HSNC University Mumbai

(2022-2023)

Ordinances and Regulations

With Respect to

Choice Based Credit System

(CBCS)

For the Programmes Under

The Faculty of Science and Technology

For the Course

Financial Mathematics (Applied Component) Curriculum

Third Year Undergraduate Programme

Semester-V and Semester -VI

With effect from the Academic year 2022-2023

Part 1. Preamble
Part 2. The Scheme of Teaching and Examination

Semester – V

Sr. No.	Choice Based Credit System			Subject Code	Remarks
1	Core Course **Financial Mathematics - I** (Applied Component)			US-T-AC-FMI-501	
2	Elective Course	Discipline Specific Elective (DSE) Course		-	
		2.1	Interdisciplinary Specific Elective (IDSE) Course	-	
		2.2	Dissertation/Project	-	
		2.3	Generic Elective (GE) Course	-	
3	Ability Enhancement Courses (AEC)			-	
4	Skill Enhancement Courses (SEC)			-	

Third year Semester-V Internal and External Assessment

Detail Scheme:

Sr. No.	Subject Code	Subject Title	Periods Per Week						Seasonal Evaluation Scheme				Total Marks
			Units	S. L.	L	T	P	Credit	S. L. E	CT	TA	SEE	
1	US-T-AC-FMI-501	Financial Mathematics-I	4	20 % *	4	0	0	2	10	20	10	60	100
3	US-T-AC-FMI-501 -P-1	Practical Sessions Based on Financial Mathematics-I with Python			0	0	4	2				100 (60 +40)	100
	Total Hours / Credit							04	Total Marks				200

One to two lectures to be taken for CONTINUOUS self-learning Evaluation.

Semester – V Units – Topics – Teaching Hours

S. N	Subject Code	Subject Unit Title		Hours /Lectures	Total No. of hours/ lectures	Credit	Total Marks
1	US-T-AC-AMA-501	I	Introduction to simple market model	15	60 L	2	100 (60+40)
		II	Introduction to risk-free assets	15			
		III	Introduction to risky assets	15			
		IV	Introduction to discrete time market models	15			
L	US-T-AC-FMA-P-501	I	Practical sessions based on Financial Mathematics I with Python	2	30x2= 60L lectures per batch	2	100 (60+40)
			TOTAL			4	200

- **Lecture Duration – 45 Minutes = 0 .75 Hours. (45 Lectures equivalent to 33.75 hours)**
- **One Credit =16.87 hours equivalent to 17 Hours**

L: Lecture: Tutorials P: Practical Ct-Core Theory, Cp-Core Practical, SLE-Self learning evaluation CT-Commutative Test, SEE- Semester End Examination, PA-Project Assessment, AT- Attendance

Part3: Detail Scheme Theory

T.Y.B.SC. MATHEMATICS SYLLABUS
(SEMESTER BASED CREDIT AND GRADING SYSTEM)
TO BE IMPLEMENTED FROM THE ACADEMIC YEAR 2022-2023
Applied Component

Curriculum Topics along with Self-Learning Topics - to be covered, through self-learning mode along with the respective Unit. Evaluation of self-learning topics to be undertaken before the concluding lecture instructions of the respective UNIT.

Course Code:

Title of course: **Financial Mathematics - I** **Total credits: 2**

Objectives:

1. Learners will be introduced to the basic concepts of investments, assets, time value of money, portfolio and investment strategies and application of mathematical concepts to finance.
2. In a practical course, learners will be introduced to financial data handling and problem-solving using Python.

Unit	Content	No. of Lectures
1	**1. Introduction to simple market model** **1.1** Concept of an investment, Types of investment, Concepts of risk-free assets and risky assets, rate of return **1.2** Basic assumptions of simple market model. No-arbitrage principle. One-step binomial model **1.3** risk and return, expected return **1.4** Conceptual introduction to forward contracts and options **1.5** Computations in Python, working with excel sheets using pandas	**15**
2	**2. Introduction to risk-free assets** **2.1.** Time value of money, interest rates and present and future values **2.2.** Annuities, amortization, continuous compounding and concept of logarithmic return **2.3.** Introduction to bonds, deterministic cash flows, internal rate of return (IRR), comparison of IRR and NPV **2.4.** Price yield curve **2.5.** Introduction to money market	**15**
3	**3. Introduction to risky assets** **3.1.** Dynamics of stock prices, expected return, concept of mutual funds **3.2.** Binomial tree model, Risk-neutral probability, Martingale principle **3.3.** Trinomial tree model **3.4.** Continuous-time model	**15**
4	**4. Introduction to discrete time market models** **4.1** Portfolio (as a vector) and investment strategy, wealth of an investor **4.2** No arbitrage principle and investment strategies **4.3** Application to binomial tree model **4.4** Fundamental theorem of asset pricing (without proof) and examples	**15**

