with Combinatorics and Graph Theory , Tata McGraw- Hill Publishing Company Limited, sixth Edition
2. S.Arumugam and A.Thangapandi Issac, Statistics, New Gamma Publishing House, 2015.

   Unit I: TB1 Chapter 5 (5.1,5.2)
   Unit II: TB1 Chapter 5 (5.3) and Chapter 6 (6.5)
   Unit III: TB2 Chapter 11
   Unit IV: TB1 Chapter 10 (10.1, 10.2)
   Unit V: TB1 Chapter 10 (10.4)

Reference Book:

Susanna S. Epp, Discrete Mathematics with Applications, Brooks/Cole, Fourth Edition, 2011.

Course Outcomes

CO No.	Upon completion of the course, the students will be able to	PSOs Addressed	Cognitive Level
CO1	Define the concept of pigeonhole principle.	1,2,3,4	Remembering
CO 2	Demonstrate the solution for problem related with permutation and combination.	1,2,4	Understanding
CO 3	Illustrate the varies example for Inclusion and Exclusion principle.	1,2,4	Applying
CO 4	Evaluate the solution for Baye's theorem.	1,2,5	Evaluating
CO 5	Discuss K-maps to simplify sum-of-products expansions.	1,2	Creating

Relationship Matrix

Semester	Course Code		Title of the Course			Hours				Credits
III	21PCMA41		Discrete Structure II			30				2
Course Outcomes (COs)	Programme Learning Outcomes (PLOs)					Programme Specific Outcomes (PSOs)				
	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO-1	✓	✓	✓	✓	✓	✓	✓	✓	✓	
CO-2	✓	✓	✓	✓		✓	✓		✓	
CO-3	✓	✓	✓	✓		✓	✓		✓	
CO-4	✓	✓	✓	✓	✓	✓	✓			✓
CO-5	✓	✓	✓	✓		✓	✓			
	Number of matches (✓) = 37 Relationship = High									

Semester – IV

Course Title	**Complex Analysis**
Total Hrs.	**75**
Hrs./Week	**5**
Sub.Code	**21PCMA41**
Course Type	**DSC-XIII**
Credits	**4**
Marks	**100**

General Objective:

To give the detailed information about analytic functions and evaluate the definite integral by using fundamental theorems.

Course Objectives:

CO No.	The learners will be able to
CO 1	Understand the basic properties of Analytic functions and radius of convergence of the series.
CO 2	Explain the geometrical properties of the curves and conformal mappings.
CO 3	Apply the Cauchy's theorem and Cauchy's integral formula for evaluating contour integral.
CO 4	Understand the general form of the Cauchy's theorem and identify the number of zeros and poles of the analytic function.
CO 5	Apply Cauchy's Residue theorem to evaluate the definite integral.

Unit – I

Complex Functions**:** Introduction to the Concept of Analytic Function - Elementary Theory of Power Series.

Unit – II

Conformality:Arcs and closed curves - Analytic functions in Regions-Conformal Mapping - Length and Area. Linear Transformations: The Linear Group - The cross ratio - Symmetry.

Unit – III

Fundamental Theorems:Line integrals – Rectifiable arcs – Line integrals as functions of arcs – Cauchy's Theorem for a Rectangle – Cauchy's Theorem in a disk. Cauchy's Integral Formula **:** The index of a point with respect to a closed curve – The integral formula – Higher derivatives .

Unit - IV

Local properties of Analytic Functions**:** Removable Singularities and Taylor's Theorem – Zeros and Poles - The Local Mapping–The maximum principle. The General forms of Cauchy's Theorems**:** Chains and cycles – simple connectivity –Homology – The general statement of Cauchy's Theorem.

Unit - V

Calculus of Residues **:** The residue Theorem – Argument Principle – Evaluation of definite integral.Harmonic functions**:** Definition and Basic properties – Mean value property – Poisson formula – Schwarz's Theorem.

Textbook:

Lars V. Ahlfors**,** Complex Analysis, McGraw- Hill International Company, Third Edition.

UNIT I: Chapter 2(1.1 to 1.4 and 2.1 to 2.5)

UNIT II: Chapter 3(2.1 to 2.4 and 3.1 to 3.3)

UNIT III: Chapter 4(1.1 to 1.5 and 2.1 to 2.3)

UNIT IV: Chapter 4(3.1 to 3.4 and 4.1 to 4.4)

UNIT V: Chapter4 (5.1 to 5.3 and 6.1 to 6.4).

