

Title of the Course	: Algebraic Structures		
Category of the Course	: CORE COURSE	Semester	: I
Course Code	: P1R3MACC1	Nature of the Course	: Skill Development
Marks	: CIA:25+Ext:75= 100	Hrs/Week	: 7
Credits	: 5	Total Inst. Hrs.	: 105

Objectives :

- To educate the advanced level of Groups
- To understand the sequential development of Abelian group concepts and skills by using materials for making the transition from the arithmetic to the symbolic
- To understand the concepts of Jordan form
- To have a brief study of Linear transformation
- To study the algebraic structure of finite fields

Unit I: Sylow's Theorem

(21 HOURS)

Counting Principle – 1st, 2nd and 3rd parts of Sylow's Theorems –

double coset – the normalizer of a group.

Unit II: Abelian Group

(21 HOURS)

Solvable groups - Direct products - Finite abelian groups - Modules

Unit III: Linear Transformation

(21 HOURS)

Linear Transformations: Canonical forms – Triangular form - Nilpotent transformations.

Unit IV: Jordan Form

(21 HOURS)

Jordan form - rational canonical form.

UNIT V: Trace and Transpose

(21 HOURS)

Trace and transpose - Hermitian, unitary, normal transformations, real quadratic form.

Text Book :

[1] I.N. Herstein, 'Topics in Algebra', Second Edition, Wiley Eastern Limited 2014.

Unit I - Chapter 2 Section 2.11 – 2.12

Unit II – Chapter 5 Sec 5.7, Chapter 2 Section 2.13 – 2.14 & Chapter 4 Section 4.5

Unit III - Chapter 6 Section 6.4 and 6.5

Unit IV - Chapter 6 Section 6.6 and 6.7

Unit V - Chapter 6 Section 6.8, 6.10 and 6.11

Reference Books:

1. **Modern Algebra**, Surjeet Singh, Quazizameeudui, Vikas Publishing House Pvt. Ltd.
2. **Contemporary Abstract Algebra**, Gallian, Narosa Publishing House, Fourth Edition, 1999.
3. M. Artin, *Algebra*, Prentice Hall of India, 1991.
4. P.B. Bhattacharya, S.K. Jain, and S.R. Nagpaul, *Basic Abstract Algebra* (II Edition) Cambridge University Press, 1997. (Indian Edition)

e - Resources:

Title of the Course: Algebraic Structures							Course Code: P1R3MACC1			
Course Outcomes (COs)	Programme Outcomes (POs)						Programme Specific Outcomes (PSOs)			Mean Score of COs
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	
CO1	3	1	3	2	3	3	3	2	1	2.3
CO2	2	1	3	1	3	3	3	2	1	2.1
CO3	3	2	3	1	3	3	3	2	1	2.3
CO4	1	2	3	2	3	3	3	2	1	2.2
CO5	3	1	2	3	3	3	3	2	1	2.3
		Mean Overall Score								2.2
		Result								High

Title of the Course	: Real Analysis – I		
Category of the Course	: CORE COURSE	Semester	: I
Course Code	: P1R3MACC2	Nature of the Course	: Skill Development
Marks	: CIA:25+Ext:75= 100	Hrs/Week	: 7
Credits	: 5	Total Inst. Hrs.	: 105

Objectives:

1. To be familiar with the advanced concepts of Real Analysis
2. To give a systematic study of Riemann stieltjes integral and calculus on $\mathbb{R}^n$
3. To have a brief study of convergence of sequences and series, Functions of several variables
4. To study Fourier Series and Gamma Function
5. To apply the contraction principle

Unit I: Functions of bounded variation and Infinite series (21HOURS)

Introduction - Properties of monotonic functions - Functions of bounded variation - Total variation - Additive property of total variation - Total variation on $[a, x]$ as a function of x - Functions of bounded variation expressed as the difference of two increasing functions - Continuous functions of bounded variation. Infinite Series : Absolute and conditional convergence - Dirichlet's test and Abel's test - Rearrangement of series - Riemann's theorem on conditionally convergent series.

Unit II: Riemann- Stieltjes integral (21 HOURS)

Introduction - Notation - The definition of the Riemann - Stieltjes integral - Linear Properties - Integration by parts- Change of variable in a Riemann - Stieltjes integral - Reduction to a Riemann Integral – Euler's summation formula - Monotonically increasing integrators, Upper and lower integrals - Additive and linearity properties of upper, lower integrals - Riemann's condition - Comparison theorems.

Unit III: Riemann- Stieltjes integral (21HOURS)

Integrators of bounded variation-Sufficient conditions for the existence of Riemann-Stieltjes integrals-Necessary conditions for the existence of RS integrals- Mean value theorems -integrals as a function of the interval – Second fundamental theorem of integral calculus-Change of variable -Second Mean Value Theorem for Riemann integral- Riemann-Stieltjes integrals depending on a parameter-Differentiation under integral sign-Lebesgue criterion for existence of Riemann integrals.

Unit IV: Infinite Series and Products (21 HOURS)

Double sequences - Double series - Rearrangement theorem for double series - A sufficient condition for equality of iterated series - Multiplication of series –Cesaro summability - Infinite products. Power series - Multiplication of power series - The Taylor's series generated by a function - Bernstein's theorem - Abel's limit theorem - Tauber's theorem

Unit V: Sequence of Functions (21 HOURS)

Pointwise convergence of sequences of functions - Examples of sequences of real - valued functions - Uniform convergence and continuity - Cauchy condition for uniform convergence - Uniform convergence of infinite series of functions - Riemann - Stieltjes integration – Non-uniform Convergence and Term-by-term Integration - Uniform convergence and differentiation - Sufficient condition for uniform convergence of a series - Mean convergence.

Text Books:

[1] Mathematical Analysis, Tom M. Apostol, Addison-Wesley Publishing Company Inc. New York, 1974.

Unit I: Chapter 6 Sec 6.1 to 6.8 and Chapter 8 Sec 8.8, 8.15, 8.17 and 8.18

Unit II: Chapter 7 Sec 7.1 to 7.7, 7.10-7.14

Unit III: Chapter 7 Sec 7.15 to 7.24, 7.26

Unit IV: Chapter 8 - Sec 8.20 to 8.26 and Chapter 9 Sec 9.14, 9.15, 9.19, 9.20, 9.22, 9.23

Unit V: Chapter 9 - Sec 9.1 to 9.2, 9.4 to 9.6, 9.8, 9.9, 9.10, 9.11, 9.13

Reference Books:

1. Analysis I and II, Serge Lang, Addison – Wesley Publishing Company, 1969.
2. Elements of Real Analysis, R. G. Bartle, 2nd Edition, John Wiley and Sons, New York, 1976.
3. Rudin, W. Principles of Mathematical Analysis, 3rd Edition. McGraw Hill Company, New York, 1976.

e - Resources:

- <http://mathforum.org>,
- <http://ocw.mit.edu/ocwweb/Mathematics>,
- <http://www.opensource.org>,
- www.mathpages.com

Outcomes:

The learners would have the ability to,

CO1	Analyze and evaluate functions of bounded variation and Rectifiable Curves	K5
CO2	Describe the concept of Riemann-Stieltjes integral and its properties.	K2
CO3	Demonstrate the concept of step function, upper function, Lebesgue function and their integrals	K3
CO4	Construct various mathematical proofs using the properties of Lebesgue integrals and establish the Levi monotone convergence theorem.	K6
CO5	Formulate the concept and properties of inner products, norms and measurable functions.	K4

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create

CO\PO Mapping:

Title of the Course: Real Analysis – I							Course Code: P1R3MACC2			
Course Outcomes (COs)	Programme Outcomes (POs)						Programme Specific Outcomes (PSOs)			Mean Score of Cos
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	
CO1	3	1	3	2	3	3	3	2	1	2.3
CO2	2	1	3	1	3	3	3	2	1	2.1
CO3	3	2	3	1	3	3	3	2	1	2.3
CO4	1	2	3	2	3	3	3	2	1	2.2
CO5	3	1	2	3	3	3	3	2	1	2.3
							Mean Overall Score			2.2
							Result			High

Title of the Course	:	Ordinary Differential Equations		
Category of the Course	:	CORE COURSE	Semester	: I
Course Code	:	P1R3MACC3	Nature of the Course	: Employability
Marks	:	CIA:25+Ext:75= 100	Hrs/Week	: 6
Credits	:	4	Total Inst. Hrs.	: 90

Objectives

- To identify an ordinary differential equation and its order
- To reduce the order of a homogenous equations
- To find the general solution of second order linear homogeneous equations with constant coefficients
- To study the existence of solution of first order equations
- To use annihilator method to solve non – homogenous equations

Unit I: Linear equations with constant coefficients (18 HOURS)

Introduction – Second order homogenous equations- Initial value problem for second order equations- Linear dependence and independence-A formula for Wronskian.

Unit II: Linear equations with constant coefficients (Cont'd.)(18 HOURS)

The Non-homogenous equations of order two-homogenous and Non-homogenous equations of order n – Initial value problems for n^{th} order Equations- Annihilator method to solve non-Homogenous equation.

Unit III: Linear equations with variable coefficients (18 HOURS)

Initial value problem – Existence and uniqueness theorem- The Wronskian and linear independence – Reduction of the order of a homogenous equation - The non- Homogenous equation- Homogenous equations with analytic coefficients - The Legendre equations.

Unit IV: Linear equations with regular singular points(18 HOURS)

The Euler equations – Second order equations with regular singular points- Exceptional cases - The Bessel equation – The Bessel equation contd.

Unit V:Existence and uniqueness of solutions to 1st order equations (18 HOURS)

Equations with variable separated - Exact equations - The method of successive approximation - The Lipschitz Condition - Convergence of the successive approximation-Non-local existence of solutions-Approximations to and uniqueness of solutions.

Text Book:

1. **An Introduction to Ordinary Differential Equations**, Earl A. Coddington, Prentice Hall of India Private Limited, New Delhi 2013.

Unit I: Chapter 2, section 1 to 5

Unit II: Chapter 2, section 6 to 11

Unit III: Chapter 3, section 1 to 8

Unit IV: Chapter 4, section 1 to 4, 6 to 8

Unit V: Chapter 5, section 1 to 8

Reference Books:

Title of the Course: Ordinary Differential Equations							Course Code: P1R3MACC3			
Course Outcomes (COs)	Programme Outcomes (POs)						Programme Specific Outcomes (PSOs)			Mean Score of Cos
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	
CO1	3	1	3	2	3	3	3	2	1	2.3
CO2	2	1	3	1	3	3	3	2	1	2.1
CO3	3	2	3	1	3	3	3	2	1	2.3
CO4	1	2	3	2	3	3	3	2	1	2.2
CO5	3	1	2	3	3	3	3	2	1	2.3
		Mean Overall Score								2.2
		Result								High

Title of the Course	:	Number Theory and Cryptography		
Category of the Course	:	DSE COURSE	Semester	: I
Course Code	:	P1R3MADSE1:1	Nature of the Course	: Employability
Marks	:	CIA:25+Ext:75= 100	Hrs/Week	: 5
Credits	:	3	Total Inst. Hrs.	: 75

Objectives:

1. To illustrate how general methods of analysis can be used to obtain results about integers and prime numbers.
2. To investigate the distribution of prime numbers.
3. To consolidate earlier knowledge of analysis through applications.
4. To study the summation formulas
5. To develop the concepts of L-functions.

Unit-I: Arithmetic Functions (15 hours)

Introduction – Notations and definitions – Generating series –Dirichlet convolution– Examples– Arithmetic functions of average –Sums of multiplicative functions –Distribution of additive functions.

Unit-II: Elementary Theory of Prime Numbers (15 hours)

The Prime Number Theorem–Tchebyshev method– Primes in arithmetic progressions – Reflections of elementary proofs of the Prime Number Theorem.

Unit-III: Characters (15 hours)

Introduction – Dirichlet characters – Primitive characters Gauss sums– Real characters – The quartic residue symbol – The Jacobi–Dirichlet and the Jacobi – Kubota symbols –Hecke characters.

Unit-IV: Summation Formulas (15 hours)

Introduction –The Euler-Maclaurin formula– The Poisson summation formula– Summation formulas for the ball –Summation formulas for the hyperbola – Functions equations of Dirichlet L–functions– Appendix: Fourier integrals and series.

Unit-V: Cryptography (15 hours)

Some topics in Elementary Number theory- Finite fields and Quadratic Residues-
Some Simple Cryptosystems- Enciphering matrices

Text Book:

1. Analytic Number Theory – Henryk Iwaniec and Emmanuel Kowalski – Colloquium Publications _ Baba BarkhaNath Printers – 2004.
2. A course in number theory and cryptography, Koblitz. N, Springer verlag, 1994

Unit I – Chapter 1 (Section 1.1 – 1.7) [1]

Unit II – Chapter 2 (Section 2.1 – 2.4) [1]

Unit III – Chapter 3 (Section 3.1 – 3.8) [1]

Unit IV – Chapter 4 (Section 4.1 – 4.6) [1]

Unit V – Chapter 1 to Chapter 3[2]

Reference Books:

1. Analytic Number Theory, Donald J. Newman, Springer-Verlag New York, Inc– 1998
2. Elementary Number Theory, David M. Burton, Tata McGraw-Hill, 7th Edition-2012
3. Basic Number Theory, SB Malik, Vikas Publishing House Pvt. Ltd.Reprint-2015.

e-Resources:

1. <https://faculty.math.illinois.edu/~hildebr/tex/examples/books/ant.pdf>
2. <http://www.freebookcentre.net/maths-books-download/Introduction-To-Number-Theory-by-Richard-Bleeksmith.html>

Outcomes:

The learners would have the ability to,

CO1	Know the basic concepts of analytic number theory	K1
CO2	Understand better the distribution of prime numbers	K2
CO3	Understand the proof of Dirichlet's theorem	K2
CO4	Know the Euler-Maclaurin formula	K1
CO5	Analyze the basic theory of Cryptography	K4

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create

CO\PO Mapping:

Title of the Course: Number Theory and Cryptography							Course Code: P1R3MADSE1:1			
Course Outcomes (COs)	Programme Outcomes (POs)						Programme Specific Outcomes (PSOs)			Mean Score of Cos
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	
CO1	3	1	3	3	1	1	3	3	2	2.2
CO2	3	3	3	2	3	3	3	3	2	2.8
CO3	2	3	1	3	2	3	1	2	3	2.2
CO4	3	2	3	1	1	2	3	1	2	2.0
CO5	1	3	3	1	3	3	3	1	2	2.2
							Mean Overall Score			2.3
							Result			High

Title of the Course	:	Graph Theory and Applications		
Category of the Course	:	DSE COURSE	Semester	: I
Course Code	:	P1R3MADSE1:2	Nature of the Course	: Employability
Marks	:	CIA:25+Ext:75= 100	Hrs/Week	: 5
Credits	:	3	Total Inst. Hrs.	: 75

Objectives:

1. To understand some applications of Graph Theory to Practical Problems and Branches of Mathematics.
2. To practice creative problem solving and improve skills in this area.
3. To see the simplicity of Graph Theory and combinatorics at make them ubiquitous.
4. To make Graph Theory easier and to be creative in Research fields .
5. To study domination in graphs.

Unit I :Matchings

(15 Hours)

Matchings – Definitions – examples - Matchings and Coverings in Bipartite Graphs – Perfect Matchings.

Unit II : Edge Colourings, Independent Sets and Cliques

(15 Hours)

Edge Chromatic Number – Vizing's Theorem – Independent sets – Ramsey's Theorem.

Unit III : Vertex Colourings

(15 Hours)

Chromatic Number – Brook's Theorem – Hajo's Conjecture – Chromatic Polynomials.

Unit IV : Planar Graphs

(15 Hours)

Plane and Planar Grpahs – Dual Graphs – Euler's Formulae – Bridges – Kuratowski's Theorem – The Five - Colour Theorem – The Four - Colour conjuncture.

Unit V : Domination in Graphs

(15 Hours)

Dominating sets in Graphs – Sets of Representatives - Applications of Domination Numbers.

Text Book:

[1] "Graph Theory with Applications" – J.A. Bondy –U.S.R Murty – The Macmillan Press Ltd.