Self-Learning topics (Unit wise)

Unit	Topics

2	**2.1** Time value of money, interest rates and present and future values
2	**2.2** Annuities, amortization
2	**2.3** Introduction to bonds, deterministic cash flows

Online Resources

NPTEL :: Mathematics - NOC:Mathematical Finance by Prof. N. Selvaraju and Prof. Siddhartha Chakrabarty, Department of Mathematics, IIT Guwahati (Week 1)

References Books:

1. Mathematics for Finance: An Introduction to Financial Engineering by Marek Capinski, Tomasaz Zastawniak, Springer Undergraduate Mathematics Series
2. The Calculus of Finance by Amber Habib, University Press.
3. An Undergraduate Introduction to Financial Mathematics by J Robert Buchanan, World Scientific.
4. Python for Finance: Mastering Data-Driven Finance by Yves Hilpisch, O'Reilly
5. Financial Theory with Python A Gentle Introduction by Yves Hilpisch, O'Reilly

Part -4 Detailed Scheme Practicals

Code: US-T-AC-FMA-P-501

Course: Practical based on Financial Mathematics I with Python

Total Credits: 02

Course Code:US-T-AC-TMA-P-501			
Unit	Content	No. of Lectures	Reference Books
I	1. Working with Excel sheets: Financial Functions 2. Computations with Python, working with Excel sheets using Pandas	03 Lectures per Practical per Batch	Reference No. 1, 2,4,5
II	3. Time value of money, present and future value calculations, amortization table using Excel. Continuous compounding using python		

	4. Deterministic cash flows, Internal rate of returns using Newton-Raphson method, Price-yield curve		
III	5. Dynamics of stock prices – Demonstration using Python, expected returns, Systematic Investment Plans: Average Acquisition cost by Rupee cost averaging method. 6. Risk-neutral probability,		
IV	7. Examples based on portfolio and investment trategies 8. Binomial tree model and examples based on fundamental theorem of asset pricing.		

Part 5. The Scheme of Teaching and Examination

Semester – VI

Sr. No.	Choice Based Credit System			Subject Code	Remarks
1	Core Course **Financial Mathematics - II** (Applied Component)			US-T-AC-FMI-601	
2	Elective Course	Discipline Specific Elective (DSE) Course		-	
		2.1	Interdisciplinary Specific Elective (IDSE) Course	-	
		2.2	Dissertation/Project	-	
		2.3	Generic Elective (GE) Course	-	
3	Ability Enhancement Courses (AEC)			-	
4	Skill Enhancement Courses (SEC)			-	

Third year Semester-VI Internal and External Assessment

Detail Scheme:

Sr. No.	Subject Code	Subject Title	Periods Per Week		Seasonal Evaluation Scheme	Total Marks

			Units	S. L.	L	T	P	Credit	S. L. E	CT	TA	SEE	
1	US-T-AC-FMA-601	Financial Mathematics-II	4	20 % *	4	0	0	2	10	20	10	60	100
3	US-T-AC-FMA-P-601	Practical Sessions Based on Financial Mathematics-II with Python			0	0	4	2				100 (60 +40)	100
	Total Hours / Credit							04	Total Marks				200

One to two lectures to be taken for CONTINUOUS self-learning Evaluation.

Semester – VI Units – Topics – Teaching Hours

S. N	Subject Code	Subject Unit Title		Hours /Lectures	Total No. of hours/ lectures	Credit	Total Marks
1	US-T-AC-AMA-601	I	Portfolio Management	15	60 L	2	100 (60+ 40)
		II	Forward and Future Contracts	15			
		III	Options	15			
		IV	Options Pricing	15			
2	US-T-AC-AMA-P601	I	Practical sessions based on Financial Mathematics II with Python	2	30x2= 60L lectures per batch	2	100 (60+ 40)
			TOTAL			4	200

- **Lecture Duration – 45 Minutes = 0 .75 Hours. (45 Lectures equivalent to 33.75 hours)**
- **One Credit =16.87 hours equivalent to 17 Hours**

L: Lecture: Tutorials P: Practical Ct-Core Theory, Cp-Core Practical, SLE-Self learning evaluation CT-Commutative Test, SEE- Semester End Examination, PA-Project Assessment, AT- Attendance

Part6: Detail Scheme Theory

T.Y.B.SC. MATHEMATICS SYLLABUS
(SEMESTER BASED CREDIT AND GRADING SYSTEM)
TO BE IMPLEMENTED FROM THE ACADEMIC YEAR 2022-2023
Applied Component

Curriculum Topics along with Self-Learning Topics - to be covered, through self-learning mode along with the respective Unit. Evaluation of self-learning topics to be undertaken before the concluding lecture instructions of the respective UNIT.

