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

Programme Name: MSc. (Applied Mathematics)

Programme Specific Outcome (PSO)

PSO1. Solve mathematical problems using analytical as well as numerical methods.
PSO2. Assimilate complex mathematical ideas and arguments.
PSO3. Recognize the relationships between different areas of Mathematics and the connections between Mathematics and other 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.
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PSO7. Implement various algorithms using advanced Object Oriented Programming languages.
PSO8. Demonstrate facility in computer programming, data processing, numerical simulation, scientific visualization, and virtual experimentation.
PSO9. Describe the study of fundamental and advanced concepts in Mathematical Analysis.
PSO10. Select appropriate methods for solving ordinary and partial differential equations which is arising in Mathematical modelling of problem.
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PSO17. Electives in the final year which elaborate prerequisite of the research field.
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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. (Applied Mathematics): Regular Programme

Year	**I**	**Core / ~~Elective / Foundation~~** **AMT2110: APPLIED ANALYSIS-I**	**Credits / Hours per week**	**05**
Semester	**I**	Year of Introduction: 2001 Year of Syllabus Revision: 2014	**Maximum Marks / Grade**	**100**
Mode of Transaction		Lectures		

Course Outcome (CO) AMT2110

CO1 Understand the limitations of functions of real variables and importance of studying functions of complex variables and its applications in physical phenomenon.
CO2 Learn about the exploration of the algebraic operations on the complex number along with geometry in argand diagram.
CO3 Able to apply continuity, differentiability, analyticity of f(z) in particular domain.
CO4 Learn about the harmonic and harmonic conjugate functions and able to apply potential theory.
CO5 Understand the mapping / transformation and able to plot image in w-plane.
CO6 Able to evaluate any complex integral using theory of Cauchy's.
CO7 Classify different types of singularities and be able to apply residue theory to evaluate integrals.
CO8 Able to describe the ideas of Laplace Transforms and their applications to solve initial and boundary value 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	Functions of complex variable, Continuity and Differentiability of function of complex variable, necessary and sufficient conditions for differentiability of f(z), Holomorphic and Homomorphic functions, Elementary properties of holomorphic functions, Harmonic functions and its applications to potential theory.	12	20	1,2,4,5	CO2 CO3 CO4	PSO2 PSO4 PSO5 PSO16	EMP	G	PE
2	Mapping and transformations: Linear transformation,I nversion and Linear fractional transformation, Conformal mapping and its applications, Mapping by elementary functions and some special functions.	08	14	2,3,5	CO5	PSO1 PSO5 PSO9 PSO16			
3	Complex Integrals: contour and contour integrals, different theorems due to Cauchy, Consequences of Cauchy's theorems, Morera's theorem. Liouville's Theorem, Maximum modulus theorem, Fundamental theorem of algebra.	12	20	2,3,4,5	CO1 CO6	PSO2 PSO4 PSO9 PSO16			
4	Power series representations of f(z)	08	14	1,2,5	CO1	PSO1 PSO5			
5	Singularities and Residues of f(z), Residue theorem. Applications of residue theory.	08	14	1,3,5	CO7	PSO1 PSO4 PSO16			
6	Reorientation of Laplace Transform and Inverse Laplace transforms, Existence theorem of Laplace Transform, Laplace Transform of Heaviside function and its applications, step functions, Unit impulse function, Laplace transform of Dirac's Delta function and Periodic function, Applications of Laplace transform to ODE (involving Heaviside function and Dirac delta function), PDE and Integral equations, Inversion integral.	12	20	1,2,3,5	CO8	PSO1 PSO5 PSO7 PSO10			

Reference Books

1.	R. V. Churchill and James Ward Brown: Complex Variables and Applications, McGraw-Hill, Inc (VI Edition).
2.	John H. Mathews and Russel Howell: Compex Analysis for Mathematics and Engineering, Narosa Publishing house.
3.	Murray R. Spiegel: Theory & problems of Compex Analysis, McGraw-Hill Co. (Metric Editions).
4.	Serge Lang: Complex Analysis, (Third Edition), Springer.
5.	R. V. Churchill : Operational Mathematics.

