Bloom's Taxonomy Levels: 1. Remember 2. Understand 3. Application 4. Analysis 5. Evaluation 6. Creation

Programme Name: MSc. (Financial Mathematics)

Programme Specific Outcome (PSO)

PSO1. Solve mathematical problems using analytical methods as well as advanced numerical, statistical and optimization methods.

PSO2. Assimilate complex mathematical ideas and arguments.

PSO3. Recognize the relationships between different areas of Mathematics and financial market and the connections between Mathematics used in finance with various disciplines.

PSO4. Give organized written and verbal explanations of mathematical reasoning in a precise and articulate manner.

PSO5. Demonstrate basic mathematical understanding and computational skills and apply appropriate software to solve practical problems.

PSO6. Demonstrate facility in computer programming, data processing, numerical simulation, scientific visualization, and virtual experimentation.

PSO7. Select appropriate methods for solving differential equations which is arising in Mathematical modelling of financial problem.

PSO8. Build, Manage and Lead a team to successfully complete financial mathematics project and communicate across teams and organizations to achieve professional objectives.

PSO9. Formulation of mathematical models and simulation of the problems in real world.

PSO10. Inculcate their skills to deal with problems arising in stock market as well as in financial institutions.

PSO11. Hands-on practice for self preparation and developing presentation skills through project and seminar.

PSO12. Training and Exposure to research literature and thesis writing through project.

PSO13. Serve financial markets by efficient allocation of investment of individuals to the most productive sectors of the economy.

PSO14. Able to provide an avenue for corporate to raise capital for productive ventures.

PSO15. Use underlying mathematical ideas for innovations in financial derivatives and ingenuity in pricing and in creating an insurance or hedge against associated risks.

Syllabus of Courses

The Maharaja Sayajirao University of Baroda **Faculty Technology and Engineering** **Department of Applied Mathematics**		**Academic Year**	**2019-20**
M.Sc. (Financial Mathematics): Regular Programme			
Year	**I**	**Core / ~~Elective / Foundation~~** **AMT 2111: Multivariate Calculus and Mathematical Analysis**	**Credits / Hours per week**	**04**
Semester	**II**	Year of Introduction: 2010 Year of Syllabus Revision: 2016	**Maximum Marks / Grade**	**100**
Mode of Transaction		Lectures		

Course Outcome (CO) AMT 2207

CO1 Understand and Evaluate the domain, range, limit, continuity, differentiability of multivariable functions.

CO2 Apply it to various applications like estimating the Taylor series expansion, maxima and minima of functions of several variables.

CO3 Understanding and evaluating gradient, curl, divergence of both scalar and vector functions. Also, estimating arc length, curvature, tangent vector, etc.

CO4 Determining the directional derivatives for both scalar and vector point functions.

CO5 Understand quadratic forms, hessian criterion, compact sets, extreme value theorem.

CO6 Understands the definition of double integrals and evaluation technique to integrate functions of two variables in Cartesian and Polar coordinate systems.

CO7 Can apply the double integrals to evaluate Volume, Mass, Area, C.G. and M.I.

CO8 Can apply the concept of change the order of integration and change of variables to evaluate double integrals.

CO9 Understands the concept of line integral with evaluation technique when integrand is a Vector point function / Scalar point function, and evaluate when integration is an independent of choice of path.

CO10 Understands the relation between double and line integrals as a Green's Theorem and can apply the concept of line integral to find out Work done, Mass, Length of curve, Area etc.

CO11 To be able to understand the concept the measure, outer measure, Lebesgue Measure, Measurable functions and their properties and use the concepts of measurable sets and measurable functions.

CO12 To be able to understand the integration of a measurable function over a measurable set.

Unit No.	Topic	Contact Hours	Weightage (%)	BT Level	CO	PSO	Elements of Employability (Emp)/ Entrepreneurship (Ent)/ Skill Development (SD)	Relevance to Local (L)/ National (N)/ Regional (R)/Global (G)	Relation to Gender (G), Environment and Sustainability (ES), Human Values (HV)and Professional Ethics (PE)
1	Differentiation for multi-variable functions and its applications • Functions of several variables • Domain, Co-domain, Range • Graphs of functions and their component functions • Partial differentiation, higher order partial derivative, Composite function • Taylor's expansion, Error and Approximation, Jacobians	09	19%	1,2,3,4,5	CO1, CO2	PSO1, PSO2, PSO4, PSO5, PSO9	EMP	G	PE
2	Vector calculus • Vector Algebra introduction • Parameterized curves; Kepler's laws of planetary motion • Functions as paths or parameterized curves • Velocity, Speed, and Acceleration • Arc length, Curvature • Length of a path as an integral • Unit tangent vector, curvature of a path or curve • Vector Fields • Functions as scalar field • Functions as vector field • The second-order formula and the Hessian • Del operated on scalar and vector field • directional derivatives	10	21%	1,2,3,4,5	CO3, CO4	PSO1, PSO2, PSO4, PSO5, PSO9			

3	Maxima and minima (extrema) of functions • Critical points and the Hessian criterion • Quadratic forms, positive definite forms • The second derivative test for extrema if scalar-valued functions • Compact sets, the Extreme Value Theorem(EVT)	05	10%	1,2,3,4,5	CO5	PSO1, PSO2, PSO4, PSO5, PSO9			
4	Double integrals • Double integrals over rectangles defined as Riemann sums integrability • Conditions for integrability • Fubini's theorem, linearity of integrals, other basic properties • Double integral over general region • Changing order of integration	07	15%	1,2,3,4,5	CO6 CO7 CO8	PSO1, PSO2, PSO4, PSO5, PSO9			
5	Change of variables • Transformation of the plane • Linear Transformations and their expansion factors • Change of variable in definite integrals of one variable • Change of variable for double integrals, Jacobians • Double integral in polar co-ordinates • Application of double integral. Theory of integration • Riemann Integral Theorem • Line Integral	09	19%	1,2,3,4,5	CO8 CO9 CO10	PSO1, PSO2, PSO4, PSO5, PSO9			
6	Theory of measures and Lebesgue integrals • Algebra of sets, Borel sets, Lebesgue measure of linear set • Outer measure, Measurable Sets, Measurable Functions • Lebesgue Integral	08	16%	1,2,3,4,5	CO11 CO12	PSO1, PSO2, PSO4, PSO5, PSO9			

Reference Books

1.	H.L. Raydon: Real Analysis
2.	Michael D. Greenberg: Advanced Engg Mathematics

Bloom's Taxonomy Levels: 1. Remember 2. Understand 3. Application 4. Analysis 5. Evaluation 6. Creation

Program Specific Outcomes for M.Sc.(Financial Mathematics)

PSO1. Solve mathematical problems using analytical methods as well as advanced numerical, statistical and optimization methods.

PSO2. Assimilate complex mathematical ideas and arguments.

PSO3. Recognize the relationships between different areas of Mathematics and financial market and the connections between Mathematics used in finance with various disciplines.

PSO4. Give organized written and verbal explanations of mathematical reasoning in a precise and articulate manner.

PSO5. Demonstrate basic mathematical understanding and computational skills and apply appropriate software to solve practical problems.

PSO6. Demonstrate facility in computer programming, data processing, numerical simulation, scientific visualization, and virtual experimentation.

PSO7. Select appropriate methods for solving differential equations which is arising in Mathematical modelling of financial problem.

PSO8. Build, Manage and Lead a team to successfully complete financial mathematics project and communicate across teams and organizations to achieve professional objectives.

PSO9. Formulation of mathematical models and simulation of the problems in real world.

PSO10. Inculcate their skills to deal with problems arising in stock market as well as in financial institutions.

PSO11. Hands-on practice for self preparation and developing presentation skills through project and seminar.

PSO12. Training and Exposure to research literature and thesis writing through project.

PSO13. Serve financial markets by efficient allocation of investment of individuals to the most productive sectors of the economy.

PSO14. Able to provide an avenue for corporate to raise capital for productive ventures.

PSO15. Use underlying mathematical ideas for innovations in financial derivatives and ingenuity in pricing and in creating an insurance or hedge against associated risks.

Syllabus of Courses

The Maharaja Sayajirao University of Baroda **Faculty Technology and Engineering** **Department of Applied Mathematics**		**Academic Year**	**2019-20**
M.Sc. (Financial Mathematics): Higher Payment Program			
Year	**I**	**Core / ~~Elective / Foundation~~** **Fundamentals of statistics (AMT2112)**	**Credits / Hours per week**	**04**
Semester	**I**	Year of Introduction: 2010 Year of Syllabus Revision: 2016	**Maximum Marks / Grade**	**100**
Mode of Transaction		Lecture		

Course Outcome (CO) (AMT2112)

CO1: Implement how to translate uncertainty problems into probability models and will apply it directly in areas such as genetics, finance, telecommunications and biomathematics.
CO2: Demonstrate the ability to analyze data by appropriately fitting, assessing, and interpreting a variety of statistical models.
CO3: Demonstrate an understanding of the basic concepts of probability theory related to stochastic event.
CO4: Understand the concept of the sampling distribution of a statistic, and in particular describe the behaviour of the sample mean.
CO5: Understand the foundations for classical inference and describe properties of the sampling distribution of the sample mean in general situations.
CO6: Able to compute probabilities using discrete and continuous distributions.
CO7: Understand moments and moment generating functions of random variable.
CO8: Demonstrate an appreciation of one—way analysis of variance (ANOVA).
CO9 : Describe and verify mathematical considerations for analyzing time series.

Unit No.	**Topic**	**Contact Hours**	**Weightage (%)**	**BT Level**	**CO**	**PSO**	**Elements of** Employability (Emp)/ Entrepreneurship (Ent)/ Skill Development (SD)	**Relevance to** Local (L)/ National (N)/ Regional (R)/Global (G)	**Relation to** Gender (G), Environment and Sustainability (ES), Human Values (HV)and

									Professional Ethics (PE)
1	Illustrating the importance of statistics in a variety of fields, including medicine and the biological, physical, and social sciences, Structure of data sets, Histograms, Means and Standard Deviations	07	14	1,2,3,6	CO1, CO2	PSO1, PSO3, PSO4, PSO10			
2	Correlation and Regression analysis, Central Limit theorem and its applications	08	17	2,3,4,5	CO2, CO4	PSO1, PSO4, PSO5			
3	Elementary concepts of hypothesis testing, estimation, confidence intervals, t-test and chi-square tests, Linear regression theory and the analysis of variance.	09	19	2,3,4,5	CO2, CO4, CO5, CO8	PSO1, PSO4, PSO10			
4	Fundamentals of probability: probability space and measure, algebras and sigma-algebras, conditional probability, dependence and independence, Baye's theorem.	08	17	2,3,4,5	CO3, CO6, CO7	PSO1, PSO5	Emp	G	ES
5	Random variables, probability distribution, Expectation theory, variance, covariance, moments and moments generating function, Introduction to basic Discrete and Continuous Distribution.	10	20	2,3,4,5	CO6, CO7	PSO1, PSO3, PSO4			
6	Time series analysis Utility of time series analysis Components of time series Measurement of trends Measurement of seasonal variations Measurement of cyclical variations Measurement of irregular variations	06	13	2,3,4,5	CO2, CO9	PSO1, PSO3, PSO5, PSO10			

Reference Books

1.	Statistics, Freedman, Pisani, and Purves, 3rd Edition. New York: W. W. Norton and Co., Inc, 1998
2.	Fundamentals of Statistics, Goon A M, Gupta M K, Dasgupta B, Volume 1 and 2.
3.	Introduction to Modern Time series analysis by Gebhard Kirchgassner, Jurgon Wolters.
4.	Statistical methods, S.P.Gupta, Sultan Chand and Sons.

Bloom's Taxonomy Levels: 1. Remember 2. Understand 3. Application 4. Analysis 5. Evaluation 6. Creation

Programme Name: MSc. (Financial Mathematics)

Programme Specific Outcome (PSO)

PSO1. Solve mathematical problems using analytical methods as well as advanced numerical, statistical and optimization methods.

PSO2. Assimilate complex mathematical ideas and arguments.

PSO3. Recognize the relationships between different areas of Mathematics and financial market and the connections between Mathematics used in finance with various disciplines.

PSO4. Give organized written and verbal explanations of mathematical reasoning in a precise and articulate manner.

PSO5. Demonstrate basic mathematical understanding and computational skills and apply appropriate software to solve practical problems.

PSO6. Demonstrate facility in computer programming, data processing, numerical simulation, scientific visualization, and virtual experimentation.

PSO7. Select appropriate methods for solving differential equations which is arising in Mathematical modelling of financial problem.

PSO8. Build, Manage and Lead a team to successfully complete financial mathematics project and communicate across teams and organizations to achieve professional objectives.

PSO9. Formulation of mathematical models and simulation of the problems in real world.