Reference Book:

V. Karunakaran, Complex Analysis, Alpha Science International Ltd, Second Edition, 2005.

Course Outcomes

CO No.	Upon completion of the course, the students will be able to	PSOs Addressed	Cognitive Level
CO 1	Summarize properties of Analytic function and power series.	1,3,5	Remembering
CO 2	Discuss the cross ratio of the Linear Transformation.	1,5	Understanding
CO 3	Calculate a contour integral applying fundamental theorems of Cauchy's.	1,2,4,5	Applying
CO 4	Analyze the local properties of analytic functions such as removable singularity, essential singularity and Poles.	1,3,5	Analyzing
CO 5	Evaluate the definite integral of the meromorphic functions.	1,2,4,5	Evaluating

Relationship Matrix

Semester	Course Code	Title of the Course					Hours			Credits
IV	21PCMA41	Complex Analysis					75			4
Course Outcomes (COs)	Programme Learning Outcomes (PLOs)					Programme Specific Outcomes (PSOs)				
	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO-1	✓	✓	✓	✓	✓	✓		✓		✓
CO-2	✓	✓	✓	✓	✓	✓				✓
CO-3	✓	✓	✓	✓	✓	✓	✓		✓	✓
CO-4	✓	✓	✓	✓	✓	✓		✓		✓
CO-5	✓	✓	✓	✓	✓	✓	✓		✓	✓
	Number of matches (✓) = 41 Relationship = High									

Semester – IV

Course Title	**Functional Analysis**
Total Hrs.	**75**
Hrs./Week	**5**
Sub.Code	**21PCMA42**
Course Type	**DSC-XIV**
Credits	**4**
Marks	**100**

General Objective:

To give an in-depth knowledge about Banach Space, Hilbert Space, various types of operators and their eigen values.

Course Objectives:

CO No.	The learners will be able to
CO-1	Understand the Real and complex spaces for Banach space
CO-2	Analyze the concepts of open mapping theorem.
CO-3	Characterize Hilbert space in terms of Banach space
CO-4	Gain knowledge to study the properties of Adjoint operators
CO-5	Evaluate the spectrum corresponding to an operator.

Unit – I

Banach Spaces: The definition and some examples – Continuous linear transformation – The Hahn Banach Theorem.

Unit – II

The natural imbedding of N in N** - The open mapping theorem – The conjugate of an operator.

Unit – III

Hilbert Spaces: The definition and some simple properties - Orthogonal complements - Orthonormal sets - The Conjugate space H^* (without proof).

Unit – IV

The adjoint of an operator – Self adjoint operator - Normal and Unitary Operator – Projections.

Unit – V

Finite dimensional Spectral Theory: Matrices – Determinants and the spectrum of an operator – The spectral Theorem.

Textbook:

George F.Simmons– Introduction to Topology and Modern Analysis, TataMcGraw-Hill Publishing Company Ltd, New Delhi.

UNIT I: Chapter 9(Section 46 to 48)
UNIT II: Chapter 9(Section 49 to 51)
UNIT III: Chapter 10(Section 52 to 55)
UNIT IV: Chapter 10(Section 56 to 59)
UNIT V: Chapter 11(Section 60 to 62)

Reference Book:

Erwin Kreyszig, Introductory Functional Analysis with Applications, Wiley Classics Library Edition Published, Singapore, 1989.

Course Outcomes

CO No.	Upon completion of the course, the students will be able to	PSOs Addressed	Cognitive Level
CO-1	Understand the structure of Linear space with different norms.	1,2	Understanding
CO-2	Apply the knowledge of weak* topology on Normed linear space.	1,4	Remembering,
CO-3	Experiment with the orthonormal basis for the Hilbert Space.	1,2,4	Applying
CO-4	Analyze the different types of operator on linear space.	1,3,4	Analyzing
CO-5	Remember the properties of an operator to evaluate Eigen value.	1,2,5	Evaluating

Relationship Matrix

Semester	Course Code	Title of the Course	Hours	Credits
IV	21PCMA42	Functional Analysis	75	4

Course Outcomes (COs)	Programme Learning Outcomes (PLOs)					Programme Specific Outcomes (PSOs)				
	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO-1	✓	✓	✓	✓		✓	✓			
CO-2	✓	✓	✓	✓		✓			✓	
CO-3	✓	✓	✓	✓		✓	✓		✓	
CO-4	✓	✓	✓	✓	✓	✓		✓	✓	
CO-5	✓	✓	✓	✓	✓	✓	✓			✓
	Number of matches (✓) = 35 Relationship = High									

Semester IV

Course Title	**R – Programming**
Total Hrs	**60**
Hrs / Week	**4**
Sub. Code	**21PCMA43**
Course Type	**DSC-XV**
Credits	**4**
Marks	**100**

General Objective:

To create the R-studio, identify the console and scripts in an easiest way. Using the API, the learner can type his own R code and remember the R Syntax easily.

