DEPARTMENT OF MATHEMATICS

COURSE STRUCTURE & SYLLABI
(For the students admitted from year 2023-2024 onwards)

Programme : M.Sc. Mathematics

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JAMAL MOHAMED COLLEGE (AUTONOMOUS)
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(Affiliated to Bharathidasan University)
TIRUCHIRAPPALLI – 620 020

M.Sc. MATHEMATICS

Sem	Course Code	Course Category	Course Title	Ins. Hrs/ Week	Credit	Marks		Total
						CIA	ESE	
I	23PMA1CC1	Core - I	Algebra - I	6	5	25	75	100
	23PMA1CC2	Core - II	Real Analysis	6	5	25	75	100
	23PMA1CC3	Core - III	Classical Dynamics	6	5	25	75	100
	23PMA1CC4	Core - IV	Ordinary Differential Equations	6	5	25	75	100
	23PMA1DE1A/B	Discipline Specific Elective - I		6	4	25	75	100
			Total	**30**	**24**			**500**
II	23PMA2CC5	Core - V	Algebra - II	6	5	25	75	100
	23PMA2CC6	Core - VI	Complex Analysis	6	5	25	75	100
	23PMA2CC7	Core - VII	Topology	6	5	25	75	100
	23PMA2CC8	Core - VIII	Numerical Analysis with Octave	6	5	25	75	100
	23PMA2DE2A/B	Discipline Specific Elective - II		6	4	25	75	100
	23PCN2CO	Community Outreach	JAMCROP	-	@	-	-	@
	@Only grades will be given		**Total**	**30**	**24**			**500**
III	23PMA3CC9	Core - IX	Functional Analysis	6	5	25	75	100
	23PMA3CC10	Core - X	Partial Differential Equations	6	5	25	75	100
	23PMA3CC11	Core - XI	Mathematical Statistics with R	6	5	25	75	100
	23PMA3CC12	Core - XII	Advanced Graph Theory	6	5	25	75	100
	23PMA3DE3AP/B	Discipline Specific Elective - III		6	4	20	80	100
	23PMA3EC1	Extra Credit Course - I*	Online Course	-	*	-	-	-
			Total	**30**	**24**			**500**
IV	23PMA4CC13	Core - XIII	Measure Theory	6	5	25	75	100
	23PMA4CC14	Core - XIV	Fluid Dynamics with MATLAB	6	5	25	75	100
	23PMA4CC15	Core - XV	Calculus of Variations and Integral Equations	6	5	25	75	100
	23PMA4DE4A/B	Discipline Specific Elective - IV		6	4	25	75	100
	23PMA4PW	Project Work	Project Work	6	4	-	100	100
	23PCNOC	Mandatory Online Course**	Online Course	-	1	-	100	100
	23PMA4EC2	Extra Credit Course - II*	Online Course	-	*	-	-	-
	*** Programme Specific Online Course for Advanced Learners** **** Any Online Course for Enhancing Additional Skills**		**Total**	**30**	**24**			**600**
			Grand Total		**96**			**2100**

DISCIPLINE SPECIFIC ELECTIVE

Semester	Course Code	Discipline Specific Elective
I	23PMA1DE1A	Financial Mathematics
	23PMA1DE1B	Combinatorics
II	23PMA2DE2A	Theory of fuzzy sets & its Applications
	23PMA2DE2B	Mathematical Modelling
III	23PMA3DE3AP	Python for Data Science - Practical
	23PMA3DE3B	Data Structures and Algorithms
IV	23PMA4DE4A	Advanced Operations Research
	23PMA4DE4B	Stochastic Processes

Semester	Course Code	Course Category	Hours/ Week	Credits	Marks for Evaluation		
					CIA	ESE	Total
I	23PMA1CC1	CORE – I	6	5	25	75	100
Course Title	**Algebra - I**						

SYLLABUS		
Unit	**Contents**	**Hours**
I	Another Counting Principle – Sylow's Theorems (first proof only).	18
II	Direct Products – Finite Abelian Groups –*The Algebra of linear transformations*	18
III	Characteristic roots -Canonical Forms: Triangular Form – Nilpotent Transformations	18
IV	Canonical Forms: Jordan Form – Rational Canonical Form.	18
V	*Trace and Transpose* – Hermitian, Unitary and Normal Transformations	18
VI	Current Trends (For CIA only) – Contemporary developments related to the linear transformations during the semester concerned.	

…… Self Study

Text Book:

I. N. Herstein, Topics in Algebra, Second Edition, Wiley India Pvt. Ltd., New Delhi,2022.
UNIT I Chapter 2: Sections 2.11, 2.12 (Section 2.12: Omit Lemma 2.12.5)
UNIT II Chapter 2: Sections 2.13, 2.14 (Section 2.14: Theorem 2.14.1 only),6.1
UNIT III Chapter 6: Sections 6.2, 6.4, 6.5
UNIT IV Chapter 6: Sections 6.6, 6.7
UNIT V Chapter 6: Sections 6.8, 6.11.

Reference Books:

1. P.B. Bhattacharya, S.K. Jain and S.R. Nagpaul, Basic Abstract Algebra, Second Edition, Cambridge University Press , (1995).
2. Michael Artin, Algebra, Second edition, Pearson-Prentice Hall, New Delhi, 2015
3. Vijay K Khanna and S K Bhambri, A course in Abstract Algebra, Third Edition, Vikas Publishing House Pvt. Ltd.

Web Resources:

1. Sylow's Theorem link: https://archive.nptel.ac.in/content/storage2/111/106/111106137/MP4/mod03lec18.mp4
2. Sylow's Second Theorem link: https://archive.nptel.ac.in/content/storage2/111/106/111106137/MP4/mod03lec19.mp4
3. Jordan Canonical form link: https://youtu.be/NSn24nt4lNU

Course Outcomes		
Upon successful completion of this course, the student will be able to:		
CO No.	**CO Statement**	**Cognitive Level (K-Level)**
CO1	demonstrate the fundamental algebraic structures of groups, rings, vector spaces and linear transformations.	**K2**
CO2	construct class equation and the different canonical forms of linear transformations.	**K3**
CO3	analyse the various canonical forms of a given linear transformation and its properties.	**K4**
CO4	determine the direct product of cyclic groups and its isomorphism	**K5**
CO5	create more examples for simple groups, Sylow p- subgroups and different canonical forms of a given linear transformation.	**K6**

Relationship Matrix:

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**	**2**	**3**	**3**	**3**	**3**	**3**	**2**	**2.7**
CO2	**3**	**2**	**2**	**3**	**3**	**3**	**3**	**3**	**3**	**2**	**2.7**
CO3	**3**	**2**	**2**	**2**	**2**	**3**	**3**	**3**	**3**	**3**	**2.6**
CO4	**3**	**2**	**2**	**3**	**2**	**3**	**3**	**3**	**2**	**2**	**2.5**
CO5	**3**	**3**	**3**	**2**	**2**	**3**	**3**	**3**	**2**	**2**	**2.6**
Mean Overall Score											**2.62**
Correlation											**High**

Mean Overall Score	**Correlation**
< 1.5	Low
≥ 1.5 and < 2.5	Medium
≥ 2.5	High

Course Coordinators:

Mr. N. Mohamed Thoiyab
Mrs. B. Shafina Banu

Semester	Course Code	Course Category	Hours/ Week	Credits	Marks for Evaluation		
					CIA	ESE	Total
I	23PMA1CC2	CORE – II	6	5	25	75	100
Course Title	**Real Analysis**						

SYLLABUS		
Unit	**Contents**	**Hours**
I	Basic topology - Metric spaces - Compact sets - Perfect sets.	18
II	Riemann - Stieltjes integral - Definition and existence of the integral - *Properties of the integral* - Integration and differentiation - Rectifiable Curves.	18
III	Sequences and series of functions - Uniform convergence- Uniform convergence and continuity - Uniform convergence and integration - Uniform convergence and differentiation – Stone -Weierstrass theorem.	18
IV	Multivariable differential calculus – Directional derivatives - Total derivative - Matrix of linear function - Jacobian matrix - Chain rule - Mean value theorem - Sufficient condition for differentiability- Equality of partial derivatives - Taylor's formula.	18
V	Functions with non-zero Jacobian determinant - Inverse function theorem - Implicit function theorem.	18

…… Self Study

Text Book:

Walter Rudin, Principles of Mathematical Analysis, McGraw-Hill International Editions, Third Edition (1987). 2. Tom M. Apostol, Mathematical Analysis, Addison-Wesley Publishing Company, Second Edition (1974).

UNIT I Chapter 2 Sections 2.15 - 2.43 T.B-1
UNIT II Chapter 6 Sections 6.1 - 6.22, 6.26, 6.27 T.B-1
UNIT III Chapter 7 Sections 7.1 - 7.18, 7.26, 7.27 T.B-1
UNIT IV Chapter 12 T.B-2
UNIT V Chapter 13 Sections 13.1 - 13.4 T.B-2

Reference Books:

1. V. Ganapathy Iyer, Mathematical analysis, Tata McGraw-Hill Publishing Company, Ltd, (1977).
2. Gabriel Klambauer, Real Analysis, American Elsevier Publishing Company, INC, (1973).

Web Resources:

1. https://nptel.ac.in/courses/111/106/111106053/
2. https://nptel.ac.in/courses/111/105/111105069/
3. https://nptel.ac.in/courses/111/105/111105098/

Course Outcomes		
Upon successful completion of this course, the student will be able to:		
CO No.	**CO Statement**	**Cognitive Level (K-Level)**
CO1	demonstrate an understanding of metric spaces, the theory of sequences and series of functions	**K2**
CO2	develop the skills in constructing rigorous mathematical arguments	**K3**
CO3	analyse the theory in the course to solve problems	**K4**
CO4	prove the theorems on differentiation and integration	**K5**
CO5	demonstrate the skills in communicating mathematics	**K6**

Relationship Matrix:

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**	**3**	**2**	**3**	**3**	**3**	**3**	**3**	**2.8**
CO2	**3**	**3**	**2**	**3**	**2**	**3**	**3**	**3**	**3**	**3**	**2.8**
CO3	**3**	**3**	**2**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**2.9**
CO4	**3**	**3**	**2**	**3**	**2**	**3**	**3**	**3**	**2**	**2**	**2.6**
CO5	**3**	**3**	**2**	**3**	**2**	**3**	**3**	**3**	**2**	**2**	**2.6**
Mean Overall Score											**2.74**
Correlation											**High**

Mean Overall Score	**Correlation**
< 1.5	Low
≥ 1.5 and < 2.5	Medium
≥ 2.5	High

Course Coordinators:

Mr. S. Masoothu

Mrs. J. Sarthaj Banu

Semester	Course Code	Course Category	Hours/ Week	Credits	Marks for Evaluation		
					CIA	ESE	Total
I	23PMA1CC3	CORE – III	6	5	25	75	100

Course Title	Classical Dynamics

SYLLABUS		
Unit	**Contents**	**Hours**
I	Mechanical system – Generalized Co-ordinates – Constraints – Virtual work – *Energy and Momentum*.	**18**
II	Derivation of Lagrange's Equation – Examples – Integrals of the motion – Simple Problems.	**18**
III	Rayleigh's Dissipation Function – Impulsive motion - *Velocity dependent potentials*.	**18**
IV	Hamilton`s principle – Hamilton's equation - *Other variational principles*.	**18**
V	Hamilton`s principal function – The Hamilton's – Jacobi equation – Separability.	**18**
VI	Current Trends (For CIA only) – Contemporary developments related to dynamical system during the semester concerned.	

…… Self Study

Text Book:

Donald. T. Green wood, Classical Dynamics, Prentice Hall of India, (1997).
UNIT I Chapter 1 Sections 1.1 - 1.5.
UNIT II Chapter 2 Sections 2.1 – 2.3.
UNIT III Chapter 3 Sections 3.1, 3.2 and 3.4
UNIT IV Chapter 4 Sections 4.1 – 4.3.
UNIT V Chapter 5 Sections 5.1 – 5.3.