PSO10. Inculcate their skills to deal with problems arising in stock market as well as in financial institutions.

PSO11. Hands-on practice for self preparation and developing presentation skills through project and seminar.

PSO12. Training and Exposure to research literature and thesis writing through project.

PSO13. Serve financial markets by efficient allocation of investment of individuals to the most productive sectors of the economy.

PSO14. Able to provide an avenue for corporate to raise capital for productive ventures.

PSO15. Use underlying mathematical ideas for innovations in financial derivatives and ingenuity in pricing and in creating an insurance or hedge against associated risks.

Syllabus of Courses

	The Maharaja Sayajirao University of Baroda **Faculty Technology and Engineering** **Department of Applied Mathematics**	**Academic Year**	**2019-20**

M.Sc. (Financial Mathematics): Regular Programme

Year	**I**	**Core / ~~Elective / Foundation~~** **AMT2112L: Practicals on Fundamentals of Statistics**	**Credits / Hours per week**	**02**
Semester	**I**	Year of Introduction: 2010 Year of Syllabus Revision: 2016	**Maximum Marks / Grade**	**50**
Mode of Transaction		Term Work, Practical and Viva		

Course Outcome (CO) (AMT2112)

CO1: Implement how to translate uncertainty problems into probability models and will apply it directly in areas such as genetics, finance, telecommunications and biomathematics.
CO2: Demonstrate the ability to analyze data by appropriately fitting, assessing, and interpreting a variety of statistical models.
CO3: Demonstrate an understanding of the basic concepts of probability theory related to stochastic event.
CO4: Understand the concept of the sampling distribution of a statistic, and in particular describe the behaviour of the sample mean.
CO5: Understand the foundations for classical inference and describe properties of the sampling distribution of the sample mean in general situations.
CO6: Able to compute probabilities using discrete and continuous distributions.
CO7: Demonstrate an appreciation of one—way analysis of variance (ANOVA).
CO8 : Describe and verify mathematical considerations for analyzing time series.

No.	**Programs**		**Course Code**	**BT Level**	**CO**	**PSO**
1	Classification of Data		AMT2112L	2	CO1, CO2	PSO5,PSO6
2	Representation of Data			2,3	CO1, CO2	
3	Measures of Central Tendency			2,3	CO1, CO2	
4	Measures of Dispersion			2,3	CO1, CO2	
5	Correlation Analysis			2,3,4	CO1, CO2	
6	Rank Correlation Analysis			2,3,4	CO1, CO2	
7	Regression Analysis			2,3,4	CO1,	

					CO2	
8	Probability Distribution			2,3,4	CO3, CO6	
9	Hypothesis Testing			2,3,4	CO4, CO5	
10	Analysis of Variance			2,3,4	CO7	
11	Time Series Analysis – I			2,3,4	CO1, CO8	
12	Time Series Analysis – II			2,3,4	CO1, CO8	

Bloom's Taxonomy Levels: 1. Remember 2. Understand 3. Application 4. Analysis 5. Evaluation 6. Creation

Programme Specific Outcomes for M.Sc.(Financial Mathematics)

PSO1. Solve mathematical problems using analytical methods as well as advanced numerical, statistical and optimization methods.
PSO2. Assimilate complex mathematical ideas and arguments.
PSO3. Recognize the relationships between different areas of Mathematics and financial market and the connections between Mathematics used in finance with various disciplines.
PSO4. Give organized written and verbal explanations of mathematical reasoning in a precise and articulate manner.
PSO5. Demonstrate basic mathematical understanding and computational skills and apply appropriate software to solve practical problems.
PSO6. Demonstrate facility in computer programming, data processing, numerical simulation, scientific visualization, and virtual experimentation.
PSO7. Select appropriate methods for solving differential equations which is arising in Mathematical modelling of financial problem.
PSO8. Build, Manage and Lead a team to successfully complete financial mathematics project and communicate across teams and organizations to achieve professional objectives.
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PSO15. Use underlying mathematical ideas for innovations in financial derivatives and ingenuity in pricing and in creating an insurance or hedge against associated risks.

Syllabus of Courses

	The Maharaja Sayajirao University of Baroda **Faculty Technology and Engineering** **Department of Applied Physics**	**Academic Year**	**2019-20**

M.Sc. (Financial Mathematics): Regular Programme

Year	**I**	**Core / ~~Elective / Foundation~~** **AMT 2113: Scientific Computing and Mathematical Software**	**Credits / Hours per week**	**04**
Semester	**I**	Year of Introduction: 2016 Year of Syllabus Revision:	**Maximum Marks / Grade**	**100**
Mode of Transaction		Lectures		

Course Outcome (CO) AMT 2113

CO1 Learn about the flowchart and design an algorithm for a given problem and to develop simple C – programs using operators.
CO2 Study about Conditional and Iterative statements which are available in C – language.
CO3 Learned about the importance and use of Arrays and Functions in C – language.
CO4 Learned about Strings, Pointers, Structures, Unions and Command Line Arguments.
CO5 Understand the concepts like File Handling in C-language.
CO6 Design real life financial problems and think creatively and provide a program giving solutions.
CO7 Apply a solution clearly and accurately in a program using matlab.
CO8 Apply the programming and spreadsheet skills for the best features of financial mathematics dealing real life problems.

Unit No.	**Topic**	**Contact Hours**	**Weightage (%)**	**BT Level**	**CO**	**PSO**	**Elements of** Employability (Emp)/ Entrepreneurship (Ent)/ Skill Development (SD)	**Relevance to** Local (L)/ National (N)/ Regional (R)/Global (G)	**Relation to** Gender (G), Environment and Sustainability (ES), Human Values (HV)and Professional Ethics (PE)
1	Algorithms: Definition and properties, developing well-known algorithms, flow-charting. Programming languages: machine	04	8.34	1,2	CO1	PSO5	SD	G	PE

	language, assembly language, High-lever languages, assemblers, compilers and interpreters.								
2	Programming preliminaries: Structure of program, Basic data types: int, float, char, double, Constants and variables, variable declaration. Input/Output of basic data types. Arithmetic operators, relational operators, logical operators, expression, precedence and order of execution, the assignment operator.	10	20.83	1,2,3	CO2 CO3	PSO6 PSO7			
3	Control structures, if, else, else if, switch, while loop, for loop, do… while loop, break and continue statements. Arrays- one dimensional and two-dimensional arrays, their internal representation benefits of using arrays. Input/Output operations on files. User defined functions: Defining and calling functions, Advance programming features	10	20.83	1,2,3,6	CO2 CO3 CO4 CO5	PSO6 PSO6			
4	MATLAB: Essentials of Matlab, Vectors, Matrices, and the colon operator, M files: Scripts and functions, Input and Output.	10	20.83	2,3,5,6	CO6 CO7	PSO5 PSO6 PSO7			
5	Graphics, Control structure and Logical Tests, Symbolic Math Toolbox, Advanced Matlab features.	10	20.83	1,2,3,4	CO6 CO7	PSO5 PSO6 PSO7			
6	Essentials of Excel, testing in Excel, Advance Excel features. Other Financial Softwares:	4	8.34	2,4,5,6	CO8	PSO6			

Reference Books

1.	J. N. Kapur: Mathematical modeling, Wiley eastern Ltd., 1994.
2.	M. M. Gibbons: A concrete approach to Mathematical modeling, John Wiley and sons, 1995.

Bloom's Taxonomy Levels: 1. Remember 2. Understand 3. Application 4. Analysis 5. Evaluation 6. Creation

Programme Name: MSc. (Financial Mathematics)

Programme Specific Outcome (PSO)

PSO1. Solve mathematical problems using analytical methods as well as advanced numerical, statistical and optimization methods.

PSO2. Assimilate complex mathematical ideas and arguments.

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PSO5. Demonstrate basic mathematical understanding and computational skills and apply appropriate software to solve practical problems.

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PSO15. Use underlying mathematical ideas for innovations in financial derivatives and ingenuity in pricing and in creating an insurance or hedge against associated risks.

Syllabus of Courses

	The Maharaja Sayajirao University of Baroda **Faculty Technology and Engineering** **Department of Applied Mathematics**	**Academic Year**	**2019-20**

M.Sc. (Financial Mathematics): Regular Programme

Year	**I**	**Core / ~~Elective / Foundation~~** **AMT 2113L: Practicals on Scientific Programming and Mathematical Softwares**	**Credits / Hours per week**	**02**
Semester	**I**	Year of Introduction: 2010 Year of Syllabus Revision: 2016	**Maximum Marks / Grade**	**50**
Mode of Transaction		Term Work, Practical and Viva		

Course Outcome (CO) (AMT2113L)

CO1 Learn about the simple introduction related to simple C – programs.

CO2 Programming related to Conditional and Iterative statements which are available in C – language.

CO3 Programming related to use of Arrays and Functions in C – language.

CO4 Programming related to numerical methods in C-Language.

CO5 Learn about the simple introduction related to MATLAB.

CO6 Learn about plotting different Graphs in MATLAB.

CO7 Programming related to Conditional and Iterative statements which are available in MATLAB.

CO8 Programming related to numerical methods in MATLAB.

No.	**Programs**		**Course Code**	**BT Level**	**CO**	**PSO**
1	Introduction of Mathematical softwares C-Program and MATLAB.		AMT 2113L	2	CO1,	PSO5,PSO6

					CO5	
2	MATLAB: Basic inbuilt commands and functions of Vectors. C-Language: Basic programs related to printing simple statements and mathematical calculations.			2,3	CO1, CO5	
3	MATLAB: Basic commands related to Matrices and its various operations, Commands related to Complex numbers C-Language: Programs related to data types and input values by user.			2,3	CO2, CO5	
4	MATLAB: Basic command for 2D – plotting.. C-language: Execution of various operators in programming.			2,3	CO2, CO6	
5	MATLAB: Basic programs related to execution of function and Script files. C-Language: Program related to basic structures and execution of if-else and nested if-else condition.			2,3,4	CO2 CO7	
6	MATLAB: Program related to basic structures and various operators. C-Language: Program related to switch-case statements.			2,3,4	CO2, CO7	
7	MATLAB: Symbolic toolbox and various advanced feature related to matlab.			2,3,4	CO2, CO7	

	C-Language: Program related to while loop and do-while loop.					
8	MATLAB: Program related to basic structures and execution of if-else and nested if-else condition. C-Language: Program related to for loop, break and continue statements.			2,3,4	CO2, CO7	
9	MATLAB: Program related to while and do-while loops. C-Language: Program related to one dimensional arrays.			2,3,4	CO2, CO7	
10	MATLAB: Program related to for loop. C-Language: Program related to two dimensional arrays.			2,3,4	CO3, CO7	
11	MATLAB: Program related to numerical methods. C-Language: Program related to numerical methods.			2,3,4	CO3, CO8	
12	MATLAB: Program related to numerical methods by using function files C-Language: Programs related to input/output functions on file.			2,3,4	CO4, CO8	

Bloom's Taxonomy Levels: 1. Remember 2. Understand 3. Application 4. Analysis 5. Evaluation 6. Creation

Programme Name: MSc. (FinancialMathematics)

Programme Specific Outcome(PSO)

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Syllabus of Courses

The Maharaja Sayajirao University of Baroda **Faculty Technology and Engineering** **Department of AppliedMathematics**		**Academic Year**	**2019-20**
M.Sc. (Financial Mathematics): Regular Programme			
Year	**I**	**Core / ~~Elective / Foundation~~** **AMT2114:Differential Equations**	**Credits / Hours per week**	**04**
Semester	**I**	Year of Introduction:2010 Year of Syllabus Revision: 2016	**Maximum Marks / Grade**	**100**
Mode of Transaction		Lectures and Tutorials		

Course Outcome (CO) AMT2114

CO1 Identify homogeneous, exact and linear differential equations of first order.

CO2 Identify homogeneous equations with constant coefficients and variable coefficients of Higher order differential equations.

CO3 Be able to implement analytical method to solve differential equation.

CO4 Analyze real-world problems in fields such as Biology, Chemistry, Economics, Engineering, and Physics, including problems related to population dynamics, mixtures, growth and decay, heating and cooling, electronic circuits, and Newtonian mechanics.

CO5 Determine Laplace transforms and inverse Laplace transforms of Heaviside (unit step) function and Dirac Delta function.Apply the Convolution Theorem to obtain inverse Laplace transforms.

CO6 Classification, mathematical modelingand solution of the hyperbolic, parabolic and elliptic equations. Analytical solution of these equations using Fourier Transform, Laplace Transform and separable variable techniques.