Course Objectives:

CO No.	The learners will be able to
CO 1	Understand the data types in R-Programming.
CO 2	Create, find and remove data in R-Programming.
CO 3	Study about the operators like mathematical and logical.
CO 4	Acquire knowledge to create the loops for vectors in their own way.
CO 5	Gain knowledge in creating data as a list using loops.

UNIT I

Introduction: Introducing to R – R Data Structures – Help functions in R – Vectors – Scalars – Declarations – recycling – Common Vector operations – Using all() and any() – Vectorized operations – NA and NULL values – Filtering – Vectorised if-then else – Vector Equality – Vector Element names

UNIT II

Matrices and arrays: Creating matrices – Matrix operations – Applying Functions to Matrix Rows and Columns – Adding and deleting rows and columns – Vector/Matrix Distinction – Avoiding Dimension Reduction – Higher Dimensional arrays.

UNIT III

Lists – Creating lists – General list operations – Accessing list components and values – applying functions to lists – recursive lists. Creating Data Frames – Matrix-like operations in frames – Merging Data Frames – Applying functions to Data frames

UNIT IV

Factors and Tables – factors and levels – Common functions used with factors – Working with tables - Other factors and table related functions.

UNIT V

Control statements – Arithmetic and Boolean operators and values – Default values for arguments - Returning Boolean values – functions are objects – Environment and Scope issues – Writing Upstairs - Recursion – Replacement functions – Tools for composing function code.

Textbook:

Norman Matloff, "The Art of R Programming: A Tour of Statistical Software Design", No Starch Press, 2011.

Reference Book:

Matthias Kohl, Introduction to statistical data analysis with R, bookboon.com – The eBook company 2015, 1st edition.

Reference Links:

1. **https://youtu.be/ChtfaUeCHKc**
2. **https://youtu.be/Hrwe8AsIy5U**
3. **https://youtu.be/OskXqFhEJ0w**
4. **https://youtu.be/XRlQh4YtD-k**
5. **https://youtu.be/TX6SE5IjkWQ**
6. **https://youtu.be/-dYq4BEcrkQ**
7. **https://youtu.be/1Xew90NCrpk**
8. **https://youtu.be/6LP1IlPjfFw**
9. **https://youtu.be/5pjBaPgGhyk**

UNIT I – Chapter: 1 & 2

UNIT II – Chapter: 3

UNIT III – Chapter: 4 & 5

UNIT IV – Chapter: 6

UNIT V – Chapter: 7 (7.1 – 7.11)

Course Outcomes

CO No.	Upon completion of the course, the students will be able to	PSOs Addressed	Cognitive Level
CO – 1	Understand the concept as to how to download andinstall R studio to work with data structures.	1,3,5	Remembering
CO – 2	Understand the data sets using matrices and arrays.	1,4,5	Understanding
CO – 3	Remember and apply the main R data structures-vector and data frames.	1,2,3	Applying
CO – 4	Analyze the basics in R – Programming to form a factors and tables.	1,4,5	Analyzing
CO – 5	Evaluate the external data into R for statistical analysis and recursion.	1,2	Evaluating

Relationship Matrix

Semester	Course Code	Title of the Course					Hours	Credits
IV	21PCMA43	R – Programming					60	4
Course Outcomes (COS)	Programme Learning Outcomes(PLOs)				Programme Specific Outcomes (PSOs)				
	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO – 1	✓	✓	✓	✓	✓	✓		✓		✓
CO – 2	✓	✓	✓	✓	✓	✓			✓	✓
CO – 3	✓	✓	✓	✓	✓	✓	✓	✓		
CO – 4	✓	✓	✓	✓	✓	✓			✓	✓
CO – 5	✓	✓	✓	✓		✓	✓			
	Number of Matches(✓) = 38 Relationship = High									

Semester – IV

Course Title	**Project**
Total Hrs.	**120**
Hrs./Week	**8**
Sub.Code	**21PCMAP41**
Course Type	**PROJECT**
Credits	**4**
Marks	**150**