Reference Book:

1 C.R. Mondal, Classical Mechanics, Revised Edition, Prentice Hall of India, (2008).

Web Resources:

1. https://www.youtube.com/watch?v=ZdNdXmAQWwI
2.https://www.youtube.com/watch?v=tUaLxI2C1Cc
3.https://www.youtube.com/watch?v=pv9Ni9DBLzM
4. https://www.youtube.com/watch?v=F4Lkp_uBqFI
5. https://www.youtube.com/watch?v=9Ki81-0RH5A

Demonstrate:

- To find generalized coordinates for a simple pendulum using MATLAB.
- To solve differential equation of motion using MATLAB (Lagrange's equationand Hamilton's Principle).
- To solve Simple Problems using MATLAB (Separability).

Course Outcomes		
Upon successful completion of this course, the student will be able to:		
CO No.	**CO Statement**	**Cognitive Level (K-Level)**
CO1	understand the principles and laws of classical dynamics, including Newton's law of motion, Lagrangian and Hamiltonian formalism.	**K2**
CO2	apply the concepts and techniques of classical dynamics to a wide range of physical systems, including mechanical systems, celestial mechanics and quantum mechanics.	**K3**
CO3	analyze the significance of Hamiltonian systems including the Hamiltonian formulation of classical dynamics, basic transformations and phase space dynamics.	**K4**
CO4	evaluate the advanced topics in classical dynamics using MATLAB, such as Hamilton – Jacobi Theory, Liouville's Theorem and Stackle's theorem.	**K5**
CO5	create and be able to develop advanced analytical skills, including the ability to perform mathematical calculations and solve complex problems in classical dynamics using MATLAB.	**K6**

Relationship Matrix:

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**	2	**1**	**3**	**1**	**3**	**3**	**2**	**3**	**1**	**2.2**
CO2	**3**	**3**	**2**	**1**	**1**	**3**	**3**	**3**	**2**	**2**	**2.3**
CO3	**2**	**3**	**2**	**2**	**2**	**3**	**3**	**2**	**2**	**1**	**2.2**
CO4	**3**	**2**	**1**	**3**	**2**	**3**	**2**	**2**	**3**	**2**	**2.3**
CO5	**3**	**2**	**2**	**3**	**2**	**3**	**2**	**2**	**3**	**2**	**2.4**
Mean Overall Score											**2.3**
Correlation											Medium

Mean Overall Score	**Correlation**
< 1.5	Low
≥ 1.5 and < 2.5	Medium
≥ 2.5	High

Course Coordinators:

Dr. S. Mohamed Yusuff Ansari

Mrs. M.S. Afya Farhana

Semester	Course Code	Course Category	Hours/ Week	Credits	Marks for Evaluation		
					CIA	ESE	Total
I	23PMA1CC4	CORE – IV	6	5	25	75	100

Course Title	Ordinary Differential Equations

SYLLABUS		
Unit	**Contents**	**Hours**
I	Second order linear Equations- *The general solution of the Homogeneous equation*. The Use of a known solution to find another- The Homogeneous equation with constant coefficients-The method of variation of parameters.	**18**
II	Oscillations and the Sturm separation theorem – The Sturm comparison theorem Series solutions of First order equations-Second order linear equations-ordinary points.	**18**
III	Regular singular points-Regular singular points (continued) - Gauss's Hypergeometricequation-* The point at Infinity*.	**18**
IV	Legendre Polynomials – Properties of Legendre Polynomials – Bessel functions – TheGamma function–Properties of Bessel functions.	**18**
V	Linear systems- Homogeneous linear systems with constant coefficients – The method of successive approximations –Picard's theorem.	**18**
VI	Current Trends (For CIA only) – Contemporary developments related to linear systems during the semester concerned.	

…… Self Study

Text Book:

G.F.Simmons, Differential Equations with Applications and Historical notes, second edition, Tata McGraw-Hill Publishing company Ltd, New Delhi, 2017.
UNIT I Sections 14, 15, 16, 17,19
UNIT II Sections 24, 25, 27, 28
UNIT III Sections 29, 30, 31, 32
UNIT IV Sections 44, 45, 46, 47
UNIT V Sections 55, 56, 68, 69

Reference Books:

1. Earl .A. Coddington, An Introduction to Ordinary Differential equations, PHI, 1961.
2. M.D. Raisinghania, Advanced Differential Equations, Seventh Revised Edition, S. Chandand Company Ltd, New Delhi, 2000.

Web Resources:

https://nptel.ac.in/courses/111/106/111106100/
https://nptel.ac.in/courses/111/108/111108081/
https://nptel.ac.in/courses/111/107/111107111/

Unit-I

Introduction to Second order ODE's
(https://www.youtube.com/watch?time_continue=2&v=dPJY0i5qNzU)
Properties of solutions of second order homogeneous ODE
(https://www.youtube.com/watch?v=iQ6SN5CDKTw)
The Use of a known solution to find another
(https://www.youtube.com/watch?time_continue=1&v=U5s1z9qaZng)
(https://www.youtube.com/watch?v=C3C67IXZIgQ)
The Homogeneous equation with constant coefficients
(https://www.youtube.com/watch?v=lUpQg32D9kE) ,
(https://www.youtube.com/watch?v=NvXF62IllCY)
The method of variation of parameters (https://www.youtube.com/watch?v=blF7FUu9Vtk)

Unit-II

ordinary points (https://www.youtube.com/watch?time_continue=1585&v=E9Mx1Ef_cD0)
Second order linear equations (https://www.youtube.com/watch?v=utSvQMsr3g8),
(https://www.youtube.com/watch?time_continue=2037&v=YQcFBh6HQ9o)

Unit-III

Legendre differential equation
(https://www.youtube.com/watch?time_continue=2&v=5c4KptxCS80)
Power series solutions around a regular singular point
(https://www.youtube.com/watch?time_continue=1944&v=3mKFtZl6ZZs)

Frobenius method (https://www.youtube.com/watch?v=2LdCV3qf-ZI), (https://www.youtube.com/watch?v=FOlHg93WtjY), (https://www.youtube.com/watch?time_continue=1&v=KcTgFeyJ6h0)

Unit-IV

Legendre polynomials (https://www.youtube.com/watch?v=k5n698fUwuU)
Properties of Legendre Polynomials (https://www.youtube.com/watch?v=g2BifBEjmnM)
Bessel differential equation (https://www.youtube.com/watch?v=_UmpTFoKqxE)
The Gamma function (https://www.youtube.com/watch?v=aK61gh-wUa4)
Properties of Bessel functions (https://www.youtube.com/watch?v=8KIs9zzTS8c), (https://www.youtube.com/watch?time_continue=4&v=MvZecjM4at8)

Unit-V

Pichard's Theorem
https://www.youtube.com/watch?v=oL97oGZUINA&list=PLbMVogVj5nJSGlf9sluucwobyr_zz6glD&index=19&t=0s
https://www.youtube.com/watch?v=2DaINaf1Zfo&list=PLbMVogVj5nJSGlf9sluucwobyr_zz6glD&index=20&t=0s

Course Outcomes		
Upon successful completion of this course, the student will be able to:		
CO No.	**CO Statement**	**Cognitive Level (K-Level)**
CO1	demonstrate and discuss Oscillations, Sturm separation and comparison Theorem with examples.	**K2**
CO2	apply domain knowledge for solving second order linear differential equations and methodof variation of parameters.	**K3**
CO3	examine the Legendre polynomials and Bessel functions with examples	**K4**
CO4	determine the linear systems with illustrative examples and Prove Picard's theorem.	**K5**
CO5	solve the Gauss's Hyper geometric equation with examples.	**K6**

Relationship Matrix:

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	**2**	**3**	**2**	**2**	**1**	**3**	**3**	**3**	**3**	**3**	**2.5**
CO2	**2**	**-**	**3**	**3**	**1**	**3**	**3**	**3**	**3**	**3**	**2.4**
CO3	**2**	**3**	**2**	**3**	**1**	**3**	**3**	**3**	**3**	**3**	**2.6**
CO4	**2**	**2**	**3**	**3**	**1**	**3**	**3**	**3**	**3**	**3**	**2.6**
CO5	**3**	**2**	**3**	**3**	**1**	**3**	**3**	**3**	**3**	**3**	**2.7**
Mean Overall Score											**2.56**
Correlation											**High**

Mean Overall Score	**Correlation**
< 1.5	Low
≥ 1.5 and < 2.5	Medium
≥ 2.5	High

Course Coordinators:

Dr. A. Prasanna
Mrs. M. Affrose Begum

Semester	Course Code	Course Category	Hours/ Week	Credits	Marks for Evaluation		
					CIA	ESE	Total
I	23PMA1DE1A	Discipline Specific Elective - I	6	4	25	75	100
Course Title	Financial Mathematics						

SYLLABUS		
Unit	**Contents**	**Hours**
I	Simple interest- *time between dates- equation of value- partial payments- simple discount- promissory notes*. Compound interest- accumulated values- compound interest tables- present values- nominal and effective rates of interest- discount and discounted values.	18
II	Compound interest- Varying rates of interest-equation of values- equated time payment. Annuities certain- present values-accumulated values- Annuity due- present values accumulated values- deferred annuity certain- present values- accumulated values- deferred annuity due- *present values- accumulated values*.	18
III	Perpetuity – immediate certain perpetuity-present values- accumulated values immediate perpetuity due- present values- accumulated values- deferred perpetuity- present values- accumulated values- variable annuities- increasing annuities- successive instalments form an AP- successive instalments form a GP- Annuities with frequency different from that with interest is convertible	18
IV	Redemption of loan- amortization of a debt- outstanding principal- interest portion & principal content in a particular repayment- Redemption of a loan by a sinking fund – Lender's sinking – further consideration on redemption of loan- Capital redemption policypure premiums – office premium	18
V	Further compound interest and investment yields-nominal and effective rates of discount- relation between i(m) and d(m)- the average yield on the life fund- weighted rate of return-money weighted rate of return- time weighted rate of return- linked internal rate of return. Bonds- purchase price-callable bonds- premium and discount-other types of bonds	18

…… Self Study

Text Books:

1. Peter Zima and Robert L.Brown, Mathematics of Finance, TataMcGraw-Hill Publishing Company Limited, Second edition ,2005.
2. Foundation of Actuarial Science (IC-28), Study Material Published by Insurance Institute of India, Reprinting February 2017.

