

SMTB3009	FINANCIAL MATHEMATICS	L	T	P	EL	C
		3	1	0	0	4

• **COURSE OBJECTIVES:**

- The objective of this course is to develop understanding on the concepts associated with financial mathematics
- To comprehend practical applications of interest rate in real life situation

UNIT I PROBABILITY

12

Hrs

Probability – Probabilities and Events – Conditional probability – Random Variables and Expected Values – Convergence and correlation – Continuous Random variables – Normal Random Variables – Properties of Normal Random Variables – The central limit Theorem – Simple Problems.

UNIT II GEOMETRIC BROWNIAN MOTION

12Hrs

Geometric Brownian Motion – G.B.M. as a limit of simple models – Brownian Motion – Simple problems - Interest rates – Present value analysis – Rate of return – Continuation of varying interest rates – An example of option pricing – other examples of pricing via arbitrage.

UNIT III THE ARBITRAGE THEOREM AND BLACK SCHOLES FORMULA

12

Hrs

The Arbitrage theorem – The multi period Binomial model – proof of the Arbitrage theorem - Black Scholes formula – properties of the Black Scholes option cost – Derivation of Black Scholes formula – simple problems.

UNIT IV ADDITIONAL RESULTS ON OPTIONS

12

Hrs

Additional results on options – Call options on Dividend paying Securities – Pricing American put options – Adding Jumps to Geometric Brownian Motion – Estimating the Volatility Parameter – Simple problems.

UNIT V VALUING BY EXPECTED UTILITY

12

Hrs

Valuing by Expected Utility – Limitation of Arbitrage pricing – valuing Investments by Expected utility – The portfolio selection problem – Value at risk and conditional value at risk The capital assets pricing model – Mean variance analysis of risk – Neutral priced Call options – Rates of return – Single period and Geometric Brownian Motion – simple problems.

Max. Hrs: 60 Hrs

Course Outcomes: At the end of the course, the student will be able to:

- CO1 Identify and approximate probability distribution for a given discrete or continuous random variable and use its properties to calculate probabilities.
- CO2 Relate the continuous time stochastic process using geometric Brownian motion.
- CO3 Apply black schools formula in financial market, which contains derivative investment instruments. Construct Arbitrage theorem to help the investors and financial analyst in price securities
- CO4 Analyze the stock prices, prices of other assets caused by unpredictable events using jumps to geometric Brownian motion.
- CO5 Evaluate the expected utility by taking the weighted average of all possible outcomes under certain circumstances.
- CO6 Compose the invariance principle that a decision maker should not be affected by the way alternates are presented.

TEXT / REFERENCE BOOKS

1. Sheldon .M.Ross, An Elementary Introduction to Mathematical Finance, 2nd Edition, Cambridge University press, 2005.
2. S.M.Ross, A first course in probability, Englewood cliffs Prentice Hall-NJ, 2002.
3. J.Cox and M.Rubinstein, Options Market, Englewood cliffs Prentice Hall-NJ, 2012.
4. J.E.Ingersill, Theory of financial decision making, Lanjarn, MD Rowerman of Little fields, 1987.

SMTB1204	SEQUENCE AND SERIES	L	T	P	EL	C
		3	1	0	0	4

COURSE OBJECTIVES:

- To understand the basic definitions of limits and convergence in the context of sequences and series of real numbers.
- To provide the limits of sequences involving elementary functions by applying Cauchy's test D'Alembert's test Raabe's test

UNIT I SEQUENCES**12 Hrs**

Sequence-Limit, Convergence of a sequence- Cauchy's general principle of convergence Cauchy's first theorem on Limits-Bounded sequences – Divergent and Oscillating Sequence.

UNIT II LIMIT OF THE SEQUENCE**12 Hrs**

Behavior of monotonic sequence – finite or infinite Sequence- Limit superior and Limit inferior -Some theorems on limits and Problems.

UNIT III INFINITE SERIES**12 Hrs**

Infinite series - Definition of Convergence, Divergence & Oscillation Series – Necessary condition for convergence –Convergence of Geometric series-Exponential & Logarithmic series –Summation of Series & Approximations using these theorems.

UNIT IV TESTING OF SERIES-I**12 Hrs**

Testing the convergence and divergence of series using Comparison test -D'Alembert's ratio test- Raabe's test and Leibnitz's Test with simple problems.

UNIT V TESTING OF SERIES-II**12Hrs**

Testing of series to obtain the convergence and divergence using Cauchy's condensation Test-Cauchy's root test and their simple problems- Alternative series with simple problems.