Unit No.	**Topic**	**Contact Hours**	**Weightage (%)**	**BT Level**	**CO**	**PSO**	**Elements of** Employability (Emp)/ Entrepreneurship (Ent)/ Skill Development (SD)	**Relevance to** Local (L)/ National (N)/ Regional (R)/Global (G)	**Relation to** Gender (G), Environment and Sustainability (ES), Human Values (HV)and Professional Ethics(P

									E)
1	**First Order Differential Equations:** Direction fields, integral curves, Explicit methods for solving separable, homogeneous, linear exact equations and some special types such as Bernoulli, Second order equations which can be reduced to first order, Elementary applications of first order equations; exponential growth and decay, population, mixing problems.	10	21	1,2,5	CO1, CO3	PSO1, PSO2 PSO7	Emp	G	PE
2	**Linear Second Order Differential Equations:** Linear dependence and independence of solutions; the Wronskian, Linear homogeneous equations with constant coefficients, Non-homogeneous linear equations and the method of reduction of order, Undetermined coefficients, variation of parameters.	10	21	1,2,5	CO2, CO3	PSO1, PSO2 PSO7			
3	**Applications of Linear Second order Differential Equations:** Harmonic linear oscillators, Electrical circuits, Forced vibrations.	4	08	1,2,3,4,5	CO3, CO4	PSO1, PSO2 PSO7			
4	Laplace Transforms: Delta functions and impulse forcing.Convolutions.	8	17	2, 3, 5	CO5				
5	Introduction to PDE: Mathematical Modeling through Parabolic PDE, Dirichlet, Neumann and Robin condition, well-posed problem. Parabolic equation: Analytical solution using Fourier Transform, Laplace Transform and separable variable approach	16	33	2, 3, 5, 6	CO6	PSO1 PSO7 PS09			
Reference Books									
1	Elementary differential equations and boundary value problems, Eighth edition, by William E. Boyce and Richard C. DiPrima								

Bloom's Taxonomy Levels: 1. Remember 2. Understand 3. Application 4. Analysis 5. Evaluation 6. Creation

Program Specific Outcomes for M.Sc.(Financial Mathematics)

PSO1. Solve mathematical problems using analytical methods as well as advanced numerical, statistical and optimization methods.

PSO2. Assimilate complex mathematical ideas and arguments.

PSO3. Recognize the relationships between different areas of Mathematics and financial market and the connections between Mathematics used in finance with various disciplines.

PSO4. Give organized written and verbal explanations of mathematical reasoning in a precise and articulate manner.

PSO5. Demonstrate basic mathematical understanding and computational skills and apply appropriate software to solve practical problems.

PSO6. Demonstrate facility in computer programming, data processing, numerical simulation, scientific visualization, and virtual experimentation.

PSO7. Select appropriate methods for solving differential equations which is arising in Mathematical modelling of financial problem.

PSO8. Build, Manage and Lead a team to successfully complete financial mathematics project and communicate across teams and organizations to achieve professional objectives.

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PSO10. Inculcate their skills to deal with problems arising in stock market as well as in financial institutions.

PSO11. Hands-on practice for self preparation and developing presentation skills through project and seminar.

PSO12. Training and Exposure to research literature and thesis writing through project.

PSO13. Serve financial markets by efficient allocation of investment of individuals to the most productive sectors of the economy.

PSO14. Able to provide an avenue for corporate to raise capital for productive ventures.

PSO15. Use underlying mathematical ideas for innovations in financial derivatives and ingenuity in pricing and in creating an insurance or hedge against associated risks.

Syllabus of Courses

The Maharaja Sayajirao University of Baroda **Faculty Technology and Engineering** **Department of AppliedMathematics**		**Academic Year**	**2019-20**
M.Sc. (Financial Mathematics): Higher Payment Program			
Year	**I**	**Core / ~~Elective / Foundation~~** **Stochastic Methods in Finance (AMT 2115)**	**Credits / Hours per week**	**04**
Semester	**I**	Year of Introduction: 2010 Year of Syllabus Revision: 2016	**Maximum Marks / Grade**	**100**
Mode of Transaction		Lecture		

Course Outcome

CO1: Understanding and simulation of random behavior of assets.
CO2: Develop the concept of random walk and Brownian motion.
CO3: Develop understanding of properties of Brownian motion, martingale, normality etc.
CO4: Introduce the concept of stochastic / ito calculus.
CO5: Introduce to stochastic differential equations and various models for asset prices.
CO6: Introduction of the Black Scholes Theory
CO7: Introduction to various financial instruments, assets and derivatives.
CO8: Develop the concept of Options and their pricing.

Unit No.	Topic	Contact Hours	Weightage (%)	BT Level	CO	PSO	Elements of Employability (Emp)/ Entrepreneurship (Ent)/ Skill Development (SD)	Relevance to Local (L)/ National (N)/ Regional (R)/Global (G)	Relation to Gender (G), Environment and Sustainability (ES), Human Values (HV)and Professio

									nal Ethics (PE)
1	• Random behavior of Assets • Stochastic processes in discrete time; random walk and the Poisson process. • Continuous time extensions of discrete concepts.	07	14	1,2,4	CO1	PSO3, PSO4, PSO9	Emp	G	ES
2	• Discrete time martingales, sub-martingales, super-martingales, stopping time and related results. • Brownian motion, Brownian motion as a limit of a symmetric random walk, properties of Brownian motion.	08	17	1,2,4	CO2, CO3	PSO3 PSO4,			
3	• Informal overview of Ito calculus: stochastic integrals, Ito formula, stochastic differential equations.	09	19	1,2,4	CO4, CO5	PSO3, PSO4, PSO7			
4	• Applications of calculus in finance: Black-Scholes equation and Black-Scholes formula.	08	17	1,2,4	CO6	PSO3 PSO4, PSO7			
5	• Introduction, The Time Value of money, Financial Instruments like Equities, Commodities, Currencies, Indices, Fixed – Income securities, Inflation proof bonds, Forwards and Futures.	10	20	1,2,3,4	CO7	PSO3 PSO4,			
6	• Introduction to options, Definitions, Writing options, The value of option before expiry, Put – call parity, Value of options, Market Conventions	06	13	1,2,3,4	CO7, CO8	PSO3 PSO4,			

Reference Books

1.	Paul Wilmott, Derivatives: The theory and practice of financial engineering, Jhon Wiley and Sons 1998.
2.	M. Capinski and T. Zastawnaik, Mathematics for Finance: An Introduction to Financial Engineering, Springer 2003.
3.	M. Capinski and T. Zastawnaik, Probability Through Problems, Springer 2001.
4.	Z. Brzezniak and T. Zastawniak, Basic Stochastic Processes, Springer 1999.
5.	OKSENDAL, Bernt, Stochastic Differential Equations: an introduction with applicaitons, Springer-Verlag, 1998.

Bloom's Taxonomy Levels: 1. Remember 2. Understand 3. Application 4. Analysis 5. Evaluation 6. Creation

Program Specific Outcomes for M.Sc.(Financial Mathematics)

PSO1. Solve mathematical problems using analytical methods as well as advanced numerical, statistical and optimization methods.

PSO2. Assimilate complex mathematical ideas and arguments.

PSO3. Recognize the relationships between different areas of Mathematics and financial market and the connections between Mathematics used in finance with various disciplines.

PSO4. Give organized written and verbal explanations of mathematical reasoning in a precise and articulate manner.

PSO5. Demonstrate basic mathematical understanding and computational skills and apply appropriate software to solve practical problems.

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PSO7. Select appropriate methods for solving differential equations which is arising in Mathematical modelling of financial problem.

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PSO14. Able to provide an avenue for corporate to raise capital for productive ventures.

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	The Maharaja Sayajirao University of Baroda **Faculty Technology and Engineering** **Department of Applied Mathematics**	**Academic Year**	**2019-20**

M. Sc. (Financial Mathematics)

Year	**II**	**Core / ~~Elective / Foundation~~** **Stochastic Methods in Finance (AMT 2115)**	**Credits / Hours per week**	**02**
Semester	**III**	Year of Introduction: 2010 Year of Syllabus Revision: 2016	**Maximum Marks / Grade**	**50**
Mode of Transaction		Term Work, Practical and Viva		

Course Outcome (CO)

CO1: Introduction to various financial instruments, assets and derivatives.
CO2: Understanding and simulation of random behavior of assets.
CO3: Develop the concept of random walk and Brownian motion.
CO4: Introduce the concept of stochastic / ito calculus.
CO5: Introduce to stochastic differential equations and various models for asset prices.
CO6: Develop the concept of Options and their pricing.
CO7: Introduction of the Black Scholes Theory

No.	Programs		Course Code	BT Level	CO	PSO
1	Introduction to Various equity based financial instruments-1		AMT2325L	1,2,3,4,5	CO1	PSO3 PSO5 PSO6 PSO7 PSO9 PSO14
2	Introduction to Various equity based financial instruments-2			1,2,3,4,5	CO1	
3	Calculation of future returns using the programming.			1,2,3,4,5	CO2	
4	Simulation of random variable generations using programming.			1,2,3,4,5	CO3	
5	Program to find various parameter like drift and volatility using programming.			1,2,3,4,5	CO3	
6	Introduction to fixed income financial instruments.			1,2,3,4,5	CO1	
7	Examples on stochastic integration.			1,2,3,4,5	CO4	
8	Examples on stochastic differential equations.			1,2,3,4,5	CO5	
9	Basics of various options of the financial market-1			1,2,3,4,5	CO6	
10	Basics of various options of the financial market-2			1,2,3,4,5	CO6	
11	Mathematical modelling of Black-Scholes equation.			1,2,3,4,5	CO7	
12	Simulation of payoff using programming.			1,2,3,4,5	CO7	

Bloom's Taxonomy Levels: 1. Remember 2. Understand 3. Application 4. Analysis 5. Evaluation 6. Creation

Programme Name: MSc. (Financial Mathematics)

Programme Specific Outcome (PSO)

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Syllabus of Courses

The Maharaja Sayajirao University of Baroda **Faculty Technology and Engineering** **Department of Applied Mathematics**		**Academic Year**	**2019-20**
M.Sc. (Financial Mathematics): Regular Programme			
Year	**I**	**Core / ~~Elective / Foundation~~** **AMT 2111: Multivariate Calculus and Mathematical Analysis**	**Credits / Hours per week**	**04**
Semester	**II**	Year of Introduction: 2010 Year of Syllabus Revision: 2016	**Maximum Marks / Grade**	**100**
Mode of Transaction		Lectures		

Course Outcome (CO) AMT 2207

CO1 Understand and Evaluate the domain, range, limit, continuity, differentiability of multivariable functions.

CO2 Apply it to various applications like estimating the Taylor series expansion, maxima and minima of functions of several variables.

CO3 Understanding and evaluating gradient, curl, divergence of both scalar and vector functions. Also, estimating arc length, curvature, tangent vector, etc.

CO4 Determining the directional derivatives for both scalar and vector point functions.

CO5 Understand quadratic forms, hessian criterion, compact sets, extreme value theorem.

CO6 Understands the definition of double integrals and evaluation technique to integrate functions of two variables in Cartesian and Polar coordinate systems.

CO7 Can apply the double integrals to evaluate Volume, Mass, Area, C.G. and M.I.

CO8 Can apply the concept of change the order of integration and change of variables to evaluate double integrals.

CO9 Understands the concept of line integral with evaluation technique when integrand is a Vector point function / Scalar point function, and evaluate when integration is an independent of choice of path.

CO10 Understands the relation between double and line integrals as a Green's Theorem and can apply the concept of line integral to find out Work done, Mass, Length of curve, Area etc.

CO11 To be able to understand the concept the measure, outer measure, Lebesgue Measure, Measurable functions and their properties and use the concepts of measurable sets and measurable functions.

CO12 To be able to understand the integration of a measurable function over a measurable set.