Unit I Chapter 3 Section 3.1 to 3.6 T.B2

Chapter 1 Section 1 to 7 T.B1

Unit II Chapter 1 Section 8 to 10 T.B1

Chapter 2 Section 1 to 13 T.B1

Unit III Chapter 2 Section 14 &15 T.B1

Chapter 3 Section 1 to 5 T.B1

Unit IV Chapter 4 Section 1 to 8 T.B1

Unit V Chapter 5 Section 1 to 6 T.B1

Chapter 8 Section 8.1 to 8.7 T.B2

Reference Book:
1. MC Cutchoon and Scoot, An introduction to the Mathematics of Finance, Hoinenmann Professional Publishing, 2013.
Web Resources:
1. https://www.youtube.com/watch?v=752RHIXDHUY 2. https://www.youtube.com/watch?v=qO1SYFZVmhY 3. https://nptel.ac.in/courses/112107260

Course Outcomes		
Upon successful completion of this course, the student will be able to:		
CO No.	**CO Statement**	**Cognitive Level (K-Level)**
CO1	explain the basic concepts of simple interest, simple discount, equivalent rates and discount value and explain an accumulated and discount values for fractional interest period	**K2**
CO2	apply the mathematical idea of annuities with examples	**K3**
CO3	analyse the Amortization of a debit	**K4**
CO4	justify bounds and related properties with illustrations	**K5**
CO5	construct the Equation of values with respect to present and accumulated values	**K6**

Relationship Matrix:

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	**2**	3	**3**	**2**	**3**	**3**	**3**	**3**	**3**	**3**	**2.8**
CO2	**2**	**2**	**2**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**2.7**
CO3	**2**	**2**	**2**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**2.7**
CO4	**2**	**2**	**2**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**2.7**
CO5	**2**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**2.9**
										Mean Overall Score	**2.76**
										Correlation	**High**

Mean Overall Score	**Correlation**
< 1.5	Low
≥ 1.5 and < 2.5	Medium
≥ 2.5	High

Course Coordinators:

Dr. A. Prasanna

Mrs. A. Reigana Begum

Semester	Course Code	Course Category	Hours/ Week	Credits	Marks for Evaluation		
					CIA	ESE	Total
I	23PMA1DE1B	Discipline Specific Elective - I	6	4	25	75	100
Course Title	**Combinatorics**						

SYLLABUS		
Unit	**Contents**	**Hours**
I	Multisets and Compositions – Weak Compositions – Compositions - Set Partitions –Stirling Numbers of the Second Kind – Recurrence Relations for Stirling Numbers of the Second Kind – When the Number of Blocks Is Not Fixed - Partitions of Integers –Non increasing Finite Sequences of Integers – Ferrer's Shapes and Their Applications – Euler's Pentagonal Number Theorem - The inclusion - Exclusion Principle – Two Intersecting Sets – Three Intersecting Sets – Any Number of Intersecting Sets.	18
II	Power Series – Generalized Binomial Coefficients – Formal Power Series – Solving Recursions - Ordinary Generating Functions – Exponential Generating Functions.	18
III	Product of Generating Function – Ordinary Generating Functions – Exponential Generating Functions - Composition of Two Generating Functions – Ordinary Generating Functions – *Exponential Generating Functions*- A Different Type of Generating Function	18
IV	The cycle Structure of Permutations – Stirling Numbers of the First Kind – Permutations of a Given type - Cycle Structure and Exponential Generating Functions –Inversions – Counting Permutations with Respect to Inversions	18
V	Unimodality – Log-Concavity – Log-Concavity Implies Unimodality – The Project Property – Injective Proofs - *The Real Zeros Property*.	18

…… Self Study

Text Book:

Miklos Bona, Introduction to Enumerative and Analytic Combinatorics, Second Edition 2015, University of Florida Gainesville, Florida, USA.

PDF Link: https://dokumen.pub/introduction-to-enumerative-and-analytic-combinatorics-2nbsped-9781482249095- 148224909x.html

Reference Book:

1. V.K. Balakrishnan – Theory and problems of combinatorics – Schaums outline series –TATA McGRAW HILL.

Web Resources:

1.https://youtu.be/FfO9ZaKRyDA

2. https://youtu.be/p8vIcmr_Pqo

Course Outcomes		
Upon successful completion of this course, the student will be able to:		
CO No.	**CO Statement**	**Cognitive Level (K-Level)**
CO1	demonstrate working knowledge of multisets and compositions, Apply the inclusion and exclusion principle.	**K2**
CO2	analyse the power series, generalized binomial coefficients, set up and solve a linear recursions relation.	**K3**
CO3	determine a generating function and apply them to combinatorial problems.	**K4**
CO4	construct the cycle structure of permutations, solve counting permutations with respect to inversions.	**K5**
CO5	elaborate the unimodality and Log-concavity, Apply the project property and the real zeros property.	**K6**

Relationship Matrix:

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	2	3	3	3	3	2	3	3	2	**2.7**
CO2	3	3	3	3	3	2	3	2	3	2	**2.7**
CO3	3	3	3	2	2	3	3	3	3	3	**2.8**
CO4	2	2	2	2	3	2	3	3	3	3	**2.5**
CO5	3	2	3	2	3	3	2	2	2	2	**2.4**
Mean Overall Score											**2.6**
Correlation											**High**

Mean Overall Score	Correlation
< 1.5	Low
≥ 1.5 and < 2.5	Medium
≥ 2.5	High

Course Coordinators:

Dr. H. Sheik Mujibur Rahman

Mrs. J. Sarthaj Banu

Semester	Course Code	Course Category	Hours/ Week	Credits	Marks for Evaluation		
					CIA	ESE	Total
II	23PMA2CC5	CORE – V	6	5	25	75	100

Course Title	Algebra - II

SYLLABUS

Unit	Contents	Hours
I	Extension fields – The Transcendence of e.	18
II	Roots of Polynomials – *More about Roots*.	18
III	The Elements of Galois Theory, Solvability by Radicals	18
IV	Finite Fields – Wedderburn's Theorem on Finite Division Rings	18
V	A Theorem of Frobenius – Integral Quaternions and the Four Square Theorem.	18

…… Self Study

Text Book:

I. N. Herstein, Topics in Algebra, Second Edition, Wiley India Pvt. Ltd., New Delhi,2022.

UNIT I Chapter 5 Sections 5.1, 5.3
UNIT II Chapter5 Sections 5.4, 5.6
UNIT III Chapter 5 Section 5.7,5.8
UNIT IV Chapter 7 Sections 7.1, 7.2 (Theorem 7.2.1-First proof only)
UNIT V Chapter 7 Sections 7.3, 7.4

Reference Books:

1. M. Artin, Algebra, Pearson - Prentice Hall, New Delhi,2007
2. P.B. Bhattacharya, S.K. Jain and S.R. Nagpaul, Basic Abstract Algebra, Second (Indian) Edition, Cambridge University Press,1997
3. Emil Artin, Galois Theory, Second Edition, Dover Publication, Inc, Mineola, New York

Web Resources:

1. Galois Theory link: https://youtu.be/G_BNxjRrQYI?list=PLyqSpQzTE6M94LuHxxu4OrViX4K45oH73
2. Finite Field link: https://youtu.be/N4kmjou0eIg

Course Outcomes		
Upon successful completion of this course, the student will be able to:		
CO No.	**CO Statement**	**Cognitive Level (K-Level)**
CO1	understand the fundamental ideas of fields, Galois theory and finite fields.	**K2**
CO2	apply the knowledge of various field structures and construct the extension, splitting fields of a given fields.	**K3**
CO3	analyse the relation between algebraic structures groups and fields.	**K4**
CO4	explain the properties of finite fields, simple, normal and separable extensions of a given fields.	**K5**
CO5	create more examples for the various extension fields of a given field and Galois groups for a given polynomial over a field.	**K6**

Relationship Matrix:

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**	**3**	**2**	**3**	**3**	**3**	**3**	**3**	**2.8**
CO2	**3**	**2**	**2**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**2.8**
CO3	**3**	**2**	**2**	**3**	**2**	**3**	**3**	**3**	**3**	**3**	**2.7**
CO4	**3**	**2**	**2**	**3**	**1**	**3**	**3**	**3**	**2**	**2**	**2.4**
CO5	**3**	**2**	**1**	**2**	**1**	**3**	**3**	**2**	**2**	**2**	**2.1**
Mean Overall Score											**2.56**
Correlation											**High**

Mean Overall Score	**Correlation**
< 1.5	Low
≥ 1.5 and < 2.5	Medium
≥ 2.5	High

Course Coordinators:

Mr. N. Mohamed Thoiyab

Mrs. B. Shafina Banu

Semester	Course Code	Course Category	Hours/ Week	Credits	Marks for Evaluation		
					CIA	ESE	Total
II	23PMA2CC6	CORE – VI	6	5	25	75	100
Course Title	Complex Analysis						

SYLLABUS		
Unit	**Contents**	**Hours**
I	Fundamental theorems – Line integrals - Rectifiable arcs - Line integrals as functions of arcs -Cauchy's theorem for a rectangle - Cauchy's theorem in a disk. Cauchy's integral formula – Index of a point with respect to a closed curve - Integral formula for higher derivatives.	**18**
II	Local properties of analytical functions – Removable singularities - Taylor's theorem - Zeros and poles. Local mapping - Maximum principle. General form of Cauchy theorem – Chains and cycles -Simple connectivity - Homology	**18**
III	General statement of Cauchy's theorem - Proof of Cauchy's theorem - Locally exact differentials. Calculus of residue - Residue theorem - Argument principle - Evaluation of definite integrals.	**18**
IV	Harmonic functions – Definition and basic properties – Mean-value property - Poisson's formula- Schwartz's theorem - Reflection principle. Power series expansions – Weierstrass's theorem – Taylor series - *Laurent series*.	**18**
V	Partial fractions and factorization – Partial fractions - Infinite products - Canonical products - *Gamma functions*.	**18**

…… Self Study

Text Book:

Lars. V. Ahlfors, Complex Analysis, McGraw Hill International Edition, Third Edition (1979).
Unit 1: Chapter 4 Sections 1.1 – 1.5, 2.1 – 2.3.
Unit II: Chapter 4 Sections 3.1 – 3.4, 4.1 – 4.3.
Unit III: Chapter 4 Sections 4.4 – 4.6, 5.1 – 5.3.
Unit IV: Chapter 4 Sections 6.1 – 6.5
Chapter 5 Sections 1.1 – 1.3.
Unit V: Chapter 5 Sections 2.1 – 2.4

Reference Books:

1. Jacob Sonnenschein and Simon Green, Elements of Complex analysis, Dickenson Publishing Company, INC. (1977).
2. S. Ponnusamy, Foundations of Complex Analysis, NarosaPvt. Ltd., Second Edition (2008).

Web Resources:

1. https://youtu.be/AruIhF83CIY
2. https://youtu.be/hy3O5g6mRyo
3. https://youtu.be/on4fqkF4qx0

Course Outcomes		
Upon successful completion of this course, the student will be able to:		
CO No.	**CO Statement**	**Cognitive Level (K-Level)**
CO1	understand the fundamental concepts of complex analysis, such as complex differentiation, complex integration, Cauchy's Theorem and the Cauchy Integral Formula.	**K2**
CO2	apply complex analysis in the study of conformal mappings, the theory of Riemann surfaces and the study of elliptic functions.	**K3**
CO3	analyse the geometric and analytic properties of complex functions and their derivatives, including singularities, poles and zeros.	**K4**
CO4	evaluate and be able to use complex analysis to solve real – world problems in areas such as fluid dynamics, electrical engineering and physics.	**K5**
CO5	create an exposure to the use of complex analysis in other areas of Mathematics.	**K6**

Relationship Matrix:

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**	**2**	**2**	**3**	**2**	**3**	**3**	**2**	**2**	**2**	**2.4**
CO2	**3**	**2**	**2**	**3**	**2**	**2**	**2**	**3**	**2**	**2**	**2.3**
CO3	**3**	**3**	**2**	**3**	**2**	**3**	**2**	**3**	**3**	**1**	**2.5**
CO4	**3**	**2**	**3**	**3**	**3**	**3**	**3**	**2**	**2**	**3**	**2.7**
CO5	**3**	**2**	**3**	**3**	**2**	**3**	**2**	**3**	**3**	**3**	**2.7**
Mean Overall Score											**2.5**
Correlation											High

Mean Overall Score	**Correlation**
< 1.5	Low
≥ 1.5 and < 2.5	Medium
≥ 2.5	High

Course Coordinators:

Dr. R. Jahir Hussain
Mrs. M.S. Afya Farhana

Semester	Course Code	Course Category	Hours/ Week	Credits	Marks for Evaluation		
					CIA	ESE	Total
II	23PMA2CC7	CORE – VII	6	5	25	75	100

Course Title	Topology

SYLLABUS		
Unit	**Contents**	**Hours**
I	Topological spaces - Basis for a topology- Order topology, product topology- Subspace Topology - Closed sets and limit points - Continuous functions - * Product Topology *.	18
II	Metric topology - Metric topology (continued) - Connected spaces.	18
III	Compact spaces - Limit point compactness - Tychonoff theorem.	18
IV	Countability axioms - Separation axioms - Urysohn lemma - Urysohn metrization theorem - Completely regular spaces.	18
V	Complete metric spaces - Compactness in metric spaces - Baire spaces.	18

…… Self Study

Text Book:

James R. Munkres, Topology A First Course, Prentice Hall of India, (1998).
UNIT I Sections 2.1 - 2.8
UNIT II Sections 2.9, 2.10, 3.1
UNIT III Sections 3.5, 3.7, 5.1
UNIT IV Sections 4.1 - 4.4, 5.2
UNIT V Sections 7.1, 7.3, 7.7

Reference Books:

1. Sze-Tsen Hu, Elements of General Topology, Holden Day, INC. (1964).
2. K.D. Joshi, Introduction to General Topology, Wiley Eastern Ltd. (1983).

Web Resources:

1. https://youtube.com/playlist?list=PLbMVogVj5nJRR7zYZifYopb52zjoScx1d

Course Outcomes

Upon successful completion of this course, the student will be able to:

CO No.	CO Statement	Cognitive Level (K-Level)
CO1	demonstrate an understanding of concepts such as open sets, closed sets and closure	**K2**
CO2	construct new topological spaces by using sub space, product and quotient topologies	**K3**
CO3	analyse the structure of the topological spaces using continuous functions and homeomorphisms	**K4**
CO4	prove the theorems related to connected, compact and complete metric spaces	**K5**
CO5	propose axioms and lemmas to prove the theorems in topological spaces	**K6**

Relationship Matrix:

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	3	2	3	3	3	3	3	2.8
CO2	3	2	2	3	2	3	3	3	3	3	2.7
CO3	3	2	2	3	3	3	3	3	3	3	2.8
CO4	3	2	2	3	1	3	3	3	2	2	2.4
CO5	3	3	2	2	1	3	3	3	2	2	2.4
Mean Overall Score											2.62
Correlation											High

Mean Overall Score	Correlation
< 1.5	Low
≥ 1.5 and < 2.5	Medium
≥ 2.5	High

Course Coordinators:

Mr. S. Masoothu

Dr. K.S. Kanzul Fathima

Semester	Course Code	Course Category	Hours/ Week	Credits	Marks for Evaluation		
					CIA	ESE	Total
II	23PMA2CC8	CORE - VIII	6	5	25	75	100

Course Title	Numerical Analysis with Octave

SYLLABUS

Unit	Contents	Hours
I	Iteration Method Based On First Degree Equations-Newton Raphson Method- Iteration Method Based On Second Degree Equations - Chebyshev Method – *Multipoint Iteration Methods* - Bridge Vieta Method - Baristow Method - Graeffes Root Squaring Method – Solving Transcendental Equations Using Octave	18
II	Direct Method- Triangularization Method-Iteration Methods-Jacobi Method-Guass Seidel Method-Successive Over Relaxation Method - Iterative Method For A^{-1} - *Eigen Values And Eigen Vectors* - Jacobi Method For Symmetric Matrices –Power Method – Solving Simultaneous Equations And Finding Eigen Values And Eigen Vectors Using Octave.	18
III	Interpolation And Approximation - Hermite Interpolation - Piecewise Cubic Inter Polation And Cubic Spline Interpolation - Bivariate Interpolation - Lagrange And Newtons - Bivariate Interpolation-Least Square Approximation-Gram-Schmidt Orthogonalizing Process- Legendre Polynomials Chebyshev Polynomials – Finding Interpolation Using Octave.	18
IV	Differentiation and Integration: Numerical Differentiation Methods Based on Interpolation - Partial Differentiation - Numerical Integration Methods Based on Interpolation – Methods Based on undetermined Coefficients - Gauss Quadrature methods-Gauss Legendre and Gauss Chebyshev Integration Method - Composite Integration method – Composite Integration Method - Double Integration Trapezoidal and Simpsons Rule Simple – Problems – Finding Differentiation and Integration (Line & Double) using Octave.	18
V	Ordinary Differential Equations: Numerical Methods - Euler Method - *Backward Euler Method* - Mid-Point Method - Single Step Method- Taylor Series Method - Runge-Kutta Methods – Implicit Runge - Kutta Methods -Predictor Corrector Methods – Solving Differential Equation Using Octave.	18
VI	Current Trends (For CIA only) – Contemporary developments related to the numerical differential equations during the semester concerned.	

…… Self Study

Text Book:

M.K.Jain, S.R.K.Iyengar, R.K.Jain, Numerical Methods for Scientific and Engineering Computation, New Age International Private Ltd, Sixth Edition(2012).
Unit I: Sections 2.3, 2.4, 2.9.
Unit II: Sections 3.2, 3.4, 3.5, 3.7, 3.11.
Unit III: Sections 4.5, 4.6, 4.7, 4.9.
Unit IV: Sections 5.2, 5.5, 5.6, 5.7, 5.8, 5.9, 5.11
Unit V: Sections 6.3, 6.4, 6.7.

Reference Books:

1. Samuvel.D, Conte and Carl De Boor, Elementary Numerical Analysis, Mc Graw Hil Company, Third edition (1965).
2. F.B. Hildebrand, Introduction to Numerical Analysis, Tata M Graw Hill Company, Second Edition(1974).

Web Resources:
1. https://nptel.ac.in/courses/111107105 2. https://www.pdfdrive.com/numerical-analysis-using-matlab-and-excel-e10002499.html 3. https://www.pdfdrive.com/numerical-and-analytical-methods-with-matlab-e178983274.html

Course Outcomes		
Upon successful completion of this course, the student will be able to:		
CO No.	**CO Statement**	**Cognitive Level (K-Level)**
CO1	recall the iteration methods to solve the problems and Interpret the approximate solution to the given problem.	**K2**
CO2	select the formula to find the approximate value.	**K3**
CO3	classify the methods to find the best solution.	**K4**
CO4	choose the appropriate method to evaluate the given problem.	**K5**
CO5	create a problem and solve using any Numerical method.	**K6**

Relationship Matrix:

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	**2**	**3**	**2**	**2**	**2**	**3**	**3**	**3**	**2**	**3**	**2.5**
CO2	**2**	**3**	**2**	**3**	**2**	**3**	**3**	**3**	**3**	**2**	**2.6**
CO3	**3**	**2**	**2**	**3**	**2**	**3**	**2**	**3**	**3**	**3**	**2.6**
CO4	**3**	**2**	**3**	**3**	**2**	**3**	**2**	**3**	**3**	**3**	**2.7**
CO5	**1**	**3**	**2**	**3**	**3**	**2**	**3**	**3**	**3**	**3**	**2.6**
										Mean Overall Score	**2.6**
										Correlation	**High**

Mean Overall Score	**Correlation**
< 1.5	Low
≥ 1.5 and < 2.5	Medium
≥ 2.5	High

Course Coordinators:

Dr. A. Mohamed Ismayil

Mrs. C. Vijayalakshmi**.**

Semester	Course Code	Course Category	Hours/ Week	Credits	Marks for Evaluation		
					CIA	ESE	Total
II	23PMA2DE2A	Discipline Specific Elective - II	6	4	25	75	100
Course Title	Theory of Fuzzy sets & its Applications						

SYLLABUS		
Unit	**Contents**	**Hours**
I	From Classical Sets to Fuzzy sets – Fuzzy set: Basic types – Fuzzy sets Versus Crisp sets Extension Principle for fuzzy sets – Operations on Fuzzy sets – *Types of operations* – Fuzzy complements.	**18**
II	Fuzzy Arithmetic – Fuzzy numbers - Linguistic variables – Arithmetic operations on intervals –Arithmetic operations on Fuzzy numbers –Lattice of Fuzzy numbers– Fuzzy equations.	**18**
III	Fuzzy Logic – Multi-valued Logics – Fuzzy Propositions – Unconditional and Unqualified Fuzzy propositions – Unconditional and qualified Propositions – Conditional and Unqualified propositions –Conditional and Qualified propositions – Linguistic Hedges – Inference from conditional Fuzzy propositions- *Inference from conditional and qualified propositions*.	**18**
IV	Fuzzy Decision making – *Individual decision making* – Fuzzy Ranking methods – Fuzzy Linear programming.	**18**
V	Fuzzy Relations – Composition of fuzzy relations – Properties of fuzzy relations.	**18**
VI	Current Trends (For CIA only) – Contemporary developments related to the fuzzy theory during the semester concerned.	

…… Self Study

Text Books:

1. George J. Klir and Bo Yuan, Fuzzy sets and Fuzzy Logic Theory and Applications, Prentice Hall of India, (2004).

2.A. NagoorGani and V.T. Chandrasekaran, A first look at Fuzzy Graph Theory, Allied Publishers Pvt. Ltd., (2010).

UNIT I	Chapter 1	Sections 1.3, 2.3	
	Chapter 3	Sections 3.1 & 3.2	**T.B -1**
UNIT II	Chapter 4	Sections 4.1 - 4.6	**T.B -1**
UNIT III	Chapter 8	Sections 8.2, 8.3, 8.5 - 8.7	**T.B -1**
UNIT IV	Chapter 15	Sections 15.2, 15.6, 15.7	**T.B -1**
UNIT V	Chapter 1	Sections 1.3 - 1.5	**T.B -2**

Reference Books:

1.H.J. Zimmermann, Fuzzy Set Theory and its Applications, Allied Publishers Limited (1991).

2.M. Ganesh, Introduction to Fuzzy sets and Fuzzy logic, Prentice Hall of India, New Delhi (2006).

3. Fuzzy Sets and systems Theory and Applications, Didier Dubois, Academic Press, (1980)

Web Resources:
1. https://nptel.ac.in/courses/108/104/108104157/
2.https://nptel.ac.in/courses/111/102/111102130/
3.https://nptel.ac.in/courses/127/105/127105006/

Course Outcomes		
Upon successful completion of this course, the student will be able to:		
CO No.	**CO Statement**	**Cognitive Level (K-Level)**
CO1	apply domain knowledge from classical sets to fuzzy sets with illustrations	**K2**
CO2	explain the fuzzy arithmetic, Linguistic variables and examine Fuzzy equations.	**K3**
CO3	estimate fuzzy logic and fuzzy propositions.	**K4**
CO4	determine fuzzy Decision making problem and Fuzzy Linear programming problem.	**K5**
CO5	discuss fuzzy relations and properties of fuzzy relations.	**K6**

Relationship Matrix:

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	3	3	2	3	3	2	3	3	**2.8**
CO2	3	3	3	3	3	2	2	3	2	3	**2.7**
CO3	3	3	3	3	2	3	3	2	3	3	**2.8**
CO4	3	3	3	3	3	3	2	3	3	2	**2.8**
CO5	2	3	2	3	3	2	3	3	3	3	**2.7**
Mean Overall Score											**2.76**
Correlation											**High**

Mean Overall Score	**Correlation**
< 1.5	Low
≥ 1.5 and < 2.5	Medium
≥ 2.5	High

Course Coordinators:

Dr. H. Sheik Mijibur Rahman

Mrs. A. Thagasin Banu

Semester	Course Code	Course Category	Hours/ Week	Credits	Marks for Evaluation		
					CIA	ESE	Total
II	23PMA2DE2B	Discipline Specific Elective - II	6	4	25	75	100

Course Title	Mathematical Modelling

SYLLABUS		
Unit	**Contents**	**Hours**
I	Mathematical Modelling through Systems of Ordinary differential Equations of the First Order : Mathematical modelling in population dynamics, *Mathematical modelling in Arms Race, Battles and international Trade in terms of systems of ordinary differential equations*- Mathematical modelling in dynamics through systems of ordinary differential equations of first order.	18
II	Mathematical Modelling through difference equations: The need for Mathematical modelling through difference equations - Some simple models - Basic theory of linear difference equations with constant coefficients - Mathematical mod modelling through difference equations in economics and finance	18
III	Mathematical Modelling through difference equations (contd.): Mathematical modelling through difference equation in population dynamics and genetics - Mathematical modelling through difference equations in probability theory - Miscellaneous examples of mathematical modelling through difference equations.	18
IV	Mathematical modelling through Graphs: Situations that can be modelled through graphs – Mathematical models in terms of directed graphs - mathematical models in terms of signed graphs - Mathematical models in terms of weighted graphs.	18
V	Mathematical Modelling through calculus of Variations and Dynamic Programming : Optimization principles and techniques - Mathematical modelling through calculus of variations – Mathematical Modelling through dynamic programming.	18
VI	Current Trends (For CIA only) – Contemporary developments related to the mathematical modelling during the semester concerned.	