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

Programme Name: MSc. (Applied Mathematics)

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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. (Applied Mathematics): Regular Programme

Year	**I**	**Core / ~~Elective / Foundation~~** **AMT2123: Linear Algebra and Calculus of Variation**	**Credits / Hours per week**	**05**
Semester	**I**	Year of Introduction: 2014	**Maximum Marks / Grade**	**100**
Mode of Transaction		Lectures		

Course Outcome (CO) AMT2123

CO1: Understands and implement the concept of diagonalization to find out solution of system of linear differential equations using exponential of a matrix.
CO2: Introduces properties of different types of operators.
CO3: Understands the Cayley-Hamilton theorem for operators and Jordan Canonical form for $n \times n$ matrices.
CO4: Can analyze the stability of linear systems.
CO5: Able to apply the theory of eigenvalues and eigenvectors to Spectral theorem and Quadratic forms.
CO6:Understand what functionals are, derive and use the Euler-Lagrange equation to find differential equations for stationary paths
CO7: Solve differential equations for stationary paths, subject to boundary conditions, in straightforward cases.

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	Revision of basic concepts of vector spaces Real world problems leading to a linear systems	16	27	1,2,3	CO1 CO2	PSO2 PSO3	Emp	G	PE

	Linear Operators, Eigen values and eigen vectors of an operator and its applications. Diagonalization of an operator and of matrices Matrix exponential Solution of system of linear differential equations Operations on Linear transformations, Its norm, Hermitian adjoint of an Operator, Hermitian , Unitary , normal and compact operators					PSO16	SD		
2	Cayley-Hamilton theorem Existence and uniqueness of operator equations, Jordan Canonical form of matrices Stability and convergence issues of linear systems: Ill condition systems, condition numbers-computations and properties, stability of linear systems, Pre- conditioning of systems	12	20	2,3,4	CO3 CO4	PSO3 PSO5 PSO9			
3	Eigen values and eigen vectors of special operators (Hermitian, unitary, normal and compact operators) The spectral theorem (The Real and complex case) Quadratic Forms: Quadratic forms, reduction and classification of quadratic forms, Principal axes theorem.	08	13	2,3,5	CO5	PSO2 PSO5 PSO9			
4	Calculus of variation Linear Functional necessary conditions for existence of minimum of a functional Euler equations Variational notation	15	25	2,3,5	CO6	PSO1 PSO2 PSO3 PSO9			
5	Functional with many independent and dependent variables Natural and essential boundary conditions Transferability conditions Minimization of functional with constraints Direct and Approximate method	09	15	1,4,5	CO7	PSO1 PSO9 PSO10			

REFERENCE

1	Serge Lange: Linear Algebra, Addison-Wesley Publishing Company, Second edition, 1970.
2	Strang Gilbert: Linear Algebra and its Applications, Cengage Learning India Private Limited, Fourth edition, 2006.
3	Vanloan C.F and Golub G.H: Matrix computations, John Hopkins university press, Third edition, 1996.
4	David C. Lay: Linear Algebra and its applications, Pearson education, Third edition, 2003.
5	Jin Ho Kwak, Sungpyo Hong: Linear Algebra, Birkhauser (Springer International Edition), Second edition, 2004.
6	Inder K. Rana: An Introduction to Linear Algebra, Ane Books Private Limited, 2010.
7	Dr. GunadharParia: Linear Algebra, New Central Book Agency (P.) Ltd., First edition, 1992.
8	Francis B. Hildebrand: Methods of Applied Mathematics, Prentice-Hall Inc., Second Edition, 1965.
9	Louis Konzsik: Applications of Calculus of Variations, CRC publications.
10	L. Elsgolks: Differential equation and Calculus of Variations, Mir publishers.