The following are the guidelines to be adhered to by the Postgraduate students :

- Individual Projects should be taken.
- The Project should be written in English only.
- The Minimum number of pages should be 60.
- Project observations, suggestions and summation/conclusion shall form part of the Project Report.
- The Projects will be evaluated by the Internal Examiner and the External Examiner for 150 marks. The distribution of mark should be 90 marks for the Project Report and 60 marks for the Viva-Voce Examination. The Division of marks for the Project Report is as follows:

Particulars	Internal Examiner	External Examiner
Wording of Title	5	5
Objectives / Formulation including Hypothesis	10	10
Review of Literature	15	15
Relevance of the Project to Social Needs	10	10
Methodology / Technique / Procedure Adopted	30	30
Summary / Findings / Conclusion / Summation	10	10
Bibliography / Annexure / Foot notes / Works Cited / Works Consulted	10	10
Total	90	90

- The Internal Examiner and the External Examiner will award the marks for each candidate. The average mark obtained by the candidate is considered marks for the Project Report.

Semester IV

Course Title	**Partial Differential Equations**
Total Hours	**60**
Hours / Week	**4**
Code	**21PEMA41A**
Course type	**DSE-IV-A**
Credits	**3**
Marks	**100**

General Objective:

To acquire the knowledge of solving partial differential equations using various methods and equation of second order with constant and variable coefficient.

Course Objectives:

CO NO.	The learners will be able to
CO 1	Understand the concept of first order partial differential equation.
CO 2	Analyze the Cauchy's method of characteristics in first order partial differential equation.
CO 3	Acquire the idea in special type of first order equations.
CO 4	Evaluate the problems using second order partial differential equation
CO 5	Compute the characteristic curves of second order equations with three variables.

UNIT I

Partial Differential Equations - Origin of First order Partial Differential Equations Cauchy's problem for first order equations- Linear equations of the first order –Integral surfaces passing through a given curve.

UNIT II

Surfaces orthogonal to a given system of surfaces – Cauchy's method of characteristics - Compatible systems of first order equations.

UNIT III

Charpit's method - Special type of first order equations- Solution satisfying the given conditions - Jacobi's Method.

UNIT IV

Partial differential equations of second order-Linear PDE with constant coefficients-Equations with variable coefficients.

UNIT V

Characteristic curves of second order equations-Characteristics of equations in three variables-The solution of linear hyperbolic equations-Separation of variables in a PDE.

Text book :

Ian N. Sneddon – Elements of Partial Differential Equations – Dover Publications, Inc-Mineola, New York.

UNIT I: Chapter 2 (Section 1 to 5)

UNIT II: Chapter 2 (Section 6, 8, 9)

UNIT III: Chapter 2(Section 10 to 13)

UNIT IV: Chapter 3(section 1, 4, 5)

UNIT V: Chapter 3(section 6-9)

Reference Books:

1. E. T. Copson, Partial Differential Equations Second edition, Cambridge University,1975.

2. K.SankaraRao, Introduction to Partial differential equations (Third edition), Prentice- Hall of India Ltd, New Delhi, 2016.

Course Outcomes

CO No.	Upon completion of the course, the students will be able to	PSOs Addressed	Cognitive Level
CO 1	Understanding the concept of the linear First order Partial Differential Equations.	1,2,5	Remembering
CO 2	Understand how to construct Cauchy's problem for first order partial differential equation.	1,2	Understanding
CO 3	Analyze the concept of the compatible systems of first order equations.	1,2	Analyzing
CO 4	Apply the charpit's and Jacobi's Method to solve the problem.	1,2,3,5	Applying
CO 5	Discuss the concept of the second order partial differential with constant and variable coefficient	1,3,4,5	Creating

Relationship Matrix

Semester	Course Code			Title of the Course				Hours		Credits
IV	21PEMA41A			Partial Differential Equations				60		3
Course Outcomes (CO)	Programme Learning Outcomes (PLOs)					Programme Specific Outcomes (PSOs)				
	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO-1	✓	✓	✓	✓	✓	✓	✓			✓
CO-2	✓	✓	✓	✓		✓	✓			
CO-3	✓	✓	✓	✓		✓	✓			
CO-4	✓	✓	✓	✓	✓	✓	✓	✓		✓
CO-5	✓	✓	✓	✓	✓	✓		✓	✓	✓
	Number of matches (✓) = 38 Relationship = High									

Semester – IV

Course Title	**Numerical Analysis**
Total Hrs	**60**
Hrs/Week	**4**
Sub.Code	**21PEMA41B**
Course Type	**DSE-IV-B**
Credits	**3**
Marks	**100**

General Objective:

To apply numerical methods to obtain approximate solutions to mathematical problem.