…… Self Study

Text Book:

J.N. Kapoor, Mathematical Modelling, Willey Eastern Limited, Reprint 2000..

Reference Books:

1. D.J.G James and J.J Macdonald, Case studies in mathematical Modelling, Stanly Thames, Cheltenham, 2003.
2. C.Dyson, Elvery, Principles of Mathematical Modelling, Academic Press ,New York, 2001.

Web Resources:

1. https://www.slideshare.net/arupparia/introduction-to-mathematical-modelling-42588379
2. https://web.ma.utexas.edu/users/m408s/m408d/CurrentWeb/LM9-1-2.php
3. https://youtu.be/CIwfCxkZ5Wk

Course Outcomes		
Upon successful completion of this course, the student will be able to:		
CO No.	**CO Statement**	**Cognitive Level (K-Level)**
CO1	understand the concepts of mathematical modelling through real world problems.	**K2**
CO2	apply and articulate what type of modelling techniques are appropriate for a given physical system.	**K3**
CO3	analyse the mathematical model of a given physical system.	**K4**
CO4	evaluate the techniques for solving a given physical system.	**K5**
CO5	create and simulate mathematical models.	**K6**

Relationship Matrix:

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	3	3	3	3	3	3	3	3	3
CO2	3	3	3	2	2	1	2	1	3	1	2.1
CO3	3	3	2	2	2	3	2	0	2	3	2.2
CO4	3	3	2	3	2	3	3	1	3	3	2.6
CO5	2	3	1	3	1	3	3	2	3	3	2.4
Mean Overall Score											2.46
Correlation											Medium

Mean Overall Score	Correlation
< 1.5	Low
≥ 1.5 and < 2.5	Medium
≥ 2.5	High

Course Coordinators:

Dr. T. SHIEK PAREETH

Mrs. A. THAGASIN BANU

Semester	Course Code	Course Category	Hours/ Week	Credits	Marks for Evaluation		
					CIA	ESE	Total
III	23PMA3CC9	Core – IX	6	5	25	75	100

Course Title	FUNCTIONAL ANALYSIS

SYLLABUS

Unit	Contents	Hours
I	Banach Space: Definition and some examples - Continuous linear transformations –Hahn Banach theorem.	18
II	Banach space (continued): Natural imbedding of N in N**- The open mapping theorem - # The conjugate of an operator #	18
III	Hilbert spaces: Definition and some simple properties - Orthogonal complements - Orthonormal sets – The conjugate space H*.	18
IV	Hilbert spaces (Continued): The adjoint of an operator - Self-adjoint operators - Normal andunitary operators - # Projections #.	18
V	Finite-Dimensional spectral theory: Matrices - Determinants and the spectrum of an operator – The spectral theorem.	18

#……# Self Study

Text Book(s):

G.F Simmons, Introduction to Topology and Modern Analysis, McGraw Hill, International Book Company, 2014. (21st reprint).

UNIT I	Chapter Nine	Sections 46 - 48
UNIT II	Chapter Nine	Sections 49 - 51
UNIT III	Chapter Ten	Sections 52 - 55
UNIT IV	Chapter Ten	Sections 56 - 59
UNIT V	Chapter Eleven	Sections 60 - 62

Reference Book(s):

1. Balmohan V. Limaye, Functional Analysis, New Age International Pvt. Ltd., Second Edition (2005).
2. M. Thamban Nair, Functional Analysis, A First Course, Prentice Hall of India (2002).
3. Sudhir Kumar Pundir, Functional Analysis, CBS Publishers and Distributors Pvt. Ltd., (2016).

Web Resource(s):

1. https://youtu.be/M1h9l5p95Yk
2. https://youtu.be/8DtYlUgike8
3. https://youtu.be/xaHkXIWcgP8
4. https://youtu.be/s-5bCfENHg8
5. https://youtu.be/mVGhIWf-CEU

Course Outcomes		
Upon successful completion of this course, the student will be able to:		
CO No.	**CO Statement**	**Cognitive Level (K-Level)**
CO1	Recall normed liner spaces and acquire more knowledge on Banach spaces through Hahn Banach theorem.	**K1**
CO2	Demonstrate and discuss Open mapping theorem and Conjugate of an operator.	**K2**
CO3	Apply domain knowledge for Hilbert Space.	**K3**
CO4	Analyze the theorem based on the Hilbert space with an operator.	**K4**
CO5	Determine the matrix, determinants of an operator and the development of finite dimensional spectral theory.	**K5, K6**

Relationship Matrix:

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	2	3	3	3	3	3	2	2.7
CO2	3	2	2	3	3	3	3	3	3	2	2.7
CO3	3	2	2	2	2	3	3	3	3	2	2.5
CO4	3	2	2	3	2	3	3	3	2	2	2.5
CO5	3	3	3	2	2	3	3	3	2	2	2.6
Mean Overall Score											2.6
Correlation											High

Mean Overall Score	Correlation
< 1.5	Low
≥ 1.5 and < 2.5	Medium
≥ 2.5	High

Course Coordinators:

1. Dr. A. Mohamed Ismayil
2. Mrs. M. Affrose Begum

Semester	Course Code	Course Category	Hours/ Week	Credits	Marks for Evaluation		
					CIA	ESE	Total
III	23PMA3CC10	CORE – X	6	5	25	75	100

Course Title	PARTIAL DIFFERENTIAL EQUATIONS

SYLLABUS

Unit	Contents	Hours
I	Curves and Surfaces-Genesis of First Order P.D.E-Classification of Integrals-Linear equations of the First Order- Pfaffian Differential Equations-Compatible Systems-Charpit's method.	18
II	Jacobi's Method-Integral Surfaces Through a given Curve-Quasi-Linear Equations.	18
III	Genesis of Second Order P.D.E-Classification of Second order P.D.E-One Dimensional Wave Equations-Vibrations of an Infinite String-Vibrations of a Semi-infinite string-*Vibrations of a string of Finite length*.	18
IV	Vibrations of a String of Finite length (Method of Separations of Variables)-Laplace Equation-Boundary Value Problems-Maximum and Minimum Principles-The Cauchy Problem -The Dirichlet Problem for the Upper Half Plane- The Neumann Problem for the Upper Half Plane-The Dirichlet Problem for a circle-The Dirichlet Exterior Problem for a circle-*The Dirichlet Problem for a Rectangle*.	18
V	The Dirichlet Problem for a Half Plane-The Dirichlet Problem for a circle-Heat Conduction Problem:Heat Conduction-Infinite rod case-Heat Conduction-Finite Rod case -Duhamel's Principle:Wave Equation-*Heat Conduction Equation*.	18

…… Self Study

Text Book(s):

T.Amarnath, An Elementary Course in Partial Differential Equations, Second Edition, Narosa Publishing House-2003

UNIT I	Chapter I	Sections 1.1 – 1.7
UNIT II	Chapter I	Sections 1.8 – 1.10
UNIT III	Chapter II	Sections 2.1 – 2.3.3
UNIT IV	Chapter II	Sections 2.3.5 – 2.4.9
UNIT V	Chapter II	Sections 2.4.12 – 2.6.2

Reference Book(s):

1. I.N.Sneddon, Elements of partial differential Equations, McGraw Hill,1985.
2. M.D.Raisinghania, Advanced differential equations, Seventh revised edition S.Chand and Company Ltd, New Delhi, 2000.

Web Resource(s):

1. https://nptel.ac.in/courses/111/103/111103021/
2. https://youtu.be/YLsNeg0Qp5M
3. https://youtu.be/FZZS91nfRgc
4. https://youtu.be/l3T4SL6lEIE
5. https://youtu.be/cNLMDPfWJeA

Course Outcomes		
Upon successful completion of this course, the student will be able to:		
CO No.	**CO Statement**	**Cognitive Level (K-Level)**
CO1	Discuss the basic concept of first order P.D.E and classification of integrals with examples.	**K2**
CO2	Illustrate the examples of Jacobi's method and quasi-linear equations	**K3**
CO3	Explain the examples for one dimensional wave equations and vibrations of a string	**K4**
CO4	Evaluate the boundary value problems in second order PDE's	**K5**
CO5	Solve the heat conduction and wave equation	**K6**

Relationship Matrix:

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	**2**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**2.9**
CO2	**2**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**2.9**
CO3	**2**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**2.9**
CO4	**2**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**2.9**
CO5	**2**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**2.9**
Mean Overall Score											**2.9**
Correlation											**High**

Mean Overall Score	Correlation
< 1.5	Low
≥ 1.5 and < 2.5	Medium
≥ 2.5	High

Course Coordinators:

1. Dr. M. Mohamed Althaf
2. Dr. K.S. Kanzul Fathima

Semester	Course Code	Course Category	Hours/ Week	Credits	Marks for Evaluation		
					CIA	ESE	Total
III	23PMA3CC11	Core – XI	6	5	25	75	100

Course Title	Mathematical Statistics with R

SYLLABUS		
Unit	**Contents**	**Hours**
I	Probability: Definition of Probability-Axiomatic-Definition-Some Properties-Booles inequality- Discrete Probability Space-General Probability Space-Induced Probability Space-Conditional Probability Measure.	**18**
II	Distribution function of a Random Variable-Decomposition of D.F's-Jordan Decomposition Theorem-Distribution functions of Vector Random Variables-Bivariate case only- Correspondence Theorem. Expectation and Moments: Definition of Expectation –properties of Expectation –Definition of Moments-Moment Generating Function-Cr-inequality-Holder's inequality-Schwarz's inequality-*Minkowski inequality*.	**18**
III	Convergence of Random Variables: Convergence in Probability-Convergence almost surely-Convergence in Distribution-Convergence in rth Mean-Monotone Convergence Theorem-Fatou's Theorem-Dominated Convergence Theorem.	**18**
IV	Laws of Large Numbers: Convergence of a Series of Independent Random Variables-Kolmogorov inequalities and almost surely Convergence- Kolmogorov three-Series Theorem –*Stability of Independent Random Variables*-Weak Law of Large numbers-Kronecker's Lemma-WLLN-IID Case- Khintchine's WLLN-Strong Law of Large Numbers-KolmogorovSLLN for i.i.d case.	**18**
V	Central Limit Theorem: Introduction –Lindeberg-Levy Theorem-Variable Distributions: Liapounov's Theorem Lindeberg-Feller Theorem.	**18**

…… Self Study

Text Book(s):

B.R.Bhat, Modern Probability Theory, Fourth Edition, New Age International, 2014.