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

Programme Name: MSc. (Applied Mathematics)

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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. (Applied Mathematics): Regular Programme

Year	**I**	**Core / ~~Elective / Foundation~~** **AMT2106: Numerical Analysis**	**Credits / Hours per week**	**05**
Semester	**I**	Year of Introduction: 1974 Year of Syllabus Revision: 2014	**Maximum Marks / Grade**	**100**
Mode of Transaction		Lectures		

Course Outcome (CO) AMT2106

CO1 Understand the basics of computer arithmetic
CO2 Understand the concepts of numerical differentiation
CO3 Study numerically eigenvalue problems and different methods for finding eigenvalues and eigenvectors
CO4 Understand the numerical solution of ODE
CO5 Understand solution of nonlinear equations
CO6 Understand the different techniques of interpolation
CO7 Understand the different techniques of numerical integration
CO8 Learn about different techniques of matrix inversion and solution of system of linear equations
CO9 Learn about different techniques of approximating the given function which is given in discrete form

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	**Computer Arithmetic:** Floating point numbers and round off errors, Absolute and relative errors. **Approximation**: Different types of approximations, Least square polynomial approximation, polynomial approximation by use of orthogonal plynomials, approximation with Chebyshev polynomials	09	15	1, 2, 5	CO1 CO9	PSO1 PSO6	EMP	G	PE
2	**Numerical differentiation** Gaussian quadrature, Romberg integration, adaptive quadrature	09	15	1, 2, 5	CO2 CO7	PSO1, PSO6			
3	**Algebraic Eigen value problem:** Properties of eigenvalues and eigenvectors, Power method, Inverse power method, Jacobi's method, Given's method, Schur and Gershgorins theorem, Orthogonal factorization, QR algorithm for eigen value problem, Eigen values of complex matrix and complex eigenvectors	09	15	2, 4, 5	CO3	PSO1 PSO5			
4	**Numerical Solution of ODE:** Single step method-Runge Kutta methods, Multistep method - Milne Simpson's method	06	10	2, 4, 5	CO4	PSO1			
5	**Matrix inversion:** Matrix inversion , Jordan's method, Escalator method and Cholesky factorizations **Solution of system of linear equations:** Pivoting and constructing an algorithm based on Gaussian elimination method, solution of equations by iterative methods(Jacobi's method, Gauss-seidel method) LU factorizations **System of nonlinear equations:** Newton Raphson's method	15	25	2,5	CO5 CO8	PSO1 PSO6			
6	**Polynomial Interpolation**:Hermite's Interpolation formula with error analysis,Richardson Interpolation,Splines and spline Interpolation, Aitken Extrapolation	12	20	1,2,,5	CO6	PSO1			

Reference Books

1.	Introduction to Numerical Analysis, C.E. Froberg, Addision Wesley Publishing Company, sixth edition (1981)
2.	Introductory Methods of Numerical Analysis, S.S. Sastri, Prentice Hall of India, New Delhi (1997)
3.	Computer based numerical Algorithms, E.V. Krishnamurthy and S.K. Sen, East – West press Pvt. Ltd. (1976)
4.	Elementary Numerical Analysis: an algorithmic approach, Conte S.D and Carl deboor, Mc Graw Hill company, Third edition (1981)
5.	Numerical analysis for scientists and Engineers, M.K. Jain, New Age International Ltd. Publishing (1992)
6.	Numerical methods, J.D.Faires and R. Burden, Brooks/Cole publishing Co., second edition (1998)

7.	Solving ordinary differential equations I and II, E.Hairer, E.P.Norsett and G.Wanner, Springer series in computational mathematics 8, Springer Berlin (1993)
8.	Introduction to Numerical Analysis, Stoer and Burlisch

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

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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. (Applied Mathematics): Regular Programme

Year	**I**	**Core / ~~Elective / Foundation~~** **AMT2105: Ordinary Differential Equations**	**Credits / Hours per week**	**05**
Semester	**I**	Year of Introduction: 1974 Year of Syllabus Revision: 2014	**Maximum Marks / Grade**	**100**
Mode of Transaction		Lectures		

Course Outcome (CO) AMT2105

CO1 Basic understanding of how any physical phenomena can be modeled by ordinary differential equations and difference equations.

CO2 Understand existence and uniqueness of solutions in closed form and power series form.

CO3 Gain a thorough understanding of the state transition matrix, its properties, its methods of computing and its role in the study of system dynamics.

