

SEMESTER III

CODE	COURSE TITLE
18MSPC310	MEASURE THEORY AND INTEGRATION

Category	CIA	ESE	L	T	P	Credit
Core	25	75	86	4	–	4

Preamble

- To acquire knowledge in the concept of measurable sets, measurable functions and the integration of such functions on the real line
- To identify integrable functions and evaluate Lebesgue integrals
- To generalize the concept of integration using measures

Prerequisite

- Knowledge in Riemann-Stieltjes integral, uniform convergence, continuity and integration

Course Outcomes

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

CO Number	CO Statement	Knowledge Level
CO1	Acquire the knowledge of Lebesgue measure in measurable sets and non-measurable sets	K2
CO2	Discuss the concept of Lebesgue integral of a bounded measurable function and measurable nonnegative function	K2
CO3	Apply differentiation and integration in monotone functions	K3
CO4	Analyze integration of measurable functions over general measure spaces	K4
CO5	Evaluate the construction of product Measures and Lebesgue measure on Euclidean space	K5

Mapping with Programme Outcomes

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	S	S	M	S	S
CO2	S	S	S	S	M
CO3	M	S	S	S	S
CO4	S	M	S	S	S
CO5	S	S	S	M	S

S – Strong; M – Medium; L – Low

Syllabus

UNIT I

18Hrs.

Lebesgue Measure: Introduction – Lebesgue Outer Measure – The σ – Algebra of Lebesgue Measurable Sets – Outer and Inner Approximation of Lebesgue Measurable Sets – Countable Additivity, Continuity and the Borel–Cantelli Lemma – *Nonmeasurable Sets*.

UNIT II

18Hrs.

Lebesgue Integration: The Riemann Integral – **The Lebesgue Integral of a Bounded Measurable Function over a Set of Finite Measure** – The Lebesgue Integral of a Measurable Nonnegative Function – *The General Lebesgue Integral* – Countable Additivity and Continuity of Integration.

UNIT III

18Hrs.

Differentiation and Integration: Continuity of Monotone Functions – Differentiability of Monotone Functions: Lebesgue’s Theorem – Functions of Bounded Variations: Jordan’s Theorem – *Absolutely Continuous Functions* – Integrating Derivatives: Differentiating Indefinite Integrals.

UNIT IV

19Hrs.

Integration over General Measure Spaces: Measurable Functions – Integration of Nonnegative Measurable Functions – **Integration of General Measurable Functions** – The Radon–Nikodym Theorem.

UNIT V

17Hrs.

The Construction of Particular Measures: Product Measures: The Theorems of Fubini and Tonelli – **Lebesgue Measure on Euclidean Space R^n** .

Note: *Italics* denotes Self Study Topics.

Text Book

Sl.No.	Author Name	Title of the Book	Publisher	Year and Edition
1.	H.L. Royden, P.M. Fitzpatrick	Real Analysis	PHI Learning Private Limited, Delhi	2014, 4 th Edition

Units	Chapter	Sections
I	2	2.1–2.6
II	4	4.1–4.5
III	6	6.1–6.5
IV	18	18.1–18.4
V	20	20.1–20.2

Reference Books

Sl.No.	Author Name	Title of the Book	Publisher	Year and Edition
1.	Bartle R.G	Elements of Real Analysis	John Wiley and Sons, New York	1976, 2 nd Edition
2.	Rudin W.	Real and complex Analysis	McGraw– Hill, New York	1986, 3 rd Edition
3.	Tom M. Apostol	Mathematical Analysis	Narosa Publishing House, New Delhi	2002, 2 nd Edition

Web Resources

1. https://youtu.be/ot253Lhx2_o
2. <https://youtu.be/Q2UmASJJSwg>
3. <https://epdf.tips/lebesgue-integration-on-euclidean-space.html>
4. <https://nptel.ac.in/courses/111101005/>
5. <https://nptel.ac.in/courses/111101100/>
6. <https://faculty.etsu.edu/gardnerr/notes>

Pedagogy

Lecture, PPT, Group Discussion, Seminar and Viva–Voce

- Question Paper Setters confine to the above **text book** only.

SEMESTER III

CODE	COURSE TITLE
18MSPC311	TOPOLOGY

Category	CIA	ESE	L	T	P	Credit
Core	25	75	86	4	–	4

Preamble

- The aim of the course is to introduce the theory of metric spaces and topological spaces with emphasis on connected and compact subspaces that all important to higher mathematics

Prerequisite

- Knowledge in open, closed sets, limit points and continuous functions

Course Outcomes

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

CO Number	CO Statement	Knowledge Level
CO1	Learn open basis and open sub basis, weak topologies, the function algebras $C(X, R)$ and $C(X, C)$	K2
CO2	Use continuous functions and homeomorphisms to understand structure of topological spaces	K2
CO3	Understand countability and separation axioms in Urysohn metrization and Tietz's extension theorem	K3
CO4	Discuss Tychonoff's theorem, locally compact spaces, compactness of metric spaces and Ascoli's theorem	K4
CO5	Analysing a function is metric, verify a given family is a topology and check a given set is open, closed, dense, compact, connected.	K5

Mapping with Programme Outcomes

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	S	S	M	M	S
CO2	S	S	M	S	M
CO3	S	S	M	M	S
CO4	S	S	S	M	S
CO5	S	M	M	S	M

S – Strong; M – Medium; L – Low

Syllabus

UNIT I

18 Hrs.

Topological Spaces and Continuous Functions: Topological Spaces–Basics for a Topology – The Order Topology –*The product Topology on $X \times Y$* – The Subspace Topology –Closed Sets and Limit Points – Continuous Functions – The Product Topology.

