M.Sc. Mathematics

SEM	Course Code	Course	Course Title	Ins. Hrs / Week	Credit	Exam Hrs	Marks		Total
							CIA	ESE	
I	20PMA1CC1	Core– I	Algebra-I	6	5	3	25	75	100
	20PMA1CC2	Core – II	Real Analysis	6	5	3	25	75	100
	20PMA1CC3	Core– III	Classical Dynamics	6	4	3	25	75	100
	20PMA1CC4	Core – IV	Ordinary Differential Equations	6	4	3	25	75	100
	20PMA1DE1	DSE – I #		6	4	3	25	75	100
			TOTAL	**30**	**22**				**500**
II	20PMA2CC5	Core – V	Algebra-II	6	5	3	25	75	100
	20PMA2CC6	Core – VI	Complex Analysis	6	5	3	25	75	100
	20PMA2CC7	Core– VII	Topology	6	4	3	25	75	100
	20PMA2CC8	Core – VIII	Numerical Analysis	6	4	3	25	75	100
	20PMA2DE2	DSE – II #		6	4	3	25	75	100
			TOTAL	**30**	**22**				**500**
III	20PMA3CC9	Core– IX	Functional Analysis	6	5	3	25	75	100
	20PMA3CC10	Core– X	Partial Differential Equations	6	5	3	25	75	100
	20PMA3CC11	Core– XI	Modern Probability Theory	6	4	3	25	75	100
	20PMA3CC12	Core– XII	Advanced Graph Theory	6	4	3	25	75	100
	20PMA3DE3T	DSE – III (a)#		3	2	3	10	40	50
	20PMA3DE3P	DSE – III (b)#		3	2	3	10	40	50
	20PMA3EC1	Extra Credit Course – I	Online Course (MOOC)	-	1*	-	-	-	-
			TOTAL	**30**	**22**				**500**
IV	20PMA4CC13	Core– XIII	Measure theory and integration	6	5	3	25	75	100
	20PMA4CC14	Core– XIV	Fluid Dynamics	6	5	3	25	75	100
	20PMA4CC15	Core– XV	Integral Equations and Calculus of Variations	6	5	3	25	75	100
	20PMA3DE4	DSE - IV #		6	4	3	25	75	100
	20PMA4PW	Project	Internship and Project Report	6	4	-	-	100	100
	20PCNOC	Online Course (Compulsory)		-	1	-	-	-	-
	20PMA4EC2	Extra Credit Course – II	Mathematics for career examinations	-	5*	3	-	100	100*
			TOTAL	**30**	**24**				**500**
			GRAND TOTAL		**90**				**2000**

*Not considered for grand total and CGPA

Discipline Specific Electives

SEMESTER	Course Code	DISCIPLINE SPECIFIC ELECTIVE
I	20PMA1DE1A	Mathematics of Finance
	20PMA1DE1B	Control Theory
II	20PMA2DE2A	Fuzzy Analysis & its Applications
	20PMA2DE2B	Mathematical Methods in Biology
III	20PMA3DE3AT	Python Programming
	20PMA3DE3AP	Python Programming - Practical
	20PMA3DE3B	Computer Algorithms
IV	20PMA4DE4A	Advanced Operations Research
	20PMA4DE4B	Stochastic Processes

Semester	Code	Course	Title of the Course	Hours	Credits	Max. marks	Internal marks	External marks
I	20PMA1CC1	Core – I	ALGEBRA-I	6	5	100	25	75

Course Outcomes:

At the end of the Course, Students will be able to:

1. Discuss Sylow's theorems, Solvability of Symmetric group with examples.
2. Construct new groups from existing groups using direct products and illustrate withsome examples.
3. Recognize the concept of vector spaces as R-module.
4. Describe some of the canonical forms of linear transformations such as triangular andnilpotent transformations.
5. Solve problems based on different kinds of transformations.

Unit I **18hours**

Another Counting Principle – Sylow's Theorems (for Theorem 2.12.1, first proof only).

Unit II **18 hours**

Solvability by Radicals – #Direct Products# – Finite Abelian Groups – Modules.

Unit III **18 hours**

Canonical Forms: Triangular Form – Nilpotent Transformations.

Unit IV **18 hours**

Canonical Forms: Jordan Form – Rational Canonical Form.

Unit V **18 hours**

#Trace and Transpose# – Hermitian, Unitary and Normal Transformations – Real Quadratic Forms.

 # # Self-study portion.

Text Book:

I. N. Herstein, Topics in Algebra, Second Edition, Wiley India Pvt. Ltd., New Delhi, 2006

UNIT I Chapter 2: Sections 2.11, 2.12 (Section 2.12: Omit Lemma 2.12.5)

UNIT II Chapter 5: Section 5.7 (Lemma 5.7.1, Lemma 5.7.2, Theorem 5.7.1 only)
Chapter 2: Sections 2.13, 2.14 (Section 2.14: Theorem 2.14.1 only)
Chapter 4: Section 4.5

UNIT III Chapter 6: Sections 6.4, 6.5

UNIT IV Chapter 6: Sections 6.6, 6.7

UNIT V Chapter 6: Sections 6.8, 6.10, 6.11

Books for Reference:

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.

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes:

Semester	Code	Title of the Paper	Hours	Credits
I	20PMA1CC1	ALGEBRA-I	6	5

Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)				
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
CO2	✓		✓	✓	✓		✓	✓	✓	✓
CO3	✓		✓	✓	✓	✓		✓	✓	✓
CO4	✓	✓		✓	✓	✓		✓	✓	✓
CO5	✓	✓	✓	✓	✓		✓		✓	✓
Number of Matches= 42, Relationship : HIGH										

Prepared by:
Mr. N. Mohamed Thoiyab
Ms. B.ShafinaBanu
Ms. C.Vijayalakshmi

Checked by:
Dr.A. Solairaju

Note:

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very poor	Poor	Moderate	High	Very high

Semester	Code	Course	Title of the Course	Hours	Credits	Max. marks	Internal marks	External marks
I	20PMA1CC2	Core – II	REAL ANALYSIS	6	5	100	25	75

Course Outcome:

At the end of the Course, Students will be able to:

1. Discuss the basic concepts of topology and illustrate with examples.
2. Apply domain knowledge for Riemann - Stieltjes integral.
3. Explain the sequences and series of functions with the examples.
4. Determine the partial derivatives and directional derivatives.
5. Prove the chain rule, inverse function theorem and Implicit function theorem.

UNIT I **18 hours**

Basic topology - Metric spaces - Compact sets - Perfect sets.

UNIT II **18 hours**

Riemann - Stieltjes integral - Definition and existence of the integral - #Properties of the integral# - Integration and differentiation - Rectifiable Curves.

UNIT III **18 hours**

Sequences and series of functions - Uniform convergence- Uniform convergence and continuity - Uniform convergence and integration - Uniform convergence and differentiation – Stone -Weierstrass theorem.

UNIT IV **18 hours**

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.

UNIT V **18 hours**

Functions with non-zero Jacobian determinant - Inverse function theorem - Implicit function theorem.

 # # Self-study portion.

Text Books:

T.B-1. Walter Rudin, Principles of Mathematical Analysis, McGraw-Hill International Editions, Third Edition (1987).

T.B-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**

Books for Reference:

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 Source

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

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes:

Semester	Code			Title of the Paper			Hours		Credits
I	20PMA1CC2			REAL ANALYSIS			6		5
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)				
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓	✓		✓	✓		✓	✓		✓
CO2	✓	✓		✓	✓	✓		✓	✓	
CO3	✓		✓	✓		✓	✓	✓		✓
CO4	✓	✓	✓	✓	✓	✓		✓	✓	
CO5		✓	✓		✓	✓	✓		✓	✓
Number of Matches= 36, Relationship : HIGH										

Prepared by :
Mr. S. Masoothu
Dr. D. Dhamodharan

Checked by :
Mr.N.Mohamed Thoyaib

Note:

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very poor	Poor	Moderate	High	Very high

Semester	Code	Course	Title of the Course	Hours	Credits	Max. marks	Internal marks	External marks
I	20PMA1CC3	Core – III	CLASSICAL DYNAMICS	6	4	100	25	75

Course Outcomes

At the end of the Course, Students will be able to:

1. Discuss the basic concepts of Mechanical System.
2. Derivation of Lagrange's Equation for holonomic and non holonomic system and solve simple problems.
3. Analyze the applications of Impulsive Motion.
4. Examine the concept of Hamilton's principle and other variational principles.
5. Express the ideas of separability using Stackle's Theorem and solving problems.