Max. Hrs: 60**Hrs****Course Outcomes: At the end of the course, the student will be able to:**

- CO1 Discuss the convergence of sequence
- CO2 Evaluate the limits of finite and infinite sequence
- CO3 Compute the convergence and summation of infinite series
- CO4 Test the convergence of series using comparison, D'Alembert's ratio test, Raabe's Test and Leibnitz's test
- CO5 Investigate the convergence of series using Cauchy's Condensation Test and Cauchy's root test
- CO6 Explore convergence and divergence of Alternating series

TEXT / REFERENCESBOOK

1. T.K. Manicavachagam Pillai, T. Natarajan, K.S. Ganapathy, , Vol. I, S. Viswanathan Pvt Limited, Chennai, 2004.
2. M.K.Singal & Asha Rani Singal, A first course in Real Analysis, R. Chand & Co. 1999.
3. Dr.S.Arumugam, Sequences & Series, New Gamma Publishers, 1999

SMTB7004	FUZZY SETS , LOGIC THEORY AND APPLICATION	L	T	P	EL	C
		3	1	0	0	4

Course Objectives:

- To introduce the theory of fuzzy sets.
- To discuss theoretical differences between fuzzy sets and classical sets.
- To discuss fuzzy logic inference
- To introduce fuzzy arithmetic concepts
- To discuss fuzzy inference applications in the area of control.

UNIT I FUZZY SET

12 Hrs

Classical sets: Operations and properties of classical sets, Mapping of classical sets to the functions. Fuzzy sets - Membership functions, Fuzzy set operations, Properties of fuzzy sets.

UNITII FUNDAMENTALS OF FUZZY LOGIC

12 Hrs

Classical and Fuzzy relations: Cartesian product, crisp relations-cardinality, operations and properties of crisp relations. Fuzzy relations-cardinality, operations, properties of fuzzy relations, fuzzy Cartesian product and composition, Fuzzy tolerance and equivalence relations, value assignments and other format of the composition operation.

UNITIII FUZZIFICATION AND DEFUZZIFICATION

12 Hrs

Features of the membership functions, various forms, Fuzzification, Defuzzification to crisp sets, - cuts for fuzzy relations, Defuzzification to scalars. Fuzzy logic and approximate reasoning, Other forms of the implication operation..

UNITIV FUZZY SYSTEMS

12 Hrs

Natural language, Linguistic hedges, Fuzzy (Rule based) System, Aggregation of fuzzy rules, Graphical techniques of inference, Membership value assignments: Intuition, Inference, rank ordering, Fuzzy Associative memories

UNIT V FUZZY CLASSIFICATION

12 Hrs

Classification by equivalence relations-crisp relations, Fuzzy relations, Cluster analysis, Cluster validity, C-Means clustering, Hard C-Means clustering, Fuzzy C-Means algorithm, Classification metric, Hardening the Fuzzy C-Partition

Max. Hrs: 60 Hrs

TEXT / REFERENCE BOOKS

Course Outcomes: At the end of the course, the student will be able to:

CO1	Interpret Fuzzy Set Theory And Uncertainty Concepts
CO2	Identify The Similarities And Differences Between Probability Theory
CO3	Fuzzy Set Theory And their Application Conditions
CO4	Apply Fuzzy Set Theory In Modeling And Analyzing Uncertainty In A Decision Problem
CO5	Apply Fuzzy Control By Examining Simple Control Problem Examples
CO6	Evaluate The Fuzzy Classification Problems With Examples

SMTB5110	MATHEMATICAL COMPUTATION WITH PYTHON	L	T	P	EL	C
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Course Objective:

- To enable the students to appreciate and understand some concepts of mathematics using python
- To solve differential equations analytically and numerically using python.
- To acquire proficiency in using python to present data graphically.

UNIT I PYTHON BASICS

9 Hrs

Introduction to Python: Python Interpreter, Using Python as calculator, Python shell, Indentation. Atoms, Identifiers and keywords, Literals, Strings, Operators(Arithmetic operator, Relational operator, Logical or Boolean operator, Assignment, Operator, Ternary operator, Bit wise operator, Increment or Decrement operator).

UNIT II BEGINNING PYTHON PROGRAMMING

9 Hrs

Creating Python Programs :Input and Output Statements, Control statements(Branching, Looping, Conditional Statement, Exit function, Difference between break, continue and pass.), Defining Functions, default arguments, Errors and Exceptions

UNIT III SYMBOLIC MATHEMATICS

9 Hrs

Introduction to the SymPy library for symbolic mathematics-Symbolic variables and expressions - Simplification, expansion, and substitution of expressions-Solving equations and systems of equations symbolically

UNIT IV NUMERICAL COMPUTATION

9 Hrs

Introduction to the NumPy- library for numerical computations- Working with arrays and matrices- Mathematical operations with NumPy arrays- Numerical differentiation and integration using SciPy- Solving Differential Equations- root finding.

UNIT V DATA VISUALIZATION WITH PYTHON

9 Hrs

Basic Plotting – Polynomial Fitting using matplotlib- Plotting trigonometric plotting using Matplotlib.