UNIT II

18 Hrs.

Connectedness and Compactness: Connected Spaces –Connected Subspaces of the Real Line –*Components* and Local Connectedness – Compact Spaces – Compact Subspaces of the Real Line.

UNIT III

18 Hrs.

Countability and Separation Axioms: **The Countability Axioms** – **The Separation Axioms** – **The Urysohn Lemma** –*The Urysohn Metrization Theorem*– The Tietz Extension Theorem.

UNIT IV

17 Hrs.

Tychonoff Theorem: The Tychonoff Theorem – Completely regular Spaces – *The Stone-Cech Compactification*.

UNIT V

19 Hrs.

Complete Metric Spaces and Functions Spaces: Complete Metric Spaces – **Compactness in Metric Spaces** – Pointwise and Compact Convergences – The Compact Open Topology – Ascoli's Theorem – **Baire Spaces and Dimension Theory:** Baire Spaces – *A Nowhere Differentiable Function*.

Note: *Italics* denotes Self Study Topics.

Text Book

Sl.No.	Author Name	Title of the Book	Publisher	Year and Edition
1.	Munkres R.	Topology	Prentice Hall, New Delhi	2008, 2 nd Edition

Units	Chapter	Sections
I	2	12-19
II	3	23-27
III	4	30-35
IV	5	37,38
V	7	43,45-47
	8	48,49

Reference Books

Sl.No.	Author Name	Title of the Book	Publisher	Year and Edition
1.	James R.Munkres	Topology	Pearson New International, United States	2015, 2 nd Edition
2.	George F.Simmons	Introduction to Topology and Modern Analysis	McGraw–Hill Book Company, United States	9 th Reprint 2004
3.	John L.Kelley	General Topology	Dover Publications, Mineola, New York, United States	2017, 1 st Edition
4.	L.Steen and J.Seebach	Counter examples in Topology	Holt,Rinehart and Winston, New York	1978, 2 nd Edition

Web Resources

1. <https://nptel.ac.in/courses/111106054/Chapter1.pdf>
2. <https://www.emathzone.com/tutorials/general-topology/connectedness-and-compactness/>
3. http://homepage.divms.uiowa.edu/~jsimon/COURSES/M132Fall07/CountabilityProperties_v3.pdf
4. <http://www.math.toronto.edu/~herzig/Tychonoff-lecture.pdf>
5. <https://www.emathzone.com/tutorials/general-topology/completely-regular-space.html>
6. <http://mathonline.wikidot.com/the-arzela-ascoli-theorem>

Pedagogy

Lecture, PPT, Group Discussion, Seminar and Viva–Voce

- Question Paper Setters confine to the above **text book** only.

SEMESTER III

CODE	COURSE TITLE
18MSPC312	FUZZY SETS AND FUZZY LOGIC

Category	CIA	ESE	L	T	P	Credit
Core	25	75	86	4	–	4

Preamble

- Fuzzy logic attempts to emulate reasoning and decision making
- To identify and solve the real life problems systematically and mathematically

Prerequisite

- Knowledge in set theory

Course Outcomes

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

CO Number	CO Statement	Knowledge Level
CO1	Calculate support, height, normal alpha cuts and strong alpha cuts from the Membership Functions and manipulate standard fuzzy operations such as Complement–norm and t– conforms	K2
CO2	Compute fuzzy relations for equivalence and compatibility	K2
CO3	Analyse the concepts of fuzzy controllers, neural networks and Fuzzy Automata	K3
CO4	Construct the membership value for fuzzy sets in direct and indirect methods	K4
CO5	Apply the applications of fuzzy theory in engineering ,biology, medicine, economics and many other disciplines	K5

Mapping with Programme Outcomes

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	S	S	M	M	S
CO2	S	S	M	S	M
CO3	S	S	M	M	S
CO4	S	M	S	S	M
CO5	S	M	M	S	M

S – Strong; M – Medium; L – Low

Syllabus

UNIT I

18 Hrs.

From Classical (Crisp) Sets to Fuzzy Sets: Introduction – *Crispsets: An Overview*. Fuzzy Sets: Basic Types – Fuzzy Sets: Basic Concepts – Characteristics and Significance of the Paradigm Shift – **Fuzzy Sets Versus Crispsets:** Additional Properties of α – Cuts – Representations of Fuzzy Sets. Extension Principle for Fuzzy Sets. **Operations on Fuzzy Sets:** Types of Operations – Fuzzy Complements – Fuzzy Intersections: t – Norms – Fuzzy Unions: t – Conorms – Combinations of Operations – Aggregation Operations

