

M.Sc. (Mathematics) Semester-II (Jan 2027-June 2027)

ADVANCED ABSTRACT ALGEBRA(II)

Detailed Syllabus:

Unit No.	Topics	No. of Lectures	CO No.
I	Modules-Cyclic modules. Simple modules. Semi-simple modules. Schuler's Lemma. Free modules. Noetherian and artinian modules and rings-Hilbert basis theorem. Wedderburn Artin theorem. Uniform modules, primary modules, and Noether-Lasker theorem.	17	1
II	Linear Transformations – Algebra of linear transformation, characteristic roots, matrices and linear transformations.	13	2
III	Canonical Forms - Similarity of linear transformations. Invariant subspaces. Reduction to triangular forms. Nilpotent transformations. Index of nilpotency. Invariants of a nilpotent transformation. The primary decomposition theorem. Jordan blocks and Jordan forms.	17	3
IV	Smith normal form over a principal ideal domain and rank. Fundamental structure theorem for finitely generated modules over a Principal ideal domain and its applications to finitely generated abelian groups.	16	4
V	Rational canonical form. Generalized Jordan form over any field.	12	5

Books Recommended:

1. P. B. Bhattacharya, S. K. Jain, S. R. Nagpaul, *Basic Abstract Algebra*, Cambridge University press, 1994
2. I. N. Herstein, *Topics in Algebra*, Wiley Eastern Ltd., 1999
3. Quazi Zameeruddin, Surjeet Singh, *Modern Algebra*, Vikas Publishing House Pvt. Ltd., 1990

Reference Books:

1. M. Artin, *Algebra*, Prentice-HallofIndia, 1991.
2. P. M. Cohn, *Algebra*, Vols.- I, II & III, John Wiley & Sons, 1982, 1989, 1991.
3. N. Jacobson, *Basic Algebra*, Vols.I, W. H. Freeman, 1980
4. S. Lang, *Algebra*, 3rd edition, Addison-Wesley, 1993.
5. I.S. Luther, I.B.S. Passi, *Algebra*, Vol.I-Groups, Vol.II-Rings, Narosa Publishing House (Vol.I- 1996, Vol. II-1999)
6. D. S. Malik, J.N. Mordeson, M. K. Sen, *Fundamentals of Abstract Algebra*, McGraw-Hill, International Edition, 1997.
7. Vivek Sahai and Vikas Bist, *Algebra*, Narosa Publishing House, 1999.
8. I. Stewart, *Galois theory*, Chapman and Hall, 1989.
9. J. P. Escofier, *Galois theory*, GTM Vol.204, Springer, 2001.
10. J.B. Fraleigh, *A first course in Algebra*, Narosa, 1982.

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M.Sc. (Mathematics) Semester-II (Jan 2027-June 2027)
REAL ANALYSIS (II)
Detailed Syllabus:

Unit No.	Topics	No. of Lectures	CO No.
I	Definition and existence of Riemann-Stieltjes integral, Properties of the Integral, integration and differentiation, the fundamental theorem of Calculus, integration of vector-valued functions, Uniform convergence and Riemann-Stieltjes integration, Rectifiable curves.	12	1
II	Lebesgue outer measure. Measurable sets. Regularity. Measurable functions. Borel and Lebesgue measurability. Non-measurable sets. Integration of Nonnegative functions. The General integral. Integration of Series.	18	2
III	Measures and outer measures, Extension of a measure. Uniqueness of Extension. Completion of a measure. Measure spaces. Integration with respect to a measure. Riemann and Lebesgue Integrals.	15	3
IV	The Four derivatives. Lebesgue Differentiation Theorem. Differentiation and Integration. Functions of Bounded variation.	14	4
V	The L_p -spaces. Convex functions. Jensen's inequality. Holder and Minkowski inequalities. Completeness of L_p , Convergence in Measure, Almost uniform convergence.	16	5

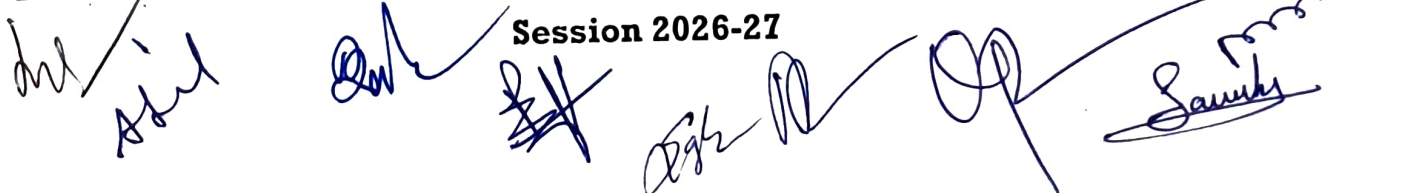
Books Recommended:

1. Walter Rudin, *Principle of Mathematical Analysis*, (3rd Edition) McGraw-Hill, Kogakusha, 1976.
2. H. L. Roydon, *Real Analysis*, Macmillan Pub. Co. Inc. (4th Edition), New York. 1962.