CO4 Qualitative analysis of a dynamical system using different tools, able to sketch a phase portrait of linear and non-linear one and two dimensional Systems of ODEs, Understand the phase plane analysis of the dynamical systems, Stability analysis of equilibrium solutions of linear systems.

CO5 Linearization of non-linear systems, determine the stability of equilibrium solution of the nonlinear dynamical systems, limit cycles and there stability, bifurcation

CO6 Sturm-Liouville eigen value problem, series solution of ODE's.

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)
Note: The topics (1-5) will be discussed for both continuous dynamical systems and discrete dynamical systems.									
1	• Mathematical modeling by means of ordinary differential equations and difference equations • Reduction of nth order equation into first order systems • Existence and uniqueness of solution of a nonlinear system of ordinary differential equations, Lispschitz condition, Gronwall's lemma.	16	26.72	1,2,3,4,5	CO1 CO2	PSO2 PSO4 PSO9 PSO15 PSO16 PS017	EMP	G	PE
2	• Phase plane Analysis • Linearization of nonlinear systems • Autonomous and non-autonomous Linear system Theory: Linear Dependence and independence of solution, Wronskian.	10	16.7	1,2,3,5	CO4 CO5	Except PSO6 PSO12 PSO13 PSO18			
3	• Transition matrix(fundamental matrix) for a linear system, solution of a nonlinear system by variation of parameters method, • computation of transition matrix , eigenvalue method, Peano-Backer series method.	10	16.7	1,2,3,5	CO3	Except PSO6 PSO12 PSO13 PSO18			
4	Stability of dynamical systems, Lyapunov, exponential and asymptotic stability and their characterization.	10	16.7	1,2,3	CO4 CO5	Except PSO6 PSO12 PSO13 PSO18			
5	Sturm -Liouville equations, Eigenvalue problems	06	10.02	1,2,3	CO6	PSO2 PSO4 PSO9 PSO15 PSO16 PSO17			
6	Series solution of non-autonomous continuous systems, Bessel and Legandre series, Frobenius method	08	13.36	1,2,3,5	CO2	PSO2 PSO4			

						PSO9 PSO15 PSO16 PSO17 PSO10			

Reference Books

1.	S.L. Ross :	Differential equations, Blaisdell publishing company, First edition, 1964
2.	Birkhoff G and Rota G.C :	Ordinary differential equations, Boston, 1962
3.	Coddington E. A and N. Levinson :	Theory of ordinary differential equations, McGraw-Hill, New York, 1955.
4.	Saber N. Elaydi :	An introduction to Differential Equations, Springer- verlag, Second edition, 1995
5.	V.I. Arnold :	Ordinary Differential Equations, Prentice- Hall of India, New Delhi, 1998
6.	Verhulst :	Nonlinear Equations and Dynamical systems Walter ordinary Differential Equation.

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

M.Sc. (Applied Mathematics): Regular Programme

Year	**I**	**Core / ~~Elective / Foundation~~** **AMT 2109L : Programming Practicals**	**Credits / Hours per week**	**03**
Semester	**I**	Year of Introduction: 1973 Year of Syllabus Revision: 2014	**Maximum Marks / Grade**	**50**
Mode of Transaction		Term work, Practical and Viva		

No.	**Experiment**		**Course Code**	**BT Level**	**CO**	**PSO**
1	**Practicals on Matlab programs:** - Polynomial and matrix operations - Finding mean, median , mode and frequency distribution - Plotting Graphs		**AMT 2124**	1,2,3,6	CO6 CO7	PSO2 PSO3 PSO5
2	Operators: - Arithmetic operations on numbers, vectors and matrices - Area of circle, square ,rectangle and triangle - Volume of cube, cylinder ,cone - Simple and compound interest			1,2,3,6	CO6 CO7	PSO2 PSO3 PSO5
3	Control Structures: - Branching Structures: if, if – else, if – elseif – else and switch statements. - Looping Structures: do – while, while, for statements.			1,2,3,6	CO6 CO7	PSO2 PSO3 PSO7
4	To calculate series expansion of function(sin x, cos x, e^x, etc.)			1,2,3,6	CO6 CO7	PSO2 PSO3 PSO7
5	Implementation of Numerical and Mathematical Algorithms computation : Using function file: To find out square root of the number using an iterative algorithm - Bisection Method, Runge-Kutta Method			1,2,3,6	CO6 CO7	PSO2 PSO3 PSO7
6	Trapezoidal Rule, Simpson's Rule			1,2,3,6	CO6 CO7	PSO2 PSO3 PSO7
7	**Numerical methods implementation using 'C++':** **Using function and class:** For obtaining roots of Non – linear equations: - Bisection Method - Regula Falsi Method - Newton Raphson Method			3,4,5,6	CO3 CO4	PSO5 PSO6 PSO7
8	For obtaining the approximate value of numerical integration:			3,4,5,6	CO3 CO4	PSO5 PSO6

