

Semester – 3

PC 11

MT03C11

MULTIVARIATE CALCULUS AND INTEGRAL TRANSFORMS

Text 1: Tom APOSTOL, *Mathematical Analysis*, Second edition, Narosa Publishing House.

Text 2: WALTER RUDIN, *Principles of Mathematical Analysis*, Third edition – International Student Edition.

Module 1: The Weirstrass theorem, other forms of Fourier series, the Fourier integral theorem, the exponential form of the Fourier integral theorem, integral transforms and convolutions, the convolution theorem for Fourier transforms.

(Chapter 11 Sections 11.15 to 11.21 of Text 1)

(20 hours.)

Module 2: Multivariable Differential Calculus

The directional derivative, directional derivatives and continuity, the total derivative, the total derivative expressed in terms of partial derivatives, An application of complex- valued functions, the matrix of a linear function, the Jacobian matrix, the chain rate matrix form of the chain rule.

(Chapter 12 Sections. 12.1 to 12.10 of Text 1)

(20 hours.)

Module 3: Implicit functions and extremum problems, the mean value theorem for differentiable functions, a sufficient condition for differentiability, a sufficient condition for equality of mixed partial derivatives, functions with non-zero Jacobian determinant, the inverse function theorem (without proof), the implicit function theorem (without proof), extrema of real- valued functions of one variable, extrema of real- valued functions of several variables.

Chapter 12 Sections-. 12.11 to 12.13. of Text 1

Chapter 13 Sections-. 13.1 to 13.6 of Text 1

(25 hours.)

Module 4: Integration of Differential Forms

Integration, primitive mappings, partitions of unity, change of variables, differential forms, Stokes theorem (without proof)

Chapter 10 Sections. 10.1 to 10.25, 10.33 of Text 2

(25 hours.)

Question Paper Pattern

	Part A	Part B	Part C
	Short questions	Short essays	Long essays
Module I	2	2	1
Module II	2	2	2
Module III	2	2	2
Module IV	2	2	1
Total	8	8	6

References:-

1. Limaye Balmohan Vishnu, Multivariate Analysis, Springer.
2. Satish Shirali and Harikrishnan, Multivariable Analysis, Springer.

PC 12

MT03C12

FUNCTIONAL ANALYSIS

Text Book: Erwin Kreyszig, Introductory Functional Analysis with applications,
John Wiley and sons, New York

Module 1

Vector Space, normed space. Banach space, further properties of normed spaces, finite dimensional normed spaces and subspaces, compactness and finite dimension, linear Operators, bounded and continuous linear operators.

(Chapter 2 - Sections 2.1 – 2.7 of the text)

(20 hours)

Module 2

Linear functionals, linear operators and functionals on finite dimensional spaces, normed spaces of operators. dual space, inner product space. Hilbert space, further properties of inner product space.

(Chapter 2 - Section 2.8 to 2.10, chapter 3 - Sections 3.1 to 3.2 of the text) (20 hours)

Module 3

Orthogonal complements and direct sums, orthonormal sets and sequences, series related to orthonormal sequences and sets, total orthonormal sets and sequences. representation of functionals on Hilbert spaces, Hilbert adjoint operators, Self adjoint, unitary and normal operators.

(Chapter 3 - Sections 3.3 to 3.6, 3.8 to 3.10 of the text)

(25 hours)

Module 4

Zorn's lemma, Hahn- Banach theorem, Hahn- Banach theorem for complex vector spaces and normed spaces, adjoint operators, reflexive spaces, category theorem (Statement only), uniform boundedness theorem

(Chapter 4 – Sections 4.1 to 4.3, 4.5 to 4.7 of the text)

(25 hours)

Question Paper Pattern

	Part A	Part B	Part C
	Short questions	Short essays	Long essays
Module I	2	3	1
Module II	2	1	2
Module III	2	1	2
Module IV	2	3	1
Total	8	8	6

References

1. Simmons, G.F, Introduction to Topology and Modern Analysis, McGraw –Hill, New York 1963.
2. Siddiqi, A.H, Functional Analysis with Applications, Tata McGraw –Hill, New Delhi : 1989
3. Somasundaram. D, Functional Analysis, S.Viswanathan Pvt. Ltd, Madras, 1994
4. Vasistha, A.R and Sharma I.N, Functional analysis, Krishnan Prakasan Media (P) Ltd, Meerut: 1995-96
5. M. Thamban Nair, Functional Analysis, A First Course, Prentice – Hall of India Pvt. Ltd, . 2008
6. Walter Rudin, Functional Analysis, TMH Edition, 1974.

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MT03C13

DIFFERENTIAL GEOMETRY

Text Book: John A. Thorpe, Elementary Topics in Differential Geometry

Module 1: Graphs and level sets, vector fields, the tangent space, surfaces, vector fields on surfaces, orientation.