Course Objectives:

CO No.	The learners will be able to
CO-1	Evaluate the algebraic and transcendental equation.
CO-2	Study the basic concepts of interpolation in various methods.
CO-3	Understand the notion of Numerical differentiation and integration.
CO-4	Know the concept of matrices of linear system of equations.
CO-5	Get a clear idea in Taylor's series, Euler's and Runge Kutta Methods.

Unit – I

Solution of Algebraic and Transcendental equations – Introduction, The Bisection Method, Method of False position, Iteration Method.

Unit – II

Interpolation: Finite differences - Forward differences, Backward differences, Central differences, Symbolic relations, Newton formula for interpolation.

Unit – III

Numerical Differentiation and Integration – Introduction - Numerical Differentiation - Errors in Numerical Differentiation - Cubic spline method - maximum and minimum values of a tabulated function, Numerical integration -Trapezoidal Rule and Simpson's 1/3 and3/8 rules.

Unit – IV

Matrices of Linear System of Equations - Gaussian Elimination method, Gauss-Jordan method, Modification of the Gauss method to compute the inverse.

Unit – V

Numerical Solution of Ordinary differential equations - Solution by Taylor Series, Picard's method of Successive approximations, Euler method, Modified Euler method - Runge-Kutta Method.

Textbook:

Introductory Methods of Numerical Analysis, (4th Edition) by **S. Sastry**, PHI Learning Pvt Ltd, New Delhi,2009.

Unit I: Chapter II (Section 2.1-2.4)
Unit II: Chapter III (Section 3.3(3.3.1-3.3.4),3.6).
Unit III: Chapter V (Section 5.1,5.2(5.2.1,5.2.2),5.3,5.4(5.4.1-5.4.3))

Unit IV: Chapter VI (Section 6.3.2,6.3.3,6.3.4)
Unit V: Chapter VII (7.2-7.4,7.4.2,7.5)

Reference Books:

1. **Kandasamy. P, Thilagavathi. K and Gunavathi. K "Numerical methods"** – S. Chand and Company Ltd, New Delhi – Revised Edition 2007.
2. **Venkataraman M. K.,"Numerical Methods in Science and Engineering"** National Publishing company V Edition 1999.

Course Outcomes

CO No.	Upon completion of the course, the students will be able to	PSOs Addressed	Cognitive Level
CO-1	Understand the fundamental concepts of algebraic and transcendental equations.	1,2	Remembering
CO-2	Analyze the common interpolation formula to solve Newton's interpolation.	1,2,3,4	Understanding
CO-3	Analyze any problems in numerical differentiation and integration.	1,2,4	Analyzing
CO-4	Evaluate upon the concept of matrices in Linear System and its types.	1,2,5	Evaluating
CO-5	Compose the numerical solutions of ordinary differential equations by the Taylor's series, Euler's and Runge Kutta Methods.	1,2	Creating

Relationship Matrix

Semester	Course Code	Title of the Course				Hours	Credits			
IV	21PEMA41B	Numerical Analysis				60	3			
Course Outcomes (COs)	Programme Learning Outcomes (PLOs)					Programme Specific Outcomes (PSOs)				
	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO-1	✓	✓	✓	✓		✓	✓			
CO-2	✓	✓	✓	✓	✓	✓	✓	✓	✓	
CO-3	✓	✓	✓	✓		✓	✓		✓	
CO-4	✓	✓	✓	✓	✓	✓	✓			✓
CO-5	✓	✓	✓	✓		✓	✓			
	Number of matches (✓) = 36 Relationship = High									

SEMESTER - IV

Course Title	Representation Theory of Finite Groups
Total Hrs.	60
Hrs./Week	4
Sub.Code	21PEMA41C
Course Type	DSE-IV-C
Credits	3
Marks	100

General Objective:

To present the ideas of group characters and basic properties of irreducible characters, as well as their connection to group algebras' ring structure.