Unit No.	Topic	Contact Hours	Weightage (%)	BT Level	CO	PSO	Elements of Employability (Emp)/ Entrepreneurship (Ent)/ Skill Development (SD)	Relevance to Local (L)/ National (N)/ Regional (R)/Global (G)	Relation to Gender (G), Environment and Sustainability (ES), Human Values (HV)and Professional Ethics (PE)
1	Differentiation for multi-variable functions and its applications • Functions of several variables • Domain, Co-domain, Range • Graphs of functions and their component functions • Partial differentiation, higher order partial derivative, Composite function • Taylor's expansion, Error and Approximation, Jacobians	09	19%	1,2,3,4,5	CO1, CO2	PSO1, PSO2, PSO4, PSO5, PSO9	EMP	G	PE
2	Vector calculus • Vector Algebra introduction • Parameterized curves; Kepler's laws of planetary motion • Functions as paths or parameterized curves • Velocity, Speed, and Acceleration • Arc length, Curvature • Length of a path as an integral • Unit tangent vector, curvature of a path or curve • Vector Fields • Functions as scalar field • Functions as vector field • The second-order formula and the Hessian • Del operated on scalar and vector field • directional derivatives	10	21%	1,2,3,4,5	CO3, CO4	PSO1, PSO2, PSO4, PSO5, PSO9			

3	Maxima and minima (extrema) of functions • Critical points and the Hessian criterion • Quadratic forms, positive definite forms • The second derivative test for extrema if scalar-valued functions • Compact sets, the Extreme Value Theorem(EVT)	05	10%	1,2,3,4,5	CO5	PSO1, PSO2, PSO4, PSO5, PSO9			
4	Double integrals • Double integrals over rectangles defined as Riemann sums integrability • Conditions for integrability • Fubini's theorem, linearity of integrals, other basic properties • Double integral over general region • Changing order of integration	07	15%	1,2,3,4,5	CO6 CO7 CO8	PSO1, PSO2, PSO4, PSO5, PSO9			
5	Change of variables • Transformation of the plane • Linear Transformations and their expansion factors • Change of variable in definite integrals of one variable • Change of variable for double integrals, Jacobians • Double integral in polar co-ordinates • Application of double integral. Theory of integration • Riemann Integral Theorem • Line Integral	09	19%	1,2,3,4,5	CO8 CO9 CO10	PSO1, PSO2, PSO4, PSO5, PSO9			
6	Theory of measures and Lebesgue integrals • Algebra of sets, Borel sets, Lebesgue measure of linear set • Outer measure, Measurable Sets, Measurable Functions • Lebesgue Integral	08	16%	1,2,3,4,5	CO11 CO12	PSO1, PSO2, PSO4, PSO5, PSO9			

Reference Books

1.	H.L. Raydon: Real Analysis
2.	Michael D. Greenberg: Advanced Engg Mathematics

Bloom's Taxonomy Levels: 1. Remember 2. Understand 3. Application 4. Analysis 5. Evaluation 6. Creation

Program Specific Outcomes for M.Sc.(Financial Mathematics)

PSO1. Solve mathematical problems using analytical methods as well as advanced numerical, statistical and optimization methods.

PSO2. Assimilate complex mathematical ideas and arguments.

PSO3. Recognize the relationships between different areas of Mathematics and financial market and the connections between Mathematics used in finance with various disciplines.

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Syllabus of Courses

The Maharaja Sayajirao University of Baroda **Faculty Technology and Engineering** **Department of Applied Mathematics**		**Academic Year**	**2019-20**
M.Sc. (Financial Mathematics): Higher Payment Program			
Year	**I**	**Core / ~~Elective / Foundation~~** **Fundamentals of statistics (AMT2112)**	**Credits / Hours per week**	**04**
Semester	**I**	Year of Introduction: 2010 Year of Syllabus Revision: 2016	**Maximum Marks / Grade**	**100**
Mode of Transaction		Lecture		

Course Outcome (CO) (AMT2112)

CO1: Implement how to translate uncertainty problems into probability models and will apply it directly in areas such as genetics, finance, telecommunications and biomathematics.
CO2: Demonstrate the ability to analyze data by appropriately fitting, assessing, and interpreting a variety of statistical models.
CO3: Demonstrate an understanding of the basic concepts of probability theory related to stochastic event.
CO4: Understand the concept of the sampling distribution of a statistic, and in particular describe the behaviour of the sample mean.
CO5: Understand the foundations for classical inference and describe properties of the sampling distribution of the sample mean in general situations.
CO6: Able to compute probabilities using discrete and continuous distributions.
CO7: Understand moments and moment generating functions of random variable.
CO8: Demonstrate an appreciation of one—way analysis of variance (ANOVA).
CO9 : Describe and verify mathematical considerations for analyzing time series.

Unit No.	**Topic**	**Contact Hours**	**Weightage (%)**	**BT Level**	**CO**	**PSO**	**Elements of** Employability (Emp)/ Entrepreneurship (Ent)/ Skill Development (SD)	**Relevance to** Local (L)/ National (N)/ Regional (R)/Global (G)	**Relation to** Gender (G), Environment and Sustainability (ES), Human Values (HV)and

									Professional Ethics (PE)
1	Illustrating the importance of statistics in a variety of fields, including medicine and the biological, physical, and social sciences, Structure of data sets, Histograms, Means and Standard Deviations	07	14	1,2,3,6	CO1, CO2	PSO1, PSO3, PSO4, PSO10			
2	Correlation and Regression analysis, Central Limit theorem and its applications	08	17	2,3,4,5	CO2, CO4	PSO1, PSO4, PSO5			
3	Elementary concepts of hypothesis testing, estimation, confidence intervals, t-test and chi-square tests, Linear regression theory and the analysis of variance.	09	19	2,3,4,5	CO2, CO4, CO5, CO8	PSO1, PSO4, PSO10			
4	Fundamentals of probability: probability space and measure, algebras and sigma-algebras, conditional probability, dependence and independence, Baye's theorem.	08	17	2,3,4,5	CO3, CO6, CO7	PSO1, PSO5	Emp	G	ES
5	Random variables, probability distribution, Expectation theory, variance, covariance, moments and moments generating function, Introduction to basic Discrete and Continuous Distribution.	10	20	2,3,4,5	CO6, CO7	PSO1, PSO3, PSO4			
6	Time series analysis Utility of time series analysis Components of time series Measurement of trends Measurement of seasonal variations Measurement of cyclical variations Measurement of irregular variations	06	13	2,3,4,5	CO2, CO9	PSO1, PSO3, PSO5, PSO10			

Reference Books

1.	Statistics, Freedman, Pisani, and Purves, 3rd Edition. New York: W. W. Norton and Co., Inc, 1998
2.	Fundamentals of Statistics, Goon A M, Gupta M K, Dasgupta B, Volume 1 and 2.
3.	Introduction to Modern Time series analysis by Gebhard Kirchgassner, Jurgon Wolters.
4.	Statistical methods, S.P.Gupta, Sultan Chand and Sons.

Bloom's Taxonomy Levels: 1. Remember 2. Understand 3. Application 4. Analysis 5. Evaluation 6. Creation

Programme Name: MSc. (Financial Mathematics)

Programme Specific Outcome (PSO)

PSO1. Solve mathematical problems using analytical methods as well as advanced numerical, statistical and optimization methods.

PSO2. Assimilate complex mathematical ideas and arguments.

PSO3. Recognize the relationships between different areas of Mathematics and financial market and the connections between Mathematics used in finance with various disciplines.

PSO4. Give organized written and verbal explanations of mathematical reasoning in a precise and articulate manner.

PSO5. Demonstrate basic mathematical understanding and computational skills and apply appropriate software to solve practical problems.

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Syllabus of Courses

	The Maharaja Sayajirao University of Baroda **Faculty Technology and Engineering** **Department of Applied Mathematics**	**Academic Year**	**2019-20**

M.Sc. (Financial Mathematics): Regular Programme

Year	**I**	**Core / ~~Elective / Foundation~~** **AMT2112L: Practicals on Fundamentals of Statistics**	**Credits / Hours per week**	**02**
Semester	**I**	Year of Introduction: 2010 Year of Syllabus Revision: 2016	**Maximum Marks / Grade**	**50**
Mode of Transaction		Term Work, Practical and Viva		

Course Outcome (CO) (AMT2112)

CO1: Implement how to translate uncertainty problems into probability models and will apply it directly in areas such as genetics, finance, telecommunications and biomathematics.
CO2: Demonstrate the ability to analyze data by appropriately fitting, assessing, and interpreting a variety of statistical models.
CO3: Demonstrate an understanding of the basic concepts of probability theory related to stochastic event.
CO4: Understand the concept of the sampling distribution of a statistic, and in particular describe the behaviour of the sample mean.
CO5: Understand the foundations for classical inference and describe properties of the sampling distribution of the sample mean in general situations.
CO6: Able to compute probabilities using discrete and continuous distributions.
CO7: Demonstrate an appreciation of one—way analysis of variance (ANOVA).
CO8 : Describe and verify mathematical considerations for analyzing time series.

No.	**Programs**		**Course Code**	**BT Level**	**CO**	**PSO**
1	Classification of Data		AMT2112L	2	CO1, CO2	PSO5,PSO6
2	Representation of Data			2,3	CO1, CO2	
3	Measures of Central Tendency			2,3	CO1, CO2	
4	Measures of Dispersion			2,3	CO1, CO2	
5	Correlation Analysis			2,3,4	CO1, CO2	
6	Rank Correlation Analysis			2,3,4	CO1, CO2	
7	Regression Analysis			2,3,4	CO1,	

					CO2	
8	Probability Distribution			2,3,4	CO3, CO6	
9	Hypothesis Testing			2,3,4	CO4, CO5	
10	Analysis of Variance			2,3,4	CO7	
11	Time Series Analysis – I			2,3,4	CO1, CO8	
12	Time Series Analysis – II			2,3,4	CO1, CO8	

Bloom's Taxonomy Levels: 1. Remember 2. Understand 3. Application 4. Analysis 5. Evaluation 6. Creation

Programme Specific Outcomes for M.Sc.(Financial Mathematics)

PSO1. Solve mathematical problems using analytical methods as well as advanced numerical, statistical and optimization methods.
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Syllabus of Courses

	The Maharaja Sayajirao University of Baroda **Faculty Technology and Engineering** **Department of Applied Physics**	**Academic Year**	**2019-20**

M.Sc. (Financial Mathematics): Regular Programme

Year	**I**	**Core / ~~Elective / Foundation~~** **AMT 2113: Scientific Computing and Mathematical Software**	**Credits / Hours per week**	**04**
Semester	**I**	Year of Introduction: 2016 Year of Syllabus Revision:	**Maximum Marks / Grade**	**100**
Mode of Transaction		Lectures		

Course Outcome (CO) AMT 2113

CO1 Learn about the flowchart and design an algorithm for a given problem and to develop simple C – programs using operators.
CO2 Study about Conditional and Iterative statements which are available in C – language.
CO3 Learned about the importance and use of Arrays and Functions in C – language.
CO4 Learned about Strings, Pointers, Structures, Unions and Command Line Arguments.
CO5 Understand the concepts like File Handling in C-language.
CO6 Design real life financial problems and think creatively and provide a program giving solutions.
CO7 Apply a solution clearly and accurately in a program using matlab.
CO8 Apply the programming and spreadsheet skills for the best features of financial mathematics dealing real life problems.

Unit No.	**Topic**	**Contact Hours**	**Weightage (%)**	**BT Level**	**CO**	**PSO**	**Elements of** Employability (Emp)/ Entrepreneurship (Ent)/ Skill Development (SD)	**Relevance to** Local (L)/ National (N)/ Regional (R)/Global (G)	**Relation to** Gender (G), Environment and Sustainability (ES), Human Values (HV)and Professional Ethics (PE)
1	Algorithms: Definition and properties, developing well-known algorithms, flow-charting. Programming languages: machine	04	8.34	1,2	CO1	PSO5	SD	G	PE

	language, assembly language, High-lever languages, assemblers, compilers and interpreters.								
2	Programming preliminaries: Structure of program, Basic data types: int, float, char, double, Constants and variables, variable declaration. Input/Output of basic data types. Arithmetic operators, relational operators, logical operators, expression, precedence and order of execution, the assignment operator.	10	20.83	1,2,3	CO2 CO3	PSO6 PSO7			
3	Control structures, if, else, else if, switch, while loop, for loop, do… while loop, break and continue statements. Arrays- one dimensional and two-dimensional arrays, their internal representation benefits of using arrays. Input/Output operations on files. User defined functions: Defining and calling functions, Advance programming features	10	20.83	1,2,3,6	CO2 CO3 CO4 CO5	PSO6 PSO6			
4	MATLAB: Essentials of Matlab, Vectors, Matrices, and the colon operator, M files: Scripts and functions, Input and Output.	10	20.83	2,3,5,6	CO6 CO7	PSO5 PSO6 PSO7			
5	Graphics, Control structure and Logical Tests, Symbolic Math Toolbox, Advanced Matlab features.	10	20.83	1,2,3,4	CO6 CO7	PSO5 PSO6 PSO7			
6	Essentials of Excel, testing in Excel, Advance Excel features. Other Financial Softwares:	4	8.34	2,4,5,6	CO8	PSO6			

Reference Books

1.	J. N. Kapur: Mathematical modeling, Wiley eastern Ltd., 1994.
2.	M. M. Gibbons: A concrete approach to Mathematical modeling, John Wiley and sons, 1995.