[2] "Fundamentals of Domination in Graphs", T.W.Haynes, S.Hedetniemi and P. J. Slater, 1998, CRC Press.

Unit – I: Chapter 5, Sec: 5.1 – 5.3 [1]

Unit – II: Chapter 6, Sec: 6.1 – 6.2 and Chapter 7, Sec: 7.1 – 7.2[1]

Unit – III: Chapter 8, Sec: 8.1 – 8.4[1]

Unit – IV: Chapter 9, Sec: 9.1 – 9.6 [1]

Unit – V: Chapter 1, Sec: 1.1 – 1.9 [2]

[1] “Graph Theory” – Harary, F – Addison - Wesley - 1969.
[2] “Graph Theory with Applications to Engineering and Computer” – Narasingh Deo –
Prentice Hall of India Pvt. Ltd. – New Delhi - 2000.

- <http://mathforum.org>,
- <http://ocw.mit.edu/ocwweb/Mathematics>,
- <http://www.opensource.org>, www.mathpages.com

The learners would have the ability to,

CO1	Understand matching and coverings	K6
CO2	Acquire the knowledge of edge coloring and Ramsey's Theorem	K1
CO3	Know about chromatic number and chromatic polynomials	K3
CO4	Characterize planar graphs and solve problems related to trees	K2
CO5	Have a deep knowledge of Dominating and its applications	K4

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create

Title of the Course: Graph Theory and Applications							Course Code: P1R3MADSE1:2			
Course Outcomes (COs)	Programme Outcomes (POs)						Programme Specific Outcomes (PSOs)			Mean Score of Cos
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	
CO1	3	2	3	2	2	3	2	1	3	2.3
CO2	3	2	3	2	2	2	1	3	2	2.2
CO3	3	3	2	3	3	2	1	3	3	2.5
CO4	2	3	2	3	3	2	1	2	3	2.3
CO5	3	2	2	2	3	2	1	3	2	2.2
		Mean Overall Score								2.3
		Result								High

Title of the Course	:	Formal Languages and Automata theory		
Category of the Course	:	DSE COURSE	Semester	: I
Course Code	:	P1R3MADSE1:3	Nature of the Course	: Employability
Marks	:	CIA:25+Ext:75= 100	Hrs/Week	: 5
Credits	:	3	Total Inst. Hrs.	: 75

Objectives:

1. To construct finite state machines and the equivalent regular expressions.
2. To provide the equivalence of languages described by finite state machines and regular expressions.
3. To construct pushdown automata and the equivalent content tree grammars.
4. To construct model for regular languages
5. To study finite automata and regular expressions.

Unit I: Mathematical Background and Languages (15 Hours)

Sets – Relations – Graphs – proofs – Formalization of languages – Expressions and grammars: Expressions – grammars.

Unit II: Automata (15 Hours)

Conceptualization of automata – Transducers – computability – Exercise.

Unit III: Regular Languages (15 Hours)

Regular Expressions – Finite Automata: Basic Definitions – Elimination of ϵ -moves.

Unit IV: Models for Regular Languages (15 Hours)

Determinism – simplification- Minimization.

Unit V: Finite Automata and regular expressions (15 Hours)

From regular expressions to finite automata: Conversion of regular expressions to finite automata – Scanning.

Text Book:

[1] “Automata and Languages – Theory and Applications”, Alexander Meduna, Springer international Edition, 2005.

Unit I : Part I sec 0.1 to 0.4 and Chapter 1 sec 1.1, 1.2: 1.2.1 and 1.2.2 only

Unit II : Chapter 2 sec 2.1 to 2.3

Unit III : Chapter 3 sec 3.1, 3.2: 3.2.1 and 3.2.2 only

Unit IV : Chapter 3 sec 3.2: 3.2.3 to 3.2.5

Unit V : Chapter 3 sec 3.3: 3.3.1 – 3.3.1.1 and 3.3.1.2

Reference Book:

[1] “Introduction to Automata Theory, Languages and Computation”, John E. Hopcroft, Rajeev Motwani and Jeffrey D. Ullman, Pearson publications, 3rd Edition.

Outcomes:

The learners would have the ability to,

CO1	Apply Automata concepts and techniques in designing systems that address real world problems	K6
CO2	Understand the connection between language and computation	K1
CO3	Analyze the computational strengths and weakness of these machines	K3
CO4	Demonstrate an in-depth understanding of theories, concepts and techniques in automata and their link to computation.	K2
CO5	The conversion of regular expression to finite automata – scanning	K4

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create

CO\PO Mapping:

Title of the Course: Formal Languages and Automata Theory							Course Code: P1R3MADSE1:3			
Course Outcomes (COs)	Programme Outcomes (POs)						Programme Specific Outcomes (PSOs)			Mean Score of COs
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	
CO1	3	2	1	3	2	1	3	1	3	2.0
CO2	2	2	3	2	2	2	1	3	2	2.1
CO3	3	2	2	2	3	2	1	1	2	2.0
CO4	2	3	2	3	2	2	1	2	3	2.2
CO5	3	2	3	2	3	3	1	3	2	2.4
		Mean Overall Score								2.1
		Result								High

Title of the Course	:	Programming in C++ and Numerical Methods		
Category of the Course	:	DSE COURSE	Semester	: I
Course Code	:	P1R3MADSE1:4P	Nature of the Course	: Employability
Marks	:	CIA:40+Ext:60= 100	Hrs/Week	: 5
Credits	:	3	Total Inst. Hrs.	: 75

Objectives:

- To gain Basic knowledge in C++ Programming such as, Expressions, Structure, Classes and Objects
- To solve problems in C++ using different numerical methods
- To make the mathematical calculations simpler
- To give the awareness of the object oriented programming
- To make applications using C++ programs

LIST OF PRACTICALS

Algebraic and transcendental equations

1. To find the roots of an equation(algebraic or transcendental) by Bisection Method.
Links: C++ Program Lab Write-Up(Flow-Chart and Algorithm)
2. To find the roots of an equation(algebraic or transcendental) by Secant Method.
Links: C++ Program Lab Write-Up(Flow-Chart and Algorithm)
3. To find the roots of an equation(algebraic or transcendental) by Newton-Raphson Method.
Links: C++ Program Lab Write-Up(Flow-Chart and Algorithm)

Linear Equations & Eigen value Problem

1. To find the roots of linear equations by Gauss Elimination Method.
Links: C++ Program Lab Write-Up(Flow-Chart and Algorithm)
2. To find the roots of linear equations by Gauss Seidel Iterative Method.
Links: C++ Program Lab Write-Up(Flow-Chart and Algorithm)
3. To find the eigen value and eigen vector of matrix by iterative method.
Links: C++ Program Lab Write-Up(Flow-Chart and Algorithm)

Interpolation:

1. To find the forward difference table from a given set of data values.
Links: C++ Program Lab Write-Up(Flow-Chart and Algorithm)
2. To find the backward difference table from a given set of data values.
Links: C++ Program Lab Write-Up(Flow-Chart and Algorithm)

Curve fitting

1. To fit a straight line to a given set of data values.
Links: C++ Program Lab Write-Up(Flow-Chart and Algorithm)
2. To fit a polynomial to a given set of data values.
Links: C++ Program Lab Write-Up(Flow-Chart and Algorithm)
3. To fit an exponential function to a given set of data values.
Links: C++ Program Lab Write-Up(Flow-Chart and Algorithm)

Differentiation

1. To find the first and second derivatives near the beginning of the table values of (x,y).
Links: C++ Program Lab Write-Up(Flow-Chart and Algorithm)
2. To find the first and second derivatives near the end of the table values of (x,y).
Links: C++ Program Lab Write-Up(Flow-Chart and Algorithm)

Integration

1. To evaluate a definite integral by trapezoidal rule.
Links: C++ Program Lab Write-Up(Flow-Chart and Algorithm)
2. To evaluate a definite integral by Simpson's 1/3 Rule.
Links: C++ Program Lab Write-Up(Flow-Chart and Algorithm)

- To evaluate a definite integral by Simpson's 3/8 Rule.

Links: C++ Program Lab Write-Up(Flow-Chart and Algorithm)

Differential Equations

- To solve a differential equation by Euler's Method.

Links: C++ Program Lab Write-Up(Flow-Chart and Algorithm)

- To solve a differential equation by Modified Euler's Method.

Links: C++ Program Lab Write-Up(Flow-Chart and Algorithm)

Text Books:

- "Object-Oriented Programming with C++", E. Balaguruswamy, Sixth Edition, Tata McGraw-Hill Publishing Company Limited.
- "Programming in C & C++", Pooja Srivastava, Khanna Publishing House, First Edition 2014.
- Numerical Recipes in C W. H. Press, B. P. Flannery, S. A. Teukolsky, W. T. Vetterling www.nr.com

Reference Books

- "Object Oriented Programming with C++" by S.S.Vinod Chandra, New age.
- "C++ Programming", D.S. Malik,

e -Resources:

- <https://nptel.ac.in/courses/106/105/106105151/>
- https://youtu.be/1rJZb_Ugc4E
- <https://books.google.com.et/books?id=pDWqpqCGLK4C&lpq=PP1&pg=PA14#v=onepage&q&f=false>

Outcomes:

The learners would have the ability to,

- | | | |
|-----|---|--------|
| CO1 | Understand and apply the C++ structure, tokens, expressions, control structures. | K2, K3 |
| CO2 | Ability to declare various prototyping, friend and virtual functions. | K3 |
| CO3 | Create Classes, objects, arrays of objects, constructors, and Destructors. | K3, K4 |
| CO4 | Analyze over loading operators and inheritance. | K4 |
| CO5 | Deliberate files, pointers and templates. Create, design and develop quality programs in C++. | K4, K5 |

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create

CO\PO Mapping:

Title of the Course: Programming in C++and Numerical Methods							Course Code: P1R3MADSE1:4P			
Course Outcomes (COs)	Programme Outcomes (POs)						Programme Specific Outcomes (PSOs)			Mean Score of Cos
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	
CO1	3	3	3	3	1	3	3	2	1	2.4
CO2	3	2	3	3	2	3	3	1	3	2.5
CO3	3	2	3	3	2	3	3	2	1	2.3
CO4	3	1	3	3	3	2	1	2	3	2.3
CO5	3	2	2	3	3	1	2	3	3	2.4
							Mean Overall Score			2.4
							Result			High

Title of the Course	:	Lie Groups and Lie Algebras		
Category of the Course	:	DSE COURSE	Semester	: I
Course Code	:	P1R3MADSE2:1	Nature of the Course	: Skill Development
Marks	:	CIA:25+Ext:75= 100	Hrs/Week	: 5
Credits	:	3	Total Inst. Hrs.	: 75

Objectives:

1. To construct finite state machines and the equivalent regular expressions.
2. To provide the equivalence of languages described by finite state machines and regular expressions.
3. To construct pushdown automata and the equivalent content tree grammars.
4. To construct model for regular languages
5. To study finite automata and regular expressions.

Unit : I Lie Algebras

(15 Hours)

Definitions and basic properties – Nilpotent Lie algebras: Engel's theorem – Solvable Lie algebras: Lie's theorem – Semisimple Lie algebras – Representation of Lie algebras: Weyl's Theorem.

Unit: II Lie Algebras Ctd

(15 Hours)

Reductive Lie algebras: Levi sub algebras; Ado's theorem – Root systems and their classification – Split semi simple lie algebras – Representation of split semi simple Lie algebras.

Unit: III Algebraic groups

(15 Hours)

Algebraic groups – Representations of algebraic groups, tensor categories – The lie algebra of an algebraic group – Semisimple algebraic groups.

Unit: IV Algebraic groups and Lie Groups

(15 Hours)

Reductive groups – Algebraic groups with unipotent centre – Real Algebraic groups – Classical Algebraic Groups - Lie groups – Lie groups and algebraic groups – Compact topological groups.

Unit: V Arithmetic Subgroups

(15 Hours)

Commensurable groups – Definitions and examples – Independence of ρ and L – Behaviour with respect to homomorphisms – Adelic description of Congruence subgroups – Applications to manifolds – Torsion-free arithmetic groups – A fundamental domain for SL_2 – Application to quadratic forms – “Large” discrete subgroups – Reduction theory.

Text Book:

1. Lie Algebras, Algebraic Groups and Lie Groups, J. S. Milne, 2013

Unit I: Chapter 1, Section 1 to 5

Unit II: Chapter 1, Section 6 to 9

Unit IV: Chapter 2, Sections 5 to 8, Chapter 3, Sections 1 to 3

Reference Books:

1. J.P. Serre, "Complex Semi Simple Lie Algebras"
2. J.E. Humphreys, "Introduction to Lie Algebras and Representation Theory"
3. A.L. Onishchik, E.B. Vinberg, "Lie Groups and Algebraic Groups"

1. <https://www.math.stonybrook.edu/~kirillov/mat552/liegroups.pdf>
2. <https://link.springer.com/book/10.1007/978-3-540-70634-2>

The learners would have the ability to,

- K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create**

Title of the Course: Lie Groups and Lie Algebras							Course Code: P1R3MADSE2:1			
Course Outcomes (COs)	Programme Outcomes (POs)						Programme Specific Outcomes (PSOs)			Mean Score of COs
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	
CO1	2	2	2	1	2	2	3	2	1	1.9
CO2	2	2	2	1	3	3	3	2	1	2.1
CO3	3	2	2	1	1	2	3	2	1	1.9
CO4	3	2	3	1	2	2	3	2	1	2.1
CO5	3	2	3	1	3	2	3	2	1	2.2
		Mean Overall Score								2.0
		Result								High

Title of the Course	: Mathematical Programming		
Category of the Course	: DSE COURSE	Semester	: I
Course Code	: P1R3MADSE2:2	Nature of the Course	: Employability
Marks	: CIA:25+Ext:75= 100	Hrs/Week	: 5
Credits	: 3	Total Inst. Hrs.	: 75

Objectives:

1. To describe the need and importance of Operations Research
2. To discuss the basic concepts and techniques for solving particular Operations Research problem
3. To develop a research proposal using the general approach for Operations Research
4. To maximize the utility of limited resources
5. To Characterize the Queueing System

Unit I: Integer Programming (15 HOURS)

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– Mixed Integer LPP – Branch-and-Bound Technique.

Unit II: Dynamic Programming (15 HOURS)

Introduction – The Recursive equation approach – Characteristics of Dynamic programming – Dynamic programming Algorithm – Solution of Discrete D.P.P – Some applications – Solution of LPP by Dynamic programming.

Unit III: Queuing Theory (15 HOURS)

Introduction–Queuing System–Elements Of Queuing System–Operating Characteristics of Queuing System–Classification of Queuing Models– Model–I(M/M/1):(∞/FIFO), Model–III(M/M/1) : (N/FIFO), Model–V(M/M/C):(∞/FIFO), Model–VI (M/M/C):(N/FIFO) - Problems in above four models.

Unit IV: Non-Linear Programming (15 Hours)

Introduction – Formulation a NLPP – General NLPP – Constrained Optimization with equality constraints – Constrained Optimization with inequality constraints Graphical Solution – Saddle point problem – Saddle points and NLPP.

Unit V: Non-Linear Programming – Methods (15 Hours)

Introduction – Graphical Solution – Kuhn-Tucker conditions with non-negative constraints – Quadratic Programming – Wolfe's Modified Simplex Method – Beale's Method- Separable Convex Programming – Separable Programming Algorithm.

Text Book:

1. Operations Research, Kanti Swarup, P.K. Gupta, Man Mohan, Sultan Chand & Sons, Educational Publishers, New Delhi.

Unit I: Chapter 7, Section 7.1 to 7.7

Unit II: Chapter 13, Section 13.1 to 13.7

Unit III: Chapter 21, Sections 21.1 – 21.4, 21.7 – 21.9.

Unit IV: Chapter 27, Sections 27.1 – 21.7.

Unit V: Chapter 28, Sections 28.1 – 28.8.

Reference Books:

- Operations Research**, Hamdy A. Taha, (sixth edition) Prentice-Hall of India Private Limited, New Delhi, 1997.
- Operations Research**, Panneerselvam. R, 2nd Edition, PHI Learning Private Limited, Delhi, 2015
- Operations Research**, Prem Kumar Gupta. Er, Hira D.S. 7th Edition, S.Chand & Company Pvt.Ltd.2014.

e - Resources:

- http://www.math.chalmers.se/Math/Grundutb/CTH/tma947/0405/kompendium_sub.pdf
- <https://core.ac.uk/download/pdf/153409843.pdf>
- <https://youtu.be/4H9dMn919cs>

Outcomes:

The learners would have the ability to,

CO1	Understand the different methods of I.P.P method and mixed integer LPP.	K2
CO2	Acquire knowledge about Dynamic programming.	K2
CO3	Study about Inventor with price breaks.	K4
CO4	Understand the concepts of Queuing system – Poisson Queuing system.	K2
CO5	Discuss Branch and Bound Techniques.	K4

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create

CO\PO Mapping:

Title of the Course: Mathematical Programming							Course Code: P1R3MADSE2:2			
Course Outcomes (COs)	Programme Outcomes (POs)						Programme Specific Outcomes (PSOs)			Mean Score of COs
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	
CO1	3	1	3	2	2	1	3	2	2	2.1
CO2	2	2	3	2	1	3	1	3	2	2.1
CO3	2	3	3	3	2	3	3	3	2	2.7
CO4	3	2	2	2	3	3	2	1	3	2.3
CO5	2	2	2	3	3	3	2	2	3	2.4
							Mean Overall Score			2.3
							Result			High

Title of the Course	: Fuzzy Sets and their Applications		
Category of the Course	: DSE COURSE	Semester	: I
Course Code	: P1R3MADSE2:3	Nature of the Course	: Skill Development
Marks	: CIA:25+Ext:75= 100	Hrs/Week	: 5
Credits	: 3	Total Inst. Hrs.	: 75

Objectives:

1. To provide the knowledge of operations on fuzzy sets
2. To introduce the mathematical field on the concept of a fuzzy numbers
3. To enable the students to develop fuzzy relations
4. To use direct methods with one expert and multiple experts
5. To know the applications of fuzzy methodology

Unit I: From Crisp Sets to Fuzzy Sets (15 HOURS)

Introduction – Crisp Sets : An overview – Fuzzy sets : Basic Types - Fuzzy sets : Basic Concepts.

Unit II : Operation on Fuzzy Sets (15 HOURS)

Types of Operations – Fuzzy complements – Fuzzy Intersections – t norms - Fuzzy unions – t conforms – Combinations of Operations.

Unit III : Fuzzy Relations (15 HOURS)

Crisp versus Fuzzy Relations – Projections and cylindric extensions – Binary Fuzzy Relations – Binary Relations on a Single set – Fuzzy Equivalence Relations– Fuzzy Compatibility Relations – Fuzzy Ordering Relations – Fuzzy morphisms.

Unit IV : Decision making in Fuzzy environments (15 HOURS)

General Discussion – Individual Decision making – multi person decision making – multi criteria decision making – multi stage decision making – fuzzy ranking methods – fuzzy linear programming.

Unit V : Application (15 HOURS)

Introduction - Medicine – Economics – Fuzzy Systems and Genetic Algorithms – Fuzzy Regression – Interpersonal Communication – Other Applications.

Text Book:

1. **Fuzzy sets and Fuzzy Logic Theory and Applications**, George J.Klir and Bo Yuan , PHI Learning Private Limited, New Delhi (2009).

Unit I: Chapter 1, Section 1.1 to 1.4

Unit II: Chapter 3, Section 3.1 to 3.5

Unit III: Chapter 5, Section 5.1 to 5.8

Unit IV: Chapter 15, Section 15.1 to 15.7

Unit V: Chapter 17, Section 17.1 to 17.7

Reference Books:

1. **Fuzzy Set Theory, Fuzzy Logic and their Applications**, A.K.Bhargava,S.

2. **Fuzzy sets and their application**, K.Pundir and R.Pundir, - Pragati edition 2012.
3. **Fuzzy set theory and its applications**, H.J.Zimmermann, Springer, 2012.

1. <https://cours.etsmtl.ca/sys843/REFS/Books/ZimmermannFuzzySetTheory2001.pdf>
2. <https://shahroodut.ac.ir/fa/download.php?id=1111124084>
3. <https://nptel.ac.in/courses/108/104/108157/>

The learners would have the ability to,

CO1	Discuss the types of operations on fuzzy sets, t- norms and fuzzy arithmetic.	K1
CO2	Study knowledge of fuzzy equivalence relations.	K2
CO3	Identify fuzzy relations, binary fuzzy relations and fuzzy equivalence relations.	K2
CO4	Gain the knowledge of constructing fuzzy sets and operations on fuzzy sets.	K4
CO5	Apply the fuzzy models to natural science and technical fields.	K3

CO\PO Mapping:

Title of the Course: Fuzzy Sets and their Applications							Course Code: P1R3MADSE2:3			
Course Outcomes (COs)	Programme Outcomes (POs)						Programme Specific Outcomes (PSOs)			Mean Score of Cos
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	
CO1	2	1	3	3	3	2	3	2	2	2.3
CO2	3	3	2	2	3	3	2	2	3	2.5
CO3	2	3	1	2	2	1	3	3	1	2.0
CO4	2	3	1	2	3	2	2	3	2	2.2
CO5	2	3	3	2	1	2	3	1	3	2.1
		Mean Overall Score								2.2
		Result								High

Title of the Course	: Discrete Mathematics		
Category of the Course	: DSE COURSE	Semester	: I
Course Code	: P1R3MADSE2:4	Nature of the Course	: Skill Development
Marks	: CIA:25+Ext:75= 100	Hrs/Week	: 5
Credits	: 3	Total Inst. Hrs.	: 75

Objectives:

1. To study the basic concepts of Algebra.
2. To introduce a number of Discrete mathematics structure found to be serving as tools even today in the development of theoretical Computer science.
3. To solve problems occurred in the development of programming languages.
4. To know the importance of discrete structures towards simulation of problems in computer science and engineering in near future.
5. To provide the knowledge of recurrence relations.

UNIT – I Mathematical Logic (15 hours)

Statement and notations – Connectives – Well formed, Logic operators, Truth tables - Tautology – Normal forms, Theory of inference for the statement calculus

UNIT – II Lattices and Boolean Algebra (15 hours)

Lattices as a partial ordering sets – Definitions and Examples – Some properties of lattices – Lattices as algebraic systems, Sub Lattices – Discrete product and homomorphism – Some special Lattices – Boolean Algebra – Definition – sub algebra – Direct product and homomorphism – Boolean functions – Representation and minimization of Boolean functions – Karnaugh Map.

UNIT – III Generating Function and Recurrence Relations (15 hours)

Generating Function – Recurrence Relations – linear Recurrence relation with constant coefficients – Homogeneous solutions – Particular solutions –Solution by the method of Generating Functions.

UNIT – IV Languages and Grammar (15 hours)

Introduction- Language- Operations on Languages- Power of a language- Regular expression and Regular sets-Regular Languages- Grammar- Language L(G) of a grammar- Types of structure grammars- Derivation tree of context free grammars- Backus Naur form- Finite state Machine- State table and state diagram- Input and Output tapes- Machine minimization.

UNIT – V Automata (15 hours)

Deterministic finite state Automata-Transition Graph- Language Accepted- Finite state Language- Kleene's theorem- Non Deterministic finite state automata- Pumping Lemma

[1] Tremly. J.P and Manohar.P.,Discrete Mathematics Structures with Application to computer Science, MCGraw Hill 1987.

UNIT – I : Chapter I - Section 1.1-1.4 except (1.4.4) [1]

UNIT – III: Chapter 5- Section 14 -19 [2]

UNIT – V : Chapter 9 – Section 19-25 [2]

1) James C. Abboh, Sets, Lattices and Boolean Algebra, Allya and Bacon Bortou, 1969.

Outcomes:

CO1 Understand the ideas of relations and functions. K2

CO3	Discuss semi groups and normal subgroups.	K4
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CO4	Have a deep knowledge of lattices and its applications	K2
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C05 Know about recurrence relations and generating functions. K2

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 – Create

Title of the Course: Discrete Mathematics							Course Code: P1R3MADSE2:4			
Course Outcomes (COs)	Programme Outcomes (POs)						Programme Specific Outcomes (PSOs)			Mean Score of Cos
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	
CO1	3	3	3	2	3	2	3	1	1	2.3
CO2	3	2	2	1	-	-	3	2	1	1.5
CO3	3	2	1	2	-	-	2	3	2	1.7
CO4	2	3	1	2	1	1	3	2	2	1.9
CO5	2	3	2	2	1	1	2	2	3	2.0
		Mean Overall Score								1.9
		Result								Medium

Title of the Course	: Advanced Algebra		
Category of the Course	: CORE COURSE	Semester	: II
Course Code	: P2R3MACC4	Nature of the Course	: Skill Development
Marks	: CIA:25+Ext:75= 100	Hrs/Week	: 6
Credits	: 5	Total Inst. Hrs.	: 90

Objectives:

- To develop computational skill in abstract algebra
- To study field extension, finite fields, division rings
- To have a brief study of roots of polynomials
- To discuss about Galois Theory
- To apply the radicals in solvability

Unit I: Extension fields (15 HOURS)

Extension fields – Transcendence of e .

Unit II: Polynomials (15 HOURS)

Roots or Polynomials.- More about roots

Unit III: Galois Theory (15 HOURS)

Elements of Galois theory.

Unit IV: Fields (15 HOURS)

Finite fields - Wedderburn's theorem on finite division rings.

Unit V: Radicals (15 HOURS)

Solvability by radicals - A theorem of Frobenius - Integral Quaternion and the Four - Square theorem..

Text Books:

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

Unit I : Chapter 5 Sec 5.1 to 5.2

Unit II : Chapter 5 Sec 5.3 and 5.5

Unit III : Chapter 5 Sec 5.6

Unit IV : Chapter 7 Sec 7.1 and 7.2 (Theorem 7.2.1 only)

Unit V : Chapter 5 Sec 5.7 (omit Lemma 5.7.1, Lemma 5.7.2 and Theorem 5.7.1) Chapter 7 Sec 7.3 and 7.4

Reference Books:

1. M. Artin, *Algebra*, Prentice Hall of India, 1991.
2. P.B. Bhattacharya, S.K. Jain, and S.R. Nagpaul, *Basic Abstract Algebra* (II Edition) Cambridge University Press, 1997. (Indian Edition)
3. I.S. Luther and I.B.S. Passi, *Algebra*, Vol. I – Groups (1996); Vol. II *Rings*, Narosa Publishing House, New Delhi, 1999
4. D.S. Malik, J.N. Mordeson and M.K. Sen, *Fundamental of Abstract Algebra*, McGraw Hill (International Edition), New York. 1997.

e - Resources:

1. <http://mathforum.org>, <http://ocw.mit.edu/ocwweb/Mathematics>,
2. <http://www.opensource.org>, www.algebra.com

Outcomes:

The learners would have the ability to,

CO1	Prove theorems applying algebraic ways of thinking	K3
CO2	Connect groups with graphs and understanding about Hamiltonian graphs.	K2
CO3	Compose clear and accurate proofs using the concepts of Galois Theory	K3
CO4	Bring out insight into Abstract Algebra with focus on axiomatic theories.	K5
CO5	Demonstrate knowledge and understanding of fundamental concepts including extension fields, Algebraic extensions, Finite fields, Class equations and Sylow's theorem.	K2

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate;K6 - Create

Title of the Course: Advanced Algebra							Course Code: P2R3MACC4			
Course Outcomes (COs)	Programme Outcomes (POs)						Programme Specific Outcomes (PSOs)			Mean Score of COs
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	
CO1	3	1	3	2	3	3	3	2	1	2.3
CO2	2	1	3	1	3	3	3	2	1	2.1
CO3	3	2	3	1	3	3	3	2	1	2.3
CO4	1	2	3	2	3	3	3	2	1	2.2
CO5	3	1	2	3	3	3	3	2	1	2.3
		Mean Overall Score								2.2
		Result								High

Title of the Course	: Real Analysis-II	Semester	: II
Category of the Course	: CORE COURSE	Nature of the Course	: Skill Development
Course Code	: P2R3MACC5	Hrs/Week	: 6
Marks	: CIA:25+Ext:75= 100	Total Inst. Hrs.	: 90
Cred	: 5		
Its			

Objectives

- To deal primarily with limit and convergence
- To discuss vector valued functions and functions with values in an arbitrary metricspace
- To confine our attention to real functions defined on intervals or segments
- To understand numerical series and power series
- To focus on continuity and connectedness

Unit I: Measures on the Real line (15 HOURS)

Lebesgue Outer Measure - Measurable sets - Regularity - Measurable Functions - Borel and Lebesgue Measurability

Unit II: Integration of Functions of a Real Variable (15 HOURS)

Integration of Non- negative functions - The General Integral - Riemann and Lebesgue Integrals

Unit III: Fourier series and Fourier integrals (15 HOURS)

Introduction - Orthogonal system of functions - The theorem on best approximation - The Fourier series of a function relative to an orthonormal system - Properties of Fourier Coefficients - The Riesz-Fischer Theorem - The convergence and representation problems in for trigonometric series - The Riemann - Lebesgue Lemma - The Dirichlet Integrals - An integral representation for the partial sums of Fourier series - Riemann's localization theorem - Sufficient conditions for convergence of a Fourier series at a particular point - Cesaro summability of Fourier series- Consequences of Fejes's theorem - The Weierstrass approximation theorem

Unit IV: Multivariable Differential Calculus (15 HOURS)

Introduction - The Directional derivative - Directional derivative and continuity - The total derivative - The total derivative expressed in terms of partial derivatives - The matrix of linear function - The Jacobian matrix - The chain rule - Matrix form of chain rule - The mean - value theorem for differentiable functions - A sufficient condition for differentiability - A sufficient condition for equality of mixed partial derivatives - Taylor's theorem for functions of $\mathbb{R}^n$ to $\mathbb{R}^1$

Unit V: Implicit Functions and Extremum Problems (15 HOURS)

Functions with non-zero Jacobian determinants – The inverse function theorem The Implicit function theorem-Extrema of real valued functions of severable variables-Extremum problems with side conditions.

Text Books:

- [1] G. de Barra, *Measure Theory and Integration*, Wiley Eastern Ltd., New Delhi, 1981.
- [2] Tom M. Apostol *Mathematical Analysis*, 2nd Edition, Addison-Wesley Publishing Co. Inc. New York, 1974.

- Unit I** : Chapter 2 Sec 2.1 to 2.5 [1]
Unit II : Chapter 3 – 3.1, 3.2 and 3.4 [1]
Unit III : Chapter 11.1 to 11.15 [2]
Unit IV : Chapter 12.1 to 12.14 [2]
Unit V : Chapter 13.1 to 13.7 [2]

Reference Books:

1. Burkill J.C. *The Lebesgue Integral*, Cambridge University Press, 1951.
2. Munroe, M.E. *Measure and Integration*. Addison-Wesley, Mass. 1971.
3. Roydon, H.L. *Real Analysis*, Macmillan Pub. Company, New York, 1988.
4. Rudin, W. *Principles of Mathematical Analysis*, McGraw Hill Company, New York, 1979.
5. Malik, S.C. and Savita Arora. *Mathematical Analysis*, Wiley Eastern Ltd. New Delhi, 1991.
6. Sanjay Arora and Bansi Lal, *Introduction to Real Analysis*, Satya Prakashan, New Delhi, 1991

e – Resources:

- <http://mathforum.org>,
- <http://ocw.mit.edu/ocwweb/Mathematics>,
- <http://www.opensource.org>

Outcomes:

The learners would have the ability to,

- | | | |
|-----|---|----|
| CO1 | Understand and describe the basic concepts of Fourier series and Fourier integrals with respect to orthogonal system. | K2 |
| CO2 | Analyze the representation and convergence problems of Fourier series | K4 |
| CO3 | Analyze and evaluate the difference between transforms of various functions | K4 |
| CO4 | Formulate and evaluate complex contour integrals directly and by the fundamental theorem | K2 |
| CO5 | Apply the Cauchy integral theorem in its various versions to compute contour integration | K3 |

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 – Create
PROGRAM SPECIFIC OUTCOMES

Title of the Course: Real Analysis – II							Course Code: P2R3MACC5			
Course Outcomes (COs)	Programme Outcomes (POs)						Programme Specific Outcomes (PSOs)			Mean Score of Cos
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	
CO1	3	1	3	2	3	3	3	2	1	2.3
CO2	2	1	3	1	3	3	3	2	1	2.1
CO3	3	2	3	1	3	3	3	2	1	2.3
CO4	1	2	3	2	3	3	3	2	1	2.2
CO5	3	1	2	3	3	3	3	2	1	2.3
							Mean Overall Score			2.2
							Result			High

Title of the Course	:	Partial Differential Equations		
Category of the Course	:	CORE COURSE	Semester	: II
Course Code	:	P2R3MACC6	Nature of the Course	: Employability
Marks	:	CIA:25+Ext:75= 100	Hrs/Week	: 6
Credits	:	4	Total Inst. Hrs.	: 90

Objectives:

- To classify Partial differential equations into linear and nonlinear equation
- To understand the notion of linear independence and the notion of a fundamental set of solutions
- To use the Laplace transform to compute solutions of equations involving impulse functions
- To find solutions of the Boundary value problems
- To obtain the solution of heat equation and wave equation subject to boundary conditions

Unit I: Mathematical Models and Classification of second order equation (15 HOURS)

Classical equations-Vibrating string – Vibrating membrane – waves in elastic medium – Conduction of heat in solids – Gravitational potential – Second order equations in two independent variables – canonical forms – equations with constant coefficients – general solution

Unit II: Cauchy Problem (15 HOURS)

The Cauchy problem – Cauchy-Kowalewsky theorem – Homogeneous wave equation – Initial Boundary value problem- Non-homogeneous boundary conditions – Finite string with fixed ends – Non-homogeneous wave equation – Riemann method – Goursat problem – spherical wave equation – cylindrical wave equation.

