Semester VI						
SL. No	**Course code**	**Course name**	**L**	**T**	**P**	**C**
1	CS 202	Automata Theory	3	1	0	8
2	MA 221	Group Theory	2	1	0	6
3	MA 320	Introduction to Mathematical Finance 2	3	0	0	6
4	CS 315	CSE Elective /Mathematics Elective/R&D project				6
5	HSS Elective II		3	0	0	6
Total credits						**32**

1	**Title of the course (L-T-P-C)**	**Automata Theory (3-1-0-8)**
2	**Pre-requisite courses(s)**	**Exposure to Discrete Structures**
3	**Course content**	Finite state machines (DFA/NFA/epsilon NFAs), regular expressions. Properties of regular languages. My hill-Nerode Theorem. Non-regularity. Push down automata. Properties of context-free languages. Turing machines:Turing hypothesis, Turing computability, Nondeterministic, multi tape and other versions of Turing machines. Church`s thesis, recursively enumerable sets and Turing computability. Universal Turing machines. Unsolvability, The halting problem, partial solvability, Turing enumerability, acceptability and decidability, unsolvable problems about Turing Machines. Post`s correspondence problem.
4	**Texts/References**	**1.** Introduction to Automata Theory, Languages and Computation, by John. E. Hopcroft, Rajeev Motwani, J. D. Ullman, 3rd edition. Pearson. 2013. **2.** Elements of the Theory of Computation, by H.R. Lewis and C. H. Papadimitrou, 2nd Edition. Prentice Hall Inc, 1998.

1	**Title of the course (L-T-P-C)**	**Group Theory (2-1-0-6)**
2	**Pre-requisite courses(s)**	**Nill**
3	**Course content**	Symmetries of plane figures, translations, rotations and reflections in the Euclidean plane, composing symmetries, inverse of a symmetry, Cayley tables Definition of group, basic properties, examples, Homomorphisms, Isomorphisms, subgroups, subgroup generated by a set, Cyclic groups, subgroups of cyclic groups, Review of Equivalence relations, Cosets, Lagrange's theorem, Normal subgroup, Quotient Group, Examples, Isomorphism theorems, Automorphisms Group actions, conjugacy classes, orbits and stabilizers, faithful and transitive actions, centralizer, normalizer, Cayley's theorem. Conjugation, Class equation, Cauchy's theorem, Applications to p-groups, Conjugacy in S 5 Sylow theorems, Simplicity of A_n and other applications Direct products, Structure of Finite abelian groups Semi-Direct products, Classification of groups of small order Normal series, Composition series, Solvable groups, Jordan- Holder theorem, Insolvability of S_5 Lower and upper central series, Nilpotent groups, Basic commutator identities, Decomposition theorem of finite nilpotent groups (if time permits) 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).
4	**Texts/References**	• M. Artin, Algebra, Prentice Hall of India, 1994. • D. S. Dummit and R. M. Foote, Abstract Algebra, 2nd Edition, John Wiley,2002. • J. A. Gallian, Contemporary Abstract Algebra, 4th Edition, Narosa, 1999. • I.N. Herstein, Topics in Algebra, Wiley, 2nd Edition, 1975. • K. D. Joshi, Foundations of Discrete Mathematics, Wiley Eastern, 1989. • S.Lang, Undergraduate Algebra, 2nd Edition, Springer, 2001.S.Lang, Algebra, 3rd Edition, Springer (India), 2004.

1	**Title of the course (L-T-P-C)**	**Introduction to Mathematical Finance 2 (3-0-0-6)**
2	**Pre-requisite courses(s)**	Calculus, Linear Algebra, Probability, Statistics, Stochastic Models or Instructor's consent
3	**Course content**	Basics, Risk Assessment and Diversification Single period utility analysis, Mean-variance portfolio analysis, Graphical Analysis of portfolios and efficient portfolios, Efficient portfolios with and without risk-free assets, Single, two and multi-index models Risk management: Concept of VaR, measuring VaR and estimating volatilities via simple moving averages and GARCH, Var in Black-Scholes, Average VaR in Black- Scholes Capital Asset Pricing Model and its extensions, Continuous- time asset pricing, Arbitragepricing
4	**Texts/References**	**1.** J. C. Francis and D. Kim, Modern Portfolio Theory: Foundations, Analysis, and New Developments, John Wiley and Sons, 2013 **2.** M. J. Capinski and E. Kopp, Portfolio Theory and Risk Management, Cambridge University Press, 2014 **3.** J.Cvitanic and F. Zapatero, Introduction to the Economics and Mathematics of Financial Markets, MIT press, 2004 **4.** E. J. Elton, M. J. Gruber, S. J. Brown, W. N. Goetzmann, Modern Portfolio Theory and Investment Analysis, 9th Edition, John Wiley and Sons, 2014