Bloom's Taxonomy Levels: 1. Remember 2. Understand 3. Application 4. Analysis 5. Evaluation 6. Creation

Programme Name: MSc. (Financial Mathematics)

Programme Specific Outcome (PSO)

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Syllabus of Courses

	The Maharaja Sayajirao University of Baroda **Faculty Technology and Engineering** **Department of Applied Mathematics**	**Academic Year**	**2019-20**

M.Sc. (Financial Mathematics): Regular Programme

Year	**I**	**Core / ~~Elective / Foundation~~** **AMT 2113L: Practicals on Scientific Programming and Mathematical Softwares**	**Credits / Hours per week**	**02**
Semester	**I**	Year of Introduction: 2010 Year of Syllabus Revision: 2016	**Maximum Marks / Grade**	**50**
Mode of Transaction		Term Work, Practical and Viva		

Course Outcome (CO) (AMT2113L)

CO1 Learn about the simple introduction related to simple C – programs.

CO2 Programming related to Conditional and Iterative statements which are available in C – language.

CO3 Programming related to use of Arrays and Functions in C – language.

CO4 Programming related to numerical methods in C-Language.

CO5 Learn about the simple introduction related to MATLAB.

CO6 Learn about plotting different Graphs in MATLAB.

CO7 Programming related to Conditional and Iterative statements which are available in MATLAB.

CO8 Programming related to numerical methods in MATLAB.

No.	**Programs**		**Course Code**	**BT Level**	**CO**	**PSO**
1	Introduction of Mathematical softwares C-Program and MATLAB.		AMT 2113L	2	CO1,	PSO5,PSO6

					CO5	
2	MATLAB: Basic inbuilt commands and functions of Vectors. C-Language: Basic programs related to printing simple statements and mathematical calculations.			2,3	CO1, CO5	
3	MATLAB: Basic commands related to Matrices and its various operations, Commands related to Complex numbers C-Language: Programs related to data types and input values by user.			2,3	CO2, CO5	
4	MATLAB: Basic command for 2D – plotting.. C-language: Execution of various operators in programming.			2,3	CO2, CO6	
5	MATLAB: Basic programs related to execution of function and Script files. C-Language: Program related to basic structures and execution of if-else and nested if-else condition.			2,3,4	CO2 CO7	
6	MATLAB: Program related to basic structures and various operators. C-Language: Program related to switch-case statements.			2,3,4	CO2, CO7	
7	MATLAB: Symbolic toolbox and various advanced feature related to matlab.			2,3,4	CO2, CO7	

	C-Language: Program related to while loop and do-while loop.					
8	MATLAB: Program related to basic structures and execution of if-else and nested if-else condition. C-Language: Program related to for loop, break and continue statements.			2,3,4	CO2, CO7	
9	MATLAB: Program related to while and do-while loops. C-Language: Program related to one dimensional arrays.			2,3,4	CO2, CO7	
10	MATLAB: Program related to for loop. C-Language: Program related to two dimensional arrays.			2,3,4	CO3, CO7	
11	MATLAB: Program related to numerical methods. C-Language: Program related to numerical methods.			2,3,4	CO3, CO8	
12	MATLAB: Program related to numerical methods by using function files C-Language: Programs related to input/output functions on file.			2,3,4	CO4, CO8	

Bloom's Taxonomy Levels: 1. Remember 2. Understand 3. Application 4. Analysis 5. Evaluation 6. Creation

Programme Name: MSc. (FinancialMathematics)

Programme Specific Outcome(PSO)

PSO1. Solve mathematical problems using analytical methods as well as advanced numerical, statistical and optimization methods.

PSO2. Assimilate complex mathematical ideas and arguments.

PSO3. Recognize the relationships between different areas of Mathematics and financial market and the connections between Mathematics used in finance with various disciplines.

PSO4. Give organized written and verbal explanations of mathematical reasoning in a precise and articulate manner.

PSO5. Demonstrate basic mathematical understanding and computational skills and apply appropriate software to solve practical problems.

PSO6. Demonstrate facility in computer programming, data processing, numerical simulation, scientific visualization, and virtual experimentation.

PSO7. Select appropriate methods for solving differential equations which is arising in Mathematical modelling of financial problem.

PSO8. Build, Manage and Lead a team to successfully complete financial mathematics project and communicate across teams and organizations to achieve professional objectives.

PSO9. Formulation of mathematical models and simulation of the problems in real world.

PSO10. Inculcate their skills to deal with problems arising in stock market as well as in financial institutions.

PSO11. Hands-on practice for self-preparation and developing presentation skills through project and seminar.

PSO12. Training and Exposure to research literature and thesis writing through project.

PSO13. Serve financial markets by efficient allocation of investment of individuals to the most productive sectors of the economy.

PSO14. Able to provide an avenue for corporate to raise capital for productive ventures.

PSO15. Use underlying mathematical ideas for innovations in financial derivatives and ingenuity in pricing and in creating an insurance or hedge against associated risks.

Syllabus of Courses

The Maharaja Sayajirao University of Baroda **Faculty Technology and Engineering** **Department of AppliedMathematics**		**Academic Year**	**2019-20**
M.Sc. (Financial Mathematics): Regular Programme			
Year	**I**	**Core / ~~Elective / Foundation~~** **AMT2114:Differential Equations**	**Credits / Hours per week**	**04**
Semester	**I**	Year of Introduction:2010 Year of Syllabus Revision: 2016	**Maximum Marks / Grade**	**100**
Mode of Transaction		Lectures and Tutorials		

Course Outcome (CO) AMT2114

CO1 Identify homogeneous, exact and linear differential equations of first order.

CO2 Identify homogeneous equations with constant coefficients and variable coefficients of Higher order differential equations.

CO3 Be able to implement analytical method to solve differential equation.

CO4 Analyze real-world problems in fields such as Biology, Chemistry, Economics, Engineering, and Physics, including problems related to population dynamics, mixtures, growth and decay, heating and cooling, electronic circuits, and Newtonian mechanics.

CO5 Determine Laplace transforms and inverse Laplace transforms of Heaviside (unit step) function and Dirac Delta function.Apply the Convolution Theorem to obtain inverse Laplace transforms.

CO6 Classification, mathematical modelingand solution of the hyperbolic, parabolic and elliptic equations. Analytical solution of these equations using Fourier Transform, Laplace Transform and separable variable techniques.

Unit No.	**Topic**	**Contact Hours**	**Weightage (%)**	**BT Level**	**CO**	**PSO**	**Elements of** Employability (Emp)/ Entrepreneurship (Ent)/ Skill Development (SD)	**Relevance to** Local (L)/ National (N)/ Regional (R)/Global (G)	**Relation to** Gender (G), Environment and Sustainability (ES), Human Values (HV)and Professional Ethics(P

									E)
1	**First Order Differential Equations:** Direction fields, integral curves, Explicit methods for solving separable, homogeneous, linear exact equations and some special types such as Bernoulli, Second order equations which can be reduced to first order, Elementary applications of first order equations; exponential growth and decay, population, mixing problems.	10	21	1,2,5	CO1, CO3	PSO1, PSO2 PSO7	Emp	G	PE
2	**Linear Second Order Differential Equations:** Linear dependence and independence of solutions; the Wronskian, Linear homogeneous equations with constant coefficients, Non-homogeneous linear equations and the method of reduction of order, Undetermined coefficients, variation of parameters.	10	21	1,2,5	CO2, CO3	PSO1, PSO2 PSO7			
3	**Applications of Linear Second order Differential Equations:** Harmonic linear oscillators, Electrical circuits, Forced vibrations.	4	08	1,2,3,4,5	CO3, CO4	PSO1, PSO2 PSO7			
4	Laplace Transforms: Delta functions and impulse forcing.Convolutions.	8	17	2, 3, 5	CO5				
5	Introduction to PDE: Mathematical Modeling through Parabolic PDE, Dirichlet, Neumann and Robin condition, well-posed problem. Parabolic equation: Analytical solution using Fourier Transform, Laplace Transform and separable variable approach	16	33	2, 3, 5, 6	CO6	PSO1 PSO7 PS09			
Reference Books									
1	Elementary differential equations and boundary value problems, Eighth edition, by William E. Boyce and Richard C. DiPrima								

Bloom's Taxonomy Levels: 1. Remember 2. Understand 3. Application 4. Analysis 5. Evaluation 6. Creation

Program Specific Outcomes for M.Sc.(Financial Mathematics)

PSO1. Solve mathematical problems using analytical methods as well as advanced numerical, statistical and optimization methods.

PSO2. Assimilate complex mathematical ideas and arguments.

PSO3. Recognize the relationships between different areas of Mathematics and financial market and the connections between Mathematics used in finance with various disciplines.

PSO4. Give organized written and verbal explanations of mathematical reasoning in a precise and articulate manner.

PSO5. Demonstrate basic mathematical understanding and computational skills and apply appropriate software to solve practical problems.

PSO6. Demonstrate facility in computer programming, data processing, numerical simulation, scientific visualization, and virtual experimentation.

PSO7. Select appropriate methods for solving differential equations which is arising in Mathematical modelling of financial problem.

PSO8. Build, Manage and Lead a team to successfully complete financial mathematics project and communicate across teams and organizations to achieve professional objectives.

PSO9. Formulation of mathematical modelsand simulation of the problems in real world.

PSO10. Inculcate their skills to deal with problems arising in stock market as well as in financial institutions.

PSO11. Hands-on practice for self preparation and developing presentation skills through project and seminar.

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PSO13. Serve financial markets by efficient allocation of investment of individuals to the most productive sectors of the economy.

PSO14. Able to provide an avenue for corporate to raise capital for productive ventures.

PSO15. Use underlying mathematical ideas for innovations in financial derivatives and ingenuity in pricing and in creating an insurance or hedge against associated risks.

Syllabus of Courses

The Maharaja Sayajirao University of Baroda **Faculty Technology and Engineering** **Department of AppliedMathematics**		**Academic Year**	**2019-20**
M.Sc. (Financial Mathematics): Higher Payment Program			
Year	**I**	**Core / ~~Elective / Foundation~~** **Stochastic Methods in Finance (AMT 2115)**	**Credits / Hours per week**	**04**
Semester	**I**	Year of Introduction: 2010 Year of Syllabus Revision: 2016	**Maximum Marks / Grade**	**100**
Mode of Transaction		Lecture		

Course Outcome

CO1: Understanding and simulation of random behavior of assets.
CO2: Develop the concept of random walk and Brownian motion.
CO3: Develop understanding of properties of Brownian motion, martingale, normality etc.
CO4: Introduce the concept of stochastic / ito calculus.
CO5: Introduce to stochastic differential equations and various models for asset prices.
CO6: Introduction of the Black Scholes Theory
CO7: Introduction to various financial instruments, assets and derivatives.
CO8: Develop the concept of Options and their pricing.

Unit No.	Topic	Contact Hours	Weightage (%)	BT Level	CO	PSO	Elements of Employability (Emp)/ Entrepreneurship (Ent)/ Skill Development (SD)	Relevance to Local (L)/ National (N)/ Regional (R)/Global (G)	Relation to Gender (G), Environment and Sustainability (ES), Human Values (HV)and Professio

									nal Ethics (PE)
1	• Random behavior of Assets • Stochastic processes in discrete time; random walk and the Poisson process. • Continuous time extensions of discrete concepts.	07	14	1,2,4	CO1	PSO3, PSO4, PSO9	Emp	G	ES
2	• Discrete time martingales, sub-martingales, super-martingales, stopping time and related results. • Brownian motion, Brownian motion as a limit of a symmetric random walk, properties of Brownian motion.	08	17	1,2,4	CO2, CO3	PSO3 PSO4,			
3	• Informal overview of Ito calculus: stochastic integrals, Ito formula, stochastic differential equations.	09	19	1,2,4	CO4, CO5	PSO3, PSO4, PSO7			
4	• Applications of calculus in finance: Black-Scholes equation and Black-Scholes formula.	08	17	1,2,4	CO6	PSO3 PSO4, PSO7			
5	• Introduction, The Time Value of money, Financial Instruments like Equities, Commodities, Currencies, Indices, Fixed – Income securities, Inflation proof bonds, Forwards and Futures.	10	20	1,2,3,4	CO7	PSO3 PSO4,			
6	• Introduction to options, Definitions, Writing options, The value of option before expiry, Put – call parity, Value of options, Market Conventions	06	13	1,2,3,4	CO7, CO8	PSO3 PSO4,			

Reference Books

1.	Paul Wilmott, Derivatives: The theory and practice of financial engineering, Jhon Wiley and Sons 1998.
2.	M. Capinski and T. Zastawnaik, Mathematics for Finance: An Introduction to Financial Engineering, Springer 2003.
3.	M. Capinski and T. Zastawnaik, Probability Through Problems, Springer 2001.
4.	Z. Brzezniak and T. Zastawniak, Basic Stochastic Processes, Springer 1999.
5.	OKSENDAL, Bernt, Stochastic Differential Equations: an introduction with applicaitons, Springer-Verlag, 1998.