UNIT I	Chapter 3	Sections 3.1-3.6
UNIT II	Chapter 4	Sections 4.1-4.4
	Chapter 5	Sections 5.1-5.3
UNIT III	Chapter 6	Sections 6.1,6.2(a),6.3,6.4(a),6.4(b),6.5(a),6.5(b),6.5(c)
UNIT IV	Chapter 10	Sections 10.1-10.2,10.3(a), 10.3(b), 10.3(d)
UNIT V	Chapter 11	Sections 11.1-11.3

Reference Book(s):

1. Fisz, Probabaility theory and Mathematical Statistics, Third Edition, John Willey &Sons 1963.
2.Murry R.Spiegal,John Jschiller,R.Aly Srinivasan,Probability and Statitcs,Third Edition,Shaum's Outline Series, 2010

Web Resource(s):

1. https://onlinecourses.nptel.ac.in/noc20_ma18/preview
2. https://www.digimat.in/nptel/courses/video/111105041/L01.html
3. https://www.digimat.in/nptel/courses/video/111102134/L09.html

Course Outcomes		
Upon successful completion of this course, the student will be able to:		
CO No.	**CO Statement**	**Cognitive Level (K-Level)**
CO1	Recall and discuss the Boole's inequality and discrete probability space with examples.	**K2**
CO2	Examine Study Jordan decomposition theorem and inequalities with examples	**K3**
CO3	Investigate the convergence of random variables and convergence in distribution	**K4**
CO4	Determine the laws of large numbers and SLLN for i.i.d case with illustrate the examples	**K5**
CO5	Prove central limit theorem and Lindeberg-Feller theorem	**K5**

Relationship Matrix:

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**	**3**	**3**	**2**	**3**	**3**	**2**	**3**	**2.8**
CO2	**1**	**3**	**1**	**3**	**3**	**3**	**1**	**3**	**3**	**3**	**2.4**
CO3	**3**	**2**	**3**	**2**	**1**	**3**	**3**	**2**	**2**	**3**	**2.4**
CO4	**3**	**3**	**3**	**3**	**3**	**1**	**3**	**3**	**3**	**1**	**2.4**
CO5	**1**	**3**	**3**	**1**	**3**	**3**	**3**	**3**	**3**	**3**	**2.6**
Mean Overall Score											**2.52**
Correlation											**High**

Mean Overall Score	**Correlation**
< 1.5	Low
≥ 1.5 and < 2.5	Medium
≥ 2.5	High

Course Coordinators:

1. Dr.P.Muruganantham
2. Dr.V.Krishnan

Semester	Course Code	Course Category	Hours/ Week	Credits	Marks for Evaluation		
					CIA	ESE	Total
III	23PMA3CC12	Core – XII	6	5	25	75	100

Course Title	ADVANCED GRAPH THEORY

SYLLABUS

Unit	Contents	Hours
I	Connectivity and edge-connectivity – 2-connected graphs – Menger's theorem.	18
II	Matching – System of Distinct Representatives and Marriage problem – Covering – 1-factor – *Stable Matching*.	18
III	Independent sets – Edge-colourings – Vizing's Theorem – Vertex Colourings – Uniquely Colourable graphs – Critical graphs.	18
IV	Predecessor and Successor – Algorithm – Graceful Labeling – Sequential functions – Magic graphs – Conservative graphs.	18
V	Perfect Graphs – Perfect Graph Theorem – Chordal Graphs – Interval Graphs – Comparability Graphs.	18

…… Self Study

Text Book(s):

M. Murugan, Topics in Graph theory and Algorithms, Muthali Publishing House, Annanagar, Chennai, First Edition (2003).

UNIT I	Chapter 3	Sections 3.1 - 3.3
UNIT II	Chapter 6	Sections 6.1 - 6.5
UNIT III	Chapter 7	Sections 7.1, 7.2, 7.4 - 7.7
UNIT IV	Chapter 10	Sections 10.1 - 10.4, 10.6, 10.7
UNIT V	Chapter 12	Sections 12.1 - 12.5

Reference Book(s):

1 F. Harary, Graph Theory, Addison-Wesley Publishing Company, INC. (1969).
2. S. Arumugam and S. Ramachandran, Invitation to Graph Theory, New Gamma Publishing House, Palayamkottai, 2006.

Web Resource(s):

1. https://www.youtube.com/watch?v=mNzg7CoF3r0#action=share
2. https://youtu.be/k5G6e-50vuw?si=MYul9RP7jrVe1ySj
3. https://youtu.be/uEtQ4NaqRoo?si=bBmh3cWgK9f-BdvF
4. https://www.youtube.com/watch?v=7UZGUiG-UCw#action=share
5. https://www.youtube.com/watch?v=Ea3DlCoc0NQ#action=share

Course Outcomes		
Upon successful completion of this course, the student will be able to:		
CO No.	**CO Statement**	**Cognitive Level (K-Level)**
CO1	Demonstrate and discuss matching and stable matching.	**K2**
CO2	Apply domain knowledge connectivity and edge-connectivity with illustrations.	**K3**
CO3	Analyze Independent sets and prove Vizing's Theorem.	**K4**
CO4	Determine the Predecessor and Successor algorithm.	**K5**
CO5	Discuss the concepts of perfect graphs, interval graphs and comparability graphs.	**K6**

Relationship Matrix:

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**	**2**	**3**	**3**	**2**	**3**	**3**	**3**	**2**	**2**	**2.6**
CO2	**2**	**3**	**2**	**3**	**1**	**3**	**3**	**3**	**2**	**2**	**2.4**
CO3	**3**	**2**	**3**	**3**	**1**	**3**	**3**	**3**	**2**	**2**	**2.5**
CO4	**3**	**2**	**2**	**3**	**2**	**3**	**3**	**3**	**2**	**2**	**2.5**
CO5	**3**	**2**	**2**	**3**	**2**	**3**	**3**	**3**	**2**	**2**	**2.5**
Mean Overall Score											**2.5**
Correlation											**High**

Mean Overall Score	Correlation
< 1.5	Low
≥ 1.5 and < 2.5	Medium
≥ 2.5	High

Course Coordinators:

1. Dr. R. Jahir Hussain
2. Dr. S. Shajitha Begum

Semester	Course Code	Course Category	Hours/ Week	Credits	Marks for Evaluation		
					CIA	ESE	Total
III	23PMA3DE3AP	Discipline Specific Electives - III	6	4	20	80	100

Course Title	Python for Data Science – Practical

SYLLABUS		
Unit	**Contents**	**Hours**
I	**DATA TYPES, EXPRESSIONS, STATEMENTS** Python interpreter and interactive mode, debugging values and types: int, float, boolean, string, and list - variables, expressions, statements - tuple assignment - precedence of operators, comments - Illustrative programs: exchange the values of two variables - circulate the values of n variables - distance between two points.	18
II	**CONTROL FLOW, FUNCTIONS, STRINGS** Conditionals: Boolean values and operators, conditional (if) - alternative (if-else), chained conditional (if-elif-else); Iteration: state, while, for, break, continue, pass - Fruitful functions: return values, parameters, local and global scope, function composition, recursion - Strings: string slices, immutability, string functions and methods, string module; Lists as arrays. Illustrative programs: square root, gcd – exponentiation - sum an array of numbers.	18
III	**LISTS, TUPLES, DICTIONARIES** Lists: list operations, list slices, list methods, list loop, mutability, aliasing, cloning lists, list parameters - Tuples: tuple assignment, tuple as return value; Dictionaries: operations and methods; advanced list processing - list comprehension - Illustrative programs: simple sorting – histogram - Students marks statement - Retail bill preparation.	18
IV	**EXPLORATORY DATA ANALYSIS** EDA fundamentals – Understanding data science – Significance of EDA – Making sense of data – Comparing EDA with classical and Bayesian analysis – Software tools for EDA - Visual Aids for EDA- Data transformation techniques-merging database, reshaping and pivoting, Transformation techniques - Grouping Datasets - data aggregation – Pivot tables and cross-tabulations. **VISUALIZING USING Python** Importing Python – Simple line plots – Simple scatter plots – visualizing errors – density and contour plots – Histograms – legends – colours – subplots – text and annotation – customization – three dimensional plotting	18
V	**UNIVARIATE ANALYSIS** Introduction to Single variable: Distributions and Variables - Numerical Summaries of Level and Spread - Scaling and Standardizing – Inequality - Smoothing Time Series. **BIVARIATE ANALYSIS** Relationships between Two Variables - Percentage Tables - Analysing Contingency Tables - Handling Several Batches - Scatterplots and Resistant Lines – Transformations.	18
VI	**Current Trends (For CIA only) – Contemporary developments related to Python programming and Data Science during the semester concerned.**	

EXPERIMENTS: -

1. Download and Install Python Compiler and interpreter.
2. Python programming using numbers and operations.
3. Identification and solving of simple real life or scientific or technical problems, and developing flow charts for the same. (Sin, Cosine, Exponential series, Electricity Billing, Retail Shop Billing, etc.)
4. Python programming using simple statements and expressions (exchange the values of two variables, distance between two points, etc.).
5. Scientific problems using Conditionals and Iterative loops. (Number Series, Number Patterns, Pyramid Pattern)
6. Implementing real-time/technical applications using Lists.
7. Implementing real-time/technical applications using Tuples.
8. Implementing programs using Functions. (Factorial, Largest Number in a List, Area of Shapes)
9. Implementing programs using Strings. (Reverse, Palindrome, Character Count, Replacing Characters)
10. Install the data Analysis and Visualization tool: Python.
11. Working with Python data frames
12. Basic plots using Python
13. Frequency distributions, Mean, Median, Mode,
14. Standard Deviation, Mean Deviation, Coefficient of variation
15. Scatter Plots
16. Correlation Coefficient
17. Regression Analysis
18. Perform exploratory data analysis on with datasets like email data set. Export all your emails as a dataset, import them inside a Python data frame, visualize them and get different insights from the data.
19. Working with Numpy arrays, Pandas data frames, Basic plots using Python Library.
20. Explore various variable and row filters in Python for cleaning data. Apply various plot features in Python on sample data sets and visualize.

Text Book(s):
1. E. Balagurusamy, Problem Solving and Python Programming, McGraw Hill Education, First Edition(2022) 2. Mohamed Abdul Hamed, Python for Data Science, Wiley, First Edition(2021)
Reference Book(s):
1. Allen B. Downey, “Think Python: How to Think like a Computer Scientist”, 2nd Edition, O’Reilly Publishers, 2023 2. Allen B. Downey, “Think Stats: Exploratory Data Analysis in Python”, Green Tea Press, 2021.
Web Resource(s):
1. https://www.python.org/ 2. https://www.programiz.com/python-programming/online-compiler/ 3. https://www.python.org/about/gettingstarted/ 4. https://www.programiz.com/python-programming 5. https://thepythonguru.com/

Course Outcomes		
Upon successful completion of this course, the student will be able to:		
CO No.	**CO Statement**	**Cognitive Level (K-Level)**
CO1	Develop and execute simple Python programs.	**K2**
CO2	Implement programs in Python using conditionals and loops for solving problems.	**K3**
CO3	Determine the methods to create and manipulate Python programs by utilizing the data structures like lists, dictionaries, tuples and sets.	**K4**
CO4	Analyse the sense of data through data visualization techniques.	**K5**
CO5	Ability to evaluate univariate and bivariate data analysis in Python.	**K6**

Relationship Matrix:

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**	**2**	**3**	**3**	**3**	**3**	**3**	**2**	**2.7**
CO2	**3**	**2**	**2**	**3**	**3**	**3**	**3**	**3**	**3**	**2**	**2.7**
CO3	**3**	**2**	**2**	**2**	**2**	**3**	**3**	**3**	**3**	**3**	**2.6**
CO4	**3**	**2**	**2**	**3**	**2**	**3**	**3**	**3**	**2**	**2**	**2.5**
CO5	**3**	**3**	**3**	**2**	**2**	**3**	**3**	**3**	**2**	**2**	**2.6**
Mean Overall Score											**2.62**
Correlation											**High**

Mean Overall Score	Correlation
< 1.5	Low
≥ 1.5 and < 2.5	Medium
≥ 2.5	High

Course Coordinators:

1. Dr. M. Mohammed Jabarulla
2. Dr. S. Shajitha Begum

Semester	Course Code	Course Category	Hours/ Week	Credits	Marks for Evaluation		
					CIA	ESE	Total
III	23PMA3DE3B	Discipline Specific Electives - III	6	4	25	75	100

Course Title	DATA STRUCTURES AND ALGORITHMS

SYLLABUS

Unit	Contents	Hours
I	Introductions and Preliminaries : Basic terminology, Elementary data organization, Data structures – Data structure operations, Algorithms : complexity, time-space Tradeoff – Mathematical Notations and Functions – Control Structures – Complexity of Algorithms.	18
II	Arrays and Stacks : Arrays – Introduction – Linear Array, Representation of Linear Array in Memory, Traversing Linear Arrays, Inserting and Deleting, Multidimensional Arrays – Stacks – Array Representation of Stack, Arithmetic Expressions: Polish Notation - *Recursion*.	18
III	Queues and Linked Lists: Queues – De-queues – Array Representation Queues – Insertion and Deletion – Linked List, Representation of Linked Lists in memory, Traversing a Linked List, Insertion into a Linked List, Deletion from a Linked List, *Two-Way Linked Lists*	18
IV	Trees and Graphs: Binary Trees, Representing Binary Trees in Memory, Traversing binary tree – threads, Binary Search Tree, Searching and Inserting in Binary Search Tree, Deleting in Binary Search tree – Graph Theory – Terminology, Sequential Representation of Graph: Adjacency Matrix, Path Matrix.	18
V	Sorting and Searching: Sorting –Bubble Sort, Insertion Sort, Selection Sort, *Merge Sort*, Quick sort, Heap Sort – Searching; Liner Search, Binary Search.	18

…… Self Study

Text Book(s):

Seymour Lipschutz and G.A. VijaylakshmiPai(Schaum's Series), Data Structures, Tata McGraw Hill Publishing Company Ltd., New Delhi, Indian Adopted Edition, 2006 .

