

BSMS-Mathematics

Semester IV						
S.No	Course Code	Course Name	L	T	P	C
1	MA 220	<u>Real Analysis</u>	2	1	0	6
2	MA 221	<u>Group Theory</u>	2	1	0	6
3	MA 202	<u>Advanced Linear Algebra</u>	2	1	0	6
4		Program Elective-I				6
5		Program Elective-II				6
		Total Credits				30

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1	Title of the course (L-T-P-C)	Real Analysis (2-1-0-6)
2	Pre-requisite courses(s)	Calculus and Linear Algebra or Instructor's consent
3	Course content	<p>Review of basic concepts of real numbers: Archimedean property, Completeness.</p> <p>Metric spaces, compactness, connectedness, (with emphasis on \mathbb{R}^n). Continuity and uniform continuity.</p> <p>Monotonic functions, Functions of bounded variation; Absolutely continuous functions.</p> <p>Derivatives of functions and Taylor's theorem. Riemann integral and its properties, characterization of Riemann integrable functions. Improper integrals, Gamma functions.</p> <p>Sequences and series of functions, uniform convergence and its relation to continuity, differentiation and integration.</p> <p>Fourier series, pointwise convergence, Fejer's theorem, Weierstrass approximation theorem.</p>
4	Texts/References	<p>W. Rudin, Principles of Mathematical Analysis, 3rd Edition, McGraw-Hill, 1983</p> <p>T. Apostol, Mathematical Analysis, 2nd Edition, Narosa, 2002.</p> <p>S. Abbott, Understanding Analysis, 2nd Edition, Springer Verlag New York, 2015</p> <p>S. R. Ghorpade and B. V. Limaye, A course in Calculus and Real Analysis, 2nd Edition, Springer international publishing, 2018</p>

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1	Title of the course (L-T-P-C)	Group Theory (2-1-0-6)
2	Pre-requisite courses(s)	NIL
3	Course content	<p>Symmetries of plane figures, translations, rotations and reflections in the Euclidean plane, composing symmetries, inverse of a symmetry, Cayley tables</p> <p>Definition of group, basic properties, examples, Homomorphisms, Isomorphisms, subgroups, subgroup generated by a set, Cyclic groups, subgroups of cyclic groups,</p> <p>Review of Equivalence relations, Cosets, Lagrange's theorem, Normal subgroup, Quotient Group, Examples, Isomorphism theorems, Automorphisms</p> <p>Group actions, conjugacy classes, orbits and stabilizers, faithful and transitive actions, centralizer, normalizer, Cayley's theorem.</p> <p>Conjugation, Class equation, Cauchy's theorem, Applications to p-groups, Conjugacy in S_n Sylow theorems, Simplicity of A_n and other applications</p> <p>Direct products, Structure of Finite abelian groups</p> <p>Semi-Direct products, Classification of groups of small order</p> <p>Normal series, Composition series, Solvable groups, Jordan- Holder theorem, Insolubility of S_5</p> <p>Lower and upper central series, Nilpotent groups, Basic commutator identities, Decomposition theorem of finite nilpotent groups (if time permits)</p> <p>Three dimensional symmetries: platonic solids and their dual, symmetries of a tetrahedron, symmetries of a cube and octahedron, symmetries of icosahedron and dodecahedron, classification of finite subgroups of $SO(3)$ (if time permits).</p>
4	Texts/References	<p>M. Artin, Algebra, Prentice Hall of India, 1994.</p> <p>D. S. Dummit and R. M. Foote, Abstract Algebra, 2nd Edition, John Wiley, 2002.</p> <p>J. A. Gallian, Contemporary Abstract Algebra, 4th Edition, Narosa, 1999.</p> <p>I.N. Herstein, Topics in Algebra, Wiley, 2nd Edition, 1975.</p> <p>K. D. Joshi, Foundations of Discrete Mathematics, Wiley Eastern, 1989.S.</p> <p>Lang, Undergraduate Algebra, 2nd Edition, Springer, 2001. S. Lang, Algebra, 3rd Edition, Springer (India), 2004.</p>

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1	Title of the course (L-T-P-C)	Advanced Linear Algebra (2-1-0-6)
2	Pre-requisite courses(s)	MA 102 or Instructor's consent
3	Course content	<p>Review of Linear algebra from MA 102:</p> <p>Systems of linear equations, matrices, rank, Gaussian elimination, Linear transformations, representation of linear transformations by matrices, rank-nullity theorem, duality and transpose, Determinants, Laplace expansions, cofactors, adjoint, Cramer's Rule.</p> <p>Abstract vector spaces over fields, subspaces, bases and dimension.</p> <p>Eigenvalues and eigenvectors, characteristic polynomials, minimal polynomials, CayleyHamilton Theorem, triangulation, diagonalization, rational canonical form, Jordan canonical form.</p> <p>Inner product spaces, Gram-Schmidt orthonormalization, orthogonal projections, linear functionals and adjoints, Hermitian, self-adjoint, unitary and normal operators, Spectral Theorem for normal operators</p> <p>Bilinear forms, symmetric and skew-symmetric bilinear forms, real quadratic forms, Sylvester's law of inertia, positive definiteness.</p>
4	Texts/References	<p>H. Anton, Elementary linear algebra and applications, 8th edition, John Wiley, 1995.</p> <p>M. Artin, Algebra, Prentice Hall of India, 1994.</p> <p>S. Kumaresan, Linear algebra - A Geometric Approach, Prentice Hall of India, 2000.</p> <p>K. Hoffman and R. Kunze, Linear Algebra, Pearson Education (India), 2003.</p> <p>S. Lang, Linear Algebra, Undergraduate Texts in Mathematics, Springer-Verlag, New York, 1989.</p> <p>G. Strang, Linear algebra and its applications, 4th edition, Thomson, 2006.</p>