Max Hrs: 45 Hrs

TEXT/REFERENCE BOOKS:

1. Allen Downey, Jeffrey Elkner, Chris Meyers. How to think like a computer scientist learning with Python / 1st Edition, 2012
2. Kenneth A. Lambert, The Fundamentals of Python: First Programs, 2011, Cengage Learning, ISBN: 978-1111822705.
3. Fuhrer, Claus, Jan Erik Solem, and Olivier Verdier. *Scientific Computing with Python 3*. Packt Publishing Ltd, 2016.
4. Johansson, Robert. *Numerical Python: A Practical Techniques Approach for Industry*. Apress, 2015.
5. Millman, K. Jarrod, and Michael Aivazis. "Python for scientists and engineers." *Computing in science & engineering* 13.2 (2011): 9-12.

 Skill Development

USEFUL WEBSITES:

1. <http://docs.python.org/3/tutorial/index.html>
2. <http://interactivepython.org/courselib/static/pythonds>
3. <http://www.ibiblio.org/g2swap/byteofpython/read/>

COURSE OUTCOME: At the end of the course, the student will be able to

CO1	To provide Basic knowledge of Python
CO2	To learn how to design and program Python applications
CO3	Develop proficiency in using SymPy, the symbolic mathematics library in Python
CO4	To learn Numerical computations with python
CO5	Understand different customization options available in Matplotlib to enhance the appearance and readability of the visualizations.
CO6	Explore different styles and themes available in Matplotlib for creating visually appealing plots



Skill Development

SMTB6101	MATHEMATICAL COMPUTATION WITH PYTHON - LAB	L	T	P	EL	C
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List of Experiments:

1. Introduction to Python Programming
2. Simple Python programs in Matrices
 - Addition, Subtraction
 - Matrix multiplication and inverse of a matrix
 - Determinant of a matrix
 - Eigen values and Eigen vectors
3. Basic mathematical operations
 - Sum of natural numbers
 - Finding factorial of a number
 - Finding square root and exponential of a given number
4. Program with relational conditional and logical Operators
 - LCM and DCD of numbers
 - Finding max and min of given numbers
5. Symbolic computations
 - Program to check the consistency of given system of equations
 - Program to solve the system of equations
 - Program to find the root of the polynomial equation
6. Numerical Computation using NumPy and Scipy
7. Differentiation and Integration
 - Program to find the derivatives of the given function
 - Partial derivative of a given function
 - Find the limit of a function
8. Plotting using matplotlib
 - Plotting standard curves
 - Line plot
 - Bar plot
 - Histogram
9. Statistics
 - Mean
 - Median
 - Mode
10. Solution of ordinary differential Equation

SMTB7005	MATHEMATICAL MODELING	L	T	P	EL	C
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Course Objective:

- Identify the significance of Mathematical Modeling and the various types of Mathematical models applied in different fields.

Unit-I INTRODUCTION

12 Hrs

Basic Steps of Mathematical Modeling, its needs, types of models, limitations, Elementary ideas of dynamical systems, Equilibrium point, node, saddle point, focus, centre and limit-cycle idea with simple illustrations and figures

Unit-II POPULATION MODELS

12 Hrs

Basic concepts, Exponential growth model, formulation, solution, interpretation and limitations. Compensation and depensation, Logistic growth model, formulation, solution, interpretation and limitations.

Unit-III EPIDEMIC MODELS

12 Hrs

Basic concepts, SI model, SIS model with constant coefficient, SIS model with coefficient as a function of time t , SIS model with constant number of carriers, SIS model when the carriers is a function of time t , SIR model, Epidemics with vaccination.

Unit-IV ECONOMIC MODELS

12 Hrs

Production and supply functions, price-elasticity, utility of consumption and consumer surplus, theory of production, production function.

Unit-V BIOLOGICAL MODELS

12 Hrs

Blood flow and oxygen transfer Modeling blood flow, viscosity, Poiseuille law, mathematical formulation of the problem, solution and interpretation.

Max. Hrs: 60 Hrs

TEXT / REFERENCE BOOKS

- Mark M. Meerschaert, Mathematical Modeling, Academic Press, New York, 1993
- W. Meyer, Concepts of Mathematical Modeling, McGraw Hill, New York, 1994
- Beltrami, Mathematics for Dynamic Modeling, Academic Press, Orlando, Florida, 1987
- N. Bailey, The Mathematical Theory of Infectious Diseases, Hafner press, New York, 1975

Course Outcomes: At the end of the course, the student will be able to:

CO1	List the origin of Mathematical Modeling, needs and limitations
CO2	Discuss the components and facts of various Population models.
CO3	Sketch the models used to explore the epidemics
CO4	Analyze the nature of the Economic models
CO5	Summarize the science of blood flow and oxygen transfer
CO6	Organize how the Poiseuille law is applied for modeling biological flows

 Skill Development