Reference Books:

1. T.M. Apostol, *Mathematical Analysis*, Narosa Publishing House, New Delhi, 1985.
2. G. Klambauer, *Mathematical Analysis*, Marcel Dekker, Inc. New York, 1975.
3. A.J. White, *Real Analysis: an introduction*, Addison-Wesley Publishing Co., Inc., 1968.
4. G. de Barra, *Measure Theory and Integration*, Wiley Eastern Limited, 1981.
5. E. Hewitt and K. Stromberg, *Real and Abstract Analysis*, Berlin, Springer, 1969.
6. P.K. Jain and V.P. Gupta, *Lebesgue Measure and Integration*, New Age International Pvt. Ltd., New Delhi, 1986.
7. I.P. Natanson, *Theory of Functions of a Real Variable*. Vol.1, Frederick Ungar Pub R. L. Wheeden and A. Zygmund, *Measure and Integral: An Introduction to Real Analysis*, Marcel Dekker Inc. 1977.
8. J.H. Williamson, *Lebesgue Integration*, Holt Rinehart and Winston, Inc. New York. 1962.
9. A. Friedman, *Foundations of Modern Analysis*, Holt, Rinehart and Winston, Inc., New York, 1970.
10. P.R. Halmos, *Measure Theory*, Van Nostrand, Princeton, 1950.
11. T.G. Hawkins, *Lebesgue's Theory of Integration: Its Origins and Development*, Chelsea, New York, 1979.
12. K.R. Parthasarathy, *Introduction to Probability and Measure*, Macmillan Company of

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M.Sc. (Mathematics) Semester-II (Jan 2027-June 2027)
GENERAL AND ALGEBRAIC TOPOLOGY
Detailed Syllabus:

Unit No.	Topics	No. of Lectures	CO No.
I	Tychonoff product topology in terms of standard sub-base and its characterizations. Projection maps. Separation axioms and product spaces.	14	1
II	Product spaces. Connectedness and product spaces. Compactness and product spaces (Tychonoff's theorem). Countability and product spaces.	18	2
III	Embedding and metrization. Embedding lemma and Tychonoff embedding. The Urysohn metrization theorem. Metrization theorems and Paracompactness-Local finiteness. The Nagata-Smirnov metrization theorem. Paracompactness. The Smirnov Metrization theorem.	13	3
IV	Nets and filter. Topology and convergence of nets. Hausdorffness and nets. Compactness and nets. Filters and their convergence. Canonical way of converting nets to filters and vice-versa. Ultra-Filters and Compactness.	15	4
V	The fundamental group and coverings spaces-Homotopy of paths. The fundamental group. Covering spaces. The fundamental group of the circle and the fundamental theorem of algebra.	15	5

Books Recommended:

1. James R. Munkres, *Topology*, (2nd Edition) Pearson Education, New Delhi, 2021.
2. K. D. Joshi, *Introduction to General Topology* (3rd Edition), New Age International Pvt. Ltd., India, 2022.

Reference Books:

1. J. Duqundji, *Topology*, Allyn and Bacon, Prentice Hall of India Pvt. Ltd., India, 1966.
2. G. F. Simmons, *Introduction to Topology and Modern Analysis*, McGraw Hill Education, 2017.
3. J. Hocking, G. Young *Topology*, New Edition, Dover Publications Inc, 1988.
4. J. L. Kelley, *General Topology*, Reprint Edition, Dover Publications Inc., 2017.
5. L. Steen, J. A. Jr. Seebach, *Counter examples in Topology*, Second Edition, Springer, 1978.
6. W. Thron, *Topologically Structures*, Holt, Rinehart and Winston, New York, 1966.
7. N. Bourbaki, *General Topology*, Springer, 1998.
8. R. Engelking, *General Topology*, Heldermann Verlag, 1989.
9. W. J. Pervin, *Foundations of General Topology*, Academic Press Inc. 2014.
10. E. H. Spanier, *Algebraic Topology*, McGraw-Hill, New York, 1966.
11. S. Willard, *General Topology*, Dover, 2004.