(Chapters 1 to 5 of the text) (15 hours)

Module 2: The Gauss map, geodesics, Parallel transport,
(Chapters 6, 7 & 8 of the text) (20 hours)

Module 3: The Weingarten map, curvature of plane curves, Arc length and line integrals
(Chapters 9, 10 & 11 of the text) (25 hours)

Module 4: Curvature of surfaces, Parametrized surfaces, local equivalence of surfaces and Parametrized surfaces.
(Chapters 12, 14 & 15 of the text). (30 hours)

Question paper pattern

	Part A Short questions	Part B Short essays	Part C Long essays
Module I	2	2	1
Module II	2	2	1
Module III	2	2	2
Module IV	2	2	2
Total	8	8	6

References:-

1. Serge Lang, Differential Manifolds
2. I.M. Siger, J.A Thorpe, Lecture notes on Elementary topology and Geometry, Springer – Verlag, 1967.
3. S. Sternberg, Lectures on Differential Geometry, Prentice-Hall, 1964.
4. M. DoCarmo, Differential Geometry of curves and surfaces.
5. Goursat, Mathematical Analysis, Vol – 1(last two chapters)

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MT03C14

NUMBER THEORY AND CRYPTOGRAPHY

Text Book: Neal Koblitz, A Course in Number Theory and Cryptography, 2nd edition, Springer Verlag.

Module 1: Some topics in Elementary Number Theory:-Time estimates for doing arithmetic, divisibility and the Euclidean algorithm, congruences, Some applications to factoring.

(Chapter – I Sections 1, 2, 3 & 4 of the text) (28 hours)

Module 2: Finite Fields and Quadratic Residues:-Finite fields, quadratic residues and reciprocity

(Chapter – II Sections 1 & 2 of the text) (14 hours)

Module 3: Public Key: - The idea of public key cryptography, **RSA**, Discrete log.

(Chapter – IV Sections 1, 2 & 3 of the text) (25 hours)

Module 4: Primality and Factoring: - Pseudo primes, The rho method, Fermat factorization and factor bases, the quadratic sieve method.

(chapter – V Sections 1, 2, 3 & 5 of the text) (23 hours)

Question Paper Pattern

	Part A Short questions	Part B Short essays	Part C Long essays
Module I	3	3	2
Module II	1	1	1
Module III	2	2	2
Module IV	2	2	1
Total	8	8	6

Reference Books:

1. **Niven, H.S. Zuckerman and H.L. Montgomery**, *An introduction to the theory of numbers*, John Wiley, 5th Edition.
2. **Ireland and Rosen**, *A Classical Introduction to Modern Number Theory*. Springer, 2nd edition, 1990.
3. **David Burton**, *Elementary Number Theory and its applications*, Mc Graw-Hill Education (India) Pvt. Ltd, 2006.
4. **Alfred J. Menezes, Paul C. van Oorschot and Scott A. Vanstone**, *Handbook of Applied*

Cryptography, CRC Press, 1996

5. **Douglas R. Stinson**, *Cryptography Theory and Practice*, Chapman & Hall, 2nd edition

6. **Victor Shoup**, *A computation Introduction to Number Theory and Algebra*, Cambridge University Press, 2005

7. **William Stallings**, *Cryptography and Network Security Principles and Practice*, Third edition, Prentice-hall, India.

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MT03C15

OPTIMIZATION TECHNIQUES

Text – 1 K.V. Mital and C. Mohan, Optimization Methods in Operation Research and Systems Analysis, 3rd edition.

Text -2- Ravindran, Philips and Solberg. Operations Research Principle and Practice, 2nd edition, John Wiley and Sons.

Module I: INTEGER PROGRAMMING

I.L.P in two dimensional space – General I.L.P. and M.I.L.P problems – cutting planes – remarks on cutting plane methods – branch and bound method – examples – general description – the 0 – 1 variable.

(Chapter 6; sections: 6.1 – 6.10 of text – 1)

(20 hours)

Module II: SENSITIVITY ANALYSIS; FLOW AND POTENTIALS IN NETWORKS

- Introduction – changes in b_i – changes in c_j – Changes in a_{ij} – introduction of new variables – introduction of new constraints – deletion of variables - deletion of constraints –Goal programming.

Graphs- definitions and notation – minimum path problem – spanning tree of minimum length – problem of minimum potential difference – scheduling of sequential activities – maximum flow problem – duality in the maximum flow problem – generalized problem of maximum flow.

(Chapter – 5 & 7 Sections 5.1 to 5.9 & 7.1 to 7.9, 7.15 of text - 1)

(25 hours)

Module III: THEORY OF GAMES

Matrix (or rectangular) games – problem of games – minimax theorem, saddle point – strategies and pay off – theorems of matrix games – graphical solution – notion of dominance – rectangular game as an L.P. problem.

(Chapter 12; Sections: 12.1 – 12.9 of text – 1)

(20 hours)

Module IV: NON- LINEAR PROGRAMMING

- Basic concepts – Taylor’s series expansion – Fibonacci Search - golden section search – Hooke and Jeeves search algorithm – gradient projection search – Lagrange multipliers – equality constraint optimization, constrained derivatives – project gradient methods with equality constraints – non-linear optimization: Kuhn-Tucker conditions – complimentary Pivot algorithms.

(Chapter 8; Sections: 8.1 – 8.14 of text – 2)

(25 hours)

Question Paper Pattern

	Part A Short questions	Part B Short essays	Part C Long essays
Module I	2	2	1
Module II	2	2	2
Module III	2	2	1
Module IV	2	2	2
Total	8	8	6

Reference:-

1. S.S. Rao, Optimization Theory and Applications, 2nd edition, New Age International Pvt.
2. J.K. Sharma, Operations Research: Theory and Applications, Third edition, Macmillan India Ltd.
3. Hamdy A. Thaha, Operations Research – An Introduction, 6th edition, Prentice Hall of India Pvt. Ltd.