Unit I **18 hours**

Mechanical system – Generalized Co-ordinates – Constraints – Virtual work – #Energy and Momentum#

Unit II **18 hours**

Derivation of Lagrange's Equation – Examples – Integrals of the motion – Simple Problems

Unit III **18 hours**

Rayleigh's Dissipation Function – Impulsive motion - #Velocity dependent potentials#

Unit IV **18 hours**

Hamilton`s principle – Hamilton's equation - #Other variational principles#

Unit V **18 hours**

Hamilton`s principal function – The Hamilton's – Jacobi equation – Separability– Simple Problems

 # #Self-study portion.

Text Book

Donald. T. Green wood, Classical Dynamics, Prentice Hall of India, (1985).

UNIT I Sections 1.1 - 1.5
UNIT II Sections 2.1 - 2.3
UNIT III Sections 3.1, 3.2 and 3.4
UNIT IV Sections 4.1, 4.2, 4.3
UNIT V Sections 5.1, 5.2 and 5.3

Books for Reference

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

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes:

Semester	Code			Title of the Paper				Hours	Credits
I	20PMA1CC3			CLASSICAL DYNAMICS				6	4
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)				
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓	✓		✓	✓	✓	✓		✓	
CO2	✓	✓		✓	✓	✓	✓			✓
CO3	✓			✓	✓	✓	✓	✓		✓
CO4	✓		✓	✓	✓	✓	✓		✓	✓
CO5	✓		✓	✓	✓			✓	✓	✓
Number of Matches= 36, Relationship : HIGH										

Prepared by:
N. Abdul Ali
M.S. Afya Farhana

Checked by:
Dr.S.Mohamed Yusuff Ansari

Semester	Code	Course	Title of the Course	Hours	Credits	Max. marks	Internal marks	External marks
I	20PMA1CC4	Core – IV	ORDINARY DIFFERENTIAL EQUATIONS	6	4	100	25	75

Course Outcomes:

At the end of the Course, Students will be able to:

1. Apply domain knowledge for solving second order linear differential equations and method of variation of parameters.
2. Demonstrate and discuss Oscillations, Sturm separation and comparison Theorem with examples.
3. Show regular singular points and solve Gauss's Hyper geometric equation with examples.
4. Investigate Legendre polynomials and Bessel functions with examples.
5. Determine linear systems with illustrative examples and Prove Picard's theorem.

UNIT I **18 hours**

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.

UNIT II **18 hours**

Oscillations and the Sturm separation theorem – The Sturm comparison theorem Series solutions of First order equations-Second order linear equations-ordinary points.

UNIT III **18 hours**

Regular singular points-Regular singular points (continued) - Gauss's Hypergeometric equation-# The point at Infinity#.

UNIT IV **18 hours**

Legendre Polynomials – Properties of Legendre Polynomials – Bessel functions –#The Gamma function#–Properties of Bessel functions.

UNIT V **18 hours**

Linear systems- Homogeneous linear systems with constant coefficients – The method of successive approximations –Picard's theorem.

 # # Self-study portion.

Text Book:

G.F.Simmons, Differential Equations with Applications and Historical notes, second edition, Tata McGraw-Hill Publishing company Ltd, New Delhi, 2003.

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

Books for Reference:

1. Earl .A. Coddington, An Introduction to Ordinary Differential equations, PHI, 1961.

2. M.D. Raisinghania, Advanced Differential Equations, Seventh Revised Edition, S. Chand and Company Ltd, New Delhi, 2000.

Website and e-learning source

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)

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes:

Semester	Code		Title of the Paper			Hours				Credits
I	20PMA1CC4		ORDINARY DIFFERENTIAL EQUATIONS			6				4
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)				
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓	✓	✓	✓	✓		✓		✓	✓
CO2		✓	✓		✓	✓	✓	✓	✓	
CO3	✓			✓		✓		✓		✓
CO4	✓	✓		✓	✓			✓	✓	
CO5	✓		✓	✓		✓	✓	✓	✓	✓
Number of Matches= 34, Relationship : Moderate										

Prepared by :

Dr. S. Ismail Mohideen
Dr. M.A. Rifayathali
Dr. K.S. Kanzul Fathima

Checked by :

Dr.A.Prasanna

Note:

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very poor	Poor	Moderate	High	Very high

Semester	Code	Course	Title of the Course	Hours	Credits	Max. marks	Internal marks	External marks
I	20PMA1DE1A	DSE – I	MATHEMATICS OF FINANCE	6	4	100	25	75

Course Outcomes:

At the end of the Course, Students will be able to:

1.Recall basic concepts of simple interest, simple discount, equivalent rates and discount value

2.Expain an accumulated and discount values for fractional interest period.

3.Apply the mathematical idea of annuities with examples.

4.Analyze the Amortization of a debit.

5.Bring out bounds and related properties with illustrations.

UNIT I **18 hours**

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.

UNIT II **18 hours**

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.

UNIT III **18 hours**

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.

UNIT IV **18 hours**

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 policy-pure premiums – office premium

UNIT V **18 hours**

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

 # #Self-study portion.

Text Books:

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

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

Books for Reference:

An introduction to the Mathematics of Finance, MC Cutchoon and Scoot-Hoinenmann Professional Publishing.

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes:

Semester	**Code**			**Title of the Paper**			**Hours**		**Credits**	
I	**20PMA1DE1A**			**MATHEMATICS OF FINANCE**			**6**		**4**	
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)				
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1		✓	✓		✓		✓	✓		✓
CO2	✓	✓	✓	✓	✓	✓	✓		✓	✓
CO3		✓	✓		✓			✓	✓	
CO4	✓		✓	✓		✓	✓	✓	✓	✓
CO5	✓	✓		✓	✓	✓	✓	✓	✓	✓
Number of Matches= 38, Relationship : HIGH										

Prepared by:
Dr.A.Prasanna
A.Nafiunisha

Checked by:
Dr.M.Mohamed Althaf

Note:

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very poor	Poor	Moderate	High	Very high

Semester	Code	Course	Title of the Course	Hours	Credits	Max. marks	Internal marks	External marks
I	20PMA1DE1B	DSE – I	CONTROL THEORY	6	4	100	25	75

Course Outcome:

At the end of the Course, Students will be able to:

1. Discuss the basic concepts of Observability and illustrate the examples.
2. Explain controllability and nonlinear systems with the examples.
3. Apply the domain knowledge of asymptotic stability of linear systems and perturbed linear systems.
4. Analyze the stabilization via linear feedback control.
5. Solve the matrix Riccati equations

UNIT I **18 hours**

Observability: Linear Systems – Observability Grammian– Constant coefficient system - Reconstruction kernel – Nonlinear Systems

UNIT II **18 hours**

Controllability: Linear systems – Controllability Grammian – Adjoint systems – Constant coefficient systems – steering function – Nonlinear systems

UNIT III **18 hours**

Stability:Stability – Uniform Stability – Asymptotic Stability of Linear Systems - Linear time varying systems – Perturbed linear systems – Nonlinear systems

UNIT IV **18 hours**

Stabilizability: Stabilization via linear feedback control – Bass method – Controllable subspace - Stabilization with restricted feedback

UNIT V **18 hours**

Optimal control: Linear time varying systems with quadratic performance criteria – Matrix Riccati equation – Linear time invariant systems – Nonlinear Systems

Text Book:

Elements of Control Theory by K.Balachandran and J.P.Dauer, Narosa, New Delhi, 1999.