Course Code: US-T-AC-AMA-601

Title of course: **Financial Mathematics - II** **Total credits: 2**

Objectives:

1. After completing the course, learners will be able to evaluate risk and returns on a portfolio.
2. In a practical course, learners will be introduced to financial data analysis (related to forward, futures and options) and problem-solving using Python.

Unit	Content	No. of Lectures
1	**1. Portfolio Management** **1.1** Risk **1.2** Investment in two securities, risk and return on a portfolio **1.3** Several securities, risk and return on a portfolio, Calculations of alpha and beta **1.4** Capital Asset Pricing Model	**15**
2	**2. Forward and future contracts** **1.1** Forward price **1.2** Value of forward contract **1.3** Futures and pricing **1.4** Hedging with futures	**15**
3	**3. Options** **3.1** Definition, Put-Call parity **3.2** Bounds on option prices, European options and American options **3.3** Variables determining option prices **3.4** Time value of options	**15**

4	**4. Options pricing** a. European options in binomial tree model b. American options in binomial tree model c. Black-Sholes formula	**15**

Self-Learning topics (Unit wise)

Unit	Topics
1	**1.4** Capital Asset Pricing Model
3	**3.4** Time value of options

Online Resources

NPTEL :: Mathematics - NOC:Mathematical Finance by Prof. N. Selvaraju and Prof. Siddhartha Chakrabarty, Department of Mathematics, IIT Guwahati (Week 1)

References Books:

1. Mathematics for Finance: An Introduction to Financial Engineering by Marek Capinski, Tomasaz Zastawniak, Springer Undergraduate Mathematics Series
2. The Calculus of Finance by Amber Habib, University Press.
3. An Undergraduate Introduction to Financial Mathematics by J Robert Buchanan, World Scientific.
4. Python for Finance: Mastering Data-Driven Finance by Yves Hilpisch, O'Reilly
5. Financial Theory with Python A Gentle Introduction by Yves Hilpisch, O'Reilly

Part -7 Detailed Scheme Practicals

Course Code:US-T-AC-AMA-P601

Course: Practical based on Financial Mathematics I with Python

Total Credits: 02

Course Code:US-T-AC-AMA-P601			
Unit	Content	No. of Lectures	Reference Books
I	1. Evaluation of risk and returns on a portfolio. 2. Capital Asset Pricing Model (CAPM).	03 Lectures per Practical per Batch	Reference No. 1, 2,4,5
II	3. Problems based on dividends, dividend yield, value of forward contract. 4. Hedging with futures.		
III	5. Put-Call parity estimations, bounds on option prices. 6. Variables determining option prices, Time value of options.		
IV	7. Option pricing in binomial tree model. 8. Black-Scholes formula.		

Operations Research (Elective B)

Unit I: Linear Programming-I

Prerequisites: Vector Space, Linear independence and dependence, Basis, Convex sets, Dimension of polyhedron, Faces. Formation of LPP, Graphical Method. Theory of the Simplex Method- Standard form of LPP, Feasible solution to basic feasible solution, Improving BFS, Optimality Condition, Unbounded solution, Alternative optima, Correspondence between BFS and extreme points. Simplex Method Simplex Algorithm, Simplex Tableau. Reference for Unit-I: G. Hadley, Linear Programming, Narosa Publishing

Unit II: Linear programming-II

Simplex Method Case of Degeneracy, Big-M Method, Infeasible solution, Alternate solution, Solution of LPP for unrestricted variable. Transportation Problem: Formation of TP, Concepts of solution, feasible solution, Finding Initial Basic Feasible Solution by North West Corner Method, Matrix Minima Method, Vogels Approximation Method. Optimal Solution by MODI method, Unbalanced and maximization type of TP.

Reference for Unit-II: 1. G. Hadley, Linear Programming, Narosa Publishing. 2. J. K. Sharma, Operations Research, Theory and Applications.

Unit III: Queuing Systems Elements of Queuing Model, Role of Exponential Distribution. Pure Birth and Death Models; Generalized Poisson Queuing Mode. Specialized Poisson Queues: Steadystate Measures of Performance, Single Server Models, Multiple Server Models, Selfservice Model, Machine-servicing Model. Reference for Unit III: 1. J. K. Sharma, Operations Research, Theory and Applications. 2. H. A. Taha, Operations Research, Prentice Hall of India. Additional Reference Books: 1. Hillier and Lieberman, Introduction to Operations Research. 2. R. Broson, Schaum Series Book in Operations Research, Tata McGraw Hill Publishing Company Ltd. USMTP07, UAMTP07

Game Theory: