Semester V						
Sr No	**Course code**	**Course name**	**L**	**T**	**P**	**C**
1	MA407T	Stochastic Models	3	0	0	6
2	MA404T	Introduction to Mathematical Finance I	3	0	0	6
3	-	CSE Elective I				6
4	-	Mathematics Elective I				6
5	-	HSS Elective I	3	0	0	6
6	CS407T	Mathematics for Data Science	3	0	0	6
Total credits						36

1	**Title of the course (L-T-P-C)**	**Stochastic Models (3-0-0-6)**
2	**Pre-requisite courses(s)**	**Probability or Instructor's Consent**
3	**Course content**	Definition and classification of general stochastic processes. Markov Chains: definition, transition probability matrices, classification of states, limiting properties. Markov Chains with Discrete State Space: Poisson process, birth and death processes. Renewal Process: renewal equation, mean renewal time, stopping time. Applications to queuing models. Markov Process with Continuous State Space: Introduction to Brownian motion.
4	**Texts/References**	**1.** Bhat, U. N. and Miller, G.K., Elements of Applied Stochastic Processes, 3rd edition, John Wiley & Sons, New York, 2002. **2.** Kulkarni, V.G., Modeling and Analysis of Stochastic Systems, 3rd Edition, Chapman and Hall/CRC, Boca Raton, 2017 **3.** J. Medhi, Stochastic Models in Queuing Theory, Academic Press, 1991. **4.** R. Nelson, Probability, Stochastic Processes, and Queuing Theory: The Mathematics of Computer Performance Modelling, SpringerVerlag, New York, 1995 **5.** Sheldon M Ross: Stochastic Processes, John Wiley and Sons, 1996. **6.** S Karlin and H M Taylor: A First Course in Stochastic Processes, Academic Press, 1975.

1	**Title of the course (L-T-P-C)**	**Introduction to Mathematical Finance I (3-0-0-6)**
2	**Pre-requisite courses(s)**	**Calculus, Linear Algebra and Probability. Instructor's permission may be sought to enrol for the course otherwise.**
3	**Course content**	Introduction to financial market and financial instruments: bonds, annuities, equities, contracts, swaps, and options Risky and risk-free assets, time value of money, binomial model for risky assets and corresponding properties Portfolio management, Capital Asset Pricing Model Options, futures and derivative, European options, Elementary stochastic calculus and Black Scholes Merton model and its numerical solution
4	**Texts/References**	**1.** John Hull, Options, Futures and Derivatives, 10th Edition (Indian), Pearson, US, 2018 **2.** Marek Capiński, Tomasz Zastawniak, Mathematics for Finance: An Introduction to Financial Engineering, 2nd Edition, Springer Verlag, London, 2011 **3.** Paul Wilmott, Paul Wilmott Introduces Quantitative Finance, 2nd Edition, John Wiler & Sons, US, 2013 **4.** Mark H. A. Davis, Mathematical Finance: A Very Short Introduction, Oxford University Press, UK, 2019

1	**Title of the course (L-T-P-C)**	**Mathematics for Data Science (3-0-0-6)**
2	**Pre-requisite courses(s)**	**Exposure to basic concepts in calculus and linear algebra**
3	**Course content**	Introduction to Data science and Motivation for the course. Review of calculus, naTve set theory, notion of limits, ordering, series, and its convergence. Introduction to Linear Algebra in Data science, notion of vector space, dimension and rank, algorithms for solving linear equations, importance of norms and notion of convergence, matrix decompositions and its use. **Importance of optimization in data science:** Birds view of Linear Regression, Multivariate Regression, Logistic Regression etc. **Convex Optimization:** Convex sets, convex functions, duality theory, different types of optimization problems, Introduction to linear program. **Algorithms:** Central of gravity method, Gradient descent methods, Nestrov acceleration, mirror descent/Nestrov dual averaging, stochastic gradient methods, Rmsprop, SIGNSGD, ADAMalgorithm etc. **Non-convex optimization:** Demonstration of convex methods on non-Convex problems; merits and disadvantages.
4	**Texts/References**	C. Bishop, "Pattern Recognition and Machine Learning,"Springer, 2006. • Cambridge university press, 2018 (reprint). for Machine Learning," Now publisher, 2017.