UNIT I Chapter 2
UNIT II Chapter 3 Sections 3.1 - 3.3
UNIT III Chapter 4
UNIT IV Chapter 5
UNIT V Chapter 6

Books for Reference:

1. Linear Differential Equations and Control by R.Conti, Academic Press,London, 1976.
2. Functional Analysis and Modern Applied Mathematics by R.F.CurtainandA.J.Pritchard, Academic Press, New York, 1977.
3. Controllability of Dynamical Systems by J.Klamka, Kluwer AcademicPublisher, Dordrecht, 1991.
4. Mathematics of Finite Dimensional Control Systems by D.L.Russell, MarcelDekker, New York,1979.
5. E.B. Lee and L. Markus, Foundations of optimal Control Theory, John Wiley,New York, 1967

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes:

Semester	Code			Title of the Paper			Hours			Credits
I	20PMA1DE1B			CONTROL THEORY			6			4
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)				
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓	✓		✓	✓		✓	✓		✓
CO2	✓	✓		✓	✓	✓		✓	✓	
CO3	✓		✓	✓		✓	✓	✓		✓
CO4	✓	✓	✓	✓	✓	✓		✓	✓	
CO5		✓	✓		✓	✓	✓		✓	✓
Number of Matches= 36, Relationship : HIGH										

Prepared by :
Dr.A.Prasanna

Checked by :
Dr.M.A.Rifayath Ali

Note:

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very poor	Poor	Moderate	High	Very high

Semester	Code	Course	Title of the Course	Hours	Credits	Max. marks	Internal marks	External marks
II	20PMA2CC5	Core – V	ALGEBRA-II	6	5	100	25	75

Course Outcomes

At the end of the Course, Students will be able to:

1. Discuss the algebraic concepts of finite and infinite fields and its illustrations.
2. Analyze the fundamental concepts of algebra and their role in modern mathematics.
3. Recognize and Recall the algebraic expressions, using the commutative, associative and distributive properties.
4. Explain the accurate and efficient use of advanced algebraic techniques
5. Demonstrate mathematical ideas through analyzing, proving and explaining concepts from advanced algebra

Unit I **18 hours**

Extension fields – The Transcendence of e .

Unit II **18 hours**

Roots of Polynomials – More about Roots.

Unit III **18 hours**

The Elements of Galois Theory.

Unit IV **18 hours**

Finite Fields – Wedderburn's Theorem on Finite Division Rings.

Unit V **18 hours**

Solvability by Radicals – A Theorem of Frobenius – Integral Quaternions and the Four-Square Theorem.

Text Book

I. N. Herstein, Topics in Algebra, Second Edition, Wiley India Pvt. Ltd., New Delhi,2006.

UNIT I Chapter 5 Sections 5.1, 5.2

UNIT II Chapter5 Sections 5.3, 5.5

UNIT III Chapter 5 Section 5.6

UNIT IV Chapter 7 Sections 7.1, 7.2 (Theorem 7.2.1 only)

UNIT V Chapter 5 Section 5.7(Omit Lemma 5.7.1 Lemma 5.7.2 and Theorem 5.7.1).
Chapter 7 Sections 7.3, 7.4

Books for Reference

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

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes:

Semester	**Code**		**Title of the Paper**			**Hours**			**Credits**	
II	**20PMA2CC5**		**ALGEBRA-II**			**6**			**5**	
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)				
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓		✓	✓	✓	✓	✓	✓	✓	
CO2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
CO3	✓			✓	✓	✓	✓	✓	✓	
CO4	✓		✓	✓	✓				✓	✓
CO5	✓		✓	✓	✓		✓	✓	✓	✓
Number of Matches= 39, Relationship : HIGH										

Prepared by:
Dr. A.Solai Raju
Mr. N. Mohamed Thoiyab
Dr. D.Dhamodaran
Ms. A. FathimaBegam

Checked by:
Dr.R.Jahir Hussain

Note:

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very poor	Poor	Moderate	High	Very high

Semester	Code	Course	Title of the Course	Hours	Credits	Max. marks	Internal marks	External marks
II	20PMA2CC6	Core – VI	COMPLEX ANALYSIS	6	5	100	25	75

Course Outcome:

At the end of the Course, Students will be able to:

1. Recognize the basic concept of Line integrals, rectifiable arcs with examples and prove Cauchy's theorems.
2. Demonstrate the homology in complex plain and prove Taylor's theorem.
3. Discuss argument principle and evaluate the definite integrals.
4. Describe the properties of Harmonic functions and prove Poisson's formula.
5. Explain the canonical products and gamma functions with examples.

UNIT I **18 hours**

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.

UNIT II **18 hours**

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.

UNIT III **18 hours**

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.

UNIT IV **18 hours**

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.

UNIT V **18 hours**

Partial fractions and factorization – Partial fractions - Infinite products - Canonical products - Gamma functions.

Text Book:

Lars. V. Ahlfors, Complex Analysis, McGraw Hill International Edition, Third Edition (1979).

UNIT I 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

Books for Reference:

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).

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes:

Semester	Code			Title of the Paper			Hours			Credits
II	20PMA2CC6			COMPLEX ANALYSIS			6			5
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)				
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓		✓	✓	✓		✓	✓	✓	✓
CO2	✓	✓		✓	✓		✓	✓	✓	✓
CO3	✓		✓	✓		✓		✓		
CO4	✓	✓	✓	✓	✓		✓	✓	✓	✓
CO5	✓	✓	✓		✓	✓	✓	✓	✓	
Number of Matches= 38, Relationship : HIGH										

Prepared by : **Checked by :**

Dr.R.Jahir Hussain Dr.A.Mohamed Ismayil

Note:

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very poor	Poor	Moderate	High	Very high

Semester	Code	Course	Title of the Course	Hours	Credits	Max. marks	Internal marks	External marks
II	20PMA2CC7	Core – VII	TOPOLOGY	6	4	100	25	75

Course Outcome:

At the end of the Course, Students will be able to:

1. Illustrate and Describe the origin of topological spaces.
2. Apply domain knowledge for metric space and connected spaces with examples.
3. Prove the Tychonoff theorem with examples.
4. Determine the countability axioms, separation axioms and prove the Urysohn lemma.
5. Explain the Baire category theorem in topological point of view.

UNIT I **18 hours**

Topological spaces - Basis for a topology- Order topology, product topology- Subspace Topology - Closed sets and limit points - Continuous functions - # Product Topology #.

UNIT II **18 hours**

Metric topology - Metric topology (continued) - Connected spaces.

UNIT III **18 hours**

Compact spaces - Limit point compactness - Tychonoff theorem.

UNIT IV **18 hours**

Countability axioms - Separation axioms - Urysohn lemma - Urysohnmetrization theorem - Completely regular spaces.

UNIT V **18 hours**

Complete metric spaces - Compactness in metric spaces - Baire spaces.

 # # Self-study portion.

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

Books for Reference:

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

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes:

Semester	Code			Title of the Paper			Hours			Credits
II	20PMA2CC7			TOPOLOGY			6			4
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)				
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓	✓		✓	✓	✓	✓	✓	✓	✓
CO2	✓	✓		✓	✓		✓	✓	✓	✓
CO3	✓		✓	✓		✓	✓	✓		
CO4	✓	✓	✓	✓	✓		✓	✓	✓	
CO5	✓	✓	✓	✓	✓	✓	✓		✓	✓
Number of Matches= 38, Relationship : HIGH										

Prepared by :
Dr. A. Nagoor Gani

Checked by :
Dr.M.Mohammed Jabarulla

Note:

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very poor	Poor	Moderate	High	Very high

Semester	Code	Course	Title of the Course	Hours	Credits	Max. marks	Internal marks	External marks
II	20PMA2CC8	Core–VIII	NUMERICAL ANALYSIS	6	4	100	25	75

Course Outcomes:

At the end of the Course, Students will be able to:

1. Recall the iteration methods to solve the problems.
2. Identify the approximate solution to the given problems.
3. Find the interpolation value with illustrations.
4. Examine the convergence of the solution for the given problems.
5. Compare various methods and choose the best method to solve the problems.

UNIT I **18 hours**

Iteration method based on Second degree equations - Chebyshev Method – Multipoint Iteration Methods – Bridge Vieta Method – Baristow Method – Graeffe's root Squaring Method.

UNIT II **18 hours**

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.

UNIT III **18 hours**

Interpolation and Approximation – Hermite Interpolation – Piecewise cubic Interpolation and cubic Spline interpolation – Bivariate interpolation – Lagrange and Newton's Bivariate interpolation – #Least Square approximation# – Gram-Schmidt Orthogonalizing Process.

UNIT IV **18 hours**

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 ChebyshevIntegration Methods – Double Integration – Trapezoidal and Simpson's Rule – Simple Problems.

UNIT V **18 hours**

Ordinary Differential Equations: Numerical Methods – Euler Method – #Backward Euler Method# – Mid-Point Method – Runge-kutta Methods – Implicit Runge-Kutta Methods – Predictor – Corrector Methods.

 # # Self-study portion.

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	Chapter II	Sections 2.4, 2.9
UNIT II	Chapter III	Sections 3.4, 3.5,3.7, 3.11
UNIT III	Chapter IV	Sections 4.5, 4.6, 4.7, 4.9
UNIT IV	Chapter V	Sections 5.2, 5.5, 5.6, 5.7, 5.8, 5.11
UNIT V	Chapter VI	Sections 6.3, 6.4, 6.7

Books for Reference:

1. Samuel. D. Conte and Carl De Boor, Elementary Numerical Analysis, McGraw Hill Company, Third Edition (1965).

2. F.B. Hildebrand, Introduction to Numerical Analysis, Tata McGraw Hill Company,2nd Edition (1974).

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes:

Semester	**Code**			**Title of the Paper**			**Hours**			**Credits**
II	**20PMA2CC8**			**NUMERICAL ANALYSIS**			**6**			**4**
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)				
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓	✓	✓	✓	✓	✓	✓		✓	
CO2	✓	✓	✓	✓		✓	✓	✓	✓	✓
CO3	✓	✓		✓		✓	✓	✓		✓
CO4		✓	✓		✓	✓	✓	✓	✓	
CO5	✓	✓		✓	✓		✓	✓	✓	✓
Number of Matches= 39, Relationship : HIGH										

Prepared By:
Dr.A. Mohamed Ismayil
Ms. HyroonBee

Checked by:
Dr.U.Abuthahir

Note:

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very poor	Poor	Moderate	High	Very high

Semester	Code	Course	Title of the Course	Hours	Credits	Max. marks	Internal marks	External marks
II	20PMA2DE2A	DSE – II	FUZZY ANALYSIS AND ITS APPLICATIONS	6	4	100	25	75

Course Outcome:

At the end of the Course, Students will be able to:

1: Apply domain knowledgefrom classical sets to fuzzy sets with illustrations.
2: Describe the fuzzy arithmetic, Linguistic variables and examine Fuzzy equations.
3: Determine fuzzy logic and fuzzy propositions.
4: Examine fuzzy Decision making problem and Fuzzy Linear programming problem.
5: Classify fuzzy relations and properties of fuzzy relations.

UNIT I **18 hours**

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.

UNIT II **18 hours**

Fuzzy Arithmetic – Fuzzy numbers - Linguistic variables – Arithmetic operations on intervals –Arithmetic operations on Fuzzy numbers –Lattice of Fuzzy numbers– Fuzzy equations.

UNIT III **18 hours**

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#.

UNIT IV **18 hours**

Fuzzy Decision making – #Individual decision making# – Fuzzy Ranking methods – Fuzzy Linear programming.

UNIT V **18 hours**

Fuzzy Relations – Composition of fuzzy relations – Properties of fuzzy relations.

 # # - Self study

Text Books:

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

T.B-2 A. Nagoor Gani 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**

Books for Reference:

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).

Web Source:

https://nptel.ac.in/courses/108/104/108104157/
https://nptel.ac.in/courses/111/102/111102130/
https://nptel.ac.in/courses/127/105/127105006/

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes:

Semester	Code			Title of the Paper			Hours			Credits
II	20PMA2DE2A			FUZZY ANALYSIS AND ITS APPLICATIONS			6			4
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)				
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓	✓		✓	✓	✓	✓	✓	✓	√
CO2	✓		✓	✓	✓	✓	✓	✓	✓	
CO3	✓	✓		✓		✓	✓	✓	✓	✓
CO4		✓	✓	✓	✓			✓	✓	✓
CO5	✓		✓	✓		✓	✓	✓		✓
Number of Matches= 39, Relationship : HIGH										

Prepared by :
Dr. A. Nagoor Gani
Dr. H. Sheik Mujibur Rahman

Checked by :
Dr.M.Mohamed Althaf

Note:

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very poor	Poor	Moderate	High	Very high

Semester	Code	Course	Title of the Course	Hours	Credits	Max. marks	Internal marks	External marks
II	20PMA2DE2B	DSE – II	MATHEMATICAL METHODS IN BIOLOGY	6	4	100	25	75

Course Outcome:

At the end of the Course, Students will be able to:

1. Discuss the sequence alignments , alignment graphs and CDNA matching with illustrations .
2. Demonstrate the Multiple sequence alignments and Multifunction tools for sequence analysis .
3. Explain the Phylogenetic analysis, Evolutionary Trees and Phylogeny with examples.
4. Apply the domain knowledge for SQL,DDL, DML and TLC commands.
5. Determine the bioinformatics tools for database search using engines.

UNIT I **18 hours**

Sequence alignments, Basic string definitions, The importance of sequence comparison in Molecular Biology, The edit distance between two strings, String alignment, Edit graphs, String similarity, Alignment graphs, Local alignment, Introduction to Gaps, CDNA matching, A concrete illustration, Choices for gap weights, Time analysis.

UNIT II **18 hours**

Overview of RDBMS, Advantages of DBNS, Normalization, Oracle data types, Introduction to SQL, DDL, DML, & TLC commands. Data definition Language, Data Manipulation Language, Transaction Control & data, Control language Grant & Revoke Privilege Command.

UNIT III **18 hours**

Multiple sequence alignments, the morphological to the molecular, Common multiple alignment methods, multiple sequence alignments, Local alignment gaps, parametric sequencealignments, suboptimal alignments, Multifunction tools for sequence analysis.

UNIT IV **18 hours**

Phylogenetic analysis, Evolutionary Trees and Phylogeny, Ultrasonic trees, Parsimony, Ultrametric problem, Perfect phylogeny, Phylogenetic alignment, Connection between multiplealignment and tree construction, Methods in Phylogeneic Analysis, Profiles and Motifs

UNIT V **18 hours**

Tools in Bioinformatics, Tools for database search using search engines, Finding scientific articles, Finding public data bases, Depositing data into public data bases, Tools for Sequence Analysis, Algorithms issues in data base search, FASTA, BLAST, Amino acid substitution matrices PAM and BLOSSUM

Text Books:

1. George Koch and Kevin Loney; ORACLE 8-THE COMPLETE REFERENCE, Tata McGraw – Hill Edition, 1988.
2. Michael Abbey andMichael J. Correy; ORACLE 8 – A BEGINNERS GUIDE, 1997.
3. Eddy, S.R., Durbin et al; Computational Molecular Biology, 2002.

4. Cynthia Gibas& Per Jampeck, Developing Bioinformatics ComputerSkills; Shroff Publishers and Distributors Private Limited, Calcutta, 2001.
5. Waterman,Michael S, Introduction to Computational Biology, Chapman and Hall, CRC Press, 2000.

Books for Reference:

1. Baxevanis, A.D., and Ouellette, Francis, B.F., Bioinformatics – A practical Guide to theAnalysis
of genes and Proteins, JohnWiley and Sons Inc. Publishing, New York, 1998.
2. Dan Gusfield, Algorithms on Strings, trees and sequences, Cambridge University Press, USA.

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes:

Semester	Code			Title of the Paper			Hours		Credits
II	20PMA2DE2B			MATHEMATICAL METHODS IN BIOLOGY			6		4
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)				
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
CO2	✓	✓		✓	✓	✓		✓	✓	
CO3	✓		✓	✓		✓	✓	✓		✓
CO4	✓	✓	✓	✓	✓		✓	✓	✓	
CO5		✓	✓		✓	✓	✓		✓	✓
Number of Matches= 36, Relationship : HIGH										

Prepared by :
Dr.A.Nagoor Gani

Checked by :
Dr.M.Mohamed Althaf

Note:

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very poor	Poor	Moderate	High	Very high

Semester	Code	Course	Title of the Course	Hours	Credits	Max. marks	Internal marks	External marks
III	20PMA3CC9	Core – IX	FUNCTIONAL ANALYSIS	6	5	100	25	75

Course Outcomes

1. To acquire more knowledge on Banach space through Hahn Banach theorem
2. Demonstrate and discuss Open mapping theorem and Conjugate of an operator.
3. Apply domain knowledge for Hilbert Space.
4. Remember the theorem based on the Hilbert space with an operator.
5. Classification and study of finite dimensional spectral theory.

UNIT I **18 hours**

Banach Space: Definition and some examples - Continuous linear transformations –Hahn Banach theorem.

UNIT II **18 hours**

Banach space (continued): Natural imbedding of N in N**- The open mapping theorem -The conjugate of an operator.

UNIT III **18 hours**

Hilbert spaces: Definition and some simple properties - Orthogonal complements -Orthonormal sets – The conjugate space H*.

UNIT IV **18 hours**

Hilbert spaces (Continued): The adjoint of an operator - Self-adjoint operators - Normal andunitary operators - #Projections#.

UNIT V **18 hours**

Finite-Dimensional spectral theory: Matrices - Determinants and the spectrum of anoperator – The spectral theorem.

 # # Self-study portion.

Text Books:

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

UNIT I	Sections	46 - 48
UNIT II	Sections	49 - 51
UNIT III	Sections	52 - 55
UNIT IV	Sections	56 - 59
UNIT V	Sections	60 – 62

Books for Reference:

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 Source

1. https://youtu.be/M1h9l5p95Yk
2. https://youtu.be/5BfJHZRgoEA
3. https://youtu.be/xaHkXIWcgP8
4. https://youtu.be/96HNI6M4mCI
5. https://youtu.be/i7LABYdOm4o
6. https://youtu.be/s-5bCfENHg8
7. https://youtu.be/8DtYlUgike8
8. https://youtu.be/mVGhIWf-CEU

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes:

Semester	**Code**			**Title of the Paper**				**Hours**		**Credits**
III	**20PMA3CC9**			**FUNCTIONAL ANALYSIS**				**6**		**5**
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)				
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓	✓		✓	✓	✓		✓	✓	✓
CO2	✓	✓		✓	✓	✓		✓		✓
CO3	✓		✓	✓	✓		✓		✓	✓
CO4	✓	✓	✓			✓	✓	✓	✓	
CO5		✓	✓	✓	✓		✓		✓	✓
Number of Matches= 36, Relationship : High										

Prepared by:
1.Dr. A. Mohamed Ismayil

Checked by:
1. Dr. U. Abuthahir

Note:

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very poor	Poor	Moderate	High	Very high

Semester	Code	Course	Title of the Course	Hours	Credits	Max. marks	Internal marks	External marks
III	20PMA3CC10	Core – X	PARTIAL DIFFERENTIAL EQUATIONS	6	5	100	25	75

Course Outcomes

1. Recognize and recall the basic concept of first order P.D.E and classification of integrals with examples.
2. Show and illustrate the examples of Jacobi's method and quasi-linear equations
3. Demonstrate the examples for one dimensional wave equations and vibrations of a string
4. Discuss the boundary value problems in second order PDE's
5. Classify heat conduction and wave equation with examples.

UNIT I **18 hours**

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.

UNIT II **18 hours**

Jacobi's Method-Integral Surfaces Through a given Curve-Quasi-Linear Equations.

UNIT III **18 hours**

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#.

UNIT IV **18 hours**

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#.

UNIT V **18 hours**

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#.

 # # Self-study portion.

Text Books:

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

Books for Reference:

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 Source

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
6. https://youtu.be/DDPO-19FyJM
7. https://youtu.be/S6w0sumMyAs
8. https://youtu.be/HFPLdAKCvRU
9. https://youtu.be/aolvx8bWFDA

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes:

Semester	**Code**			**Title of the Paper**			**Hours**		**Credits**
III	**20PMA3CC10**			**PARTIAL DIFFERENTIAL EQUATIONS**			**6**		**5**
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)				
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1		✓	✓	✓	✓		✓	✓		
CO2	✓		✓	✓	✓	✓		✓	✓	✓
CO3	✓	✓		✓		✓		✓	✓	✓
CO4		✓	✓		✓	✓	✓		✓	✓
CO5	✓		✓	✓	✓		✓	✓	✓	✓
Number of Matches= 36, Relationship : High										

Prepared by:
1.Dr. A. Prasanna
2. Ms. A. Nafiunisha

Checked by:
1. Dr.M.Mohamed Althaf

Note:

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very poor	Poor	Moderate	High	Very high

Semester	Code	Course	Title of the Course	Hours	Credits	Max. marks	Internal marks	External marks
III	20PMA3C11	Core – XI	MODERN PROBABILITY THEORY	6	4	100	25	75

Course Outcomes

1. Recall and discuss the Booles inequality and discrete probability space with examples.
2. Examine Study Jordan decomposition theorem and inequalities with examples.
3. Investigate the convergence of random variables and convergence in distribution.
4. Determine the laws of large numbers and SLLN for i.i.d case with illustrate the examples.
5. Prove central limit theorem and Lindeberg-Feller theorem.

UNIT I **18 hours**

Probability: Definition of Probability-Axiomatic-Definition-Some Properties-Booles inequality- Discrete Probability Space-General Probability Space-Induced Probability Space-Conditional Probability Measure.

UNIT II **18 hours**

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-C_r-inequality-Holder's inequality-Schwarz's inequality-Minkowski inequality.

UNIT III **18 hours**

Convergence of Random Variables: Convergence in Probability-Convergence almost surely-Convergence in Distribution-Convergence in r^{th} Mean-Monotone Convergence Theorem-Fatou's Theorem-Dominated Convergence Theorem.

UNIT IV **18 hours**

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-Kolmogorov-SLLN for i.i.d case.

UNIT V **18 hours**

Central Limit Theorem: Introduction –Lindeberg-Levy Theorem-Variable Distributions: Liapounov's Theorem-Lindeberg-Feller Theorem.

 # # Self-study portion.

Text Books:

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 6.1-6.5
UNIT IV	Chapter 10	Sections 10.1-10.3
UNIT V	Chapter 11	Sections 11.1-11.3

Books for Reference:

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.

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes:

Semester	**Code**			**Title of the Paper**				**Hours**		**Credits**
III	**20PMA3C11**			**MODERN PROBABILITY THEORY**				**6**		**4**
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)				
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓	✓		✓	✓		✓	✓		✓
CO2		✓		✓	✓	✓		✓	✓	✓
CO3	✓		✓			✓	✓			✓
CO4	✓	✓	✓	✓	✓		✓	✓	✓	
CO5		✓	✓		✓	✓	✓	✓	✓	✓
Number of Matches= 35, Relationship : High										

Prepared by:
1.Dr.P.Muruganantham

Checked by:
1. Ms.A.Thagasin Banu

Note:

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very poor	Poor	Moderate	High	Very high

Semester	Code	Course	Title of the Course	Hours	Credits	Max. marks	Internal marks	External marks
III	20PMA3CC12	Core – XII	ADVANCED GRAPH THEORY	6	4	100	25	75

Course Outcomes

1. Apply domain knowledge connectivity and edge-connectivity withillustrations.
2. Demonstrate and discuss matching and stable matching.
3. Bring out Independent sets and prove Vizing's Theorem.
4. Determine the predecessor and successor algorithm.
5. Discuss the concepts of perfect graphs and interval graphs.

UNIT I **18 hours**

Connectivity and edge-connectivity – 2-connected graphs – Menger's theorem.

UNIT II **18 hours**

Matching – System of Distinct Representatives and Marriage problem – Covering – 1-factor – Stable Matching.

UNIT III **18 hours**

Independent sets – Edge-colourings – Vizing's Theorem – Vertex Colourings – Uniquely Colourable graphs – Critical graphs.

UNIT IV **18 hours**

Predecessor and Successor – Algorithm – Graceful Labeling – Sequential functions – Magic graphs – Conservative graphs.

UNIT V **18 hours**

Perfect Graphs – Perfect Graph Theorem – Chordal Graphs – Interval Graphs – Comparability Graphs.

 # # Self-study portion.

Text Books:

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

Books for Reference:

1. S. Arumugam and S. Ramachandran, Invitation to Graph Theory, New Gamma Publishing House, Palayamkottai, 2006.
2. S.A. Choudum, First Course in Graph Theory, Macmillan India Limited, New Delhi (2009).
3. F. Harary, Graph Theory, Addison-Wesley Publishing Company, INC. (1969).

Web Source

1. https://www.youtube.com/watch?v=mNzg7CoF3r0#action=share
2. https://www.youtube.com/watch?v=7UZGUiG-UCw#action=share
3. https://www.youtube.com/watch?v=Ea3DlCoc0NQ#action=share

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes:

Semester	**Code**			**Title of the Paper**			**Hours**		**Credits**
III	**20PMA3CC12**			**ADVANCED GRAPH THEORY**			**6**		**4**
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1		✓	✓		✓		✓	✓		✓
CO2	✓	✓	✓	✓	✓	✓	✓		✓	✓
CO3		✓	✓		✓			✓	✓	
CO4	✓		✓	✓		✓	✓	✓	✓	✓
CO5	✓	✓		✓	✓	✓	✓	✓	✓	✓
Number of Matches= 38, Relationship : High										

Prepared by:
1.Dr. R. Jahir Hussain

Checked by:
1. Dr. H. Sheik Mujibur Rahman

Note:

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very poor	Poor	Moderate	High	Very high

Semester	Code	Course	Title of the Course	Hours	Credits	Max. marks	Internal marks	External marks
III	20PMA3DE3AT	DSE – III	PYTHON PROGRAMMING	3	2	50	10	40

Course Outcomes

1. To provide introduction to comments, operators, variables andPython Objects.
2. Explain Standard Type operators, numbers and built-in Functions in python programming.
3. Learn strings, lists and tuples in Python programming.
4. Implement conditionals and loops for Python Programs.
5. To construct regular expressions and network programming in Python.

UNIT I **15 Hours**

What is Python – Origins of Python – Features of Python –Downloading and Installing Python – Running Python - Comments - Operators - Variables and Assignment **-** Python Objects - Standard Types - Other Built-in Types.

UNIT II **15Hours**

Internal Types - Standard Type Operators - Standard Type Built-in Functions - Categorizing the Standard Types - Unsupported Types - Introduction to Numbers – Integers - Floating Point Real Numbers - Complex Numbers – Operators - Built-in Functions -Sequences.

UNIT III **15Hours**

Strings - Strings and Operators - String-only Operators - Built-in Functions - String Built-in Methods - Special Features of Strings - Lists **–** Operators - Built-in Functions - List Type Built-in Methods - Special Features of Lists - Tuples - Tuple Operators and Built-in Functions - Special Features of Tuples .

UNIT IV 15Hours

Conditionals and Loops **-** if statement - else statement - else if statement - while statement - for statement - break statement - continue statement - pass statement - else statement -File Objects - File Built-in Function - File Built-in Methods - File Built-in Attributes - Standard Files -Command-line Arguments - File System - File Execution - Persistent Storage Modules

UNIT V **15Hours**

Regular Expressions – Introduction – Special symbols and characters for Regular Expressions – Regular Expressions and Python – Network Programming – Introduction – Network programming in Python – Sockets : Communication end points.

 # # Self-study portion.

Text Books:

Chun, J Wesley, CORE Python Programming*,* 2nd Edition*,* Pearson, 2007 Reprint 2010.

UNIT I	Chapter 1	Section - 1.1 to 1.5
	Chapter 2	Section- 2.3 to 2.5
	Chapter 4	Section - 4.1 to 4.3
UNIT II	Chapter 4	Section -4.4,4.5,4.6,4.8,4.9
	Chapter 5	Section- 5.1 to 5.6
UNIT III	Chapter 6	Section-6.2 to 6.7 and 6.11 to 6.18
UNIT IV	Chapter 8	Section-8.1 to 8.10
	Chapter9	Section -9.1 to 9.9
UNIT V	Chapter 15	Section-15.2,15.3
	Chapter 16	Section- 16.1,16.2,16.3

Books for Reference:

1. Jeffrey Elkner, Chris Meyers Allen Downey, Learning with Python, Dreamtech Press, 2015.

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes:

Semester	**Code**			**Title of the Paper**			**Hours**			**Credits**
III	**20PMA3DE3AT**			**PYTHON PROGRAMMING**			**3**			**2**
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)				
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓	✓		✓	✓		✓	✓		✓
CO2	✓	✓		✓	✓	✓			✓	
CO3			✓	✓		✓	✓	✓		✓
CO4	✓	✓	✓		✓	✓		✓	✓	
CO5		✓	✓		✓		✓		✓	✓
Number of Matches= 32, Relationship : Moderate										

Prepared by:
1.Dr. M. Mohamed Jabarulla

Checked by:
1. Dr. S. Shajitha Begum

Note:

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very poor	Poor	Moderate	High	Very high

Semester	Code	Course	Title of the Course	Hours	Credits	Max. marks	Internal marks	External marks
III	20PMA3DE3AP	DSE – III	PYTHON PROGRAMMING - Practical	3	2	50	10	40

Objective:

To enable the students acquire programming skills by applying various features of Python Language.

List of Practical:

1. Program to demonstrate arithmetic operations.
2. Program using numbers and operators.
3. Program using string built-in functions.
4. Program using functions and modules.
5. Program using lists.
6. Program using tuples.
7. Program using conditional statement.
8. Program using looping statement.
9. Program using continue, pass and else statement.
10. Program to read and write file.

Prepared by:

1.Dr. M. Mohamed Jabarulla

Checked by:

1. Dr. S. Shajitha Begum

Semester	Code	Course	Title of the Course	Hours	Credits	Max. marks	Internal marks	External marks
III	20PMA3DE3B	DSE – III	COMPUTER ALGORITHMS	6	4	100	25	75

UNIT I **18 hours**

Algorithm – Definition, Time Complexity. Elementary Data Structures – Stacks, Queues, Trees, Priority Queues, Heaps, Heapsort, Graphs.

UNIT II **18 hours**

Divide and Conquer – General method, Binary search, Merge sort, Quick sort.

UNIT III **18 hours**

The Greedy Method – Knapsack problem, Job sequencing with dead lines, Optimal storage on tapes, Optimal merge patterns.

UNIT IV **18 hours**

Basic traversal – Inorder, preorder, postorder traversals, Breadth first search and traversal, Depth first search and traversal Backtracking – Sum of subsets, *n*-Queens problem (*n*= 4, 8).

UNIT V **18 hours**

NP – Hard and *NP* – complete problems – Basic Concepts, Cook's Theorem(Statement only), Conjunctive Normal Form(CNF) – satisfiability reduces to Clique Decision Problem(CDP), The Clique Decision Problem(CDP) reduces to The Node Cover Decision Problem .

 # # Self-study portion.

Text Book:

Ellis Horowitz, SartajSahni, Sanguthevar Rajasekaran, 'Fundamentals of Computer Algorithms', Galgotia Publications, 1998.

UNIT I	Chapter I	Section 1.1
	Chapter II	Sections 2.1 - 2.5
UNIT II	Chapter III	Sections 3.1 - 3.5
UNIT III	Chapter IV	Sections 4.1 - 4.5
UNIT IV	Chapter VI	Section 6.1
	Chapter VII	Sections 7.1 - 7.3
UNIT V	Chapter XI	Sections 11.1 - 11.3

Books for Reference:

1. Thomas H.Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, 'Introduction toAlgorithms', Second Edition, Prentice Hall of India, 2004.
2. Alfred V.Aho, John E.Hopcroft and Jeffrey D.Ullman, 'Data Structures and Algorithms',Addison-Wesley, 1983.
3. M. Gary and S. Johnson, 'Computers and Interactability: A guide to theory of *NP*Completeness',W. H. Freeman & Company, 1979.

Semester	Code	Course	Title of the Course	Hours	Credits	Max. marks	Internal marks	External marks
IV	20PMA4CC13	Core – XIII	MEASURE THEORY AND INTEGRATION	6	5	100	25	75

Course Outcomes

1. Apply domain knowledge for Measure on a real line and illustrate with examples.
2. Discuss the concepts of Borel and Lebesgue measurability with suitable examples
3. Explain the abstract measure space with the examples.
4. Determine the Almost uniform convergence and study decomposition of measure.
5. Prove the Radon Nikodym theorem and Fubini's theorem.

Unit I **18hours**

#Set function and properties on sets in real line# -Measure on a real line – LebesgueOuter measure – Measurable sets – Regularity – Measurable functions.

Unit II **18 hours**

#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.

Unit III **18 hours**

#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.

Unit IV **18 hours**

#Countable and additive# - Convergence in measure – Almost uniform convergence - Signed measure and their derivatives – Hahn Decomposition – Jordan Decomposition.

Unit V **18 hours**

#Product space# - RadonNikodym theorem – Measure and Integration in a Product space – Measurability in a Product Space – Product Measure and Fubini's theorem.

 # # Self-study portion.

Text Books:

G. De Barra,Measure Theory and Integration, New Age International (P) Limited, Publishers,New Delhi Fourth Reprint, (1997).

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

Books for Reference:

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 Source

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

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes:

Semester	**Code**		**Title of the Paper**			**Hours**			**Credits**	
IV	**20PMA4CC13**		**MEASURE THEORY AND INTEGRATION**			**6**			**5**	
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)				
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓	✓	✓	✓		✓	✓	✓	✓	✓
CO2			✓	✓	✓		✓		✓	✓
CO3	✓		✓		✓	✓		✓		✓
CO4	✓	✓		✓		✓		✓	✓	
CO5	✓	✓	✓	✓	✓		✓		✓	✓
Number of Matches= 36, Relationship : High										

Prepared by:
1.Ms. M. S. Afya Farhana

Checked by:
1. Dr. D. Dhamodharan

Note:

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very poor	Poor	Moderate	High	Very high

Semester	Code	Course	Title of the Course	Hours	Credits	Max. marks	Internal marks	External marks
IV	20PMA4CC14	Core – XIV	FLUID DYNAMICS	6	5	100	25	75

Course Outcomes

1. Demonstrate and discuss fluid flows, stream lines, vorticity vector and equation of continuity with examples.
2. Derive the Euler's equation of motion and Bernoulli's equation with the examples.
3. Distinguish sources, sinks and doublets and analyze the axis-symmetric flows and stokes stream function.
4. Determine the concept of two-dimensional flows and complex potential flows.
5. Acquire the Milne-Thomson circle theorem and theorem of Blasius and illustrate some applications of the circle theorem.

UNIT I **18 hours**

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#.

UNIT II **18 hours**

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#.

UNIT III **18 hours**

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.

UNIT IV **18 hours**

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.

UNIT V **18 hours**

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.

 # # Self-study portion.

Text Books:

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

Books for Reference:

1.Goyal and Gupta, Fluid Dynamics,Edition 17, PragatiPrakashan ,(2011).
2. Raja Subramanian,Fluid Mechanics –Introduction and Application, Jaicopublishing houseEdition 2(2008).

Web Source

1. https://nptel.ac.in/courses/103/106/103106159/
2. https://nptel.ac.in/courses/112/105/112105269/
3. https://www.youtube.com/watch?v=TaUXPnIFd6Q
4. https://www.youtube.com/watch?v=luGzHVdE4TE
5. https://www.youtube.com/watch?v=3AcTSjvTnnA
6. https://www.youtube.com/watch?v=etjEykTm95s
7. https://www.youtube.com/watch?v=vcNvhnqC68A
8. https://www.youtube.com/watch?v=UM-pkVPw4tE

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes:

Semester	**Code**		**Title of the Paper**			**Hours**		**Credits**		
IV	**20PMA4C14**		**FLUID DYNAMICS**			**6**		**5**		
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)				
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1		✓	✓	✓		✓	✓	✓	✓	
CO2	✓	✓		✓	✓	✓	✓		✓	✓
CO3		✓	✓		✓	✓	✓	✓		✓
CO4	✓		✓	✓				✓	✓	✓
CO5	✓	✓	✓		✓	✓		✓	✓	✓
Number of Matches= 36, Relationship : High										

Prepared by:
1.Dr. S. Mohamed Yusuff Ansari

Checked by:
1. Ms.S.Sharmila Banu

Note:

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very poor	Poor	Moderate	High	Very high

Semester	Code	Course	Title of the Course	Hours	Credits	Max. marks	Internal marks	External marks
IV	20PMA4CC15	Core – XV	INTEGRAL EQUATIONS AND CALCULUS OF VARIATIONS	6	5	100	25	75

Course Outcomes

1. Discuss the basic concepts of eigen values and eigen functions with illustrate the examples.
2. Determine the method of successive approximations and Volterra integral equations with suitable examples.
3. Study of applications to ordinary differential equations and solve the Abel integral equations.
4. Applying domain knowledge for maxima and minima illustrate the examples.
5. Bring out natural boundary conditions and transition conditions withIllustrations.

UNIT I **18 hours**

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#.

UNIT II **18 hours**

Method of successive approximations - Iterative scheme - #Examples# - Volterra IntegralEquations - #Examples# - Some results about the resolvent Kernel.

UNIT III **18 hours**

Applications to ordinary differential equations - Initial value problems – Boundary valueProblems - #Examples# - Singular integral equations - Abel Integral Equation - #Examples#.

UNIT IV **18 hours**

Calculus of variations and applications - Maxima and Minima – Simplest case - #Illustrativeexamples#.

UNIT V **18 hours**

Natural Boundary conditions and transition conditions – Variational notation - #More general case # - Constraints and Lagrange multipliers.

 # # Self-study portion.

Text Books:

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

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

Books for Reference:

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 Source

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/rCWzF1yvZlQ
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
9. https://youtu.be/eL4cgrLIkUo
10. https://youtu.be/SLzFIZUJkz0

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes:

Semester	**Code**			**Title of the Paper**				**Hours**		**Credits**
IV	**20PMA4CC15**			**INTEGRAL EQUATIONS AND CALCULUS OF VARIATIONS**				**6**		**5**
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)				
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1			✓	✓		✓	✓	✓		✓
CO2	✓		✓	✓	✓		✓		✓	✓
CO3		✓		✓		✓		✓	✓	✓
CO4	✓	✓	✓		✓	✓	✓	✓	✓	
CO5	✓	✓		✓	✓	✓	✓	✓		✓
Number of Matches= 36, Relationship : High										

Prepared by:
1.Dr. M. Mohamed Jabarulla

Checked by:
1. Dr. D. Dhamodharan

Note:

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very poor	Poor	Moderate	High	Very high

Semester	Code	Course	Title of the Course	Hours	Credits	Max. marks	Internal marks	External marks
IV	20PMA4DE4A	DSE – IV	ADVANCED OPERATIONS RESEARCH	6	4	100	25	75

Course Outcomes

1. Discuss the basic concepts of integer linear programming and sensitivity analysiswith examples.
2. Construct the goal programming problem and general goal programming model.
3. Investigate the decision making environments and games with illustrate examples.
4. Demonstrate the inventory problems and EOQ models with examples.
5. Determine dynamic programming with illustrative examples and study dynamic programming models.

UNIT I **18 hours**

Integer Linear Programming – Types of Integer Programming Problems – Gomory's All Integer Cutting Plane Method - #Gomory's Mixed Integer Cutting Plane Method#. Sensitivity Analysis – Change in Objective Function Coefficient – Addition of New Variable – Addition of New Constraint.

UNIT II **18 hours**

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 –Graphical Solution method of GP –Modified Simplex Method of GP.

UNIT III **18 hours**

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.

UNIT IV **18hours**

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. Single item inventory control models with shortages – Model II (a): EOQ model with constant rate of demand and variable order cycle time.

UNIT V **18 hours**

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.

 # # Self-study portion.

Text Books:

J.K. Sharma, Operations Research Theory and Applications, Macmillan India Ltd., Fourth Edition, (2010).

UNIT I Sections 7.1, 7.2, 7.4, 7.5, 6.1 and 6.2 (6.2.1, 6.2.4, 6.2.5)
UNIT II Sections 8.1-8.6
UNIT III Sections 11.1, 11.2, 11.3, 11.4(11.4.1 -11.4.5), 11.5(11.5.1) 12.1, 12.2, 12.3(12.3.1), 12.4, 12.5, 12.6.4
UNIT IV Sections 14.1, 14.2, 14.4, 14.5(14.5.1–14.5.4), 14.6(14.6.1-14.6.3), 14.7, 14.8 (Part)
UNIT V Sections 22.1, 22.2, 22.3, 22.4 (Model -I and Model -II), 22.5

Books for Reference:

1. Prem Kumar Gupta and D.S. Hira, Operations research, S. Chand, (2000).

2. Kantiswarup, P.K. Gupta and Manmohan, Operations Research, Sultan Chand & Sons, (2009).

Web Source

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

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes:

Semester	**Code**			**Title of the Paper**			**Hours**			**Credits**
IV	**20PMA4DE4A**			**ADVANCED OPERATIONS RESEARCH**			**6**			**4**
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)				
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
CO2	✓	✓		✓	✓	✓		✓	✓	
CO3	✓		✓	✓		✓	✓	✓		✓
CO4	✓	✓	✓	✓	✓		✓	✓	✓	
CO5		✓	✓		✓	✓	✓		✓	✓
Number of Matches= 39, Relationship : High										

Prepared by:

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Checked by:

1. Dr. H. Sheik Mujibur Rahman

Note:

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very poor	Poor	Moderate	High	Very high

Semester	Code	Course	Title of the Course	Hours	Credits	Max. marks	Internal marks	External marks
IV	20PMA4DE4B	DSE – IV	STOCHASTIC PROCESSES	6	4	100	25	75

UNIT I **18 hours**

Introduction – Specification of Stochastic Processes – Stationary Processes – Second- Order Processes – Stationarity – Gaussian Processes - Markov Chains – Definition and examples– Transition matrix – Probability distribution – Order of a Markov chain – Markov chains as graphs – Higher transition probabilities.

UNIT II **18 hours**

Classification of States and Chains – Communication Relations – Class Property -Classifications of Chains – Classification of States: First Passage Time Distribution -Determination of Higher transition probabilities – Aperoidic Chain: Limiting Behavior – Stability of a Markov System – Limiting Behavior - #Graph theoretic approach#.

UNIT III **18 hours**

Poisson Processes - Introduction – Postulates for Poisson process – Properties of Poisson process– Poisson process and related distributions – Interarrival Time – Further Properties ofPoisson Process.

UNIT IV **18 hours**

Renewal Processes - Renewal Processes in discrete time – Relation between F(s) and P(s) – Renewal interval - Generalized Form: Delayed Recurrent Event - Renewal Theory in Discrete Time – Renewal Processes in Continuous Time – Renewal Function and RenewalDensity - Renewal Equation.

UNIT V **18 hours**

Queueing Processes – Steady State Distribution – General relationships in Queueing Theory – Little's Formula – Queueing Model M/M/1: Steady state behavior – Transient behaviour of M/M/1 Model.

 # # Self-study portion.

Text Book:

Medhi, J, Stochastic Processes, Second Edition (Reprint), New Age International Publishers, New Delhi, 2002.

UNIT I	Chapter 2	Sections 2.1 - 2.3
	Chapter 3	Sections 3.1, 3.2
UNIT II	Chapter 3	Sections 3.4 - 3.7
UNIT III	Chapter 4	Sections 4.1 - 4.2
UNIT IV	Chapter 6	Sections 6.1- 6.3
UNIT V	Chapter 10	Sections 10.1 - 10.2.2, 10.3

Books for Reference:

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.

Semester	Code	Course	Title of the Course	Hours	Credits	Max. marks	Internal marks	External marks
IV	20PMA4EC2	Extra Credit – II	MATHEMATICS FOR CAREER EXAMINATIONS	-	5	100	-	100

UNIT I

Analysis: Elementary set theory, finite, countable and uncountable sets, Real number system as a complete ordered field, Archimedean property, supremum, infimum. Sequences and series, convergence, limsup, liminf. Bolzano Weierstrass theorem, Heine Borel theorem. Continuity, uniform continuity, differentiability, mean value theorem. Sequences and series of functions, uniform convergence. Riemann sums and Riemann integral, Improper Integrals. Monotonic functions, types of discontinuity, functions of bounded variation, Lebesgue measure, Lebesgue integral. Functions of several variables, directional derivative, partial derivative, derivative as a linear transformation, inverse and implicit function theorems. Metric spaces, compactness, connectedness. Normed linear Spaces. Spaces of continuous functions as examples.

Linear Algebra: Vector spaces, subspaces, linear dependence, basis, dimension, algebra of lineartransformations. Algebra of matrices, rank and determinant of matrices, linear equations. Eigenvalues and eigenvectors, Cayley-Hamilton theorem. Matrix representation of linear transformations. Change of basis, canonical forms, diagonal forms, triangular forms, Jordan forms. Inner product spaces, orthonormal basis. Quadratic forms, reduction and classification of quadratic forms.

UNIT II

Complex Analysis: Algebra of complex numbers, the complex plane, polynomials, power series,transcendental functions such as exponential, trigonometric and hyperbolic functions. Analytic functions, Cauchy-Riemann equations. Contour integral, Cauchy's theorem, Cauchy's integral formula, Liouville's theorem, Maximum modulus principle, Schwarz lemma, Open mapping theorem. Taylor series, Laurent series, calculus of residues. Conformal mappings, Mobius transformations.

Algebra: Permutations, combinations, pigeon-hole principle, inclusion-exclusion principle, derangements. Fundamental theorem of arithmetic, divisibility in Z, congruences, Chinese Remainder Theorem, Euler's Ø- function, primitive roots. Groups, subgroups, normal subgroups, quotient groups, homomorphisms, cyclic groups, permutation groups, Cayley's theorem, class equations, Sylow theorems. Rings, ideals, prime and maximal ideals, quotient rings, unique factorization domain, principal ideal domain, Euclidean domain. Polynomial rings and irreducibility criteria. Fields, finite fields, field extensions, Galois Theory.

Topology: basis, dense sets, subspace and product topology, separation axioms, connectedness and compactness.

UNIT III

Ordinary Differential Equations (ODEs):

Existence and uniqueness of solutions of initial value problems for first order ordinary differentialequations, singular solutions of first order ODEs, system of first order ODEs. General theory of homogenous and non-homogeneous linear ODEs, variation of parameters, Sturm-Liouville boundary value problem, Green's function.

Partial Differential Equations (PDEs):

Lagrange and Charpit methods for solving first order PDEs, Cauchy problem for first order PDEs. Classification of second order PDEs, General solution of higher order PDEs with constant coefficients, Method of separation of variables for Laplace, Heat and Wave equations.

Numerical Analysis :

Numerical solutions of algebraic equations, Method of iteration and Newton-Raphson method, Rate of convergence, Solution of systems of linear algebraic equations using Gauss elimination and Gauss-Seidel methods, Finite differences, Lagrange, Hermite and spline interpolation, Numerical differentiation and integration, Numerical solutions of ODEs using Picard, Euler, modified Euler and Runge-Kutta methods.

Calculus of Variations:

Variation of a functional, Euler-Lagrange equation, Necessary and sufficient conditions for extrema. Variational methods for boundary value problems in ordinary and partial differential equations.

Linear Integral Equations:
Linear integral equation of the first and second kind of Fredholm and Volterra type, Solutions with separable kernels. Characteristic numbers and eigenfunctions, resolvent kernel.
Classical Mechanics:
Generalized coordinates, Lagrange's equations, Hamilton's canonical equations, Hamilton's principle and principle of least action, Two-dimensional motion of rigid bodies, Euler's dynamicalequations for the motion of a rigid body about an axis, theory of small oscillations.

UNIT IV
Descriptive statistics, exploratory data analysis Sample space, discrete probability, independent events, Bayes theorem. Random variables and distribution functions (univariate and multivariate); expectation and moments. Independent random variables, marginal and conditional distributions. Characteristic functions. Probability inequalities (Tchebyshef, Markov, Jensen). Modes of convergence, weak and strong laws of large numbers, Central Limit theorems (i.i.d. case). Markov chains with finite and countable state space, classification of states, limiting behaviour of n-step transition probabilities, stationary distribution, Poisson and birth-and-death processes. Standard discrete and continuous univariate distributions. sampling distributions, standard errors and asymptotic distributions, distribution of order statistics and range. Methods of estimation, properties of estimators, confidence intervals. Tests of hypotheses: most powerfuland uniformly most powerful tests, likelihood ratio tests. Analysis of discrete data and chi-square test of goodness of fit. Large sample tests. Simple nonparametric tests for one and two sample problems, rank correlation and test for independence. Elementary Bayesian inference. Gauss-Markov models, estimability of parameters, best linear unbiased estimators, confidence intervals, tests for linear hypotheses. Analysis of variance and covariance. Fixed, random and mixed effects models. Simple and multiple linear regression. Elementary regression diagnostics. Logistic regression.

UNIT V
Multivariate normal distribution, Wishart distribution and their properties. Distribution of quadratic forms. Inference for parameters, partial and multiple correlation coefficients and related tests. Data reduction techniques: Principle component analysis, Discriminant analysis, Cluster analysis, Canonical correlation. Simple random sampling, stratified sampling and systematic sampling. Probability proportional to size sampling. Ratio and regression methods. Completely randomized designs, randomized block designs and Latin-square designs. Connectedness and orthogonality of block designs, BIBD. 2K factorial experiments: confounding and construction. Hazard function and failure rates, censoring and life testing, series and parallel systems. Linear programming problem, simplex methods, duality. Elementary queuing and inventory models. Steady-state solutions of Markovian queuing models: M/M/1, M/M/1 with limited waiting space, M/M/C, M/M/C with limited waiting space, M/G/1.

Text Book:
Pawan Sharma, Suraj Singh, Anshuman, UGC CSIR NET/SET (JRF & LS) Mathematical Sciences, Arihant Publisher, 2016.

Books for Reference:
1. CSIR-NET Toppers Handwritten Notes- Mathematical Science – 8 books- Latest Edition 2020.
2. Tripathi A. M., Truemans CSIR Mathematical Sciences , Trueman's Publisher.
3. P.C. Mittal, Ritesh Mishra, Joint CSIR UGC-NET Mathematical Sciences (Part-B & C) Exam Guide, Ramesh Publishing House, 2020.