	- Trapezoidal Rule - Simpson's 1/3rd Rule - Simpson's 3/8th Rule - Weddle's rule					PSO7
9	For solving the initial value problem: - Euler's Method			3,4,5,6	CO3 CO4	PSO5 PSO6 PSO7
10	For solving the linear system of equations: - Gauss Elimination - Gauss – Jacobi Method - Gauss – Seidal Method			3,4,5,6	CO3 CO4	PSO5 PSO6 PSO7
11	For obtaining the finite difference table and finding the value of y for an unknown x(not given in the table) using Interpolation - Newton – Forward Interpolation Formula - Newton – Backward Interpolation Formula - Langrange interpolation formula - Newton divided difference formula			3,4,5,6	CO3 CO4	PSO5 PSO6 PSO7
12	Operations on Complex Numbers using structure			1,2,3,4	CO3 CO4	PSO5 PSO6 PSO7
13	Area of circle, square ,rectangle and triangle**,**Volume of cube, cylinder ,cone**,**Simple and compound interest**,**Multiplication Table			1,2,3,4	CO3 CO4	PSO2 PSO3 PSO5
14	To calculate series expansion of function(sin x, cos x, e^x, etc.)			1,2,3,4	CO3 CO4	PSO2 PSO3 PSO5

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

M.Sc. (Applied Mathematics): Regular Programme

Year	**I**	**Core / ~~Elective / Foundation~~** **AMT****: Programming using Java and Python**	**Credits / Hours per week**	**05**
Semester	**I**	Year of Introduction: 2019	**Maximum Marks / Grade**	**100**
Mode of Transaction		Lectures		

Course Outcome (CO) AMT****

CO1 Understand the use of OOPs concepts.
CO2 Solve real world problems using OOP techniques.
CO3 Understand the use of abstraction.
CO4 Understand the use of Packages and Interface in java.
CO5 Design real life situational problems and think creatively and provide a program giving solutions.
CO6 Apply a solution clearly and accurately in a program using Python.
CO7 Apply the programming skills for the best features of mathematics, engineering and natural sciences 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	**Java:** Introduction to programming and history of programming. Procedural programming, Structured programming and Object Oriented Programming. Main	05	8.33	1,2	CO1	PSO2 PSO3 PSO5	SD	G	PE

	features of object oriented programming: encapsulation, inheritance and polymorphism. History of Java Language; Java programming environment and JDK; Structure of a Java Program. Compiling and running a simple java program. Demonstration of important features of java from the simple program frame work.								
2	Language fundamentals: Data Types – Primitive and Reference types. Literals of primitive types and String type. Variables and type declaration statements. Assignment operator. Widening and narrowing conversions among primitive and reference types. Casting and type conversion. Wrapper classes and their methods. Defining a class. Attributes and methods. Access specifiers. Instance and class members. Constructors and constructor overloading. Constructor chaining. Method overloading. Creation of objects and accessing instance methods. Writing procedural programs within the framework of a single class.	10	16.66	1,2,3	CO2 CO3	PSO2 PSO3 PSO7			
3	Use of Java Language in Maths, and Java language strict math class for mathematical function. Doing arbitrary precession, arithmetic and prime number calculation using the Java math library, Reuse of existing classes. Aggregation and Inheritance. Method overriding and variable shadowing. Chaining constructors : super(). The Object class and its methods. Constructing Inheritance hierarchies. Upcasting and Dynamic binding.	10	16.67	1,2,3,6	CO2 CO3	PSO2 PSO3 PSO7			
4	Runtime polymorphism. Interfaces. Packages and CLASSPATH. Inner classes. Fundamental classes from Java.lang and java.util packages. Exception handling.	10	16.67	3,4,5,6	CO2 CO3 CO4 CO5	PSO2 PSO3 PSO7			