UNIT II

18 Hrs.

Fuzzy Arithmetic: Fuzzy Numbers – Linguistic Variables – Arithmetic Operations on Intervals, Fuzzy Numbers – Lattice of Fuzzy Numbers. Fuzzy Equations. **Fuzzy Relation:** *Crisp Versus Fuzzy Relations* – Projections and Cylindric Extensions – Binary Fuzzy Relations – Binary Relations on a Single Set – Fuzzy Equivalence Relations – Fuzzy Compatibility Relations – **Fuzzy Ordering Relations** – Fuzzy Morphisms – Sup- i Compositions at Fuzzy Relations – Inf- ω_i Compositions of Fuzzy Relations.

UNIT III

18 Hrs.

Constructing Fuzzy Sets And Operations On Fuzzy Sets: *General Discussion* – Methods of Construction: An Overview – Direct Methods with one Expert – Direct Methods with Multiple Experts – Indirect Methods with one Expert – Indirect Methods with Multiple Experts – Constructions from Sample Data.

UNIT IV

18 Hrs.

Fuzzy Systems: *General Discussion* – Fuzzy Controllers: An Overview – Fuzzy Controllers: an Example – Fuzzy Systems and Neural Networks – **Fuzzy Neural Networks** – Fuzzy Automata – Fuzzy Dynamic Systems

UNIT V

18 Hrs.

Miscellaneous Applications: Introduction – Medicine – Economics – **Fuzzy Systems and Genetic Algorithms** – *Fuzzy Regression* – Interpersonal Communication – Other Applications

Note: *Italics* denotes Self Study Topics.

Text Book

Sl.No.	Author Name	Title of the Book	Publisher	Year and Edition
1.	George Klir J. and Bo Yuan	Fuzzy Sets and Fuzzy Logic: Theory and Applications	Prentice Hall of India Private Limited, New Delhi	2008, 1 st Edition

Units	Chapter	Sections
I	1	1.1–1.5
	2	2.1–2.3
	3	3.1–3.6
II	4	4.1–4.6
	5	5.1–5.10
III	10	10.1–10.7
IV	12	12.1–12.7
V	17	17.1–17.7

Reference Books

Sl.No.	Author Name	Title of the Book	Publisher	Year and Edition
1.	George J. Klir, Tina A.Folger	Fuzzy sets, uncertainty and information	Prentice Hall of India Ltd, New Delhi	2006, 1 st edition
2.	Zimmermann H.J.	Fuzzy set Theory and its Applications	Springer Private Limited, New Delhi	2006, 4 th edition
3.	Zimmermann H.J	Fuzzy sets, Decision Making, and Expert Systems	Kluwer, Boston	1993, 4 th edition

Web Resources

1. <https://www.journals.elsevier.com/fuzzy-sets-and-systems>
2. <https://www.ifi.uzh.ch/fuzzylogicscrip>
3. http://www.tutorialspoint.com/fuzzy_logic/fuzzy_logic_control_systemhttps://www.cs.e.iitb.ac.in/~cs621-2011/lectures_2009/cs621-lect38-fuzzy-logic
4. <https://www.sciencedirect.com/science/article/pii/S1474667017568949>

Pedagogy

Lecture, PPT, Quiz, Group Discussion, Seminar and Case Study

- Question Paper Setters confine to the above **text book** only.

SEMESTER III

CODE	COURSE TITLE
18MSPC313	NUMERICAL ANALYSIS

Category	CIA	ESE	L	T	P	Credit
Core	25	75	86	4	–	4

Preamble

- To acquire the knowledge in the concept of Advanced Numerical Methods
- To identify solutions of Elliptic, Parabolic and Hyperbolic Partial Differential Equations

Prerequisite

- Knowledge in differentiation and integration

Course Outcomes

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

CO Number	CO Statement	Knowledge Level
CO1	Acquire the knowledge numerical differentiation and integration	K2
CO2	Apply the concept of solution of system of equation and method of iteration.	K2 & K4
CO3	Analyze the boundary value problems and characteristic value problems	K3& K4
CO4	Demonstrate Euler and RungeKutta method and examine the Adams Moulton method.	K4
CO5	Evaluate the concepts Poisson equation, Laplace's equation, explicit method and wave equation by finite differences.	K5

Mapping with Programme Outcomes

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	S	S	M	M	S
CO2	S	S	M	S	M
CO3	S	S	M	M	S
CO4	S	S	S	M	S
CO5	S	M	M	S	M

S – Strong; M – Medium; L – Low

Syllabus

UNIT I

18 Hrs.

Solution of Nonlinear Equations: Newton's Method – Convergence of Newton's Method – Error Bairstow's Method for Quadratic Factors. **Numerical Differentiation and Integration:** Derivatives from Difference Tables – Higher Order Derivatives – Divided Difference, Central-Difference Formulas – **The Trapezoidal Rule** – Romberg Integration – Simpson's 1/3 Rule.