UNIT I	Chapter I	Sections 1.1-1.5,
	Chapter II	Sections 2.2, 2.4, 2.5
UNIT II	Chapter IV	Sections 4.1-4.5, 4.9
	Chapter VI	Sections 6.1-6.3, 6.5,6.7
UNIT III	Chapter VI	Sections 6.1.0-6.1.2
	Chapter V	Sections 5.1-5.4,5.7-5.8,5.1.0
UNIT IV	Chapter VI	Sections 7.1-7.9
	Chapter VII	Sections 8.1-8.3
	Chapter V	Section 5
UNIT V	Chapter IX	Section 9.1-9.6, 4.6-4.8, 6.6, 7.17.

Reference Book(s):

Ashok N. Kamthane, Introduction to Data Structures in C, Pearaon Edition,2007

Web Resource(s):

1. https://youtu.be/zWg7U0OEAoE

Course Outcomes		
Upon successful completion of this course, the student will be able to:		
CO No.	**CO Statement**	**Cognitive Level (K-Level)**
CO1	Explain Banach space through Hahn Banach theorem	**K2**
CO2	Construct the Open mapping theorem and Conjugate of an operator.	**K3**
CO3	Analyze domain knowledge for Hilbert Space.	**K4**
CO4	Prove the theorem based on the Hilbert space with an operator.	**K5**
CO5	Discuss finite dimensional spectral theory.	**K6**

Relationship Matrix:

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	**2**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**2.9**
CO2	**2**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**2.9**
CO3	**2**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**2.9**
CO4	**2**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**2.9**
CO5	**2**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**2.9**
Mean Overall Score											**2.9**
Correlation											**High**

Mean Overall Score	Correlation
< 1.5	Low
≥ 1.5 and < 2.5	Medium
≥ 2.5	High

Course Coordinators:

1. Dr. M. Mohamed Althaf
2. Mrs. M. Affrose Begum

Semester	Course Code	Course Category	Hours/ Week	Credits	Marks for Evaluation		
					CIA	ESE	Total
IV	23PMA4CC13	Core – XIII	6	5	25	75	100

Course Title	MEASURE THEORY

SYLLABUS

Unit	Contents	Hours
I	*Set function and properties on sets in real line* -Measure on a real line – Lebesgue Outer measure – Measurable sets – Regularity – Measurable functions.	18
II	*Borel set- Continuous function and integral function* - Borel and Lebesgue measurability – Integration of Functions of a real variable – Integration of non-negative functions – General Integral.	18
III	*Measure on measurable space* - Abstract Measure Space – Measure and Outer measure – Uniqueness of the extension – Completion of a measure – Measure space – Integration with respect to measure.	18
IV	*Countable and additive* - Convergence in measure – Almost uniform convergence - Signed measure and their derivatives – Hahn Decomposition – Jordan Decomposition.	18
V	*Product space* - Radon Nikodym theorem – Measure and Integration in a Product space – Measurability in a Product Space – Product Measure and Fubini's theorem.	18

…… Self Study

Text Book(s):

G. De Barra, Measure Theory and Integration, New Age International (P) Limited Publishers, New Delhi, Second Edition (2013).

UNIT I	Sections 2.1 – 2.4
UNIT II	Sections 2.5, 3.1 – 3.2
UNIT III	Sections 5.1 - 5.6
UNIT IV	Sections 7.1,7.2,8.1,8.2
UNIT V	Sections 8.3, 10.1, 10.2

Reference Book(s):

1. M. C. Munroe, Measure and Integration, Addison, Wesley Publishing Company, Second Edition (1971).
2. H.L. Roydon and P.M. Fitzpatrick, Real Analysis, Prentice Hall of India**,** Learning Pvt. Ltd., New Delhi, Four Edition (2011).

Web Resource(s):

1. https://youtu.be/Uh_91ffyWr4
2. https://youtu.be/wmL29BLqrW4
3. https://youtu.be/3sBfw_IEEX4
4. https://youtu.be/JBRu0yAbOqM
5. https://youtu.be/_wThvhkiH5M

Course Outcomes		
Upon successful completion of this course, the student will be able to:		
CO No.	**CO Statement**	**Cognitive Level (K-Level)**
CO1	Explain Measure on a real line and illustrate with examples.	**K2**
CO2	Explain the concepts of Borel and Lebesgue measurability with suitable examples	**K3**
CO3	Analyse the abstract measure space with examples.	**K4**
CO4	Evaluate the Almost uniform convergence and study decomposition of measure.	**K5**
CO5	Construct the proofs of Radon Nikodym theorem and Fubini's theorem.	**K6**

Relationship Matrix:

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**	**2**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**2.9**
CO2	**3**	**2**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**2.9**
CO3	**3**	**2**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**2.9**
CO4	**3**	**2**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**2.9**
CO5	**3**	**2**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**2.9**
Mean Overall Score											**2.9**
Correlation											**High**

Mean Overall Score	Correlation
< 1.5	Low
≥ 1.5 and < 2.5	Medium
≥ 2.5	High

Course Coordinators:

1. Dr. M. Mohamed Althaf
2. Mrs. M.S. Afya Farhana

Semester	Course Code	Course Category	Hours/ Week	Credits	Marks for Evaluation		
					CIA	ESE	Total
IV	23PMA4CC14	CORE – XIV	6	5	25	75	100

Course Title	FLUID DYNAMICS WITH MATLAB

SYLLABUS

Unit	Contents	Hours
I	Real fluids and ideal fluids - Velocity of a fluid at a point - Streamlines and pathlines - Steady and unsteady flows. Velocity potential - Vorticity vector - *Local and particle rates of change* - Equation of continuity - Worked examples - *Acceleration of a point of a fluid*.	18
II	Pressure at a point in a fluid at rest - Pressure at a point in a moving fluid - *Conditions at a boundary of two inviscid Immissible fluids* - Euler's equations of motion - Bernoulli's equation - Worked examples - Some flows involving axial symmetry - Some special two dimensional flows - *Impulsive motion*.	18
III	Some three dimensional flows - Sources, sinks and doublets - *Images in a rigid infinite plane* - Axis-symmetric flows - Stokes stream function - Some special forms of the stream function for Axis-symmetric irrotational motions.	18
IV	Two dimensional flow - Use of cylindrical polar coordinates - Stream function. *Complex potential for two-dimensional irrotational - Incompressible flow* - Complex velocity potential for standard two-dimensional flows - Uniform stream, line sources and line sinks, line doublets, line vortices - Worked examples.	18
V	Two dimensional image systems – Milne-Thomson circle theorem - Some applications of the circle theorem - Extension of the circle theorem - Theorem of Blasius - *Use of conformal transformation – Some hydro dynamical aspects of conformal transformation* - Worked example.	18

…… Self Study

Text Book(s):

F. Chorlton, Textbook of Fluid Dynamics, CBS Publication and Distribution (2004).

UNIT I	Chapter 2	Sections 2.1 to 2.9
UNIT II	Chapter 3	Sections 3.1 to 3.6, 3.9 to 3.11
UNIT III	Chapter 4	Sections 4.1 to 4.3, 4.5, 4.5.1
UNIT IV	Chapter 5	Sections 5.1 to 5.6
UNIT V	Chapter 5	Sections 5.7 to 5.10.2

Reference Book(s):

1. Goyal and Gupta, Fluid Dynamics, Edition 17, Pragati Prakashan ,(2011).
2. Raja Subramanian, Fluid Mechanics –Introduction and Application, Jaico publishing house Edition2 (2008).

Web Resource(s):

1. https://www.youtube.com/watch?v=ZnnXl7ryBMI
2. https://www.youtube.com/watch?v=EtUCgn3T9eE
3. https://www.youtube.com/watch?v=qC6k7X8JVa0
4. https://nptel.ac.in/courses/112/105/112105269/
5. https://www.youtube.com/watch?v=luGzHVdE4TE
6. https://www.youtube.com/watch?v=3AcTSjvTnnA
7. https://www.youtube.com/watch?v=vcNvhnqC68A
8. https://www.youtube.com/watch?v=UM-pkVPw4tE

Course Outcomes		
Upon successful completion of this course, the student will be able to:		
CO No.	**CO Statement**	**Cognitive Level (K-Level)**
CO1	Demonstrate and discuss fluid flows, stream lines, vorticity vector and equation of continuity with examples.	**K2**
CO2	Distinguish sources, sinks and doublets and analyze the axis-symmetric flows and stokes stream function.	**K3**
CO3	Construct the Euler's equation of motion and Bernoulli's equation with the examples.	**K4**
CO4	Determine the concept of two-dimensional flows and complex potential flows.	**K5**
CO5	Acquire the Milne-Thomson circle theorem and theorem of Blasius and illustrate some applications of the circle theorem.	**K6**

Relationship Matrix:

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**	**2**	**3**	**3**	**3**	**3**	**3**	**2**	**2.7**
CO2	**3**	**2**	**2**	**3**	**3**	**3**	**3**	**3**	**3**	**2**	**2.7**
CO3	**3**	**2**	**2**	**2**	**2**	**3**	**3**	**3**	**3**	**3**	**2.6**
CO4	**3**	**2**	**2**	**3**	**2**	**3**	**3**	**3**	**2**	**2**	**2.5**
CO5	**3**	**3**	**3**	**2**	**2**	**3**	**3**	**3**	**2**	**2**	**2.6**
										Mean Overall Score	**2.62**
										Correlation	**High**

Mean Overall Score	Correlation
< 1.5	Low
≥ 1.5 and < 2.5	Medium
≥ 2.5	High

Course Coordinators:

1. Dr. S. Mohamed Yusuff Ansari
2. Ms.S.Sharmila Banu

Semester	Course Code	Course Category	Hours/ Week	Credits	Marks for Evaluation		
					CIA	ESE	Total
IV	23PMA4CC15	Core – XV	6	5	25	75	100

Course Title	CALCULUS OF VARIATIONS AND INTEGRAL EQUATIONS

SYLLABUS

Unit	Contents	Hours
I	Calculus of variations and applications - Maxima and Minima – Simplest case - *Illustrative examples*.	18
II	Natural Boundary conditions and transition conditions – Variational notation - *More general case *- Constraints and Lagrange multipliers.	18
III	Regularity conditions - Special kinds of kernels – Eigen values and Eigen functions – Convolution Integral – Inner or Scalar product of two functions.Integral equations with separable kernels – Reduction to a system of Algebraic Equations - *Examples* - Fredholm Alternative - *Examples*.	18
IV	Method of successive approximations - Iterative scheme - *Examples* - Volterra Integral Equations - *Examples*- Some results about the resolvent Kernel.	18
V	Applications to ordinary differential equations - Initial value problems – Boundary value Problems - *Examples* - Singular integral equations - Abel Integral Equation - *Examples*.	18

…… Self Study

Text Book(s):

1. Francis B. Hildebrand, Methods of Applied Mathematics, Dover, Prentice Hall of India, New York, Dover, Second Edition (1992).
2. Ram P. Kanwal, Linear Integral Equations Theory and Technique, Academic Press, Birkhäuser, New York (2013).