	Multi threading. Thread synchronization. Input and Output: The Java.io package. Inputstream and Output stream classes. Filter classes. Reader and Write classes.								
5	**Python:** History and Origin of Python Language, Features of Python, Limitations, Major Applications of Python, Getting, Installing Python, Setting up Path and Environment Variables, Running Python, First Python Program, Python Interactive Help Feature, Python differences from other languages. Keywords, Identifiers, Python Statement, Indentation, Documentation, Variables, Multiple Assignment, Understanding Data Type, Data Type Conversion, Python Input and Output Functions, Import command. Operators in Python, Expressions, Precedence, Associativity of Operators, Non Associative Operators. Decision making statements, Python loops, Python control statements.	10	16.67	1,2,3,4	CO6 CO7	PSO2 PSO3 PSO5			
6	Numbers, Lists, Tuples, Sets, Dictionary, Functions & Methods of Dictionary, Strings (in detail with their methods and operations). Functions, Advantages of Functions, Built-in Functions, User defined functions, Anonymous functions, Pass by value Vs. Pass by Reference, Recursion, Scope and Lifetime of Variables. Module definition, Need of modules, Creating a module, Importing module, Path Searching of a Module, Module Reloading, Standard Modules, Python Packages. Multidimensional Numpy arrays, Numerical computation with Numpy arrays, tensorflow, Examples of linear regression, multi linear regression and logistic regression. 2-D and 3-D graphing. Pandas library and handling data in CSV and various formats.	15	25	3,4,5,6	CO5 CO6 CO7	PSO5 PSO6 PSO7			

Reference Books

1. Pravin M. Jain: The class of JAVA, Pearson, 2011.

2.	Horstmann and Cornell**:** Core Java, Sun Microsystems & Prentice-Hall, 2012.
3.	Naughton and Schildt**:** Complete Reference Java, Tata McGraw Hill, 2017.
4.	Arnold and Gosling**:**The Java Programming Language, Addison-Wesley, 2005.
5.	John V. Guttag: Introduction to computation and Programming using Python, MIT Press (PHI reprint), Second edition, 2016
6.	Pooja Sharma : Programming in Python, BPB Publications, 2017

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

M.Sc. (Applied Mathematics): Regular Programme

Year	**I**	**Core / ~~Elective / Foundation~~** **AMT :Programming Practicals**	**Credits / Hours per week**	**03**
Semester	**I**	Year of Introduction: 2014 Year of Syllabus Revision: 2019	**Maximum Marks / Grade**	**50**
Mode of Transaction		Term work, Practical and Viva	**PSO7 is common for all experiments**	

No.	**Experiment**		**Course Code**	**BT Level**	**CO**	**PSO**
1.	**Practicals on Java programs:** Introduction to Editor and Terminal in Ubuntu, Compiling and running Programs in Ubuntu, Programs based on printing Message, letters and patterns using System.out.println ( ).			1, 2, 3	CO1	PSO5 PSO6
2.	Programs based on demonstration of various datatypes and operators, printing size and range of datatypes, casting, wrapper class.			1, 2, 3	CO1	PSO5 PSO6
3.	Programs based on taking user inputs using command line arguments and Scanner class.			1, 2, 3	CO1	PSO5 PSO6
4.	Java program based on conditional statements (if, if-else, if-elseif, nested if-else, switch case			1, 2, 3	CO2 CO3	PSO1 PSO3 PSO6
5.	Programs based on one dimensional and two dimensional arrays			1, 2, 3	CO2 CO3	PSO1 PSO3 PSO6
6.	Programs based on Loop statements (for loop, while loop, do-while loop)			1, 2, 3	CO2 CO3	PSO1 PSO3 PSO6
7.	Programs based on making class having various constructors, members and methods.			1, 2, 3	CO2 CO3	PSO6