M.Sc. (Mathematics) Semester-II (Jan 2027-June 2027)
ADVANCED COMPLEX ANALYSIS(II)
Detailed Syllabus:

Unit No.	Topics	No. of Lectures	CO No.
I	Weierstrass' factorization theorem. Gamma function and its properties. Riemann Zeta function. Riemann's functional equation. Runge's theorem. Mittag-Leffler's theorem.	18	1
II	Analytic Continuation. Uniqueness of direct analytic continuation. Uniqueness of analytic continuation along a curve. Power series method of analytic continuation Schwarz Reflection Principle. Monodromy theorem and its consequences.	13	2
III	Harmonic functions on a disk. Harnack' sin equality and theorem. Dirichlet Problem. Green's function.	16	3
IV	Canonical products. Jensen's formula. Poisson-Jensen formula. Hadamard's three circles theorem. Order of an entire function. Exponent of Convergence. Borel's theorem. Hadamard's factorization theorem.	13	4
V	The range of an analytic function. Bloch's theorem. The Little Picard theorem. Schottky's theorem. Montel Caratheodory and the Great picard theorem. Univalent functions. Bieberbach's conjecture (Statement only) and the $1/4$ -theorem.	15	5

Books Recommended:

1. L. V. Ahlfors, *Complex Analysis*, McGraw-Hill, 1979.
2. J. B. Conway, *Functions of one Complex variable*, Narosa Publishing House, 1980.

Reference Books:

1. H. A. Priestly, *Introduction to Complex Analysis*, Clarendon Press, Oxford, 1990.
2. D. Sarason, *Complex Function Theory*, (2nd Edition) American Mathematical Society, 2007.
3. Liang-shin Hahn & Bernard Epstein, *Classical Complex Analysis*, Jones and Bartlett Publishers International, London, 1996.
4. S. Lang, *Complex Analysis*, Addison Wesley, 1977.
5. Mark J. Ablowitz and A.S. Fokas, *Complex Variables: Introduction and Applications*, Cambridge University press, South Asian Edition, 1998.
6. E. Hille, *Analytic Function Theory* (2Vols.) Gonn & Co., 1959.
7. W.H.J. Fuchs, *Topics in the Theory of Functions of one Complex Variable*, D. Van Nostrand Co., 1967.
8. C. Caratheodory, *Theory of Functions* (2Vols.) Chelsea Publishing Company, 1964.
9. M. Heins, *Complex Function Theory*, Academic Press, 1968.
10. E. C Titchmarsh, *The Theory of Functions*, Oxford University Press, London, 1939.
11. W. A. Veech, *A Second Course in Complex Analysis*, W.A. Benjamin, 1967.
12. S. Ponnusamy, *Foundations of Complex Analysis*, Narosa Publishing House, 19
13. Walter Rudin, *Real and Complex Analysis*, Mc Graw-Hill Book Co., 1966.
14. S. Saks and A. Zygmund, *Analytic Functions*, Monografic Matematyczne, 1952

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M.Sc. (Mathematics) Semester-II (Jan 2027-June 2027)
ADVANCED DISCRETE MATHEMATICS (II)
Detailed Syllabus:

Unit No.	Topics	No. of Lectures	CO No.
I	Graph Theory-Definition of (Undirected) Graphs, Paths, Circuits, Cycles, & Sub graphs. Induced Sub graphs. Degree of a vertex. Connectivity. Planar Graphs and their properties. Trees. Euler's Formula for connected planar Graphs. Complete & Complete Bipartite Graphs. Kuratowski's Theorem (statement only) and its use.	12	1
II	Spanning Trees, Cut-sets, Fundamental Cut-sets, and Cycle. Minimal Spanning Trees and Kruskal's Algorithm. Matrix Representations of Graphs. Euler's Theorem on the Existence of Eulerian Paths and Circuits.	12	2
III	Graphs. In degree and Out degree of a Vertex. Weighted undirected Graphs. Dijkstra's Algorithm, strong Connectivity & Warshall's Algorithm. Directed Trees. Search trees. Tree Traversals.	12	3
IV	Introductory Computability Theory-Finite State Machines and their Transition Table Diagrams. Equivalence of finite State Machines. Reduced Machines. Homomorphism.	12	4
V	Finite Automata. Acceptors. Non-deterministic Finite Automata and equivalence of its power to that of Deterministic Finite Automata. Moore and mealy Machines. Turing Machine and Partial Recursive Functions. The Pumping Lemma. Kleene's Theorem.	12	5

Books Recommended:

1. C.I. Ima, *Elements of Discrete Mathematics*, McGraw Hill Education India, 1986
2. J.P. Tremblay & R. Manohar, *Discrete Mathematical Structures with Applications to Computer Science*, McGraw-Hill Book Co., 1997.

Reference Books:

1. J.L. Gersting, *Mathematical Structures for Computer Science*, W.H. Freeman and Company, 2003.
2. Seymour Lipschutz, *Finite Mathematics*, McGraw-Hill Book Company, 1983.
3. S. Witala, *Discrete Mathematics- A Unified Approach*, McGraw-Hill BookCo., 1987
4. J.E. Hopcroft and J. D Ullman, *Introduction to Automata Theory, Languages & Computation*, Narosa Publishing House, 2001
5. N. Deo, *Graph Theory with Application to Engineering and Computer Sciences*, Prentice Hall of India, 1979
6. Z. L. P. Mishra and N. Chandrashekar, *Theory of Computer Science*, Prentice Hall of India, 2002