Course Objectives:

CO No.	The learners will be able to
CO-1	Understand the concepts of G-Module and group algebras
CO-2	Explain FG – Homomorphism and Machke's theorem
CO-3	Comprehend irreducible modules and conjugacy classes
CO-4	Know about characters and inner characters of $\mathbb{C}G$-module.
CO-5	Understand the character table and orthogonal relation

Unit – I :

Group representations - FG Modules - FG - submodules and Reducibility - Group algebras

Unit – II:

FG-homomorphisms – Maschke's theorem – Consequences of Maschke's theorem – Schur's lemma.

Unit – III:

Irreducible modules and the group algebra - More on the group algebra - Conjugacy classes.

Unit – IV :

Characters - Inner product of characters.

Unit – V :

The number of irreducible characters - Character Tables and Orthogonality relations - Normal subgroups and Lifted characters.

Textbook:

G.James and M.Liebeck, "Representations and Characters of Groups", 2nd Edition, Cambridge University Press, London, 2001.

UNIT-I: Chapter 3 to 6

UNIT-II: Chapter 7 to 8 and Chapter 9 (Sec 9.1,9.2)

UNIT-III : Chapter 10 to 11 and Chapter 12 (Sec 12.1,12.2)

UNIT-IV : Chapter 13 and Chapter 14 (Sec 14.1, 14.2)

UNIT-V : Chapter 15, Chapter 16 (Sec 16.1, 16.2) and Chapter 17 (Sec 17.1, 17.2)

Reference Books:

1. C.W. Curtis and I.Reiner, "Methods of Representation Theory with Applications to Finite Groups and Orders", Volume 1, Wiley – Interscience, New York, 1981.
2. J.P. Serre, "Linear Representation of Finite Groups", Springer-Verlag, New York, 1977.
3. W.Fulton and J. Harris, "Representation Theory – A First Course", Graduate Texts in Mathematics 129, Springer – Verlag, New York, 1991.

Course Outcomes

CO No.	Upon completion of the course, the students will be able to	PSOs Addressed	Cognitive Level
CO-1	Recognize the connection between RG-module and representation of group	1,2,5	Understanding
CO-2	Apply Schur's lemma to determine irreducible representation of finite abelian groups	1,5	Applying
CO-3	Analyze the structure of the group algebra $\mathbb{C}G$.	1,2,5	Analyzing
CO-4	Calculate the dimension of Hom(V,W) over $\mathbb{C}G$.	1,4,5	Evaluating
CO-5	Find all the normal subgroups of G by character table`	1,3,5	Evaluating

Relationship Matrix

Semester	Course Code	Title of the Course	Hours	Credits
IV	21PEMA41C	Representation Theory of Finite Groups	60	3

Course Outcomes (COs)	Programme Learning Outcomes (PLOs)					Programme Specific Outcomes (PSOs)				
	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO-1	✓	✓			✓	✓	✓			✓
CO-2	✓	✓			✓	✓				✓
CO-3	✓	✓			✓	✓	✓			✓
CO-4	✓			✓	✓	✓	✓		✓	✓
CO-5	✓		✓		✓	✓	✓	✓		✓
	Number of matches (✓) = 31 Relationship = Medium									

Semester IV

Course Title	**R – Programming Practical**
Total Hrs	**60**
Hrs / Week	**4**
Sub. Code	**21PCMA4P1**
Course Type	**Practical-IV**
Credits	**2**
Marks	**100/2**

General Objective:

To obtain the knowledge for downloading the R studio and install it and be able to work in a workspace containing an R data frame. Also gain knowledge to Run, edit and save the script from R studio.

Course Objectives:

CO No.	**The learners will be able to**
CO 1	Compose R data into external files.
CO 2	Study about basic math functions like sum(), Avg(), etc.
CO 3	Display the results using graphs.
CO 4	Create and change the data in vectors, matrices and arrays using loops.
CO 5	Save the customize graphs in different ways.

1. Introduction to R
2. Identifying Types of Variables: Level of Measurement.
3. Univariate Statistics
4. Introduction to Probability.
5. The Normal curve.
6. Measures of Central Tendency and Dispersion.
7. Standard Deviations, Standard Scores and the Normal Distribution
8. Sampling
9. Hypothesis Testing: Testing the Significance of the difference between two means.
10. Hypothesis testing: One and Two tailed Tests.
11. Bivariate Statistics for Normal Data.
12. Bivariate Statistics for Ordinal Data.
13. Bivariate Statistics for Interval / Ratio Data.
14. OLS Regression – Modelling Continuous Outcomes.