Unit III: Method of Separation of Variables (15 HOURS)

Separation of variable- Vibrating string problem – Existence and uniqueness of solution of vibrating string problem- Heat conduction problem – Existence and uniqueness of solution of heat conduction problem – Laplace and beam equations.

Unit IV: Boundary Value Problems (15 HOURS)

Boundary value problems – Maximum and minimum principles – Uniqueness and continuity theorem – Dirichlet Problem for a circle, a circular annulus, a rectangle – Dirichlet problem involving Poisson equation – Neumann problem for a circle and a rectangle.

Unit V: Green's Function (15 HOURS)

The Delta function – Green's function – Method of Green's function – Dirichlet Problem for the Laplace and Helmholtz operators – Method of images and eigen functions – Higher dimensional problem – Neumann Problem

Text Book:

[1] TynMyint-U and LokenathDebnath, *Partial Differential Equations for Scientists and Engineers* (Third Edition), North Hollan, New York, 1987

Unit I: Chapter 2: Sect 2.1 to 2.6 and Chapter 3- Sec 3.1 to 3.4

Unit II: Chapter 4 : Sections 4.1 to 4.11

Unit III: Chapter 6 Sec 6.1 to 6.6

Unit IV: Chapter 8: Sec 8.1 to 8.9

Unit V : Chapter 10, Sec 10.1 to 10.9

Reference Books:

1. M.M.Smirnov, *Second Order partial Differential Equations*, Leningrad, 1964.
2. I.N.Sneddon, *Elements of Partial Differential Equations*, McGraw Hill, New Delhi, 1983.

- ### e - Resources:

- ### Outcomes:

CO1	To understand and classify second order equations and find general solutions	K6
CO2	To analyse and solve wave equations in different polar coordinates	K1
CO3	To solve Vibrating string problem, Heat conduction problem, to identify and solve Laplace and beam equations	K3
CO4	To apply maximum and minimum principle's and solve Dirichlet, Neumann problems for various boundary conditions	K2
CO5	To apply Green's function and solve Dirichlet, Laplace problems, to apply Helmholtz operation and to solve Higher dimensional problem	K4

PROGRAM SPECIFIC OUTCOMES

Title of the Course: Partial Differential Equations							Course Code: P2R3MACC6			
Course Outcomes (COs)	Programme Outcomes (POs)						Programme Specific Outcomes (PSOs)			Mean Score of Cos
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	
CO1	3	1	3	2	3	3	3	2	1	2.3
CO2	2	1	3	1	3	3	3	2	1	2.1
CO3	3	2	3	1	3	3	3	2	1	2.3
CO4	1	2	3	2	3	3	3	2	1	2.2
CO5	3	1	2	3	3	3	3	2	1	2.3
		Mean Overall Score								2.2
		Result								High

Title of the Course	:	Algebraic Topology			
Category of the Course	:	ELECTIVE	Semester	:	II
Course Code	:	P2R3MADSE3:1	Nature of the Course	:	Employability
Marks	:	CIA:25+Ext:75= 100	Hrs/Week	:	4
Credits	:	3	Total Inst. Hrs.	:	60

Objectives:

1. To introduce the notion of homotopy and covering spaces.
2. To Demonstrate fundamental group of circle and punctured plane.
3. To Study the essential and Inessential maps.
4. To Know the Jordan separation theorem.
5. To study the Jordan curve theorem.

UNIT: I

Homotopy of Paths-The Fundamental Group-Covering spaces.

UNIT: II

The Fundamental group of the circle – The Fundamental group of the punctured plane- The Fundamental group of S^n .

UNIT: III

Fundamental groups of surfaces- Essential and Inessential maps-The Fundamental theorem of algebra.

UNIT: IV

Homotopy type – The Jordan separation theorem.

UNIT: V

The Jordan Curve Theorem.

TEXTBOOK:

1. Topology – A first course by James R.Munkres, Prentice-Hall of India Pvt Ltd, Third print.

REFERENCE BOOKS:

1. A basic course in Algebraic Topology by William S Massey, Springer , First Edition.
2. Lecture notes on Elementary Topology and Geometry(Under graduate Texts in Mathematics) by I.M.Singer and John A Thorpe, Springer-Verlag, New York.
3. Elements of Algebraic Topology by James R. Munkres ,Addison-Wesley Publishing Company-1984

e-Resources:

1. <https://pi.math.cornell.edu/~hatcher/AT/AT.pdf>

2. <https://www.maths.ed.ac.uk/~v1ranick/papers/diecktop.pdf>

Outcomes:

The learners would have the ability to,

CO1	Explain the fundamental concepts of Algebraic topology.	K5
CO2	Demonstrate accurate and efficient use of Algebraic topology techniques.	K5
CO3	Demonstrate capacity for Mathematical Reasoning through analyzing, proving and explaining concepts from Algebraic topology.	K5
CO4	Applying problem solving using algebraic topology techniques.	K3
CO5	Acquire roles in modern mathematics and applied contexts	K2

PROGRAM SPECIFIC OUTCOMES

Title of the Course: Algebraic Topology							Course Code: P2R3MADSE3:1			
Course Outcomes (COs)	Programme Outcomes (POs)						Programme Specific Outcomes (PSOs)			Mean Score of COs
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	
CO1	3	1	3	2	3	3	3	2	1	2.2
CO2	2	1	3	1	3	3	3	2	1	2.1
CO3	3	2	3	1	3	3	3	2	1	2.3
CO4	1	2	3	2	3	3	3	2	1	2.2
CO5	3	1	2	3	3	3	3	2	1	2.3
		Mean Overall Score								2.2
		Result								High

Title of the Course	: Mathematical Statistics		
Category of the Course	: ELECTIVE	Semester	: II
Course Code	: P2R3MADSE3:2	Nature of the Course	: Employability
Marks	: CIA:25+Ext:75= 100	Hrs/Week	: 4
Credits	: 3	Total Inst. Hrs.	: 60

Objectives:

- To Compute and interpret a correlation coefficient and linear regression analysis
- To understand the relationship between point estimate and interval estimation
- To understand the purpose of analysis of variance
- To Achieve quality in production and service organizations, through the use of adequate statistical techniques
- To compute analysis data generated by functional experiments by using analysis of variance

Unit I: Correlation and Regression

(15 HOURS)

Multiple and partial correlation – Yule's Notation – Plane of Regression – Generalization – Properties of residuals – Coefficient of multiple correlation – Properties of multiple correlation-coefficient of partial correlation.

Unit II: Theory of Estimation

(15 HOURS)

Method of estimation – Method of maximum likelihood Estimation - Method of minimum variance – Method of moments – Confidence intervals and confidence limits – confidence intervals of large sample.

Unit III: Non-Parametric Methods

(15 HOURS)

Introductions - Advantages and Drawbacks of Non-parametric methods over parametric methods – Basic distribution – Wald - Wolfowitz Run test – test for randomness – median test – sign test – Mann-Whitney – Wilcoxon U Test.(Related simple problems)

Unit IV: Statistical Quality Control

(15 HOURS)

Introduction – Definition - Basic of statistical quality control – Benefits – Process Control and Product Control – Control limits – Specification Limits and Tolerance Limits- 3σ Control Limits – Tools for S.Q.C – Control charts for variables $\bar{X}$ and R Charts – Criterion for Detecting Lack of Control in $\bar{X}$ and R Charts – Interpretation- Control Charts for Standard Deviation σ Charts (Related simple problem)

Unit V: Analysis of Variance

(15 HOURS)

Introduction – One way classification – Statistical Analysis of the model – Two Way classification – Statistical Analysis of the Model – Analysis of Two-Way classified data with K- Observation per cell.(Related simple problems)

Text Books:

1. **Fundamentals of Mathematical Statistics**, S.C Gupta and V.K Kapoor, Sultan Chand & Sons, New Delhi, 2002.
2. **Fundamentals of Applied Statistics**, S.C. Gupta and V.K. Kapoor, Sultan Chand & Sons, New Delhi, 2007.

Unit I : Chapter : 12sec:12.4 to 12.11 [1]

Unit II : Chapter: 17 sec: 17.6 to 17.7.1 [1]

Unit III: Chapter:18 sec: 18.7 to 18.7.7 [1]

Unit IV: Chapter : 1 sec 1.1 to 1.8.4 [2]

Unit V: Chapter: 5 sec: 5.1 to 5.4[2]

Reference Books:

1. **Statistics for Management**, K.Subramani and A. Santha, Scitech Publications Pvt.Ltd., 2nd Edition.
2. **Mathematical Statistics**, J. N. Kapur, H .C. Saxena, Chand and Co. Publication Ltd.

e - Resources:

1. <http://dcpehvpmp.org/E-Content/Stat/FUNDAMENTAL%20OF%20MATHEMATICAL%20STATISTICS-S%20C%20GUPTA%20&%20V%20K%20KAPOOR.pdf>
2. http://www.ru.ac.bd/wp-content/uploads/sites/25/2019/03/201_04_01_Bijma-An-Introduction-to-Mathematical-Statistics-2017.pdf
3. <https://youtu.be/cjTgyRUaD1s>

Outcomes:

The learners would have the ability to,

CO1	Acquire the knowledge of multiple and partial correlation.	K2
CO2	Analyze the Theory of Estimation and methods of estimating a parameter through sampling and test their Goodness.	K5
CO3	Study the advantages and drawbacks of Non – parametric method and test for randomness.	K5
CO4	Demonstrate the ability to use the methods of statistical process control.	K3
CO5	Know about analysis of one way and two way classifications.	K2

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create
PROGRAM SPECIFIC OUTCOMES

Title of the Course: Mathematical Statistics							Course Code: P2R3MADSE3:2			
Course Outcomes (COs)	Programme Outcomes (POs)						Programme Specific Outcomes (PSOs)			Mean Score of COs
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	
CO1	3	2	3	3	3	2	3	3	3	2.8
CO2	3	2	3	3	3	3	2	1	3	2.5
CO3	3	1	2	3	2	3	3	1	2	2.2
CO4	3	1	2	3	3	3	1	2	2	2.2
CO5	3	1	2	2	3	3	2	2	3	2.3
							Mean Overall Score			2.4
							Result			High

Title of the Course	: Statistics data analysis using R- Programming		
Category of the Course	: ELECTIVE	Semester	: II
Course Code	: P2R3MADSE3:3P	Nature of the Course	: Employability
Marks	: CIA:40+Ext:60= 100	Hrs/Week	: 4
Credits	: 3	Total Inst. Hrs.	: 60

Objectives

- To learn the open source platform
- To be familiar with the workspace in R
- To understand the Arithmetic and Logarithms concepts
- To interact with Vectors
- To work with matrices in R-programming

Unit I: (15 HOURS)

Introduction to R programming: R-introduction – Uses of R – advantages and Disadvantages - Installing R – Installing R packages -Basic Syntax-Data types-Import and Export Data.

Unit II: (15 HOURS)

Data Structures and variables: Creating variables-Operators of R -Decision making of R – R-loops- Functions of R

Unit III: (15 HOURS)

Descriptive statistics in R: Mean, median, Variance, Standard Deviation and range.
Statistical Graphs in R: Histogram, Bar Charts, Pie Charts, Box plot, Scatter plot.
Sampling- simple Random Sampling, Stratified random sampling

Unit IV: (15 HOURS)

Coding of Discrete Distribution – Bernoulli, Binomial, Poisson, Geometric and hyper Geometric Distributions.

Unit V: (15 HOURS)

Coding of Continuous Distribution -Normal, Lognormal, Exponential, Cauchy , Gamma and beta Distributions

Text Book:

1. Gareth james, Daniela witten, Trevor hastie and Robert tibshirani (2017): An introduction to statistical learning with Applications in R
2. Mariz , L: Rizzo statistical computing with R , Chapman & hall/crc.

Reference Books:

[1] “The Book of R - A First Course in Programming and Statistics”,Tilman M. Davies, William Pollock publisher 2016.

Reference Books:

- [2] “R Fundamentals and Programming Techniques”, Thomas Lumley, R Core Development Team and UW Dept of Biostatistics, 2006.
- [3] “Hands-On Programming with R”, Garrett Grolemond, O’Reilly Media publication, 2014.

e-Resources:

1. <https://youtu.be/mqaffQZ-U3M>
2. https://cran.r-project.org/doc/contrib/Paradis-rdebuts_en.pdf

Outcomes:

The learners would have the ability to,

CO1	Show the installation of R programming Environment	K5
CO2	Utilize and R Data types for developing programs	K3
CO3	Make use of different R Data Structures	K3
CO4	Develop programming logic using R packages	K6
CO5	Analyze the datasets using R programming capabilities.	K4

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create

Relationship matrix for Course outcomes, Programme outcomes /Programme Specific Outcomes

Title of the Course: Statistics Data Analysis using R Programming							Course Code: P2R3MADSE3:3P			
Course Outcomes (COs)	Programme Outcomes (POs)						Programme Specific Outcomes (PSOs)			Mean Score of COs
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	
CO1	2	1	3	1	2	3	3	2	3	2.2
CO2	2	2	3	3	3	2	3	2	2	2.4
CO3	3	2	3	3	3	1	2	3	2	2.4
CO4	3	3	2	1	2	2	2	2	2	2.1
CO5	3	2	2	2	3	2	1	2	1	2.0
		Mean Overall Score								2.2
		Result								High

Title of the Course	: Tensor Analysis and Relativity		
Category of the Course	: ELECTIVE	Semester	: II
Course Code	: P2R3MADSE3:4	Nature of the Course	: Employability
Marks	: CIA:25+Ext:75= 100	Hrs/Week	: 4
Credits	: 3	Total Inst. Hrs.	: 60

Unit I: Tensor Algebra

(15 HOURS)

Systems of Different orders-Summation convention – Kronecker symbols – Transformation of coordinates in S_n – Invariants -Covariant and contravariant vectors –Tensors of Second order -mixed tensors -zero tensor -tensor field -Algebra of tensor – Equality of tensor-Symmetric and skew – symmetric tensor-outer multiplication – Quotient law of atensor- Reciprocal tensor of tensor – Relative tensor – cross products of vector

Unit II: Tensor Calculus

(15 HOURS)

Riemannian space – Christoffel symbols and their properties

Unit III: Tensor Calculus cont.

(15 HOURS)

Covariant Differentiation of tensors – Riemann – Christoffel curvature tensor – intrinsic Differentiation.