UNIT II

18 Hrs.

Solution of System of Equations: The Gauss Elimination Method and Gauss Jordan Method – LU Decomposition Method – **Matrix Inversion by Gauss-Jordan Method** – **Methods of Iteration:** Jacobi and Gauss Seidal Iteration – *Relaxation Method*.

UNIT III

18 Hrs.

Solution of Ordinary Differential Equations: **Taylor Series Method** – Euler and Modified Euler Methods – **Second Order Runge Kutta Method** – Fourth Order Runge Kutta Method – Milne's Method – **Adams Moulton Method – stability considerations**.

UNIT IV

17 Hrs.

Boundary Value Problems and Characteristic Value Problems: Solution through a Set of Equations – **Derivative Boundary Conditions** – **Characteristic Value Problems** – Eigen Values of a Matrix by Iteration – **The Power Method**.

UNIT V

19 Hrs.

Numerical Solution of Partial Differential Equations: Solutions of Elliptic, Parabolic and Hyperbolic Partial Differential Equations: Laplace's Equation on a Rectangular Region – Iterative Methods for Laplace Equation – The Poisson Equation – Derivative Boundary Conditions – Solving the Equation for Time – **Dependent Heat Flow:** The Explicit Method – **The Crank Nicolson Method** – Solving the Wave Equation by Finite Differences.

Note: *Italics* denotes Self Study Topics.

Text Book

Sl.No.	Author Name	Title of the Book	Publisher	Year and Edition
1.	Gerald C.F Wheatley P.O	Applied Numerical Analysis	Addison Wesley, United States	Reprint 2003, 6 th Edition

Units	Chapter	Sections
I	I	1.4, 1.5, 1.8
	V	5.2, 5.3, 5.6, 5.7
II	II	2.3–2.5, 2.7, 2.10, 2.11
III	VI	6.2–6.4, 6.6, 6.7
IV	VII	7.3 – 7.5
V	VIII	8.1–8.3

Reference Books

Sl.No.	Author Name	Title of the Book	Publisher	Year and Edition
1.	Bluden R.L., Douglas Fairs J	Numerical Analysis	P.W.S. Kent publishing company, Boston	1989, 4 th Edition
2.	Kandasamy P., Thilagavathy K., Gunavathi K	Numerical Methods	S.Chand and company limited, New Delhi	2003, 2 nd Revised Edition
3.	Sastry S.S	Introductory Methods to Numerical Analysis	Prentice Hall of India, New Delhi	1983, 1 st Reprint Edition

Web Resources

1. <http://www.s-cool.co.uk/a-level/maths/numerical-analysis>
2. [https://math.uconn.edu/research/research areas/numerical-analysis](https://math.uconn.edu/research/research%20areas/numerical-analysis)
3. https://onlinecourses.nptel.ac.in/noc17_ma14/course
4. <http://nm.mathforcollege.com>
5. <http://mathforum.org/advanced/numerical.html>
6. <https://www.youtube.com/watch?v=eHNUE0KtUN>

Pedagogy

Lecture, PPT, Group Discussion, Seminar and Viva-Voce

- Question Paper Setters confine to the above text book only.

SEMESTER III

CODE	COURSE TITLE
18MSPSP02	Programming in LaTeX - Practical

Category	CIA	ESE	L	T	P	Credit
Skill Based Subject II	40	60	-	-	45	5

Preamble

- To propagate importance of the open source software's. As it is a programming package, it is useful for typesetting and makes the alignment easy and neat. This paper enables the students to learn the latest techniques that is helpful to prepare a printable document in an enhanced manner

prerequisite

- Undergraduate-level mathematics and experience with basic computer operations

List of Practicals

- 1) Create nested list in LaTeX.
- 2) Create a document in book format.
- 3) Draw a complete bipartite graph and label using LaTeX draw.
- 4) Import pictures in LaTeX.
- 5) Create hyperlinks in LaTeX documents.
- 6) Create a LaTeX document with the below expressions
 - i) Subscripts and Superscripts
 - ii) Brackets and Parentheses
 - iii) Fractions and Binomials
 - iv) Aligning equations
 - v) Operators
 - vi) Spacing in math mode
 - vii) Integrals, sums and limits
 - viii) List of Greek letters and math symbols
 - ix) Mathematical fonts
- 7) Draw a pie chart in LaTeX.

8) Type the following in LaTeX

i)
$$1 + \frac{ab}{a + \frac{bc}{d + \frac{5c}{3xy}}}$$

ii)
$$\sqrt{2 + \sqrt{2 + \sqrt{2 + \sqrt{x + y}}}}$$

9) Give colors for graphical presentation in LaTeX.

10) Draw a sine curve in LaTeX.

11) Draw three types of diagrams of benzene in LaTeX.

12) Convert a LaTeX file to PowerPoint presentation.

13) Prepare your resume in LaTeX.

14) Prepare PG Project in LaTeX format.

14) Prepare an article for Mathematical journal.

SEMESTER III

CODE	COURSE TITLE
18MSPS303	PROBLEM SOLVING IN ALGEBRA AND REAL ANALYSIS

Category	CIA	ESE	L	T	P	Credit
Skill Based Subject III	25	75	-	45	-	5

Preamble

- To impart the knowledge in problem solving techniques

prerequisite

- Knowledge in Algebra and Analysis

Syllabus

UNIT I

9 Hrs.

Analysis: Elementary set theory – Finite, Countable and Uncountable Sets – Real number system as a complete ordered field – Archimedean property – Supremum–Infimum (Problems only).

UNIT II

9 Hrs.

Analysis: Sequences and Series – Convergences – Limsup, Liminf – Continuity – Uniform Continuity – Differentiability – Mean Value Theorem – Sequences and series of functions – Uniform Convergence (Problems only).

UNIT III

9 Hrs.

Linear Algebra: Vector Spaces – Subspaces – Linear Independence – Basis – Dimensions – Algebra of Linear Transformations – Algebra of Matrices – Rank and Determinant of Matrices – Linear Equations – Eigen Values and Eigen Vectors – Cayley Hamilton Theorem (Problems only).

UNIT IV

9 Hrs.

Algebra: Permutations – Combinations – Fundamental Theorem of Arithmetic – Divisibility in Z (Problems only).

UNIT V

9 Hrs.

Group Theory: Groups -Subgroups -Normal Subgroups – Quotient Groups – Homomorphisms – Cyclic Groups – Permutation Groups – Cayley's Theorem – Class Equations - Sylow Theorem (Problems only).

Reference Books:

Sl.No.	Author	Book	Publisher	Year and Edition
1	Prasun Kumar Nayak	Linear Algebra Concepts and Applications	Books and Allied (P) Ltd, Kolkata	2016, 2 nd Edition
2	Dipak Chatterjee	Abstract Algebra	Prentice Hall of India, Delhi	2001, 1 st Edition
3	Robert G. Bartle, Donald R. Sherbert	Introduction to Real Analysis	Wiley India, New Delhi	2015, 4 th Edition
4	Vijay K Khanna, S.K. Bhambri	A Course in Abstract Algebra	Vikas Publishing House Pvt Ltd, New Delhi	2008, 3 rd Edition

Web Resources:

1. <https://nptel.ac.in/courses/111106051/>
2. <https://www.khanacademy.org/math/linear-algebra/vectors-and-spaces/modal/v/linear-subspaces>
3. <https://nptel.ac.in/courses/111106053/4>
4. https://www.researchgate.net/publication/237380490_problems_and_solutions_in_real_and_complex_analysis
5. https://www.academia.edu/7141249/Abstract_Algebra_Manual_Problems_and_solution_only_the_section_on_GROUPS_
6. <https://www.examrace.com/CSIR/CSIR-Sample-Old-Papers/Mathematical-Sciences/>

Pedagogy

PPT, Quiz, Group Discussion, Seminar

- Question Paper Setters confine to the above **text book** only

SEMESTER IV

CODE	COURSE TITLE
18MSPC414	FUNCTIONAL ANALYSIS

Category	CIA	ESE	L	T	P	Credit
Core	25	75	86	4	–	4

Preamble

- To understand the basic function spaces and to introduce the related branches of algebra and geometry and present an unified treatment to problems in different branches of analysis

Prerequisite

- Knowledge in Linear Algebra, Analysis, Ordinary Differential Equations

Course Outcomes

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

CO Number	CO Statement	Knowledge Level
CO1	Understand the basic and simple examples in Banach spaces	K2
CO2	Analyze the Determinants and spectrum of an operator in finite dimensional spectral theory	K3
CO3	Demonstrate the adjoint of an operator and examine the normal and unitary operators	K4
CO4	Apply the concept of Hilbert Spaces	K4
CO5	Evaluate the concepts of Banach algebra and solve its problems	K5

Mapping with Programme Outcomes

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	M	S	M	M	S
CO2	S	S	M	S	M
CO3	M	S	S	M	S
CO4	S	M	M	M	S
CO5	M	S	S	S	M

S – Strong; M – Medium; L – Low

Syllabus

UNIT I

18 Hrs.

Banach Spaces: The Definition and Some Examples – Continuous Linear Transformations – The Hahn – Banach Theorem – *The Natural Imbedding of N in N^{**}* – The Open Mapping Theorem.

UNIT II

19 Hrs.

Banach Spaces and Hilbert Spaces: **The Conjugate of an Operator** – Hilbert Spaces – The Definition and Some Simple Properties – **Orthogonal Complements** – *Orthonormal Sets*.

UNIT III

18 Hrs.

Hilbert Spaces: The Conjugate Space H^* – *The Adjoint of an Operator* – **Self-Adjoint Operators** – Normal and Unitary Operators – Projections.

UNIT IV

17 Hrs.

Finite-Dimensional Spectral Theory: Matrices – Determinants and the Spectrum of an Operator – *The Spectral Theorem*.