Course Outcomes

CO No.	Upon completion of the course, the students will be able to	PSOs Addressed	Cognitive Level
CO – 1	Understand the programming language for statistical analysis.	1,2,5	Understanding
CO – 2	Evaluate the problems in probability and statistics.	1,2,4	Evaluating
CO – 3	Analyze and explore data sets to create test table.	1,2,3	
CO – 4	Analyse as to how to find the regression values using R-Programming.	1,2,4	Analyzing
CO – 5	Estimate the program and find the value for sampling.	1,2,5	Creating

Relationship Matrix

Semester	Course Code	Title of the Course					Hours	Credits		
IV	21PCMA4P1	R– ProgrammingPractical					60	2		
Course Outcomes (COS)	Programme Learning Outcome (PLOs)					Programme Specific Outcomes (PSOs)				
	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO – 1	✓	✓	✓	✓	✓	✓	✓			✓
CO – 2	✓	✓	✓	✓		✓	✓		✓	
CO – 3	✓	✓	✓	✓	✓	✓	✓	✓		
CO – 4	✓	✓	✓	✓		✓	✓		✓	
CO – 5	✓	✓	✓	✓	✓	✓	✓			✓
	Number of Matches(✓) = 38 Relationship = High									

INTERDISCIPLINARY COURSES (2021 – 2024)							
SEM	TITLE OF THE COURSE	COURSE CODE	H/W	C	MARKS		
					I	E	T
DEPT. OF ENGLISH							
II	SOFT SKILLS	**21PIEN11**	**2**	**2**	**40**	**60**	**100/2**
III	ENGLISH FOR BUSINESS COMMUNICATION	**21PIEN31**	**2**	**2**	**40**	**60**	**100/2**
DEPT. OF HISTORY							
II	INDIAN HISTORY FOR COMPETITIVE EXAMINATIONS UPTO 1707A.D	**21PIHS11**	**2**	**2**	**40**	**60**	**100/2**
III	INDIAN HISTORY FOR COMPETITIVE EXAMINATIONS FROM (1707-1947 A.D)	**21PIHS31**	**2**	**2**	**40**	**60**	**100/2**
DEPT. OF COMMERCE							
II	ENTREPRENEURIAL DEVELOPMENT	**21PICO11**	**2**	**2**	**40**	**60**	**100/2**
III	HUMAN RESOURCE MANAGEMENT	**21PICO31**	**2**	**2**	**40**	**60**	**100/2**
DEPT. OF MATHEMATICS							
II	DISCRETE STRUCTURE – I	**21PIMA11**	**2**	**2**	**40**	**60**	**100/2**
III	DISCRETE STRUCTURE – II	**21PIMA31**	**2**	**2**	**40**	**60**	**100/2**
DEPT. OF CHEMISTRY							
II	ANALYTICAL BIOCHEMISTRY	**21PICH11**	**2**	**2**	**40**	**60**	**100/2**
III	INDUSTRIAL CHEMISTRY	**21PICH31**	**2**	**2**	**40**	**60**	**100/2**
DEPT. OF COMPUTER SCIENCE							
II	DIGITAL LITERACY	**21PICS11**	**2**	**2**	**40**	**60**	**100/2**
III	DIGITAL TECHNOLOGY	**21PICS31**	**2**	**2**	**40**	**60**	**100/2**
DEPT. OF MICROBIOLOGY							
II	MICROBIOLOGY AND HUMAN HEALTH	**21PIMB11**	**2**	**2**	**40**	**60**	**100/2**
III	ENTREPRENEURSHIP IN MICROBIOLOGY	**21PIMB31**	**2**	**2**	**40**	**60**	**100/2**
DEPT. OF PHYSICS							
II	THE BASICS OF DIGITAL ELECTRONICS	**21PIPH11**	**2**	**2**	**40**	**60**	**100/2**
III	ENERGY PHYSICS	**21PIPH31**	**2**	**2**	**40**	**60**	**100/2**
DEPT. OF ZOOLOGY							
II	ORNAMENTAL FISH CULTURE	**21PIZO11**	**2**	**2**	**40**	**60**	**100/2**
III	APPLIED ZOOLOGY	**21PIZO31**	**2**	**2**	**40**	**60**	**100/2**
DEPT. OF NUTRITION AND DIETETICS							
II	DIET THERAPY-I	**21PIND11**	**2**	**2**	**40**	**60**	**100/2**
III	DIET THERAPY-II	**21PIND31**	**2**	**2**	**40**	**60**	**100/2**

THE SCHEME OF EXAMINATIONS UNDER CHOICE BASED CREDIT SYSTEM

- The medium of instruction in all the UG and PG Programmes is English and Students shall write the CIA Tests and the Semester Examinations in English. Three CIA Tests for one hour each will be conducted. For the calculation of CIA Tests marks the average of the best two tests will be taken. The portion for each test can be 1.5 units of the unitized syllabi.
- Two assignments for the Undergraduate Programmes and one assignment and one seminar for the Postgraduate Programmes are compulsory.
- Two Practical Examinations will be conducted for CIA at the end of the semester and the average will be taken.