Bloom's Taxonomy Levels: 1. Remember 2. Understand 3. Application 4. Analysis 5. Evaluation 6. Creation

Program Specific Outcomes for M.Sc.(Financial Mathematics)

PSO1. Solve mathematical problems using analytical methods as well as advanced numerical, statistical and optimization methods.

PSO2. Assimilate complex mathematical ideas and arguments.

PSO3. Recognize the relationships between different areas of Mathematics and financial market and the connections between Mathematics used in finance with various disciplines.

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PSO5. Demonstrate basic mathematical understanding and computational skills and apply appropriate software to solve practical problems.

PSO6. Demonstrate facility in computer programming, data processing, numerical simulation, scientific visualization, and virtual experimentation.

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	The Maharaja Sayajirao University of Baroda **Faculty Technology and Engineering** **Department of Applied Mathematics**	**Academic Year**	**2019-20**

M. Sc. (Financial Mathematics)

Year	**II**	**Core / ~~Elective / Foundation~~** **Stochastic Methods in Finance (AMT 2115)**	**Credits / Hours per week**	**02**
Semester	**III**	Year of Introduction: 2010 Year of Syllabus Revision: 2016	**Maximum Marks / Grade**	**50**
Mode of Transaction		Term Work, Practical and Viva		

Course Outcome (CO)

CO1: Introduction to various financial instruments, assets and derivatives.
CO2: Understanding and simulation of random behavior of assets.
CO3: Develop the concept of random walk and Brownian motion.
CO4: Introduce the concept of stochastic / ito calculus.
CO5: Introduce to stochastic differential equations and various models for asset prices.
CO6: Develop the concept of Options and their pricing.
CO7: Introduction of the Black Scholes Theory

No.	Programs		Course Code	BT Level	CO	PSO
1	Introduction to Various equity based financial instruments-1		AMT2325L	1,2,3,4,5	CO1	PSO3 PSO5 PSO6 PSO7 PSO9 PSO14
2	Introduction to Various equity based financial instruments-2			1,2,3,4,5	CO1	
3	Calculation of future returns using the programming.			1,2,3,4,5	CO2	
4	Simulation of random variable generations using programming.			1,2,3,4,5	CO3	
5	Program to find various parameter like drift and volatility using programming.			1,2,3,4,5	CO3	
6	Introduction to fixed income financial instruments.			1,2,3,4,5	CO1	
7	Examples on stochastic integration.			1,2,3,4,5	CO4	
8	Examples on stochastic differential equations.			1,2,3,4,5	CO5	
9	Basics of various options of the financial market-1			1,2,3,4,5	CO6	
10	Basics of various options of the financial market-2			1,2,3,4,5	CO6	
11	Mathematical modelling of Black-Scholes equation.			1,2,3,4,5	CO7	
12	Simulation of payoff using programming.			1,2,3,4,5	CO7	

Bloom's Taxonomy Levels: 1. Remember 2. Understand 3. Application 4. Analysis 5. Evaluation 6. Creation

Programme Name: MSc. (Financial Mathematics)

Programme Specific Outcome (PSO)

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Syllabus of Courses

The Maharaja Sayajirao University of Baroda **Faculty Technology and Engineering** **Department of Applied Mathematics**		**Academic Year**	**2019-20**
M.Sc. (Financial Mathematics): Regular Programme			
Year	**I**	**Core / ~~Elective / Foundation~~** **AMT 2111: Multivariate Calculus and Mathematical Analysis**	**Credits / Hours per week**	**04**
Semester	**II**	Year of Introduction: 2010 Year of Syllabus Revision: 2016	**Maximum Marks / Grade**	**100**
Mode of Transaction		Lectures		

Course Outcome (CO) AMT 2207

CO1 Understand and Evaluate the domain, range, limit, continuity, differentiability of multivariable functions.

CO2 Apply it to various applications like estimating the Taylor series expansion, maxima and minima of functions of several variables.

CO3 Understanding and evaluating gradient, curl, divergence of both scalar and vector functions. Also, estimating arc length, curvature, tangent vector, etc.

CO4 Determining the directional derivatives for both scalar and vector point functions.

CO5 Understand quadratic forms, hessian criterion, compact sets, extreme value theorem.

CO6 Understands the definition of double integrals and evaluation technique to integrate functions of two variables in Cartesian and Polar coordinate systems.

CO7 Can apply the double integrals to evaluate Volume, Mass, Area, C.G. and M.I.

CO8 Can apply the concept of change the order of integration and change of variables to evaluate double integrals.

CO9 Understands the concept of line integral with evaluation technique when integrand is a Vector point function / Scalar point function, and evaluate when integration is an independent of choice of path.

CO10 Understands the relation between double and line integrals as a Green's Theorem and can apply the concept of line integral to find out Work done, Mass, Length of curve, Area etc.

CO11 To be able to understand the concept the measure, outer measure, Lebesgue Measure, Measurable functions and their properties and use the concepts of measurable sets and measurable functions.

CO12 To be able to understand the integration of a measurable function over a measurable set.

Unit No.	Topic	Contact Hours	Weightage (%)	BT Level	CO	PSO	Elements of Employability (Emp)/ Entrepreneurship (Ent)/ Skill Development (SD)	Relevance to Local (L)/ National (N)/ Regional (R)/Global (G)	Relation to Gender (G), Environment and Sustainability (ES), Human Values (HV)and Professional Ethics (PE)
1	Differentiation for multi-variable functions and its applications • Functions of several variables • Domain, Co-domain, Range • Graphs of functions and their component functions • Partial differentiation, higher order partial derivative, Composite function • Taylor's expansion, Error and Approximation, Jacobians	09	19%	1,2,3,4,5	CO1, CO2	PSO1, PSO2, PSO4, PSO5, PSO9	EMP	G	PE
2	Vector calculus • Vector Algebra introduction • Parameterized curves; Kepler's laws of planetary motion • Functions as paths or parameterized curves • Velocity, Speed, and Acceleration • Arc length, Curvature • Length of a path as an integral • Unit tangent vector, curvature of a path or curve • Vector Fields • Functions as scalar field • Functions as vector field • The second-order formula and the Hessian • Del operated on scalar and vector field • directional derivatives	10	21%	1,2,3,4,5	CO3, CO4	PSO1, PSO2, PSO4, PSO5, PSO9			

3	Maxima and minima (extrema) of functions • Critical points and the Hessian criterion • Quadratic forms, positive definite forms • The second derivative test for extrema if scalar-valued functions • Compact sets, the Extreme Value Theorem(EVT)	05	10%	1,2,3,4,5	CO5	PSO1, PSO2, PSO4, PSO5, PSO9			
4	Double integrals • Double integrals over rectangles defined as Riemann sums integrability • Conditions for integrability • Fubini's theorem, linearity of integrals, other basic properties • Double integral over general region • Changing order of integration	07	15%	1,2,3,4,5	CO6 CO7 CO8	PSO1, PSO2, PSO4, PSO5, PSO9			
5	Change of variables • Transformation of the plane • Linear Transformations and their expansion factors • Change of variable in definite integrals of one variable • Change of variable for double integrals, Jacobians • Double integral in polar co-ordinates • Application of double integral. Theory of integration • Riemann Integral Theorem • Line Integral	09	19%	1,2,3,4,5	CO8 CO9 CO10	PSO1, PSO2, PSO4, PSO5, PSO9			
6	Theory of measures and Lebesgue integrals • Algebra of sets, Borel sets, Lebesgue measure of linear set • Outer measure, Measurable Sets, Measurable Functions • Lebesgue Integral	08	16%	1,2,3,4,5	CO11 CO12	PSO1, PSO2, PSO4, PSO5, PSO9			

Reference Books

1.	H.L. Raydon: Real Analysis
2.	Michael D. Greenberg: Advanced Engg Mathematics

Bloom's Taxonomy Levels: 1. Remember 2. Understand 3. Application 4. Analysis 5. Evaluation 6. Creation

Program Specific Outcomes for M.Sc.(Financial Mathematics)

PSO1. Solve mathematical problems using analytical methods as well as advanced numerical, statistical and optimization methods.

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Syllabus of Courses

The Maharaja Sayajirao University of Baroda **Faculty Technology and Engineering** **Department of Applied Mathematics**		**Academic Year**	**2019-20**
M.Sc. (Financial Mathematics): Higher Payment Program			
Year	**I**	**Core / ~~Elective / Foundation~~** **Fundamentals of statistics (AMT2112)**	**Credits / Hours per week**	**04**
Semester	**I**	Year of Introduction: 2010 Year of Syllabus Revision: 2016	**Maximum Marks / Grade**	**100**
Mode of Transaction		Lecture		

Course Outcome (CO) (AMT2112)

CO1: Implement how to translate uncertainty problems into probability models and will apply it directly in areas such as genetics, finance, telecommunications and biomathematics.
CO2: Demonstrate the ability to analyze data by appropriately fitting, assessing, and interpreting a variety of statistical models.
CO3: Demonstrate an understanding of the basic concepts of probability theory related to stochastic event.
CO4: Understand the concept of the sampling distribution of a statistic, and in particular describe the behaviour of the sample mean.
CO5: Understand the foundations for classical inference and describe properties of the sampling distribution of the sample mean in general situations.
CO6: Able to compute probabilities using discrete and continuous distributions.
CO7: Understand moments and moment generating functions of random variable.
CO8: Demonstrate an appreciation of one—way analysis of variance (ANOVA).
CO9 : Describe and verify mathematical considerations for analyzing time series.

Unit No.	**Topic**	**Contact Hours**	**Weightage (%)**	**BT Level**	**CO**	**PSO**	**Elements of** Employability (Emp)/ Entrepreneurship (Ent)/ Skill Development (SD)	**Relevance to** Local (L)/ National (N)/ Regional (R)/Global (G)	**Relation to** Gender (G), Environment and Sustainability (ES), Human Values (HV)and

									Professional Ethics (PE)
1	Illustrating the importance of statistics in a variety of fields, including medicine and the biological, physical, and social sciences, Structure of data sets, Histograms, Means and Standard Deviations	07	14	1,2,3,6	CO1, CO2	PSO1, PSO3, PSO4, PSO10			
2	Correlation and Regression analysis, Central Limit theorem and its applications	08	17	2,3,4,5	CO2, CO4	PSO1, PSO4, PSO5			
3	Elementary concepts of hypothesis testing, estimation, confidence intervals, t-test and chi-square tests, Linear regression theory and the analysis of variance.	09	19	2,3,4,5	CO2, CO4, CO5, CO8	PSO1, PSO4, PSO10			
4	Fundamentals of probability: probability space and measure, algebras and sigma-algebras, conditional probability, dependence and independence, Baye's theorem.	08	17	2,3,4,5	CO3, CO6, CO7	PSO1, PSO5	Emp	G	ES
5	Random variables, probability distribution, Expectation theory, variance, covariance, moments and moments generating function, Introduction to basic Discrete and Continuous Distribution.	10	20	2,3,4,5	CO6, CO7	PSO1, PSO3, PSO4			
6	Time series analysis Utility of time series analysis Components of time series Measurement of trends Measurement of seasonal variations Measurement of cyclical variations Measurement of irregular variations	06	13	2,3,4,5	CO2, CO9	PSO1, PSO3, PSO5, PSO10			

Reference Books

1.	Statistics, Freedman, Pisani, and Purves, 3rd Edition. New York: W. W. Norton and Co., Inc, 1998
2.	Fundamentals of Statistics, Goon A M, Gupta M K, Dasgupta B, Volume 1 and 2.
3.	Introduction to Modern Time series analysis by Gebhard Kirchgassner, Jurgon Wolters.
4.	Statistical methods, S.P.Gupta, Sultan Chand and Sons.

Bloom's Taxonomy Levels: 1. Remember 2. Understand 3. Application 4. Analysis 5. Evaluation 6. Creation

Programme Name: MSc. (Financial Mathematics)

Programme Specific Outcome (PSO)

PSO1. Solve mathematical problems using analytical methods as well as advanced numerical, statistical and optimization methods.

PSO2. Assimilate complex mathematical ideas and arguments.

PSO3. Recognize the relationships between different areas of Mathematics and financial market and the connections between Mathematics used in finance with various disciplines.

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PSO5. Demonstrate basic mathematical understanding and computational skills and apply appropriate software to solve practical problems.

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PSO8. Build, Manage and Lead a team to successfully complete financial mathematics project and communicate across teams and organizations to achieve professional objectives.