8.	Programs based on inheritance, polymorphism, interface and packages.			1, 3. 4	CO2 CO3 CO4 CO5	PSO6
9.	Programs based on abstract class and exception handling			1, 3, 4	CO2 CO3	PSO6

					CO4 CO5	
10.	Programs based on file handling, reading a text file, counting number of characters and digits in a text file.			1, 3, 4	CO2 CO3 CO4 CO5	PSO6
11.	**Practicals on Python programs:** - Programs to develop logic - Polynomial and matrix operations - Finding mean, median , mode and frequency distribution - Plotting Graphs			1,3,4	CO5 CO6 CO7	PSO3 PSO5 PSO6 PSO12
12.	Operators: - Arithmetic operations on numbers, vectors and matrices - Area of various shapes - Volume of various shapes			1,2,3	CO6 CO7	PSO3 PSO5 PSO6
13.	Control Structures: - Branching Structures: if, if – else, if – elseif – else and switch statements. - Looping Structures: do – while, while, for statements.			1,2,3,4 ,5	CO5 CO6 CO7	PSO1 PSO3 PSO6
14.	To calculate series expansion of function(sin x, cos x, e^x, etc.)			1,2,3,4 ,5	CO5 CO6 CO7	PSO3 PSO6

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

Programme Name: MSc. (Applied Mathematics)

Programme Specific Outcome (PSO)

PSO1. Solve mathematical problems using analytical as well as numerical methods.
PSO2. Assimilate complex mathematical ideas and arguments.
PSO3. Recognize the relationships between different areas of Mathematics and the connections between Mathematics and other disciplines.
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PSO17. Electives in the final year which elaborate prerequisite of the research field.
PSO18. Hands-on practice for self preparation and developing presentation skills through project and seminar.
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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. (Applied Mathematics): Regular Programme

Year	**I**	**Core / ~~Elective / Foundation~~** **AMT2204: Applied Analysis -II**	**Credits / Hours per week**	**05**
Semester	**II**	Year of Introduction: 2001 Year of Syllabus Revision: 2014	**Maximum Marks / Grade**	**100**
Mode of Transaction		Lectures		

Course Outcome (CO) AMT2204

CO1 To be able to use the concepts of measurable set and measurable functions, concept the outer measure, measure, Lebesgue Measure, Measurable functions and its properties

CO2 To be able to understand the integration of a measurable function over a measurable set, To be able to apply the theorems of monotone and dominated convergence and Fatou's lemma;

CO3 To be able to understand the properties of LP-spaces, and Approximation theorems

CO4 Understand the limitation of discontinuous function into series form and representation of function in Fourier series

CO5 To learn about the reprensentation of non periodic function into Fourier transform and to understand the properties of Fourier transform

CO5 To learn about the reprensentation of function given in discrete form in terms of discrete Fourier transform(DFT) ,properties of Fourier transform and algorithms of evaluating DFT using Fast Fourier Transform.

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	Measure spaces, Properties of measurable functions and measures, Lebesgue measure on R^k. L^P spaces:	12	20	1,2,3,4,5	CO1	PSO2 PSO4 PSO5 PSO15 PSO16	EMP	G	PE
2	Integration of positive and complex functions, Convergence theorems and completion of a measure	12	20	1,2,3,4,5	CO2	PSO2 PSO4 PSO5 PSO15 PSO16			
3	Convex functions and inequalities, LP-spaces, Jensen, Holder and Minkowski inequalities. Approximation by continuous functions.	12	20	1,2,3,4,5	CO3	PSO2 PSO4 PSO5 PSO15 PSO16			
5	**Fourier Series:** Orientation of representation theory, Convergence of Fourier Series,Gibb's Phenomenon	6	10	1,2,3,4	CO4	PSO2 PSO4 PSO17 PSO23 PSO24 PSO26			
6	**Fourier transform:** Fourier integral and Fourier transform in $L^1(\mathbb{R})$, properties of Fourier transform, convolution ,Riemann Lebesgue theorem, transforms of derivatives and derivatives of transforms, inversion theorem Fourier transform in $L^2(\mathbb{R})$, Parseval's formula and Plancherel's theorem **DFT and FFT:** definition and properties of DFT, description of FFT algorithms and examples	18	30	1,2,3,4	CO5 CO6	PSO2 PSO4 PSO17 PSO23 PSO24 PSO26	EMP	G	PE