Distribution of Marks for the Students admitted into the UG and PG Programmes from the academic year 2021-2022
CIA Tests and Semester Examinations

Undergraduate, Certificate, Diploma and Advanced Diploma Programmes						
Course Type	TOTAL MARKS	CIA TESTS MAX.MARKS	SEMESTER EXAMINATION Max. Marks	PASSING MINIMUM		
				CIA	SEM. EXAM	OVERALL
Theory	100	25	75	Nil	30	40
Practical (2Hrs.)	50	20	30	Nil	12	20
Practical (4Hrs.)	100	40	60	Nil	24	40
Project	100	Nil	Report- 60 Marks Viva-Voce- 40 Marks	Nil	Nil	100

Postgraduate Programmes						
Course Type	TOTAL MARKS	CIA MARKS	SEMESTER EXAM	PASSING MINIMUM		
				CIA	SEM. EXAM	OVERALL
Theory	100	40	60	Nil	30	50
Practical	50	20	30	Nil	15	25
Practical (for PG Maths only)	100	40	60	Nil	30	50
Project Report	150	Nil	Project Report- 90 Marks Viva-Voce Examination - 60 Marks	Nil	Nill	150

CIA TESTS

Distribution of Marks

Components	Tests (A)			Assignment (B)	Seminar (C)	Record Note (D)	Total (A+B+C+D)
	I	II	III				
UG-Theory	20	20	20	5	-	-	25
	The Average of the Best Two Tests:20						
PG-Theory	30	30	30	5	5	-	40
	The Average of the Best Two Tests:30						
UG-Practical (2 hrs)	15	15		-	-	5	20
	The Average of the Tests: 15						
UG-Practical (4 hrs)	30	30		-	-	10	40
	The Average of the Tests: 30						
PG-Practical	15	15		-	-	5	20
	The Average of the Tests: 15						
PG-Practical (Maths only)	30	30		-	-	10	40
	The Average of the Tests: 30						

Question Pattern for CIA Test (Theory)

Programme	Question Paper Pattern			Total (A+B+C)
	Part-A	Part-B	Part-C	
UG	MCQs- 8x0.5=4 marks	Internal Choice (Either or type). 2x4=8 marks Answer should not exceed 250 words	Internal Choice (Either or type) 1x8=8 marks Answer should not exceed 500 words	20
PG	MCQs- 20x0.5=10 marks	Internal Choice (Either or type) 3x4=12 marks Answer should not exceed 250 words	Internal Choice (Either or type) 1x8=8 marks Answer should not exceed 500 words	30

End Semester Examination (ESE)

The students who have put in the required number of days of attendance are eligible to appear for the End Semester Examinations irrespective of whether they have passed in the CIA Tests or not. They have to pay the examination fees for all the current courses and the arrear courses, if any, and submit the application form before the due date specified for the purpose. For any reason, the dates will not be extended. Hall tickets will be issued only for those who have paid the fees. The question papers for the End Semester Examinations for all the theory courses of the UG and the PG Programmes will be set for 75 marks.

Question Pattern for End Semester Examinations (Theory)

Programme	Question Paper Pattern			Total (A+B+C)
	Part-A	**Part-B**	**Part-C**	
UG	MCQs- 30x0.5=15 marks	Internal Choice (Either or type) 5x4=20 marks Answer should not exceed 250 words	Internal Choice (Either or type) 5x8=40 marks Answer should not exceed 500 words	**75**
PG	MCQs- 30x0.5=15 marks	Internal Choice (Either or type) 5x4=20 marks Answer should not exceed 250 words	Internal Choice (Either or type) 5x8=40 marks Answer should not exceed 500 words	$\left(\frac{x}{75} \mathbf{x\ 60}\right)$ **60**

The Question Paper Pattern for the End Semester Examinations (Practical)

The Question Paper Pattern is designed by the respective departments.