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Syllabus of Courses

	The Maharaja Sayajirao University of Baroda **Faculty Technology and Engineering** **Department of Applied Mathematics**	**Academic Year**	**2019-20**

M.Sc. (Financial Mathematics): Regular Programme

Year	**I**	**Core / ~~Elective / Foundation~~** **AMT2112L: Practicals on Fundamentals of Statistics**	**Credits / Hours per week**	**02**
Semester	**I**	Year of Introduction: 2010 Year of Syllabus Revision: 2016	**Maximum Marks / Grade**	**50**
Mode of Transaction		Term Work, Practical and Viva		

Course Outcome (CO) (AMT2112)

CO1: Implement how to translate uncertainty problems into probability models and will apply it directly in areas such as genetics, finance, telecommunications and biomathematics.
CO2: Demonstrate the ability to analyze data by appropriately fitting, assessing, and interpreting a variety of statistical models.
CO3: Demonstrate an understanding of the basic concepts of probability theory related to stochastic event.
CO4: Understand the concept of the sampling distribution of a statistic, and in particular describe the behaviour of the sample mean.
CO5: Understand the foundations for classical inference and describe properties of the sampling distribution of the sample mean in general situations.
CO6: Able to compute probabilities using discrete and continuous distributions.
CO7: Demonstrate an appreciation of one—way analysis of variance (ANOVA).
CO8 : Describe and verify mathematical considerations for analyzing time series.

No.	**Programs**		**Course Code**	**BT Level**	**CO**	**PSO**
1	Classification of Data		AMT2112L	2	CO1, CO2	PSO5,PSO6
2	Representation of Data			2,3	CO1, CO2	
3	Measures of Central Tendency			2,3	CO1, CO2	
4	Measures of Dispersion			2,3	CO1, CO2	
5	Correlation Analysis			2,3,4	CO1, CO2	
6	Rank Correlation Analysis			2,3,4	CO1, CO2	
7	Regression Analysis			2,3,4	CO1,	

					CO2	
8	Probability Distribution			2,3,4	CO3, CO6	
9	Hypothesis Testing			2,3,4	CO4, CO5	
10	Analysis of Variance			2,3,4	CO7	
11	Time Series Analysis – I			2,3,4	CO1, CO8	
12	Time Series Analysis – II			2,3,4	CO1, CO8	

Bloom's Taxonomy Levels: 1. Remember 2. Understand 3. Application 4. Analysis 5. Evaluation 6. Creation

Programme Specific Outcomes for M.Sc.(Financial Mathematics)

PSO1. Solve mathematical problems using analytical methods as well as advanced numerical, statistical and optimization methods.
PSO2. Assimilate complex mathematical ideas and arguments.
PSO3. Recognize the relationships between different areas of Mathematics and financial market and the connections between Mathematics used in finance with various disciplines.
PSO4. Give organized written and verbal explanations of mathematical reasoning in a precise and articulate manner.
PSO5. Demonstrate basic mathematical understanding and computational skills and apply appropriate software to solve practical problems.
PSO6. Demonstrate facility in computer programming, data processing, numerical simulation, scientific visualization, and virtual experimentation.
PSO7. Select appropriate methods for solving differential equations which is arising in Mathematical modelling of financial problem.
PSO8. Build, Manage and Lead a team to successfully complete financial mathematics project and communicate across teams and organizations to achieve professional objectives.
PSO9. Formulation of mathematical models and simulation of the problems in real world.
PSO10. Inculcate their skills to deal with problems arising in stock market as well as in financial institutions.
PSO11. Hands-on practice for self preparation and developing presentation skills through project and seminar.
PSO12. Training and Exposure to research literature and thesis writing through project.
PSO13. Serve financial markets by efficient allocation of investment of individuals to the most productive sectors of the economy.
PSO14. Able to provide an avenue for corporate to raise capital for productive ventures.
PSO15. Use underlying mathematical ideas for innovations in financial derivatives and ingenuity in pricing and in creating an insurance or hedge against associated risks.

Syllabus of Courses

	The Maharaja Sayajirao University of Baroda **Faculty Technology and Engineering** **Department of Applied Physics**	**Academic Year**	**2019-20**

M.Sc. (Financial Mathematics): Regular Programme

Year	**I**	**Core / ~~Elective / Foundation~~** **AMT 2113: Scientific Computing and Mathematical Software**	**Credits / Hours per week**	**04**
Semester	**I**	Year of Introduction: 2016 Year of Syllabus Revision:	**Maximum Marks / Grade**	**100**
Mode of Transaction		Lectures		

Course Outcome (CO) AMT 2113

CO1 Learn about the flowchart and design an algorithm for a given problem and to develop simple C – programs using operators.
CO2 Study about Conditional and Iterative statements which are available in C – language.
CO3 Learned about the importance and use of Arrays and Functions in C – language.
CO4 Learned about Strings, Pointers, Structures, Unions and Command Line Arguments.
CO5 Understand the concepts like File Handling in C-language.
CO6 Design real life financial problems and think creatively and provide a program giving solutions.
CO7 Apply a solution clearly and accurately in a program using matlab.
CO8 Apply the programming and spreadsheet skills for the best features of financial mathematics dealing real life problems.

Unit No.	**Topic**	**Contact Hours**	**Weightage (%)**	**BT Level**	**CO**	**PSO**	**Elements of** Employability (Emp)/ Entrepreneurship (Ent)/ Skill Development (SD)	**Relevance to** Local (L)/ National (N)/ Regional (R)/Global (G)	**Relation to** Gender (G), Environment and Sustainability (ES), Human Values (HV)and Professional Ethics (PE)
1	Algorithms: Definition and properties, developing well-known algorithms, flow-charting. Programming languages: machine	04	8.34	1,2	CO1	PSO5	SD	G	PE

	language, assembly language, High-lever languages, assemblers, compilers and interpreters.								
2	Programming preliminaries: Structure of program, Basic data types: int, float, char, double, Constants and variables, variable declaration. Input/Output of basic data types. Arithmetic operators, relational operators, logical operators, expression, precedence and order of execution, the assignment operator.	10	20.83	1,2,3	CO2 CO3	PSO6 PSO7			
3	Control structures, if, else, else if, switch, while loop, for loop, do… while loop, break and continue statements. Arrays- one dimensional and two-dimensional arrays, their internal representation benefits of using arrays. Input/Output operations on files. User defined functions: Defining and calling functions, Advance programming features	10	20.83	1,2,3,6	CO2 CO3 CO4 CO5	PSO6 PSO6			
4	MATLAB: Essentials of Matlab, Vectors, Matrices, and the colon operator, M files: Scripts and functions, Input and Output.	10	20.83	2,3,5,6	CO6 CO7	PSO5 PSO6 PSO7			
5	Graphics, Control structure and Logical Tests, Symbolic Math Toolbox, Advanced Matlab features.	10	20.83	1,2,3,4	CO6 CO7	PSO5 PSO6 PSO7			
6	Essentials of Excel, testing in Excel, Advance Excel features. Other Financial Softwares:	4	8.34	2,4,5,6	CO8	PSO6			

Reference Books

1.	J. N. Kapur: Mathematical modeling, Wiley eastern Ltd., 1994.
2.	M. M. Gibbons: A concrete approach to Mathematical modeling, John Wiley and sons, 1995.

Bloom's Taxonomy Levels: 1. Remember 2. Understand 3. Application 4. Analysis 5. Evaluation 6. Creation

Programme Name: MSc. (Financial Mathematics)

Programme Specific Outcome (PSO)

PSO1. Solve mathematical problems using analytical methods as well as advanced numerical, statistical and optimization methods.

PSO2. Assimilate complex mathematical ideas and arguments.

PSO3. Recognize the relationships between different areas of Mathematics and financial market and the connections between Mathematics used in finance with various disciplines.

PSO4. Give organized written and verbal explanations of mathematical reasoning in a precise and articulate manner.

PSO5. Demonstrate basic mathematical understanding and computational skills and apply appropriate software to solve practical problems.

PSO6. Demonstrate facility in computer programming, data processing, numerical simulation, scientific visualization, and virtual experimentation.

PSO7. Select appropriate methods for solving differential equations which is arising in Mathematical modelling of financial problem.

PSO8. Build, Manage and Lead a team to successfully complete financial mathematics project and communicate across teams and organizations to achieve professional objectives.

PSO9. Formulation of mathematical models and simulation of the problems in real world.

PSO10. Inculcate their skills to deal with problems arising in stock market as well as in financial institutions.

PSO11. Hands-on practice for self preparation and developing presentation skills through project and seminar.

PSO12. Training and Exposure to research literature and thesis writing through project.

PSO13. Serve financial markets by efficient allocation of investment of individuals to the most productive sectors of the economy.

PSO14. Able to provide an avenue for corporate to raise capital for productive ventures.

PSO15. Use underlying mathematical ideas for innovations in financial derivatives and ingenuity in pricing and in creating an insurance or hedge against associated risks.

Syllabus of Courses

	The Maharaja Sayajirao University of Baroda **Faculty Technology and Engineering** **Department of Applied Mathematics**	**Academic Year**	**2019-20**

M.Sc. (Financial Mathematics): Regular Programme

Year	**I**	**Core / ~~Elective / Foundation~~** **AMT 2113L: Practicals on Scientific Programming and Mathematical Softwares**	**Credits / Hours per week**	**02**
Semester	**I**	Year of Introduction: 2010 Year of Syllabus Revision: 2016	**Maximum Marks / Grade**	**50**
Mode of Transaction		Term Work, Practical and Viva		

Course Outcome (CO) (AMT2113L)

CO1 Learn about the simple introduction related to simple C – programs.

CO2 Programming related to Conditional and Iterative statements which are available in C – language.

CO3 Programming related to use of Arrays and Functions in C – language.

CO4 Programming related to numerical methods in C-Language.

CO5 Learn about the simple introduction related to MATLAB.

CO6 Learn about plotting different Graphs in MATLAB.

CO7 Programming related to Conditional and Iterative statements which are available in MATLAB.

CO8 Programming related to numerical methods in MATLAB.

No.	**Programs**		**Course Code**	**BT Level**	**CO**	**PSO**
1	Introduction of Mathematical softwares C-Program and MATLAB.		AMT 2113L	2	CO1,	PSO5,PSO6

					CO5	
2	MATLAB: Basic inbuilt commands and functions of Vectors. C-Language: Basic programs related to printing simple statements and mathematical calculations.			2,3	CO1, CO5	
3	MATLAB: Basic commands related to Matrices and its various operations, Commands related to Complex numbers C-Language: Programs related to data types and input values by user.			2,3	CO2, CO5	
4	MATLAB: Basic command for 2D – plotting.. C-language: Execution of various operators in programming.			2,3	CO2, CO6	
5	MATLAB: Basic programs related to execution of function and Script files. C-Language: Program related to basic structures and execution of if-else and nested if-else condition.			2,3,4	CO2 CO7	
6	MATLAB: Program related to basic structures and various operators. C-Language: Program related to switch-case statements.			2,3,4	CO2, CO7	
7	MATLAB: Symbolic toolbox and various advanced feature related to matlab.			2,3,4	CO2, CO7	

	C-Language: Program related to while loop and do-while loop.					
8	MATLAB: Program related to basic structures and execution of if-else and nested if-else condition. C-Language: Program related to for loop, break and continue statements.			2,3,4	CO2, CO7	
9	MATLAB: Program related to while and do-while loops. C-Language: Program related to one dimensional arrays.			2,3,4	CO2, CO7	
10	MATLAB: Program related to for loop. C-Language: Program related to two dimensional arrays.			2,3,4	CO3, CO7	
11	MATLAB: Program related to numerical methods. C-Language: Program related to numerical methods.			2,3,4	CO3, CO8	
12	MATLAB: Program related to numerical methods by using function files C-Language: Programs related to input/output functions on file.			2,3,4	CO4, CO8	

Bloom's Taxonomy Levels: 1. Remember 2. Understand 3. Application 4. Analysis 5. Evaluation 6. Creation

Programme Name: MSc. (FinancialMathematics)

Programme Specific Outcome(PSO)

PSO1. Solve mathematical problems using analytical methods as well as advanced numerical, statistical and optimization methods.

PSO2. Assimilate complex mathematical ideas and arguments.

PSO3. Recognize the relationships between different areas of Mathematics and financial market and the connections between Mathematics used in finance with various disciplines.

PSO4. Give organized written and verbal explanations of mathematical reasoning in a precise and articulate manner.

PSO5. Demonstrate basic mathematical understanding and computational skills and apply appropriate software to solve practical problems.

PSO6. Demonstrate facility in computer programming, data processing, numerical simulation, scientific visualization, and virtual experimentation.

PSO7. Select appropriate methods for solving differential equations which is arising in Mathematical modelling of financial problem.

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PSO12. Training and Exposure to research literature and thesis writing through project.

PSO13. Serve financial markets by efficient allocation of investment of individuals to the most productive sectors of the economy.

PSO14. Able to provide an avenue for corporate to raise capital for productive ventures.

PSO15. Use underlying mathematical ideas for innovations in financial derivatives and ingenuity in pricing and in creating an insurance or hedge against associated risks.