Unit IV: Special theory of Relativity

(15 HOURS)

Galilean transformation – Maxwell's Equation – The Ether theory – the principle of Relativity Relativistic kinematics – Lorentz Transformation equations – Events and simultaneity – Example – Einstein train – time dilation – Longitudinal Contraction – Invariant intensity – proper time and proper distance – world line – example – twin paradox -addition velocities – Relativistic doppler effects

Unit V: Relativistic Dynamics

(15 HOURS)

Momentum – energy – momentum – energy four vector -force -conversation of energy – mass and energy – example – inelastic collision – principle of equivalence – Lagrange and Hamiltonian formulations.

Text Book:

1. U.C. de , Absosali shaikh and joydeep Sengupta, tensor calculus, Narosa publishing house, New Delhi 2004
2. D. Greenwood, classical Dynamics, prentice hall of india , New Delhi 1985.

Unit I: Chapter 1, 1.1 -1.3, 1.7and 1.8, Chapter 2, 2.1 – 2.19[1]

Unit II: Chapter 3, 3.1-3.2[1]

Unit III: Chapter 3, 3.3-3.5[1]

Unit IV: Chapter 7, 7.1-7.2[2]

Unit V: Chapter 7, 7.3-7.4[2]

Reference Books:

- [1] “Tensor Calculus”,JL Synge and A.Schild, Toronto, 1949
- [2] “The Mathematical theory of Relativity”, A.S. Eddington, Cambridge University press, 1930.

e-Resources:

1. <https://youtu.be/mqaffQZ-U3M>
2. https://cran.r-project.org/doc/contrib/Paradis-rdebuts_en.pdf

The learners would have the ability to,

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create

Title of the Course: Tensor Analysis and Relativity							Course Code: P2R3MADSE3:4			
Course Outcomes (COs)	Programme Outcomes (POs)						Programme Specific Outcomes (PSOs)			Mean Score of Cos
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	
CO1	2	2	3	3	1	1	3	2	2	2.1
CO2	3	2	2	3	2	3	3	1	2	2.3
CO3	3	2	1	2	3	3	1	2	3	2.2
CO4	2	3	1	2	3	2	1	1	3	2.0
CO5	3	2	3	1	2	3	2	3	2	2.3
		Mean Overall Score								2.2
		Result								High

Title of the Course	: Wavelets		
Category of the Course	: ELECTIVE	Semester	: II
Course Code	: P2R3MADSE4:1	Nature of the Course	: Skill Development
Marks	: CIA:25+Ext:75= 100	Hrs/Week	: 4
Credits	: 3	Total Inst. Hrs.	: 60

Objectives:

- To present a mathematical introduction to the wavelet theory.
- To extend the students knowledge with continuous and discrete wavelet transforms.
- To develop and strengthen the wavelet base and wavelet packages, wavelets and singular integrals.
- To study the applications related for example to signal analysis, image processing.
- To discuss numerical analysis.

Unit I: Introduction

(15 HOURS)

Stationary and non-stationary signals, Signal representation using basis and frames, Brief introduction to Fourier transform and Short time Fourier transform, Time- frequency analysis, Bases of time frequency: orthogonal, Filter banks, Multi resolution formulation: Wavelets from filters.

Unit II: Continuous Wavelet Transform

(15 HOURS)

Continuous wavelet transform (CWT), Time and frequency resolution of the continuous wavelet transform, Construction of continuous wavelets: Spline, orthonormal, bi-orthonormal, Redundancy of CWT, Zoom property of the continuous wavelet transform, Filtering in continuous wavelet transform domain.

Unit III: Discrete Wavelet Transform And Filter banks

(15 HOURS)

Orthogonal and bi- orthogonal two-channel filter banks, Design of two-channel filter banks, Tree-structured filter banks, Discrete wavelet transform, Non-linear approximation in the Wavelet domain, multi resolution analysis, Construction and Computation of the discrete wavelet transform.

Unit IV: Multi Resolution Analysis

(15 HOURS)

Multirate discrete time systems, Parameterization of discrete wavelets, Bi-orthogonal wavelet bases, Two dimensional, wavelet transforms and Extensions to higher dimensions, wave packets.

Unit V: Applications

(15 HOURS)

Signal and Image compression, Detection of signal changes, analysis and classification of audio signals using CWT, Wavelet based signal de-noising and energy compaction, Wavelets in adaptive filtering, Adaptive wavelet techniques in signal acquisition, coding and lossy transmission, Digital Communication and Multicarrier Modulation, Trans multiplexers, Image fusion, Edge Detection and object isolation.

Text Books:

1. A Wavelet Tour of Signal Processing, 2nd edition, S. Mallat, Academic Press, 1999.
2. Wavelets and Sub band Coding, M. Vetterli and J. Kovacevic, Prentice Hall, 1995.
3. Wavelet transforms: Introduction, Theory and applications, Raghuveer rao and AjitS. Bopardikar, Pearson Education Asia, 2000.

References

1. Fundamentals of Wavelets: Theory, Algorithms, and Applications, J.C. Goswami and A.K.

Chan, 2nd ed., Wiley, 2011.

2. Wavelets and their Applications, Michel Misiti, Yves Misiti, Georges Oppenheim, Jean-Michel Poggi, John Wiley & Sons, 2010 .

3. A primer on Wavelets and their scientific applications, J S Walker, CRC press, 2002.

4. Multirate Systems and Filter Banks, P. P. Vaidyanathan, Pearson Education, 2004.

5. Wavelets : from math to practice, Desanka.P. Radunovik, Springer, 2009.

6. Insight into wavelets from theory to practice, K P Soman and KL Ramachandran, PHI, 2008.

e-Resources:

1. https://www.google.co.in/books/edition/A_Friendly_Guide_to_Wavelets/rfRnrhJwoloC?hl=en&gbpv=1&dq=A+friendly+guide+to+Wavelets,+Gerald+keiser,+Springer,+2011+pdf&printsec=frontcover

2. https://www.google.co.in/books/edition/Wavelets_and_Signal_Processing/IYUMyVRdJkC?hl=en&gbpv=1&dq=Wavelets+and+signal+processing:+An+application+based+introduction,+Stark,+Springer,+2005.&pg=PP4&printsec=frontcover

Outcomes:

The learners would have the ability to,

CO1 Presents a mathematical introduction to the wavelet theory: Continuous and discrete wavelet transform K2

CO2 Applications related for example to signal analysis, image processing, numerical analysis K3

CO3 Handle problems and conduct researches related to theoretical and applied problems related to wavelet theory K5

CO4 In particular techniques connected with signal and image processing, data banks should be studied K4

CO5 Participate in scientific discussions and conduct researches on high international level in wavelet theory K4

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create

Title of the Course: Wavelets							Course Code: P2R3MADSE4:1			
Course Outcomes (COs)	Programme Outcomes (POs)						Programme Specific Outcomes (PSOs)			Mean Score of COs
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	
CO1	2	3	3	3	2	2	2	3	2	2.4
CO2	2	3	3	3	2	2	2	3	2	2.4
CO3	2	3	3	3	2	2	2	3	2	2.4
CO4	3	2	2	2	-	1	2	3	2	1.9
CO5	2	3	3	3	2	2	2	3	2	2.4
							Mean Overall Score			2.3
							Result			High

Title of the Course	:	Modeling and Simulation with Excel			
Category of the Course	:	ELECTIVE	Semester	:	II
Course Code	:	P2R3MADSE4:2P	Nature of the Course	:	Employability
Marks	:	CIA:40+Ext:60= 100	Hrs/Week	:	4
Credits	:	3	Total Inst. Hrs.	:	60

Objectives:

- Understand the fundamentals of data analysis and modeling concepts.
- To apply statistical methods to analyze and interpret data accurately.
- To build predictive models to forecast trends and make informed decisions.
- To develop simulation models to evaluate scenarios and assess risks.
- To utilize Excel's built-in tools and add-ins for data analysis and modeling.

Practicals:

1. Introduction to data analysis and modeling
2. Advanced formulas and functions in Excel
3. Data Cleaning techniques
4. Descriptive statistics and data visualization
5. Statistical Analysis in Excel
6. Predictive Modeling with Excel
7. Optimization Modeling in Excel
8. Simulation Modeling in Excel
9. Data analysis in Excel for Finance
10. Data Analysis in Excel for Education

Text Books:

1. Excel Data Analysis Modeling and Simulation, Hector Guerrero, Springer

Reference Books:

1. Data Analysis with Microsoft Excel, Berk & Carey,

e-Resources:

1. <https://www.google.co.in/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&cad=rja&uact=8&ved=2ahUKEwjducqBhviCAxWmSmwGHQCdCaoQFnoECA4QAQ&url=https%3A%2F%2Fdocushare.sfu.ca%2Fdsweb%2FGet%2FVersion-493516%2FData%2520Analysis%2520and%2520Business%2520Modelling.pdf&usg=AOvVaw27xjWCnlWO8h8U-KkC4vWB&opi=89978449>

- COURSE OUTCOMES:**

At the end of this course, the students will be able to:

CO1	Describe the roll of important elements of discrete event simulation and modelling paradigm.	K2
CO2	Conceptualize real world situations related to systems development decisions from source of requirements.	K2
CO3	Interpret the model and apply the results to resolve critical issues in a real world environment.	K6
CO4	Apply random number variates to develop simulation models	K4
CO5	Analyze output data produced by a model and test validity of the model.	K4

Title of the Course: Modeling and Simulation with Excel							Course Code: P2R3MADSE4:2P			
Course Outcomes (COs)	Programme Outcomes (POs)						Programme Specific Outcomes (PSOs)			Mean Score of COs
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	
CO1	3	2	3	1	2	1	3	2	1	2.0
CO2	3	2	3	1	2	1	3	2	1	2.0
CO3	3	3	3	3	2	1	3	3	1	2.4
CO4	3	3	3	3	1	1	3	3	1	2.3
CO5	3	3	3	3	2	1	3	3	1	2.4
		Mean Overall Score								2.2
		Result								High

Title of the Course	:	Machine Learning and Artificial Intelligence		
Category of the Course	:	ELECTIVE	Semester	: II
Course Code	:	P2R3MADSE4:3	Nature of the Course	: Employability
Marks	:	CIA:25+Ext:75= 100	Hrs/Week	: 4
Credits	:	3	Total Inst. Hrs.	: 60

Objectives:

- Study about uninformed and Heuristic search techniques.
- Learn techniques for reasoning under uncertainty
- Introduce Machine Learning and supervised learning algorithms
- Study about ensembling and unsupervised learning algorithms
- Learn the basics of deep learning using neural networks

UNIT I PROBLEM SOLVING (15 HOURS)

Introduction to AI - AI Applications - Problem solving agents – search algorithms – uninformed search strategies – Heuristic search strategies – Local search and optimization problems – adversarial search – constraint satisfaction problems (CSP)

UNIT II PROBABILISTIC REASONING (15 HOURS)

Acting under uncertainty – Bayesian inference – naïve bayes models. Probabilistic reasoning – Bayesian networks – exact inference in BN – approximate inference in BN – causal networks.

UNIT III SUPERVISED LEARNING (15 HOURS)

Introduction to machine learning – Linear Regression Models: Least squares, single & multiple variables, Bayesian linear regression, gradient descent, Linear Classification Models: Discriminant function – Probabilistic discriminative model - Logistic regression, Probabilistic generative model – Naive Bayes, Maximum margin classifier – Support vector machine, Decision Tree, Random forests

UNIT IV ENSEMBLE TECHNIQUES AND UNSUPERVISED LEARNING (15 HOURS)

Combining multiple learners: Model combination schemes, Voting, Ensemble Learning - bagging, boosting, stacking, Unsupervised learning: K-means, Instance Based Learning: KNN, Gaussian mixture models and Expectation maximization

UNIT V NEURAL NETWORKS (15 HOURS)

Perceptron - Multilayer perceptron, activation functions, network training – gradient descent optimization – stochastic gradient descent, error backpropagation, from shallow networks to deep networks – Unit saturation (aka the vanishing gradient problem) – ReLU, hyperparameter tuning, batch normalization, regularization, dropout.

1. Stuart Russell and Peter Norvig, “Artificial Intelligence – A Modern Approach”, Fourth Edition, Pearson Education, 2021.
2. Ethem Alpaydin, “Introduction to Machine Learning”, MIT Press, Fourth Edition, 2020.

1. Dan W. Patterson, “Introduction to Artificial Intelligence and Expert Systems”, Pearson Education, 2007
2. Kevin Night, Elaine Rich, and Nair B., “Artificial Intelligence”, McGraw Hill, 2008
3. Mehryar Mohri, Afshin Rostamizadeh, Ameet Talwalkar, “Foundations of Machine Learning”, MIT Press, 2012.

At the end of this course, the students will be able to:

CO1: Use appropriate search algorithms for problem solving	K2
CO2: Apply reasoning under uncertainty	K3
CO3: Build supervised learning models	K4
CO4: Build ensembling and unsupervised models	K4
CO5: Build deep learning neural network models	K4

Title of the Course: - Machine Learning and Artificial Intelligence							Course Code: P2R3MADSE4:3			
Course Outcomes (COs)	Programme Outcomes (POs)						Programme Specific Outcomes (PSOs)			Mean Score of COs
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	
CO1	3	1	3	2	1	2	3	2	1	2.0
CO2	3	1	3	2	1	1	3	2	1	1.9
CO3	3	1	3	2	1	2	3	3	1	2.0
CO4	3	1	3	2	2	1	3	3	1	2.1
CO5	3	1	3	2	2	1	3	3	1	2.1
		Mean Overall Score								2.0
		Result								High

Title of the Course	: Neural Network		
Category of the Course	: ELECTIVE	Semester	: II
Course Code	: P2R3MADSE4:4	Nature of the Course	: Skill Development
Marks	: CIA:25+Ext:75= 100	Hrs/Week	: 4
Credits	: 3	Total Inst. Hrs.	: 60

Objectives:

- Study about uninformed and Heuristic search techniques.
- Learn techniques for reasoning under uncertainty
- Introduce Machine Learning and supervised learning algorithms
- Study about ensembling and unsupervised learning algorithms
- Learn the basics of deep learning using neural networks

Unit I: Perception and Adeline

(15 Hours)

Network with threshold activation functions – Perception learning rule and convergence theorem – The adaptive linear element – Networks with linear activation functions: the delta rule – Exclusive – OR problem - Multi layer perception can do everything.

Unit II: Back Propagation

(15 Hours)

Multi layer feed-forward networks – The generalized delta rule – Working with back propagation – An example – Other activation functions – Deficiencies of back propagation – Advanced Algorithms – How good are multi-layer feed-forward networks? – Applications.

Unit III: Recurrent Networks

(15 Hours)

The generalized delta-rule in recurrent networks – The Hopfield network – Boltzmann machines.

Unit IV: Self Organizing Networks

(15 Hours)

Competitive Learning – Kohonen network – Principal component networks – Adaptive resonance theory.

Unit V: Applications

(15 Hours)

Robot Control – End – effector positioning – Camera-robot coordination is function approximation – Robot arm dynamics – Mobile robots – Model based navigation – Sensor based control.

Text Book:

1. An Introduction to Neural Networks, Ben Krose and Patrick van der Smagt, Eighth Edition, November 1996.

Unit: 1 sec: 3 3.1 to 3.6

Unit II sec: 4 fully

Unit III sec: 5 fully

Unit V Sec: 8 fully

1. Neural Networks and Deep learning, Charu C. Aggarwal, Springer International Publishing, 2018.

<https://neuralnetworksandlearning.com>

The learners would have the ability to,

CO1	Acquire the knowledge of Networks with linear activation functions	K2
CO2	Understand about multi-layer feed-forward networks	K5
CO3	Learn about primitive roots and indices.	K3
CO4	Acquire the knowledge of Kohonen network	K2
CO5	Application of Camera-robot coordination	K5

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create

Title of the Course: Neural Networks							Course Code: P2R3MADSE4:4			
Course Outcomes (COs)	Programme Outcomes (POs)						Programme Specific Outcomes (PSOs)			Mean Score of COs
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	
CO1	3	3	2	3	2	1	3	2	1	2.2
CO2	3	3	2	3	2	1	3	2	1	2.2
CO3	3	2	2	3	2	1	3	1	1	2.0
CO4	2	3	3	2	2	1	3	2	1	2.1
CO5	3	2	2	3	2	1	3	2	1	2.1
		Mean Overall Score								2.1
		Result								High

Title of the Course	: Mathematical Documentation using LATEX		
Category of the Course	: Skill Enhancement	Semester	: II
Course Code	: P2R3MASEC1P	Nature of the Course	: Employability
Marks	: CIA:40+Ext:60= 100	Hrs/Week	: 4
Credits	: 2	Total Inst. Hrs.	: 60

Objectives:

- To learn the basic functions of Latex
- To explore some of the more advanced features available.
- To develop their skills in order to more fully utilize its functions in particular using Bibtex to help manage their references in relation to the Latex document.
- To Typeset complex mathematical formulae.
- Main objective for typesetting to journal articles.

Unit – I Text, Symbols and Commands (8 hours)

Command names and arguments – Environments-Declarations – Lengths – Special characters – Fine-tuning text – Word division.

Unit-II Document Layout and Organization(7 hours)

Document class – Page style – Parts of the document – Table of contents.

Unit – III Displayed Text (6 hours)

Changing font – Centering – indenting.

Unit – IV Listing the Text (7 hours)

Lists – Generalized lists -Theorem like declarations – Tabulator stops-Boxes – Tables.

Unit – V Mathematical Formulas (8 hours)

Mathematical environments - Main elements of Math mode -Mathematical symbols – Additional elements – Fine tuning Mathematics– Beyond standard latex.

Text Book:

1. Kopka, H., Daly, P.W. (2003) *A Guide to LATEX*, Fourth Edition, London: Addison Wesley.
2. Lamport, L.(1994).*Latex: A document preparation system*. Addison Wesley Professional.

Reference Book:

1. Mittelbach, F.(2007).*The Latex Graphics Companion* (2nd ed.). Addison-Wesley Professional.
2. Mittelbach, F., Goossens, M., Braams, J., Carlisle, D., Rowley, C.(2004).*The Latex Companion*. Addison-Wesley Professional.

e – Resources:

<https://www.tug.org/twg/mactex/tutorials/ltxprimer-1.0.pdf>

Outcomes:

The learners would have the ability to,

CO1	Typeset mathematical formulae using LaTeX.	K3
CO2	Use the preamble of LaTeX file to define document class and layout options.	K3
CO3	Use nested list and enumerate environments within a document.	K3
CO4	Acquire the knowledge of tabular and array environments within LaTeX document.	K2
CO5	Use various methods to either create or import graphics into a LaTeX document.	K5

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create

Title of the Course: Mathematical Documentation using LATEX							Course Code: P2R3MASEC1P			
Course Outcomes (COs)	Programme Outcomes (POs)						Programme Specific Outcomes (PSOs)			Mean Score of Cos
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	
CO1	3	2	2	2	2	1	3	2	1	2.0
CO2	3	2	2	3	2	1	3	2	1	2.1
CO3	3	2	2	3	2	1	3	1	1	2.0
CO4	2	3	2	2	2	1	3	2	1	2.0
CO5	3	2	3	3	2	1	2	2	1	2.1
		Mean Overall Score								2.0
		Result								High

Title of the Course	: Complex Analysis		
Category of the Course	: CORE COURSE	Semester	: III
Course Code	: P3R3MACC7	Nature of the Course	: Skill Development
Marks	: CIA:25+Ext:75= 100	Hrs/Week	: 6
Credits	: 5	Total Inst. Hrs.	: 90

Objectives:

- To understand the concepts of Analytical function
- Apply Cauchy's integral formula to evaluate complex line integrals
- Expand functions in Taylor's and Weierstrass theorems
- Apply the Residue theorem to evaluate real integrals
- To use the two dimension Laplace's equation in Cartesian or polar co-ordinates to determine whether a real valued is harmonic or not

Unit I: Complex functions

(18 Hours)

Introduction to the concept of Analytical function – Elementary theory of Power series – The exponential and Trigonometric Functions.

Unit II: Fundamental Theorems and Cauchy's Integral Formula

(18 Hours)

Line Integrals- Rectifiable Arc's – Line Integrals as Functions of Arcs-Cauchy's Theorem for a Rectangle – Cauchy's Theorem in a Disk – The Index of a point with respect to a closed curve – The Integral Formula – Higher Derivatives.

Unit III: Local Properties of Analytic Functions

(18 Hours)

Removable singularities, Taylor's Theorem – Zeros and Poles – Weierstrass Theorem – The Local Mapping-The Maximum Principle – Schwartz Lemma.

Unit IV: General Form of Cauchy's Theorem and the Calculus of Residues

(18 Hours)

Chains and Cycles – Simple Connectivity – Locally Exact Differentials-Multiply Connected Regions – The Residue Theorems – The Argument Principle – Evaluation of Definite Integrals.

Unit V: Harmonic Function

(18 Hours)

Definition and Basic Properties – Interpretation – The Mean Value Property – Maximum Principle – Poisson's Formula-Schwarz's Theorem – The Reflection Principle.

Text Book:

[1] "Complex Analysis", Lars V. Ahlfors, III edition McGraw Hills Education(India) 2013.

Unit I : Chapter 2 – All sections

Unit II : Chapter 4- Sec 1(1.1 to 1.5), Sec2 (2.1 to 2.3)

Unit III : Chapter 4- Sec 3(3.1 to 3.4)

Unit IV : Chapter 4- Sec 4(4.1,4.2,4.6 and 4.7) and Sec 5(5.1 to 5.3)

Unit V : Chapter 4- Sec 6(6.1 to 6.5)

Reference Books:

1) Complex Analysis, Sarge Lang, Addison Wesley, 1977.

2) Foundations of Complex Analysis, S.Ponnusamy, Narosa Publishing House, New Delhi.

e – Resources:

1. https://www.fing.edu.uy/~cerminar/Complex_Analysis.pdf
2. <https://www.iitg.ac.in/physics/fac/charu/courses/ph503/book.pdf>
3. <https://nptel.ac.in/courses/111/103/111103070/>

Outcomes:

The learners would have the ability to,

CO1	Recognize the concept of Analytical function.	K1
CO2	Study cauchy's theorem for a rectangle in a disk.	K2
CO3	Use Taylor's theorem and the maximum principle.	K3
CO4	Have a deep understanding of Residues to evaluate definite integrals.	K2
CO5	Know about Schwarz's theorem and reflection principle.	K4

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create

Relationship matrix for Course outcomes, Programme outcomes /Programme Specific Outcomes:

Title of the Course:Complex Analysis						Course Code:P3R3MACC7					
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Score of COs
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	3	3	2	1	2	1	3	3	2	3	2.3
CO2	3	3	3	2	2	2	3	2	3	2	2.5
CO3	3	2	2	1	2	3	2	3	2	1	2.1
CO4	3	3	3	2	1	3	2	3	3	1	2.4
CO5	3	2	3	1	1	3	3	2	3	3	2.4
		Mean Overall Score									2.34
		Result									High

Title of the Course	: Fluid Dynamics	Semester	: III
Category of the Course	: CORE COURSE	Nature of the Course	: Employability
Course Code	: P3R3MACC8	Hrs/Week	: 6
Marks	: CIA:25+Ext:75= 100	Total Inst. Hrs.	: 90
Credits	: 5		

Objectives:

- To introduce the fundamentals of fluid Dynamics such as kinematics of fluid, incompressible flow and boundary layer flows
- To discuss of the case of steady motion under conservative body forces and Some Potential Theorems
- To show where fluid mechanics concepts are common with those of solid Dynamics and indicate some fundamental areas of difference
- To develop skills in formulating and solving physics problems
- To introduce viscosity and show what are Newtonian and non-Newtonian fluids

Unit I: Kinematics of Fluids in Motion (17 hours)

Real fluids and Ideal Fluids – Velocity of a fluid at a point – Streamlines and Path lines; Steady and Unsteady flows - Velocity Potential - Velocity Vector – Local and Particle rates of change – Equations of Continuity – Worked Examples.

Unit II: Equations of Motions of a Fluid (18 hours)

Pressure at a point in a fluid at rest – Pressure at a point in a moving fluid – Conditions at a boundary at Two inviscid immiscible fluids – Euler's Equation of a Motion – Bernoulli's Equation – Worked Examples – Discussion of the case of steady motion under conservative body forces – Some Potential Theorems – Some flows involving Axial Symmetry.

Unit III: Some Three Dimensional Flows (18 hours)

Introduction – Source, Sinks and Doublets, Images in a rigid infinite plane – Images in Solid spheres – Axi-Symmetric Flows:Stoke's stream function – Some special forms of the stream function for Axi-Symmetric irrotational motion.

Unit IV: Some Two Dimensional Flows (20 hours)

Complex Velocity Potentials For Standard Two – Dimensional Flows – Uniform Stream –Line Sources and Line Sinks – Line Doublets – Line Vortices – Some Worked Examples – Two Dimensional Image System – Milne-Thomson Circle Theorem – Theorem Of Blasius.

Unit V: Viscous Flow (17 hours)

Viscous flow – Some solvable problems in viscous flow – Steady viscous flow in Tubes – Steady viscous flow in Tubes of Uniform cross-section.

Text Book:

[1] “Text Book of fluid Dynamics”, by Charlton, CBS Publications, New Delhi.,1985.

Unit I :Chapter 2 Sec 2.1 to 2.8

Unit II :Chapter3 Sec 3.1 to 3.9

Unit III :Chapter 4 Sec 4.1 to 4.5

Unit IV :Chapter 5 Sec 5.5 to 5.9

Unit V :Chapter 8 Sec to 8.10 to 8.11

- [1] “**Introduction to Fluid Mechanics**”, R.W.Fox and A.T.McDonald. Wiley, 1985.
- [2] “**Fluid Mechanics with Problems and Solutions**”, E.Krause, Springer, 2005.
- [3] “**Mechanics of Fluids**”, B.S.Massey, J.W.Smith and A.J.W.Smith, Taylor and Francis, New York, 2005
- [4] “**Fluid Flow Phenomena**”, P.Orlandi, Kluwer, New York, 2002.
- [5] “**Basics of Fluid Mechanics and Introduction to Computational Fluid Dynamics**”, T.Petrila, Springer, Berlin, 2004.

CO1	Identify and obtain the values to fluid properties and relationship between them	K1
CO2	Understand the principles of continuity, momentum and energy as applied to fluid motions.	K2
CO3	Recognize these principles written in form of mathematical equations.	K4
CO4	Apply dimensional analysis to predict physical parameters that influence the flow in fluid mechanics.	K3
CO5	Understanding the problems of viscosity and show what are Newtonian and non-Newtonian fluids.	K2

Relationship matrix for Course outcomes, Programme outcomes /Programme Specific Outcomes:

Title of the Course: Fluid Dynamics						Course Code: P3R3MACC8					
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Score of COs
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	3	1	3	2	3	3	3	2	1	2	2.3
CO2	2	1	3	1	3	3	3	2	1	3	2.1
CO3	3	2	3	1	3	3	3	2	1	2	2.3
CO4	1	2	3	2	3	3	3	2	1	3	2.2
CO5	3	1	2	3	3	3	3	2	2	2	2.3
		Mean Overall Score									2.2
		Result									High

Title of the Course	: Topology		
Category of the Course	: CORE COURSE	Semester	: III
Course Code	: P3R3MACC9	Nature of the Course	: Entrepreneurship
Marks	: CIA:25+Ext:75= 100	Hrs/Week	: 6
Credits	: 5	Total Inst. Hrs.	: 90

Objectives:

- To develop and understand Topological spaces including connectedness and compactness.
- To study the continuous functions on the topological spaces and study their homeomorphisms.
- To study regular second countable spaces which are metrizable.
- To be familiar with compactness.
- To understand countability axioms and normal spaces.

Unit I: Topological Spaces

(18 Hours)

Topological Spaces – Basis for a Topology – The Order Topology – The Product Topology on $X \times Y$ – The Subspace topology – Closed sets and Limit points.

Unit II: Continuous Functions

(18 Hours)

Continuous functions – The Product topology – The metric Topology – The metric Topology (continued).

Unit III: Connectedness

(18 Hours)

Connected Spaces – Connected subspaces of the Real line, Linear Continuum, Intermediate Theorem – Components and Local connectedness.

Unit IV: Compactness

(18 Hours)

Compact spaces – The Tube Lemma – Compact Subspaces of the Real line – Extreme Value Theorem, Uniform Continuity Theorem – Limit Point Compactness- Local compactness.

Unit V: Countability and Separation Axioms

(18 Hours)

The Countability axioms – The Separation axioms – Normal Spaces – The Uryshon lemma- The Uryshon Metrization theorem- The Tietz Extension theorem- The Tychonoff theorem.

Text Book:

[1] “Topology”, James R. Munkres, Pearson Education Pvt. Ltd. II Edition.

Unit I: Chapter 2, Sec 12 to 17

Unit II: Chapter 2, Sec 18 to 21

Unit III: Chapter 3, Sec 23 to 25

Unit IV: Chapter 3, Sec 26 to 29

Unit V: Chapter 4, Sec 30 to 36.

Reference Books:

[1] “Topology”, J. Dugunji, Prentice Hall of India, 1966.

[2] “Introduction to Topology and Modern Analysis”, George F. Simmons, McGraw Hill Book co.,1963.

[3] “General Topology” J. C. Kelly, Van Nostrand, Reinhold Co., Newyork, 1955.

e-Resources:

Title of the Course: Topology						Course Code: P3R3MACC9					
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Score of COs
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO1	PSO2	PSO4	PSO5	
CO1	3	1	3	2	3	3	3	2	1	2	2.3
CO2	2	1	3	1	3	3	3	2	1	3	2.2
CO3	3	2	3	1	3	3	3	2	1	2	2.3
CO4	1	2	3	2	3	3	3	2	1	3	2.3
CO5	3	1	2	3	3	3	3	2	2	2	2.4
		Mean Overall Score									2.3
		Result									High

Title of the Course	: NUMERICAL ANALYSIS		
Category of the Course	: CORE COURSE	Semester	: III
Course Code	: P3R3MACC10	Nature of the Course	: Employability
Marks	: CIA:25+Ext:75= 100	Hrs/Week	: 6
Credits	: 4	Total Inst. Hrs.	: 90

Objectives:

- To understand the concept of transcendental and polynomial equations.
- To know the eigen values and eigen vectors and matrices.
- To know the techniques of Numerical Differentiation and Numerical Integration.
- To know how to use iterative methods to solve systems of linear equations.
- To develop skills in using shooting method and finite elements methods.

Unit I: Transcendental and Polynomial Equations (18 Hours)

Iteration Methods Based on Second degree equation - Rate of convergence - General Iteration Methods-System of non-linear equations - Methods for Complex Roots-Polynomial equations.

Unit II: Eigen Values and Eigen Vectors (18 Hours)

Eigen values and Eigen vectors-Jacobi Method for Symmetric Matrices - Givens Method for Symmetric Matrices – Householder's method for symmetric matrices - Rutishauser Method for Arbitrary Matrices - Power Method - Inverse Power Method.

Unit III: Interpolation and Approximation (18 Hours)

Interpolating Polynomials using Finite Differences - Hermite Interpolations - Piecewise and Spline Interpolation - Bivariate Interpolation-Approximation- Least Square Approximation.

Unit IV: Differentiation and Integration (18 Hours)

Numerical Differentiation - Optimum Choice of Step-Length-Extrapolation methods-Numerical Integration - Methods based on interpolation - Methods based on undetermined coefficients- Composite Integration Methods-Romberg Integration.

Unit V: ODE - Boundary Value Problems:- (18 Hours)

Introduction – Initial Value Problem - Shooting Method - Finite Difference Methods – Finite Element Methods.

Text Book:

[1] “Numerical Methods Scientific and Engineering Computation”, sixth edition by M.K.Jain, Iyengar and R.K.Jain, New Age International (P) Ltd. Reprint- 2012.