UNIT V

18 Hrs.

Banach Algebra: The Definition and Some Examples of Banach Algebras – Regular and Singular Elements – *Topological Divisors of Zero* – The Spectrum – The Formula for the Spectral Radius.

Note: *Italics* denotes Self Study Topics

Text Book

Sl.No.	Author Name	Title of the Book	Publisher	Year and Edition
1.	Simmons G.F.	Introduction to Topology and Modern Analysis	McGraw– Hill Book Company, London	2018, 29 th Reprint

Units	Chapter	Sections
I	9	46–50
II	9	51–54
	10	52–54
III	10	55–59
IV	11	60–63
V	12	64–68

Reference Books

S.No.	Author Name	Title of the Book	Publisher	Year and Edition
1.	Goffman C. and Pedrick.G.A	First course in Functional Analysis	Prentice Hall of India, New Delhi	1987, 2 nd Edition
2.	Bachman G and Narici L	Functional Analysis	Academic Press, New York	1996, 2 nd Edition
3.	Lustenik L.A and Sobolev V.J	Elements of Functional Analysis	Hindustan Publishing Corporation, New Delhi	1985, 3 rd Edition
4	Taylor A.E., David C.Lay	Introduction to Functional Analysis	Rajhans Publication, New York	1980, 2 nd Edition

Web Resources

1. <https://www.khanacademy.org/math/old-ap-calculus-ab/ab-derivatives-analyze-functions>
2. <https://users.math.msu.edu/users/jeffrey/920/920notes.pdf>
3. <https://www.khanacademy.org/math/old-differential-calculus/analyzing-func-with-calc-dc>
4. <https://ocw.mit.edu/courses/mathematics/18-102-introduction-to-functional-analysis-spring-2009/lecture-notes/>

Pedagogy

Lecture, PPT, Quiz, Group Discussion, Seminar

- Question Paper Setters Confine to the above text book only

SEMESTER IV

CODE	COURSE TITLE
18MSPC415	MATHEMATICAL METHODS

Category	CIA	ESE	L	T	P	Credit
Core	25	75	87	3	–	4

Preamble

- To develop the application of integral transforms in the analysis of some boundary value and initial value problems in Applied Mathematics

Prerequisite

- Knowledge in Transforms and Differential Equations

Course Outcomes

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

CO Number	CO Statement	Knowledge Level
CO1	Understand the concepts of Fourier Transforms and its applications	K2
CO2	Discuss the properties of Hankel transforms and Dirichlet Problems	K2
CO3	Analyze the types of integral equations	K3
CO4	Apply the concepts of initial Value and boundary Value problems	K4
CO5	Demonstrate the method of variations with fixed Boundaries	K5

Mapping with Programme Outcomes

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	M	M	S	L	S
CO2	M	S	S	S	M
CO3	S	M	M	S	S
CO4	M	S	S	M	S
CO5	S	S	M	S	S

S – Strong; M – Medium; L – Low

Syllabus

UNIT I

18 Hrs.

Fourier Transforms: Fourier Sine and Cosine Transforms – *Fourier Transform of Derivatives* – Fourier Transform of Simple Functions – Convolution Integral – Parseval's Theorem – Solution of PDE by Fourier Transform – Laplace Equation in Half Plane – In Infinite Strips – In Semi Infinite Strip – The Linear Diffusion Equation on a Semi Infinite Line – The Two Dimensional Diffusion Equation.

UNIT II

18 Hrs.

Hankel Transforms: Properties of Hankel Transform – *Hankel Inversion Theorem of Derivatives of Functions* – *The Parseval's Relation* – Relation between Fourier and Hankel Transforms – Axisymmetric Dirichlet Problem for a Half Space – Axisymmetric Dirichlet Problem for a Thick Plate.

UNIT III

18 Hrs.

Integral Equations with Separable Kernels: Type of Integral Equations – *Integral Fredholm Alternative* – Examples – Approximate Method – **Method of Successive Approximations:** Examples – *Volterra Integral Equations* – Examples.

UNIT IV

17 Hrs.

Application of Ordinary Differential Equation: *Initial Value Problems* – Boundary Value Problems – Singular Integral Equations – *Abel Integral Equation* – Examples.

UNIT V

19 Hrs.

The Method of Variations in Problems with Fixed Boundaries: Calculus of Variations – Variation and its Properties – *Euler's Equation* – Functionals of the Integral Form – Functional Dependent on Higher Order Derivatives – Functional Dependent on the Functions of Several Independent Variables – *Variational Problems in Parametric Form* – Applications.

Note: *Italics* denotes Self Study Topics.

Text Book

S.No.	Author Name	Title of the Book	Publisher	Year and Edition
1.	Sneddon I.N	The use of Integral Transforms Units(I & II)	McGraw-Hill Book Company, New York	1979, 1 st Edition
2.	Ram.P.Kanwal	Linear Integral Equation Theory and Technique Units(III & IV)	Academic Press. Inc(London).Ltd, New York	1971, 1 st Edition
3.	Elsgolts L.	Differential Equations and Calculus of Variations	Mir Publishers, Moscow	1973, 2 nd Edition

			(UnitV)		
Units		Chapter		Sections	
I		2		2.4 – 2.7, 2.9 – 2.10, 2.16 .1–(a),(b),(c),2.16.2–(a),(b)	
II		5		5.2–5.4,5.6–5.7, 5.10.1,5.10.2	
III		2		2.3–2.5	
		3		3.2–3.4	
IV		5		5.1–5.2	
		8		8.1–8.2	
V		6		6.1–6.7	

Reference Books

S.No.	Author Name	Title of the Book	Publisher	Year and Edition
1.	Mikhlin S.G.	Integral Equations	Pergamon Press, oxford, London	1957, 1 st Edition
2.	Zemanian A.H.,	Generalized Integral Transformation	Johnwiley& sons, Int., New York	1969, 1 st Edition
3.	Sneddon I.N.	Fourier Transforms	McGraw–Hill, New York	1951, 1 st Edition

Web Resources

1. <http://nptel.ac.in/courses/111107098/1>
2. <http://nptel.ac.in/courses/111107098/3>
3. <http://www.sciencedirect.com/book/9780080095547>
4. https://www.researchgate.net/publication/235643374_Handbook_of_Integral_Equations
5. <https://www.khanacademy.org/math/differential-equations/laplace-transform/convolution-integral>

Pedagogy

Lecture, PPT, Quiz, Group Discussion, Seminar

- Question Paper Setters Confine to the above text book only

SEMESTER IV

CODE	COURSE TITLE
18MSPC416	MECHANICS

Category	CIA	ESE	L	T	P	Credit
CORE	25	75	86	4	–	4

Preamble

- To develop the ability to determine Lagrangian & Hamiltonian functions of mechanical systems and to obtain the corresponding equations of motions

prerequisite

- Knowledge in constraints, transformations and characteristic functions

Course Outcomes

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

CO Number	CO Statement	Knowledge Level
CO1	Understand the concepts of D'Alembert's principle and Lagrange's equations	K2
CO2	Discuss the concepts of Lagrange's equations from Hamilton's principle and properties	K2
CO3	Analyze the canonical equations of Hamilton and conservation theorems	K3
CO4	Demonstrate the concept of Poisson brackets and other canonical invariants	K4
CO5	Evaluate the concepts of Hamilton–Jacobi equation	K5

Mapping with Programme Outcomes

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	S	S	M	M	S
CO2	S	S	M	S	M
CO3	S	S	M	M	S
CO4	S	S	S	M	S
CO5	S	M	M	S	M

S – Strong; M – Medium; L – Low

Syllabus

UNIT I

18 Hrs.

Survey of Elementary Principles: Constraints – Generalized Coordinates, Holonomic and Non - Holonomic Systems, Scleronomic and Rheonomic Systems. D'Alembert's Principle and Lagrange's Equations – **Velocity** – *Dependent Potentials and the Dissipation Function* – **Some Applications of the Lagrange Formulation.**

Unit II

18 Hrs.

Variation Principles and Lagrange's Equations: Hamilton's Principle – **Some Techniques of Calculus of Variations** – Derivation of Lagrange's Equations from Hamilton's Principle – *Extension of Hamilton's Principle to Non Holonomic Systems* – Conservation Theorems and Symmetry Properties.

Unit III

18Hrs.

Hamilton Equations of Motion: Legendre Transformations and the Hamilton Equations of Motion – Canonical Equations of Hamilton – Cyclic Coordinates and Conservation Theorems – Routh's Procedure – *Derivation of Hamilton's Equations from a Variational Principle* – The Principle of Least Action.

Unit IV

18 Hrs.

Canonical Transformations: The Equations of Canonical Transformation – Examples of Canonical Transformations – Poisson Brackets and Other Canonical Invariants – *Integral Invariants of Poincare*– Lagrange Brackets.

Unit V

18 Hrs.

Hamilton–Jacobi Theory: Hamilton–Jacobi Equations for Hamilton's Principal Function – **Harmonic Oscillator Problem** – Hamilton–Jacobi Equation for Hamilton's Characteristic Function – ***Separation of Variables in the Hamilton–Jacobi Equation.***

Note: *Italics* denotes Self Study Topics.

Text Book

Sl.No.	Author Name	Title of the Book	Publisher	Year and Edition
1.	Goldstein H	Classical Mechanics	Narosa Publishing house, New Delhi	Reprint 2018, 2 nd Edition

Units	Chapter	Sections
I	1	1.3 - 1.6
II	2	2.1 - 2.4, 2.6
III	8	8.1 - 8.3, 8.5, 8.6
IV	9	9.1, 9.2, 9.4, 9.5
V	10	10.1 - 10.4

Reference Books

Sl.No.	Author Name	Title of the Book	Publisher	Year and Edition
1.	Gantmacher F.	Analytic Mechanics	MIR Publishers, Moscow	1975, 2 nd Edition
2.	Gelfand I.M., Fomin S.V	Calculus of Variations	Dover Publications, United States	2000, 1 st Edition
3.	Loney S.L	An Elementary Treatise on Statics	Kalyani Publishers, New Delhi	Reprint 2012

Web Resources

1. <http://nptel.ac.in/courses/108107098/37>
2. <http://nptel.ac.in/courses/112108201/19>
3. <http://nptel.ac.in/courses/112108201/36>
4. <https://www.khanacademy.org/science/ap-physics-1/simple-harmonic-motion-ap/v/equation-for-simple-harmonic-oscillators>

Pedagogy

Lecture, PPT, Quiz, Group Discussion, Seminar

- Question Paper Setters confine to the above **text book** only.

SEMESTER IV

CODE	COURSE TITLE
18MSPS417	GRAPH THEORY

Category	CIA	ESE	L	T	P	Credit
Core	25	75	87	3	–	4

Preamble

- To introduce the concept of Graphs, connectivity, colorings, planner graphs and its applications in computing, social and natural sciences

Prerequisite

- Basic knowledge in mappings and set theory

Course Outcomes

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

CO Number	CO Statement	Knowledge Level
CO1	Understand the concepts of graphs and sub graphs	K2
CO2	Discuss the Euler tours and Hamilton cycles of the graph	K3
CO3	Discuss about matching and edge coloring of the graph	K3
CO4	Analyze the ideas of independent sets and vertex coloring	K4
CO5	Evaluate the concepts of planner graphs and directed graphs	K5

Mapping with Programme Outcomes

COS/POS	PO1	PO2	PO3	PO4	PO5
CO1	S	S	S	M	S
CO2	S	M	S	M	S
CO3	S	S	M	S	S
CO4	S	S	S	S	M
CO5	S	S	S	S	M

S – Strong; M – Medium; L – Low

Syllabus

UNIT I

18 Hrs.

Graphs, Subgraphs: Graphs and Simple Graphs – **Graph isomorphism** – The Incidence and Adjacency Matrices – Subgraphs – Vertex degrees – Paths and Connection – Cycles. **Trees:** Trees – Cut Edges and Bonds – Cut Vertices – Cayley's Formula.

UNIT II

18 Hrs.

Connectivity: Connectivity, Blocks. **Euler tours and Hamilton Cycles:** Euler Tours – Hamilton Cycles.

UNIT III

18 Hrs.

Matchings: Matchings – Matchings Coverings in Bipartite Graphs – *Perfect Matchings* – **Edge Colourings:** Edge Chromatic Number – Vizing's Theorem.

UNIT IV

18 Hrs.

Independent Sets, Cliques: Independent Sets – Ramsey's Theorem. **Vertex Colorings:** Chromatic Number – Brook's Theorem – Hajos Conjecture – **Chromatic Polynomials** – Girth and Chromatic Number.

UNIT V

18 Hrs.

Planar Graphs: **Plane and Planar Graphs** – Dual Graphs – Euler's Formula – Bridges – Kuratowski's Theorem (proof omitted) – The Five Color Theorem and the Four color Conjecture – NonHamiltonian Planar Graphs – **Directed Graphs:** Directed Graphs – *Directed Paths* – Directed Cycles.

Note: *Italics* denotes Self Study Topics

Text Book

Sl.No.	Author Name	Title of the Book	Publisher	Year and Edition
1.	Bondy J.A., Murty U.S.R	Graph Theory with applications	American Elsevier, Publishing Co., Inc., New York,	1976, 5 th Edition

Units	Chapter	Sections
I	1	1.1–1.6
	2	2.1–2.4
II	3	3.1–3.2
	4	4.1–4.2
III	5	5.1–5.3
	6	6.1–6.2
IV	7	7.1–7.2
	8	8.1–8.5
V	9	9.1–9.7
	10	10.1–10.3

Reference Books

Sl.No.	Author Name	Title of the Book	Publisher	Year and Edition
1.	Harary F.	Graph Theory	Addison –Wesley Publishing Company, United States	1969, 1 st Edition
2.	Murugan M.	Graph Theory and Algorithms	Muthali Publishing House, Anna Nagar, Chennai	2003, 1 st Edition.
3.	Narshingh Deo	Graph Theory with Applications to Engineering and Computer Science	Prentice–Hall and India Private Limited, Delhi	2003, 1 st Edition.

Web Resources:

- <https://nptel.ac.in/courses/106108054/>
- <https://nptel.ac.in/courses/106108054/16>
- https://www.khanacademy.org/computing/computer-science/algorithms/graph-representation/a/describing-graphs?utm=1701771789&content=330437864380&keyword=&device=m&gclid=CjwKCAiAqt7jBRACeiwAof2uKygjnvwDEEG0ceeGx5LJ4TGGAI9OUIVazre58UiwzPzGYQRSvj_8FBoCt68QAvD_BwE
- <http://www.freebookcentre.net/maths-books-download/Graph-Theory-Lecture-Notes-by-NPTEL.html>
- <http://www.freebookcentre.net/maths-books-download/Graph-Theory-and-Applications.html>

Pedagogy

Lecture, PPT, Quiz, Group Discussion, Seminar

- Question Paper Setters confine to the above text book only