Syllabus of Courses

The Maharaja Sayajirao University of Baroda **Faculty Technology and Engineering** **Department of AppliedMathematics**		**Academic Year**	**2019-20**
M.Sc. (Financial Mathematics): Regular Programme			
Year	**I**	**Core / ~~Elective / Foundation~~** **AMT2114:Differential Equations**	**Credits / Hours per week**	**04**
Semester	**I**	Year of Introduction:2010 Year of Syllabus Revision: 2016	**Maximum Marks / Grade**	**100**
Mode of Transaction		Lectures and Tutorials		

Course Outcome (CO) AMT2114

CO1 Identify homogeneous, exact and linear differential equations of first order.

CO2 Identify homogeneous equations with constant coefficients and variable coefficients of Higher order differential equations.

CO3 Be able to implement analytical method to solve differential equation.

CO4 Analyze real-world problems in fields such as Biology, Chemistry, Economics, Engineering, and Physics, including problems related to population dynamics, mixtures, growth and decay, heating and cooling, electronic circuits, and Newtonian mechanics.

CO5 Determine Laplace transforms and inverse Laplace transforms of Heaviside (unit step) function and Dirac Delta function.Apply the Convolution Theorem to obtain inverse Laplace transforms.

CO6 Classification, mathematical modelingand solution of the hyperbolic, parabolic and elliptic equations. Analytical solution of these equations using Fourier Transform, Laplace Transform and separable variable techniques.

Unit No.	**Topic**	**Contact Hours**	**Weightage (%)**	**BT Level**	**CO**	**PSO**	**Elements of** Employability (Emp)/ Entrepreneurship (Ent)/ Skill Development (SD)	**Relevance to** Local (L)/ National (N)/ Regional (R)/Global (G)	**Relation to** Gender (G), Environment and Sustainability (ES), Human Values (HV)and Professional Ethics(P

									E)
1	**First Order Differential Equations:** Direction fields, integral curves, Explicit methods for solving separable, homogeneous, linear exact equations and some special types such as Bernoulli, Second order equations which can be reduced to first order, Elementary applications of first order equations; exponential growth and decay, population, mixing problems.	10	21	1,2,5	CO1, CO3	PSO1, PSO2 PSO7	Emp	G	PE
2	**Linear Second Order Differential Equations:** Linear dependence and independence of solutions; the Wronskian, Linear homogeneous equations with constant coefficients, Non-homogeneous linear equations and the method of reduction of order, Undetermined coefficients, variation of parameters.	10	21	1,2,5	CO2, CO3	PSO1, PSO2 PSO7			
3	**Applications of Linear Second order Differential Equations:** Harmonic linear oscillators, Electrical circuits, Forced vibrations.	4	08	1,2,3,4,5	CO3, CO4	PSO1, PSO2 PSO7			
4	Laplace Transforms: Delta functions and impulse forcing.Convolutions.	8	17	2, 3, 5	CO5				
5	Introduction to PDE: Mathematical Modeling through Parabolic PDE, Dirichlet, Neumann and Robin condition, well-posed problem. Parabolic equation: Analytical solution using Fourier Transform, Laplace Transform and separable variable approach	16	33	2, 3, 5, 6	CO6	PSO1 PSO7 PS09			
Reference Books									
1	Elementary differential equations and boundary value problems, Eighth edition, by William E. Boyce and Richard C. DiPrima								

Bloom's Taxonomy Levels: 1. Remember 2. Understand 3. Application 4. Analysis 5. Evaluation 6. Creation

Program Specific Outcomes for M.Sc.(Financial Mathematics)

PSO1. Solve mathematical problems using analytical methods as well as advanced numerical, statistical and optimization methods.

PSO2. Assimilate complex mathematical ideas and arguments.

PSO3. Recognize the relationships between different areas of Mathematics and financial market and the connections between Mathematics used in finance with various disciplines.

PSO4. Give organized written and verbal explanations of mathematical reasoning in a precise and articulate manner.

PSO5. Demonstrate basic mathematical understanding and computational skills and apply appropriate software to solve practical problems.

PSO6. Demonstrate facility in computer programming, data processing, numerical simulation, scientific visualization, and virtual experimentation.

PSO7. Select appropriate methods for solving differential equations which is arising in Mathematical modelling of financial problem.

PSO8. Build, Manage and Lead a team to successfully complete financial mathematics project and communicate across teams and organizations to achieve professional objectives.

PSO9. Formulation of mathematical modelsand simulation of the problems in real world.

PSO10. Inculcate their skills to deal with problems arising in stock market as well as in financial institutions.

PSO11. Hands-on practice for self preparation and developing presentation skills through project and seminar.

PSO12. Training and Exposure to research literature and thesis writing through project.

PSO13. Serve financial markets by efficient allocation of investment of individuals to the most productive sectors of the economy.

PSO14. Able to provide an avenue for corporate to raise capital for productive ventures.

PSO15. Use underlying mathematical ideas for innovations in financial derivatives and ingenuity in pricing and in creating an insurance or hedge against associated risks.

Syllabus of Courses

The Maharaja Sayajirao University of Baroda **Faculty Technology and Engineering** **Department of AppliedMathematics**		**Academic Year**	**2019-20**
M.Sc. (Financial Mathematics): Higher Payment Program			
Year	**I**	**Core / ~~Elective / Foundation~~** **Stochastic Methods in Finance (AMT 2115)**	**Credits / Hours per week**	**04**
Semester	**I**	Year of Introduction: 2010 Year of Syllabus Revision: 2016	**Maximum Marks / Grade**	**100**
Mode of Transaction		Lecture		

Course Outcome

CO1: Understanding and simulation of random behavior of assets.
CO2: Develop the concept of random walk and Brownian motion.
CO3: Develop understanding of properties of Brownian motion, martingale, normality etc.
CO4: Introduce the concept of stochastic / ito calculus.
CO5: Introduce to stochastic differential equations and various models for asset prices.
CO6: Introduction of the Black Scholes Theory
CO7: Introduction to various financial instruments, assets and derivatives.
CO8: Develop the concept of Options and their pricing.

Unit No.	Topic	Contact Hours	Weightage (%)	BT Level	CO	PSO	Elements of Employability (Emp)/ Entrepreneurship (Ent)/ Skill Development (SD)	Relevance to Local (L)/ National (N)/ Regional (R)/Global (G)	Relation to Gender (G), Environment and Sustainability (ES), Human Values (HV)and Professio

									nal Ethics (PE)
1	• Random behavior of Assets • Stochastic processes in discrete time; random walk and the Poisson process. • Continuous time extensions of discrete concepts.	07	14	1,2,4	CO1	PSO3, PSO4, PSO9	Emp	G	ES
2	• Discrete time martingales, sub-martingales, super-martingales, stopping time and related results. • Brownian motion, Brownian motion as a limit of a symmetric random walk, properties of Brownian motion.	08	17	1,2,4	CO2, CO3	PSO3 PSO4,			
3	• Informal overview of Ito calculus: stochastic integrals, Ito formula, stochastic differential equations.	09	19	1,2,4	CO4, CO5	PSO3, PSO4, PSO7			
4	• Applications of calculus in finance: Black-Scholes equation and Black-Scholes formula.	08	17	1,2,4	CO6	PSO3 PSO4, PSO7			
5	• Introduction, The Time Value of money, Financial Instruments like Equities, Commodities, Currencies, Indices, Fixed – Income securities, Inflation proof bonds, Forwards and Futures.	10	20	1,2,3,4	CO7	PSO3 PSO4,			
6	• Introduction to options, Definitions, Writing options, The value of option before expiry, Put – call parity, Value of options, Market Conventions	06	13	1,2,3,4	CO7, CO8	PSO3 PSO4,			

Reference Books

1.	Paul Wilmott, Derivatives: The theory and practice of financial engineering, Jhon Wiley and Sons 1998.
2.	M. Capinski and T. Zastawnaik, Mathematics for Finance: An Introduction to Financial Engineering, Springer 2003.
3.	M. Capinski and T. Zastawnaik, Probability Through Problems, Springer 2001.
4.	Z. Brzezniak and T. Zastawniak, Basic Stochastic Processes, Springer 1999.
5.	OKSENDAL, Bernt, Stochastic Differential Equations: an introduction with applicaitons, Springer-Verlag, 1998.

Bloom's Taxonomy Levels: 1. Remember 2. Understand 3. Application 4. Analysis 5. Evaluation 6. Creation

Program Specific Outcomes for M.Sc.(Financial Mathematics)

PSO1. Solve mathematical problems using analytical methods as well as advanced numerical, statistical and optimization methods.

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PSO12. Training and Exposure to research literature and thesis writing through project.

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PSO14. Able to provide an avenue for corporate to raise capital for productive ventures.

PSO15. Use underlying mathematical ideas for innovations in financial derivatives and ingenuity in pricing and in creating an insurance or hedge against associated risks.

	The Maharaja Sayajirao University of Baroda **Faculty Technology and Engineering** **Department of Applied Mathematics**	**Academic Year**	**2019-20**

M. Sc. (Financial Mathematics)

Year	**II**	**Core / ~~Elective / Foundation~~** **Stochastic Methods in Finance (AMT 2115)**	**Credits / Hours per week**	**02**
Semester	**III**	Year of Introduction: 2010 Year of Syllabus Revision: 2016	**Maximum Marks / Grade**	**50**
Mode of Transaction		Term Work, Practical and Viva		

Course Outcome (CO)

CO1: Introduction to various financial instruments, assets and derivatives.
CO2: Understanding and simulation of random behavior of assets.
CO3: Develop the concept of random walk and Brownian motion.
CO4: Introduce the concept of stochastic / ito calculus.
CO5: Introduce to stochastic differential equations and various models for asset prices.
CO6: Develop the concept of Options and their pricing.
CO7: Introduction of the Black Scholes Theory

No.	Programs		Course Code	BT Level	CO	PSO
1	Introduction to Various equity based financial instruments-1		AMT2325L	1,2,3,4,5	CO1	PSO3 PSO5 PSO6 PSO7 PSO9 PSO14
2	Introduction to Various equity based financial instruments-2			1,2,3,4,5	CO1	
3	Calculation of future returns using the programming.			1,2,3,4,5	CO2	
4	Simulation of random variable generations using programming.			1,2,3,4,5	CO3	
5	Program to find various parameter like drift and volatility using programming.			1,2,3,4,5	CO3	
6	Introduction to fixed income financial instruments.			1,2,3,4,5	CO1	
7	Examples on stochastic integration.			1,2,3,4,5	CO4	
8	Examples on stochastic differential equations.			1,2,3,4,5	CO5	
9	Basics of various options of the financial market-1			1,2,3,4,5	CO6	
10	Basics of various options of the financial market-2			1,2,3,4,5	CO6	
11	Mathematical modelling of Black-Scholes equation.			1,2,3,4,5	CO7	
12	Simulation of payoff using programming.			1,2,3,4,5	CO7	

	The Maharaja Sayajirao University of Baroda **Faculty Technology and Engineering** **Department of Applied Physics**		**Academic Year**	**2019-20**
M.Sc. (Financial Mathematics): Regular Programme				
Year	**II**	**Core / ~~Elective / Foundation~~** **AMT2401L:** **MATHEMATICAL FINANCE DISSERTATION/PROJECT**	**Credits / Hours per week**	**04**
Semester	**I**	Year of Introduction: 2007 Year of Syllabus Revision: 2012	**Maximum Marks / Grade**	**100**
Mode of Transaction				

1. Construction of martingale pricing measures by maximizing entropy
2. Continuous time limit of the binomial model
3. Estimating volatility using ARCH models
4. Optimal investments using utility functions
5. Real options
6. Mean-VaR portfolio theory
7. Liquidity risk by means of VaR
8. Valuation of companies using real options
9. Coherent risk measures
10. Capital structure
11. Optimal portfolios in Heath-Jarrow-Morton model
12. Conditional Value at Risk
13. Applications of change of numeraire for option pricing
14. Copulas in finance
15. Single factor short rate models
16. Modeling credit risk – structural approach
17. Credit risk – reduced form approach

18. Credit risk – probabilities of default
19. Stochastic backward equations in finance
20. Computer simulations of interest rate models
21. Stochastic differential delay equations in finance
22. Methods of designing pension schemes
23. Fundamental theorem of asset pricing and its extensions
24. Implied volatility, volatility smile, stochastic volatility
25. Complete market models implied by call options
26. Monte Carlo valuation of American type derivative securities
27. Microscopic simulation of the stock market
28. Pricing weather derivatives by utility maximization
29. Arbitrage pricing of mortgage-backed securities
30. Computer implementation of finite-difference option pricing schemes
31. Construction of life table, Creation of premium table for hypothetical life insurance plan
32. Pension mathematics
33. Advance security analysis and portfolio management
34. Sharpe's Ratio