Unit I : Chapter 2 Sec 2.4 to 2.9 (page No. 29-99)

Unit II : Chapter 3 Sec 3.5 to 3.12 except 3.6 (Page No. 170-173 & 179-200)

Unit III : Chapter 4 Sec 4.4 to 4.9 (Page No. 235-301)

Unit IV : Chapter 5 Sec 5.2 to 5.4 and 5.6 to 5.10 (Page No. 320-342)

Unit V : Chapter 7 Sec 7.1 to 7.4 (Page No. 550-630)

[1] S.S.Sastry, "Introduction methods of Numerical Analysis", Prentice Hall of India, New Delhi,(1998).
[2] R.L.Burden and J.DouglasFairis, "Numerical Analysis", P.W.S.Kent Publishing company, Bostan(1989), Fourth Edition.

1. http://www.ikiu.ac.ir/public-files/profiles/items/090ad_1410599906.pdf
2. <https://perhuaman.files.wordpress.com/2014/07/metodos-numericos.pdf>
3. <http://www.math.iitb.ac.in/~baskar/book.pdf>

CO1	Understand the fundamentals of solutions of Algebraic and transcendental equations	K2
CO2	Understand how use Householder's method, power method	K2
CO3	Acquire knowledge to use hermite interpolation and least square approximation	K4
CO4	Apply to interpolation and extrapolation method	K4
CO5	Use shooting method, to solve initial value problem	K3

Relationship matrix for Course outcomes, Programme outcomes /Programme Specific Outcomes:

Title of the Course: NUMERICAL ANALYSIS						Course Code: P3R3MACC10					
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Score of COs
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO1	PSO2	PSO4	PSO5	
CO1	3	2	3	2	3	3	3	2	2	3	2.6
CO2	3	2	3	1	3	3	2	2	2	2	2.3
CO3	2	2	3	2	3	3	3	3	1	3	2.3
CO4	2	2	3	2	3	3	2	2	1	2	2.3
CO5	3	2	2	3	3	3	3	2	1	2	2.4
		Mean Overall Score									2.3
		Result									High

Title of the Course	: CALCULUS OF VARIATIONS AND INTEGRAL EQUATIONS		
Category of the Course	: DSE COURSE	Semester	: III
Course Code	: P3R3MADSE5:1	Nature of the Course	: Employability
Marks	: CIA:25+Ext:75= 100	Hrs/Week	: 3
Credits	: 3	Total Inst. Hrs.	: 45

Objectives:

- To find the external functions that make the functional attain a maximum or minimum value
- To understand boundary value problems involving certain types of differential equation like Lagrange's equations.
- To study Green's function and its uses.
- To study the influence function.
- To use iterative method for solving equations of the second kind.

Unit I: Calculus of Variations (9 Hours)

Maxima and Minima - The Simplest Case - Illustrative Examples – Natural boundary conditions and Transition conditions – The Variational notation – The more general case.

Unit II: Applications of Calculus of Variations (9 Hours)

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

Unit III: Integral Equations (9 Hours)

Introduction – Relations between Differential and Integral Equations – The Green's function – Alternative definition of the Green's function.

Unit IV: Linear Equation in Cause and Effect (9 Hours)

The influence function – Fredholm equations with separable kernels – Illustrative examples.

Unit V: Applications of Integral Equations (9 Hours)

Hilbert – Schmidt theory – Iterative methods for solving equations of the second kind – The Fredholm theory – Neumann series.

Text Book:

[1] "Methods of Applied Mathematics" – Francis B.Hilderbrand , second edition – Prentice - Hall of India pvt, New Delhi, 1968.

Unit – I: Chapter 2, Sec: 2.1 – 2.6

Unit – II: Chapter 2, Sec: 2.7 – 2.11

Unit – III: Chapter 3, Sec: 3.1 – 3.4

Unit – IV: Chapter 3, Sec: 3.5 – 3.7

Unit – V: Chapter 3, Sec: 3.8 – 3.10

Reference Book:

[1] “Linear integral Equations, Theory and Techniques” – R.P.Kanwal, Academic press, New York, 1971.

e– Resources:

1. http://www.ikiu.ac.ir/public-files/profiles/items/090ad_1410599906.pdf
2. <https://perhuaman.files.wordpress.com/2014/07/metodos-numericos.pdf>
3. <http://www.math.iitb.ac.in/~baskar/book.pdf>

The learners would have the ability to,

CO1	Acquire the knowledge of natural boundary conditions and transition condition	K2
CO2	Understand and apply the application of calculus of variations, using Hamilton’s principle	K2
CO3	Know about the applications of Green’s function to solve the integral equations	K2
CO4	Study Fredholm equations with seperable kernels	K4
CO5	Apply iterative methods for solving equations of the second kind, using Fredholm theory	K3

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create

CO/PO Mapping :

Title of the Course: CALCULUS OF VARIATIONS AND INTEGRAL EQUATIONS						Course Code: P3R3MADSE5:1					
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Score of COs
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO1	PSO2	PSO4	PSO5	
CO1	3	2	3	2	3	3	3	2	2	3	2.6
CO2	3	2	3	1	3	3	2	2	2	2	2.3
CO3	2	2	3	2	3	3	3	3	1	3	2.3
CO4	2	2	3	2	3	3	2	2	1	2	2.3
CO5	3	2	2	3	3	3	3	2	1	2	2.4
		Mean Overall Score									2.3
		Result									High

Title of the Course	: ADVANCED NUMBER THEORY		
Category of the Course	: DSE COURSE	Semester	: III
Course Code	: P3R3MADSE5:2	Nature of the Course	: Employability
Marks	: CIA:25+Ext:75= 100	Hrs/Week	: 3
Credits	: 3	Total Inst. Hrs.	: 45

Objectives:

- To prove results involving divisibility and greatest common divisors.
- To apply Euler – Fermat’s Theorem to prove relations involving prime numbers.
- To apply primitive roots for primes – composite numbers.
- To study perfect and Amicable numbers.
- To find the use of a Fibonacci sequence in Pell’s equations.

UNIT I: Number Theoretic Functions

(9 Hours)

The sum and number of divisors-The Mobius Inversion formula – The Greatest Integer Function – An Application to the calendar.

UNIT II: Euler’s Generalization of Fermat’s Theorem

(9 Hours)

Leonhard Euler – Euler’s Phi-Function – Euler’s Theorem – Some properties of the Phi-Function.

UNIT III: Primitive Roots and Indices

(9 Hours)

The order of an Integer Modulo n – Primitive Roots for primes – composite Numbers having primitive Roots – The Theory of Indices.

UNIT IV: Number of Special Form

(9 Hours)

Marin Mersenne – Perfect Numbers – Mersenne Primes and Amicable Numbers – Fermat Numbers.

UNIT V: Fibonacci Number and Continued Fraction

(9 Hours)

Fibonacci – The Fibonacci Sequence – Certain Identities – Involving Fibonacci Numbers – Srinivasa Ramanujan – Finite Continued Fractions – Infinite continued Fractions – Farey Fractions – Pell’s Equation.

Text Book:

[1] “Elementary Number Theory” by David M. Burton, Tata McGraw – Hill Edition. 2012.

UNIT I: Chapter 6

UNIT II: Chapter 7

UNIT III: Chapter 8

UNIT IV: Chapter 11

UNIT V: Chapter 14 and 15

Reference Books:

- 1) “Basic Number Theory” by S.B. Malik, Second Revised Edition 1998.
- 2) “Number Theory” by Hari Krishnan, Twelfth Ed

e – Resources:

1. https://iqti.iisc.ac.in/wp-content/uploads/2021/06/stark_number_theory_chap1-3.pdf
2. <https://dudhnoicollege.ac.in/online/attendance/classnotes/files/1626791483.pdf>

Outcomes:

The learners would have the ability to,

CO1	Study the Mobius Inversion formula	K2
CO2	Acquire the knowledge of phi – function.	K2
CO3	Learn about primitive roots and indices.	K3
CO4	Acquire the knowledge of number of special form.	K4
CO5	Demonstrate an in – depth understanding of Fibonacci sequences and Srinivasa Ramanujan finite continued frsactipons.	K5

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create

Relationship matrix for Course outcomes, Programme outcomes /Programme Specific Outcomes:

Title of the Course: Advanced Number Theory						Course Code: P3R3MADSE5:2					
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Score of COs
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO1	PSO2	PSO4	PSO5	
CO1	3	3	3	3	1	3	3	3	2	3	2.7
CO2	3	3	1	2	3	3	3	2	3	3	2.6
CO3	3	3	3	1	2	3	3	2	3	1	2.2
CO4	3	2	3	1	3	3	3	1	2	3	2.4
CO5	3	3	3	1	3	3	3	3	1	3	2.6
		Mean Overall Score									2.5
		Result									High

Title of the Course	:	Ethical Attitude in Mathematical Research	
Category of the Course	:	DSE COURSE	Semester : III
Course Code	:	P3R3MADSE5:3	Nature of the Course : Skill Development
Marks	:	CIA:25+Ext:75= 100	Hrs/Week : 3
Credits	:	3	Total Inst. Hrs. : 45

Objectives :

- To provide systematic structure
- To enhance the Research Quality
- To find a solution to Theoretical and Practical problems
- To gain familiarity with a phenomena
- To verify and test existing facts and theory

Unit I : An Introduction

(9 HOURS)

Meaning of Research - Objectives of Research - Motivation in Research - Types of Research - Research Approaches - Significance of Research – Research Methods versus Methodology - Research and Scientific Method - Importance of knowing How Research is Done – Research Process - Criteria of Good Research - Problems Encountered by Researchers in India Defining the Research problem :Selecting the Problem - Necessity of Defining the Problem - Technique involved in defining a problem.

Unit-II : Research and Sampling Design

(9 HOURS)

Meaning of Research Design - Need for Research Design - Features of a Good Design - Important Concepts Relating to Research Design - Different Research Designs - Basic Principles of Experimental Designs – Design of Sample Survey: Introduction – Sample Design- Sampling and Non Sampling Errors - Census and sample survey - Types of sample Designs.

Unit III: Measurement and scaling Techniques

(9 HOURS)

Quantitative and Qualitative Data – Classification of Measurement Scale – Goodness of Measurement scale - Sources of Error in Measurement - Technique of Developing Measurement Tools - scaling - scale classification Bases - scaling Techniques – Multidimensional Scaling – Deciding the Scale.

Unit IV: Method of data collection

(9 HOURS)

Introduction – Experiments and Surveys - Collection of primary data – Collection of secondary Data - Selection of Appropriate Method for data collection - case study method.

Unit V: Interpretation and Report writing

(9 HOURS)

Meaning of Interpretation - Technique of Interpretation - Precaution in interpretation - Significance of Report writing - Difference steps in Writing Report -Layout of the Research Report - Types of Reports – Oral Presentation - Mechanics of Writing a Research Report - Precautions for Writing Research Reports - Conclusion.

Text Book:

1. **Research Methodology** (second Revised Edition), C.R.Kothari ; New Age Publishers, 3rd edition, 2014. Unit I: Chapter 1 & Chapter 2, Section 2.1 to 2.4

Unit II: Chapter 3, Section 3.1 to 3.6 & Chapter 4, Section 4.1 to 4.5

Unit III: Chapter 5

Unit IV: Chapter 6

Unit V: Chapter 19

Reference Books:

1. **Research Methodology**, R. Pannerselvam, PHI Publications, 7th edition, 2009.
2. **Fundamental of Research Methodology and Statistics**, Y.K. Singh, New Age International Publishers, 2006.

e – Resources:

1. <https://digitalcommons.unl.edu/cgi/viewcontent.cgi?article=8547&context=libphilprac>
2. https://www.academia.edu/34065815/In_Search_of_Defining_Ethics_in_Mathematics_Education_Research_Editorial

Outcomes:

The learners would have the ability to,

CO1	Organize, co-ordinate and focus the research aptitude with confidence	K3
CO2	Improve the concepts of Research Design	K5
CO3	Select appropriate method for data collection	K5
CO4	Collect and Analyze data to support Business for Decision Making Process	K4
CO5	Create suitable mechanics for report writing	K3

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 – Create

Relationship matrix for Course outcomes, Programme outcomes /Programme Specific Outcomes:

Title of the Course: Ethical Attitude in Mathematical Research						Course Code: P3R3MADSE5:3					
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Score of COs
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO1	PSO2	PSO4	PSO5	
CO1	3	3	3	3	1	2	3	3	3	3	2.7
CO2	3	3	1	3	2	3	3	3	3	2	2.6
CO3	1	1	2	3	1	2	3	3	3	2	2.0
CO4	2	2	2	3	2	1	3	1	3	1	2.0
CO5	3	3	1	3	1	3	3	1	3	3	2.4
										Mean Overall Score	2.3
										Result	High

Title of the Course	: Programming in MATLAB (Practical)		
Category of the Course	: DSE COURSE	Semester	: III
Course Code	: P3R3MADSE5:4P	Nature of the Course	: Employability
Marks	: CIA:40+Ext:60= 100	Hrs/Week	: 3
Credits	: 3	Total Inst. Hrs.	: 45

Objectives:

- To apply Computer theory and algorithmic aspects in various situations.
- To design and debug the programs.
- To develop program skills independently themselves.

LIST OF PRACTICALS

1. MATLAB program involving matrix manipulation.
Sec: 3.7 - 3.10.3 [1], Page: 48 – 68
2. MATLAB program to find Eigen Values and Eigen Vectors
Sec: 8.1 [2], Page: 371 – 373
3. MATLAB program to solve a system of linear equations using matrix method.
Sec: 2.3 [2], Page: 92
4. MATLAB program to solve polynomial equation.
Sec: 4.1 – 4.11 [1], Page: 81 – 89.
5. MATLAB program to draw two-dimensional plots.
Sec: 6.1 and 6.2[1], Page: 120 – 129.
6. MATLAB program to draw multiple plots.
Sec: 6.3[1] Page: 129 – 131
7. MATLAB program to draw style options, legend command and sub plots.
Sec: 6.4 – 6.6, Page: 132 – 135
8. MATLAB program to draw Three Dimensional plots.
Sec: 6.8.1 – 6.8.8, Page: 146 – 151
9. MATLAB program to solve constrained optimization.
Sec: 7.3.2[2], Page: 352 – 355
10. MATLAB program to solve Graphical LPP.
Sec: 7.3.3[2], Page: 355 – 357
11. MATLAB program to solve Laplace Transform and Inverse Laplace Transform.
Sec: 11.2[1] Page: 265 – 266
12. MATLAB program to solve partial Fractions expansion.
Sec: 11.4[1], Page: 267 – 269
13. MATLAB program to solve transfer function representation
Sec: 11.5[1], Page: 270 – 271
14. MATLAB program to solve Zeros, Poles and Pole – Zero map of a transfer function Sec:
11.6[1], Page: 272

TEXT BOOKS:

- [1] “MATLAB and Its Applications in Engineering” By Raj Kumar Bansal, Ashok Kumar Goel, Manoj Kumar Sharma - Dorling Kindersely (India) Pvt. Ltd.,
- [2] “Applied Numerical Methods using MATLAB” By Won Young Yang, Wenwu Cao, Tae – Sang Chung, John Morris, A John Wiley and sons Inc Publications

1. <https://www.mccormick.northwestern.edu/documents/students/Postgraduate/introduction-to-matlab.pdf>
2. <http://www.uop.edu.pk/ocontents/A%20Guide%20to%20MATLAB.pdf>

The learners would have the ability to,

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 – Create

Relationship matrix for Course outcomes, Programme outcomes /Programme Specific Outcomes:

Title of the Course: Programming in MATHLAB (Practical)						Course Code: P3R3MADSE5:4P					
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Score of COs
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO1	PSO2	PSO4	PSO5	
CO1	2	2	3	2	3	2	3	3	3	3	2.6
CO2	3	2	2	1	3	3	2	3	3	2	2.6
CO3	2	2	3	2	3	3	3	3	1	3	2.3
CO4	3	2	3	2	1	3	2	2	1	2	2.3
CO5	3	2	2	3	3	3	3	2	1	2	2.4
		Mean Overall Score									2.4
		Result									High

Title of the Course	: Numerical Ability and Reasoning		
Category of the Course	: SE COURSE	Semester	: III
Course Code	: P3R3MASEC2:1	Nature of the Course	: Skill Development
Marks	: CIA:25+Ext:75= 100	Hrs/Week	: 3
Credits	: 2	Total Inst. Hrs.	: 45

Objectives

- To provide the knowledge of Permutation
- To educate the students in computational skill
- To make the students prepare for competitive examinations
- To be better equipped in a relative sense as for as preparation for entrance examinations involving placement opportunities
- To educate the knowledge of Quantitative Aptitude

UNIT I: Permutation and Combination (9 hours)

Permutation – Factorial Notation – Combination – Arrangements - Fundamental Principles of Counting.

UNIT II: Arithmetical Reasoning (7 hours)

Calculation based problems – Data based Questions – Problems on ages – Venn Diagram based Questions.

UNIT III: Mathematical Operations and Logical Sequence of Words (10 hours)

Mathematical Operators – Sequence of Occurrence of events or various stages in a process – Sequence of objects in a class or group, from part to the whole - Sequence of increasing/decreasing size, value, intensity, etc. – Sequence in which a chain of given objects is formed.

UNIT IV: Logic (10 hours)

Logical Reasoning – Classification of Propositions – Logical Deduction – Mediate Deductive Inference - Rules for deriving the conclusion from two given premises – Two Premise Arguments with two conclusions - Two Premise Arguments with more than two conclusions – Three Premise Arguments.

UNIT V: Analytical Reasoning and Problems on Cubes and Dice (9 hours)

Analytical Reasoning – Problems on Dice – Problems on Cubes – Painting a stack of Cubes.

Text Book:

[1] “Quantitative Aptitude and Reasoning”, R.V. Praveen, PHI Private Limited, Delhi, Second Edition, 2013.

Unit I: Part I - Chapter 2

Unit II: Part I - Chapter 38

Unit III: Part II - Chapters 13 & 15

Unit IV: Part II – Chapter 16

Unit V: Part II - Chapters 25 & 26

Reference Books:

[1] “Quantitative Aptitude for Competitive Examinations” by R.S. Aggarwal – S.Chand & sons, New Delhi 2006.

[2] “Quantitative methods” by D.C. Sonchati, S.Chand & sons Delhi.

e-Resources:

- Outcomes:** The learners would have the ability to,

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 – Create

Title of the Course: Numerical Ability and Reasoning						Course Code: P3R3MASEC2:1					
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Score of COs
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	3	1	3	2	3	3	3	2	1	3	2.3
CO2	2	1	3	1	2	3	3	2	3	2	2.1
CO3	3	2	3	1	2	2	3	2	1	1	2.3
CO4	1	2	3	2	3	2	3	2	2	3	2.2
CO5	3	1	2	3	1	3	3	2	1	2	2.3
		Mean Overall Score									2.2
		Result									High

Title of the Course	:	Differential Equations using SCILAB (Practical)		
Category of the Course	:	SE COURSE	Semester	: III
Course Code	:	P3R3MASEC2:2P	Nature of the Course	: Skill Development
Marks	:	CIA:40+Ext:60= 100	Hrs/Week	: 3
Credits	:	2	Total Inst. Hrs.	: 45

Objectives:

- To explore Ordinary Differential Equations
- To understand and find complementary functions
- To model the exercise based convergence and divergence using SCILAB
- To explore some of the tools in SCILAB.
- To work through some of the problems involving Differential Equations.

List of Practicals

1. Program to find the solution of Differential Equations by finding complementary functions
2. Program to find the solution of Differential Equations by changing independent variable.
3. Program to find the solution of Differential Equations by changing dependent variable.
4. Program to test for exactness and solve the Differential Equations of second order.
5. Program to illustrate convergence, divergence or oscillatory of the given sequence using SCILAB.
6. Program to illustrate convergence, divergence or oscillatory of the given series using SCILAB.
7. Using Cauchy's criterion to determine convergence of the given sequence.
8. Using Cauchy's criterion to determine convergence of the given series.
9. Program to test the convergence of the series using Leibnitz's theorem.
10. Maxima programs to solve Exact Differential Equations.
11. Maxima programs to solve Linear Differential Equations.
12. Maxima programs to solve Bernouli's Differential Equations.
13. Maxima programs to solve 1st order but not of first degree differential equations – solvable for p only.
14. Maxima programs to solve Cauchy's and Legendre's equations.

Reference Books:

1. Programming using SCILAB, Akhilesh Kumar.
2. Introduction to SCILAB-Gilberto E.Urroz
3. Scilab tutorial for Computational Science, Graeme Chandler and Stephen Roberts.

e-Resources:

1. <https://www.math.utah.edu/~gustafso/s2014/3150/pdeNotes/urroz-ode-scilab.pdf>
2. <http://www.aagasc.edu.in/Scilab-Book-Akhilesh.pdf>

Outcomes:**The learners would have the ability to,**

CO1	Learn SCILAB and Maxima software	K2
CO2	Problem solve on differential equations by using SCILAB.	K4
CO3	Problem solve on sequence by using SCILAB	K4
CO4	Understand the SCILAB demonstration	K2
CO5	Practice the track test with all SCILAB app	K3

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create**Relationship matrix for Course outcomes, Programme outcomes /Programme Specific Outcomes:**

Title of the Course: Differential Equations using SCILAB						Course Code: P3R3MASEC2:2P					
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Score of COs
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO1	PSO2	PSO4	PSO5	
CO1	3	2	1	3	3	1	2	3	3	3	2.4
CO2	3	2	1	3	2	3	2	1	3	3	2.3
CO3	3	2	1	3	2	3	2	1	1	2	2.0
CO4	3	2	1	3	3	2	1	1	3	3	2.2
CO5	3	2	1	2	3	3	3	3	3	1	2.4
		Mean Overall Score									2.3
		Result									High

Title of the Course	:	INTERNSHIP	Semester	:	III
Category of the Course	:	CORE COURSE	Nature of the Course	:	Skill Development
Course Code	:	P3R3MAINT	Hrs/Week	:	-
Marks	:	100	Total Inst. Hrs.	:	-
Credits	:	3			

Title of the Course	:	Functional Analysis			
Category of the Course	:	CORE COURSE	Semester	:	IV
Course Code	:	P4R3MACC11	Nature of the Course	:	Skill Development
Marks	:	CIA:25+Ext:75= 100	Hrs/Week	:	6
Credits	:	5	Total Inst. Hrs.	:	90

Objectives:

- To understand the definition and fundamental properties of metric spaces, including the ideas of convergence, continuity, completeness, compactness and connectedness
- To understand the definition and fundamental properties of Hilbert spaces, and bounded linear maps between them
- To generalize the basic concepts of geometry and linear algebra can be generalized to infinite dimensional spaces
- To study Banach Algebras
- To study Picard's theorem and Stone's theorem

Unit I : Banach Spaces

(18 HOURS)

The definition and some examples – Continuation linear transformations – The Hahn-Banach theorem – The natural imbedding of N in N^{**} – The open mapping theorem – The conjugate of an operator.

Unit II : Hilbert Spaces

(18 HOURS)

Definition and properties – Orthogonal complements and direct sums – Orthonormal sets and sequences – Series related to orthonormal sets and sequences – Maximal orthonormal sets and sequences – Projection theorem – Representation of functionals on Hilbert spaces.

Unit III : Operators on Hilbert Spaces

(18 HOURS)

The adjoint of an operator – Self adjoint operator – Normal and Unitary operators – Projections – The spectrum of bounded operator – Spectral theorem for normal and self adjoint operator.

Unit IV: Finite Dimensional Spectral Theory

(18 HOURS)

Matrices – Determinants and the spectrum of an operator – The spectral Theorem

Unit V: Banach Algebras

(18 HOURS)

Introduction to Banach Algebras - Definition, Examples and some related basic results – Regular and singular elements – The spectrum – The formula for the spectral radius.

Text Book:

1. **Introduction to topology and Modern Analysis**, G.F. Simmons, Mc Graw Hill Education (India) Edition 2004.
Unit I: Chapter 9 Fully (page No. 211-242)
Unit II: Chapter 10 (Page No. 243-261)
Unit III: Chapter 10 (Page No. 262-277)
Unit IV: Chapter 11 Fully (Page No. 278-294)
Unit V: Chapter 12 Fully (Page No. 301-317)

Reference Books:

1. **Functional Analysis**, Walter Rudin, TMH Edition 1974.
2. **Functional Analysis**, B.V Linaye, Functional Analysis, Wiley Eastern limited, Bombay, second Edition 1985

e – Resources:

1. <https://docs.ufpr.br/~eidam/2019/2/CM075/Kreyszig.pdf>
2. <http://www.freebookcentre.net/maths-books-download/Functional-Analysis-pdf.html>
3. <https://youtu.be/nE67uOPfRbI>

Outcomes:

The learners would have the ability to,

CO1	Understand the concept of Banach spaces & Hilbert spaces.	K2
CO2	Acquire knowledge about Hilbert spaces.	K2
CO3	Describe the structure of finite dimensional spectral theory.	K5
CO4	Study about Regular, singular elements and the spectrum.	K4
CO5	Learn about fixed point theorem, Picard's theorem and Stone's theorem.	K2

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create

Relationship matrix for Course outcomes, Programme outcomes /Programme Specific Outcomes:

Title of the Course: Functional Analysis						Course Code: P4R3MACC11					
Course Outcome s (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Score of COs
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO1	PSO2	PSO4	PSO5	
CO1	3	2	1	3	3	1	2	3	3	3	2.4
CO2	3	2	3	3	3	3	2	1	3	3	2.6
CO3	3	1	2	3	2	3	2	3	1	2	2.2
CO4	3	1	3	3	3	2	1	3	3	3	2.5
CO5	3	1	3	2	3	3	3	3	3	1	2.5
		Mean Overall Score									2.4
		Result									High

Title of the Course	: Differential Geometry		
Category of the Course	: CORE COURSE	Semester	: IV
Course Code	: P4R3MACC12	Nature of the Course	: Employability
Marks	: CIA:25+Ext:75= 100	Hrs/Week	: 6
Credits	: 5	Total Inst. Hrs.	: 90

Objectives

- To introduce the notion of surfaces and their properties
- To study geodesics and differential geometry of surfaces
- To introduce concepts of surface of constant curvature
- To improve the skills of solving non intrinsic and study its properties
- To introduces Differential geometry of surfaces.

Unit I: Space Curves (18 hours)

Definition of a space curve-Arc length-tangent-normal and binormal-curvature and torsion- contact between curves and surfaces-tangent surface –involutes and evolutes-Intrinsic equation-fundamental existence theorem for space curve-Helics.

Unit II: Intrinsic properties of a Surface (18 hours)

Definition of a surface –Curves on a surface-Surface of a revolution- Helicoids-Metric-direction coefficients-Families of curves-Isometric correspondence-Intrinsic properties.

Unit III: Geodesics: (18 hours)

Geodesic-Canonical geodesic equations-Normal property of geodesic-Existence theorem-Geodesic parallels-Geodesic curvature-Gauss Bonnet theorem-Gaussian Curvature-Surface of constant curvature.

Unit IV: Non Intrinsic properties of a surface (18 hours)

The second fundamental form-Principal curvature –Lines of curvature-Developable associated with space curves on surface-Minimal surfaces-Ruled surfaces.

Unit V: Differential Geometry of surfaces (18 hours)

Compact surfaces whose points are umbilics- Hilberts lemma-Compact surface of constant curvature-Complete surface and their characterization-Hilberts theorem-Conjugate points on Geodesics.

Text Book:

1. T.J.Willmore, An Introduction to Differential Geometry, Oxford University Press, New Delhi.

Unit I: Chapter I, Sections 1-9

Unit II: Chapter II, Sections 1-9

Unit III: Chapter II, sections 10-18

Unit IV: Chapter III, Sections 1-8

Unit V : Chapter IV, Sections 1-8

Reference Books:

1. Struik D.T. "Lectures on classical differential geometry", Addition- Wesley, Mass

Title of the Course: Differential Geometry						Course Code:P4R3MACC12					
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Score of COs
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO1	PSO2	PSO4	PSO5	
CO1	3	2	3	2	1	1	3	3	2	3	2.3
CO2	3	1	1	2	3	3	2	2	3	2	2.2
CO3	3	2	1	3	2	2	3	2	3	3	2.2
CO4	3	2	2	1	3	3	2	1	2	1	2.0
CO5	3	3	1	1	3	3	2	3	1	2	2.2
		Mean Overall Score									2.2
		Result									High

Title of the Course	: Stochastic Processes		
Category of the Course	: CORE COURSE	Semester	: IV
Course Code	: P4R3MACC13	Nature of the Course	: Entrepreneurship
Marks	: CIA:25+Ext:75= 100	Hrs/Week	: 6
Credits	: 5	Total Inst. Hrs.	: 90

Objectives:

- To understand the notion of a Markov chain
- To understand how simple ideas of conditional probability can be used to give a thorough and effective account of discrete-time Markov chains
- To apply these ideas to answer basic questions in several applied situations including genetics, branching processes and random walks
- To develop skills in analysing and interpreting the results
- To discuss steady state Transient behaviour of M/M/1 model

Unit I: Stochastic Processes

(9 HOURS)

Introduction – Specification of Stochastic processes – Stationary Processes – stationary – Gaussian processes - Markov Chains – Definitions and Examples – Higher Transition Probabilities – Generalization of Independent Bernoulli trials – Sequence of Chain – Dependent trials.

Unit II :Classification of states and chains

(9 HOURS)

Communication relations – class property – classification of chains – transient and Persistent (recurrent) states – related theorems - Determination of Higher Transition Probabilities – Stability of a Markov system – Stationary distribution – Theorem and problems.

Unit III : Markov Processes with Discrete State space

(9 HOURS)

Poisson Process – Postulates for poisson process – Theorems and problems – Properties of poisson process – Poisson processes and related distributions – Generalisation of poisson process – Time dependent poisson processes – Birth and death process.

Unit IV: Renewal Processes and Theory

(9 HOURS)

Renewal Process in discrete time – Relation between $F(s)$ and $P(s)$ - Renewal Processes in continuous time – Renewal equation – Stopping time – Wald's equation – Renewal theorems.

Unit V: Stochastic Processes in Queuing

(9 HOURS)

Queuing systems: General concepts – Queueing processes – steady state distribution – Little's formula – The Queueing model M/M/1: study state behaviour – steady state solution – waiting time distributions – Transient behaviour of M/M/1 model.

Text Books:

1. **Stochastic Processes**, J.Medhi, , Second edition, 1994 - Wiley Eastern limited, Chennai.

Unit I - Chapter 2, Sec 2.1 – 2.3 & Chapter 3, Sec 3.1 – 3.3

Unit II - Chapter 3, Sec 3.4 – 3.6, 3.8 – 3.11

Unit V - Chapter, Sec 10.1 – 10.3.

1. **A First course in Stochastic Processes**, Samuel Kolri ,Howard M.Taylor ,2nd Edition.
2. **Stochastic Processes**, Srinivasan and Medha, N.V Prabhu , Macmillan New York.

1. <https://nptel.ac.in/courses/111/102/111102014/#>
2. <http://home.ustc.edu.cn/~alex2014/SPpdf/Stochastic%20Processes%20SM.pdf>
3. https://web.ma.utexas.edu/users/gordanz/notes/introduction_to_stochastic_processes.pdf

CO1	Acquire the knowledge of stochastic process, transition probabilities.	K2
CO2	Understand transient and persistent state , stability of a Markov system.	K2
CO3	Be familiar with Poisson process – Birth and death process.	K1
CO4	Know about renewal process and renewal theorem.	K4
CO5	Study about Queuing system – M/M/1: steady state behavior.	K5

Relationship matrix for Course outcomes, Programme outcomes /Programme Specific Outcomes:

Title of the Course: Stochastic Processes						Course Code: P4R3MACC13					
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Score of COs
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO1	PSO2	PSO4	PSO5	
CO1	3	3	3	3	1	3	3	3	2	3	2.7
CO2	3	3	1	2	3	3	2	2	3	3	2.5
CO3	3	3	3	1	2	3	2	2	3	1	2.3
CO4	3	2	3	1	3	3	3	1	2	3	2.4
CO5	3	3	3	1	3	3	1	3	1	3	2.4
		Mean Overall Score									2.5
		Result									High

Title of the Course	:	Project Work			
Category of the Course	:	CORE COURSE	Semester	:	IV
Course Code	:	P4R3MACC14PW	Nature of the Course	:	Skill Development
Marks	:	100	Hrs/Week	:	12
Credits	:	5	Total Inst. Hrs.	:	180