UNIT I	Sections 2.1, 2.2, 2.3	T.B-1
UNIT II	Sections 2.4 - 2.7	T.B-1
UNIT III	Sections 1.1 - 1.6, 2.1 - 2.4	T.B-2
UNIT IV	Sections 3.1 - 3.5	T.B-2
UNIT V	Sections 5.1, 5.2, 5.3, 8.1, 8.2	T.B-2

Reference Book(s):

1. Sudir K. Pundir and Rimple Pundir, Integral Equations and Boundary Value Problems, Pragati Prakasam, Meerut (2005).
2. M. D. Raisinghania, Integral Equations and Boundary Value Problems, S. Chand & Co., New Delhi (2007).

Web Resource(s):

1. https://nptel.ac.in/courses/111/107/111107103/
2. https://youtu.be/WPlBrzjI1KI?t=804
3. https://youtu.be/K0t53t7RLWY?t=132
4. https://youtu.be/rCWzF1yvZl
5. https://youtu.be/u4yhu8QMC2M
6. https://youtu.be/76P7MS-Y1Bk
7. https://youtu.be/Ccng6vYW-i0?t=190
8. https://youtu.be/BVf9tkJaiu0?t=454

Course Outcomes		
Upon successful completion of this course, the student will be able to:		
CO No.	**CO Statement**	**Cognitive Level (K-Level)**
CO1	Interpret the knowledge for calculus of varaitions.	**K2**
CO2	Implement the natural boundary conditions and transition conditions.	**K3**
CO3	Analyze the regularity conditions and system of algebraic equations	**K4**
CO4	Evaluate the method of successive approximations in an integral equations .	**K5**
CO5	Generate the applications to ordinary differential equations and Abel integral equations	**K6**

Relationship Matrix:

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**	**2**	**3**	**3**	**3**	**3**	**3**	**2**	**2.7**
CO2	**3**	**2**	**2**	**3**	**3**	**3**	**3**	**3**	**3**	**2**	**2.7**
CO3	**3**	**2**	**2**	**2**	**2**	**3**	**3**	**3**	**3**	**3**	**2.6**
CO4	**3**	**2**	**2**	**3**	**2**	**3**	**3**	**3**	**2**	**2**	**2.5**
CO5	**3**	**3**	**3**	**2**	**2**	**3**	**3**	**3**	**2**	**2**	**2.6**
										Mean Overall Score	**2.62**
										Correlation	**High**

Mean Overall Score	Correlation
< 1.5	Low
≥ 1.5 and < 2.5	Medium
≥ 2.5	High

Course Coordinators:

1. Dr. M. Mohammed Jabarulla
2. Mrs. A. Thagasin Banu

Semester	Course Code	Course Category	Hours/ Week	Credits	Marks for Evaluation		
					CIA	ESE	Total
IV	23PMA4DE4A	DSE - IV	6	4	25	75	100

Course Title	ADVANCED OPERATIONS RESEARCH

SYLLABUS		
Unit	**Contents**	**Hours**
I	Sensitivity Analysis – Change in Objective Function Coefficient – Addition of New Variable - Integer Linear Programming – Types of Integer Programming Problems – Gomory's All Integer Cutting Plane Method - * Gomory's Mixed Integer Cutting Plane Method*.	18
II	Goal Programming – Difference between LP and GP approach – *Concept of Goal Programming* - Goal Programming model formulation – Single Goal with Multiple sub Goals – Equally ranked Multiple Goals – Ranking and Weighting of Unequal Multiple Goals - General GP Model–Modified Simplex Method of GP	18
III	Decision Theory – *Steps of Decision making process* – Types of Decision Making Environments – Decision Making Under Uncertainty - Decision Making Under Risk - Expected Monetary Value. Theory of Games –Two Person Zero Sum Games –Games with Saddle Point –Rules to determine Saddle point -Games without Saddle Point -Related problems – Principles of Dominance –Graphical Method.	18
IV	Deterministic Inventory Control models – *Meaning of inventory control – Reasons for carrying inventory – Factors involved in inventory problem analysis* - Inventory cost components – Demand for inventory items - Replenishment lead time - Length of planning period – Inventory model building – Single item inventory control modes without shortages – Model I(a): EOQ model with constant rate of demand, Model I(c): Economic production Quantity model when supply is gradual.	18
V	Dynamic Programming – Dynamic Programming Terminology – Developing Optimal Decision Policy – *General Algorithm* - Dynamic Programming Under Certainty – Model-I: Shortest Route Problem – Model-II: Multiple Separable Return Function and Single Additive Constraint -Dynamic Programming Approach for Solving Linear Programming Problems	18

* * Self-study portion.

Text Book(s):

J.K. Sharma, Operations Research Theory and Applications, Trinity Press, New Delhi, Sixth Edition, (2017).

UNIT I	Chapter 6	Sections 6.1 & 6.2.1, 6.2.4
	Chapter 6	Sections 7.1, 7.2, 7.4, 7.5
UNIT II	Chapter 8	Sections 8.1-8.4, 8.6
UNIT III	Chapter 11	Sections 11.1, 11.2, 11.3, 11.4.1 -11.4.5, 11.5.1
	Chapter 12	Sections 12.1, 12.2, 12.3, 12.4, 12.5, 12.6.4
UNIT IV	Chapter 14	Sections 14.1, 14.2, 14.4, 14.5, 14.6, 14.7 (Model I(a) and Model I(c))
UNIT V	Chapter 22	Sections 22.1, 22.2, 22.3, 22.4 (Model -I and Model -II), 22.5

Reference Book(s):

1. Prem Kumar Gupta and D.S. Hira, Operations research, S. Chand, 7th Revised Edition (2014).
2. Kantiswarup, P.K. Gupta and Manmohan, Operations Research, Sultan Chand & Sons, (2009).

Web Resource(s):
1. https://nptel.ac.in/courses/111/107/111107128/ 2. https://www.youtube.com/playlist?list=PLbMVogVj5nJT8iTaUR8FoWBuJy0vs-Z3C 3. https://www.youtube.com/channel/UCW6912n7NwlBO7rPTIxHm0w 4. https://swayam.gov.in/nd2_cec20_ma19/preview 5. https://swayam.gov.in/nd1_noc20_ma45/preview

Course Outcomes		
Upon successful completion of this course, the student will be able to:		
CO No.	**CO Statement**	**Cognitive Level (K-Level)**
CO1	Discuss the basic concepts of integer linear programming and sensitivity analysis with examples.	**K2**
CO2	Construct the goal programming problem and general goal programming model.	**K3**
CO3	Investigate the decision making environments and games with illustrate examples.	**K4**
CO4	Evaluate the inventory problems and EOQ models with examples.	**K5**
CO5	Formulate dynamic programming with illustrative examples and Estimate dynamic programming models.	**K6**

Relationship Matrix:

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**	**2**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**2.9**
CO2	**3**	**2**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**2.9**
CO3	**3**	**2**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**2.9**
CO4	**3**	**2**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**2.9**
CO5	**3**	**2**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**2.9**
										Mean Overall Score	**2.9**
										Correlation	**High**

Mean Overall Score	**Correlation**
< 1.5	Low
≥ 1.5 and < 2.5	Medium
≥ 2.5	High

Course Coordinators:

Dr. M.A. Rifayathali

Dr. M. Mohamed Althaf

Semester	Course Code	Course Category	Hours/ Week	Credits	Marks for Evaluation		
					CIA	ESE	Total
IV	23PMA4DE4B	DSE – IV	6	4	25	75	100

Course Title	Stochastic Processes

SYLLABUS		
Unit	**Contents**	**Hours**
I	Markov Processes with Continuous State Space: Introduction-Brownian Motion-Wiener Process-Differential Equations for a Wiener Process-Kolmogorov Equations-First Passage time distribution for Wiener Process-Ornstein-Uhlenbeck Process.	18
II	Markov Renewal and Semi-Markov Processes-Introduction-Definitions and Preliminary Results-Markov renewal Equation-Limiting Behaviour-First Passage Time.	18
III	Stationary Processes and Time Series – introduction-Models of Time Series-Time and Frequency Domain: Power Spectrum-Statistical Analysis of Time Series: #Some Observations#.	18
IV	Branching Processes-Introduction-Properties of Generating Functions of Branching Processes-Probability of Extinction-Distribution of the Total Number of Progeny-Conditional Limit Laws.	18
V	Generalisations of the Classical Galton-Watson Process-Continuous-Time Markov Branching Process-Age Dependent Branching Process: Bellman-Harris Process - Birth and Death Processes in Queueing Theory: Multichannel Models-#Non-birth and Death Queueing Processes: Bulk Queues#.	18

* For Theory Core Course, wherever possible

Text Book(s):

Medhi, J, Stochastic Processes, Second Edition (Reprint), New Age International Publishers, New Delhi, 2002.
UNIT I Chapter 5 Sections 5.1 – 5.6
UNIT II Chapter 7 Sections 7.1 – 7.5
UNIT III Chapter 8 Sections 8.1 – 8.4
UNIT IV Chapter 9 Sections 9.1- 9.5
UNIT V Chapter 9 Sections 9.6 – 9.9 Chapter 10 Sections 10.4– 10.5
Self-study portion.

Reference Book(s):

1. Basu, A. K., "Introduction to Stochastic Process", Narosa Publishing House, New Delhi,2007.
2. Chung, K.L. and Sahlia, F.A., "Elementary Probability Theory with Stochastic Processes and an Introduction to Mathematical Finance", Springer (India) Pvt. Ltd., New Delhi, 2005.
3. Srinivasan, S. K. and Mehatha, K.M., "Stochastic Processes", Tata McGraw–Hill Publishing Co. Ltd., New Delhi, 1988.

Web Resource(s):

1. https://onlinecourses.nptel.ac.in/noc19_ma30/preview
2. https://www.youtube.com/watch?v=l04F077ICkw
3. https://onlinecourses.nptel.ac.in/noc23_ma38/preview

Course Outcomes		
Upon successful completion of this course, the student will be able to:		
CO No.	**CO Statement**	**Cognitive Level (K-Level)**
CO1	Remember Brownian Motion-Wiener Process-Differential Equations for a Wiener Process.	**K1**
CO2	Understand the concepts of Markov Renewal and Semi-Markov Processes	**K2**
CO3	Apply Stationary Processes and Time Series - Statistical Analysis of Time Series	**K3**
CO4	Analyze Branching Processes Properties of Generating Functions	**K4,K5**
CO5	Create the new mathematical model in stochastic processes.	**K6**

Relationship Matrix:

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**	**3**	**3**	**3**	**2**	**2**	**3**	**3**	**2.6**
CO2	**2**	**3**	**3**	**1**	**2**	**1**	**3**	**3**	**3**	**3**	**2.4**
CO3	**3**	**2**	**1**	**3**	**2**	**1**	**3**	**3**	**3**	**3**	**2.4**
CO4	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**1**	**1**	**3**	**2.6**
CO5	**3**	**3**	**3**	**3**	**3**	**3**	**1**	**2**	**3**	**3**	**2.7**
Mean Overall Score											**2.54**
Correlation											**High**

Mean Overall Score	Correlation
< 1.5	Low
≥ 1.5 and < 2.5	Medium
≥ 2.5	High

Course Coordinator:

Dr.V.Krishnan
M.Affrose Begum