# Mathematics and Computing

| Semester V | | | | | | |
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| **SL. 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** | HS201T | Economics | 3 | 0 | 0 | 6 |
| **4** | CS403T | Graph Theory and Combinatorics/Introduction to Graph Theory | 3 | 0 | 0 | 6 |
| **5** | | Elective | | | | 6 |
| **6** | | Elective | | | | 6 |
| **Total credits** | | | | | | **36** |

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| 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.<br>**2.** Kulkarni, V.G., Modeling and Analysis of Stochastic Systems, 3rd Edition, Chapman and Hall/CRC, Boca Raton, 2017<br>**3.** J. Medhi, Stochastic Models in Queuing Theory, Academic Press, 1991.<br>**4.** R. Nelson, Probability, Stochastic Processes, and Queuing Theory: The Mathematics of Computer Performance Modelling, SpringerVerlag, New York, 1995<br>**5.** Sheldon M Ross: Stochastic Processes, John Wiley and Sons, 1996.<br>**6.** S Karlin and H M Taylor: A First Course in Stochastic Processes, Academic Press, 1975. |

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| 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<br><br>Risky and risk-free assets, time value of money, binomial model for risky assets and corresponding properties<br><br>Portfolio management, Capital Asset Pricing Model<br><br>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<br>**2.** Marek Capiński, Tomasz Zastawniak, Mathematics for Finance: An Introduction to Financial Engineering, 2nd Edition, Springer Verlag, London, 2011<br>**3.** Paul Wilmott, Paul Wilmott Introduces Quantitative Finance, 2nd Edition, John Wiler & Sons, US, 2013<br>**4.** Mark H. A. Davis, Mathematical Finance: A Very Short Introduction, Oxford University Press, UK, 2019 |

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| **1** | **Title of the course** (L-T-P-C) | **Economics** **(2-1-0-6)** |
| **2** | **Pre-requisite courses(s)** | -- |
| **3** | **Course content** | Basic economic problems. resource constraints and Welfare maximizations. Nature of Economics: Positive and normative economics; Micro and macroeconomics, Basic concepts in economics. The role of the State in economic activity; market and government failures; New Economic Policy in India. Theory of utility and consumer choice. Theories of demand, supply and market equilibrium. Theories of firm, production and costs. Market structures. Perfect and imperfect competition, oligopoly, monopoly. An overview of macroeconomics, measurement and determination of national income. Consumption, savings, and investments. Commercial and central banking. Relationship between money, output and prices. Inflation - causes, consequences and remedies. International trade, foreign exchange and balance payments, stabilization policies : Monetary, Fiscal and Exchange rate policies. |
| **4** | **Texts/References** | **1.** P. A. Samuelson & W. D. Nordhaus, Economics, McGraw Hill, NY, 1995.<br>**2.** A. Koutsoyiannis, Modern Microeconomics, Macmillan, 1975. R. Pindyck and D. L. Rubinfeld, Microeconomics, Macmillan publishing company, NY, 1989.<br>**3.** R. J. Gordon, Macroeconomics 4th edition, Little Brown and Co., Boston, 1987.<br>**4.** William F. Shughart II, The Organization of Industry, Richard D. Irwin, Illinois, 1990.<br>**5.** R.S. Pindyck and D.L. Rubinfeld. Microeconomics The ($7^{th}$ Edition), Pearson Prentice Hall, New Jersey, 2009.<br>**6.** R. Dornbusch, S. Fischer, and R. Startz. Macroeconomics (9th Edition), McGraw-Hill Inc. New York, 2004. |

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| **1** | **Title of the course** (L-T-P-C) | **Graph Theory and Combinatorics/Introduction to Graph Theory (3-0-0-6)** |
| **2** | **Pre-requisite courses(s)** | Discrete Structures |
| **3** | **Course content** | Fundamentals of graph theory. Topics include: connectivity, planarity, perfect graphs, coloring, matchings and extremal problems.<br>Basic concepts in combinatorics. Topics include: counting techniques, inclusion-exclusion principles, permutations, combinations and pigeon- hole principle. |
| **4** | **Texts/References** | "An Introduction to Quantum Field Theory", Michael Peskin and Daniel Schroeder (Addison Wesley)<br>"Introduction to Quantum Field Theory", A. Zee<br>"Quantum Field Theory", Lewis H. Ryder<br>"Quantum Field Theory and Critical Phenomena", by Jean Zinn-Justin.<br>"Quantum field Theory for the Gifted Amateur", T. Lancaster and Stephen J. Blundell<br>NPTEL lectures in Quantum Field Theory (https://nptel.ac.in/courses/115106065/) |