Reference Books	
1.	Rudin Walter L : Real and Complex analysis, Mc Graw-Hill book company, Third edition
2.	H. L. Royden : Real analysis, The Macmillan company, NewYork, 1963
3.	Rechard Goldberg : Fourier Transform
4.	R. N. Bracewell : The Fourier transform and its applications
5.	G. P. Tolstov : Fourier series, Prentice-Hall, inc.

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

Programme Name: MSc. (Applied Mathematics)

Programme Specific Outcome(PSO)

PSO1. Solve mathematical problems using analytical as well as numerical methods.
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PSO15. Inculcate their skills to deal with industrial problems.
PSO16. Advanced understanding to qualify for various competitive exams to build their academic as well as industrial career.
PSO17. Electives in the final year which elaborate prerequisite of the research field.
PSO18. Hands on practice for self-preparation and developing presentation skills through project and seminar.
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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. (Applied Mathematics): Regular Programme

Year	**I**	**Core / ~~Elective / Foundation~~** **AMT2201: Applied Statisitics**	**Credits / Hours per week**	**05**
Semester	**II**	Year of Introduction: 2001 Year of Syllabus Revision: 2014	**Maximum Marks / Grade**	**100**
Mode of Transaction		Lectures		

Course Outcome (CO) AMT2201

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: Understand basic probability theoryas well as be familiar with discrete and continuous random variables.

CO3: Able to compute probabilities using various distributions and Chebisev's inequality.

CO4: Understand moments and moment generating functions of random variable.

CO5: Classify Markov chain models and apply it to appropriate models.

CO6: Able to analysis, classify and interpret data to answer questions about the real world problem.

CO7: Understand data description, statistical inference, hypothesis testing, analysis of association and variance.

CO8: Implement a proficiency in collection, organization, design, and drawing inferences from data using appropriate statistical methodology and problem solving skill.

CO9: Able to demonstrate the ability to analyze data by appropriately fitting, assessing, and interpreting a variety of statistical models.

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 ProfessionalEthics (PE)

1	Reorientation of probability, discrete and continuous random variable, cumulative distribution function. Binomial, Poisson and Normal distributions,	12	20	1,2,5	CO1 CO2 CO3	PSO4 PSO12	Emp	G	PE
2	Expectations, moments and moment generating functions.Law of large number,Chebyshev's inequality.	10	17	2,4	CO4	PSO3 PSO12			
3	Stochastic processes: Markov chains with finite and countable state space, classification of states, limiting behavior of n-step transition probabilities, continuous Markov process. Hidden Markov chain with applications.	08	13	3,5	CO5	PSO6 PSO12			
4	Correlation, Regression and multiple regression using least square techniques,curve fitting,	08	13	1, 2, 3	CO6 CO9	PSO5 PSO2 PSO12			
5	Central limit theorem, confidence interval for mean , variance, chi-square test of goodness of fit, contingency tables, one population case, two population case, testing of hypotheses, small samples and large samples, sampling techniques, Simple random sampling with and without replacement, stratified sampling.	14	24	1,2,3,4,5	CO7 CO8	PSO5 PSO12			
6	Control charts for variables and attributes, acceptance sampling by attributes, simple, double and sequential sampling plans, Design of experiments.	08	13	1,2,3,5	CO6 CO8	PSO5 PSO12			

REFERENCES

1	**Hogg and Tannis: Probability and Statistical inference, sixth edition, Prentice- Hall, Upper Suddle River, New Jersey, 2000**
2	**Larsen and Marx: An Introduction to Mathematical Statistics and its applications, Third edition, Prentice - Hall, Upper Saddle River, New Jersey, 2001**
3	**Mendenhall, Wackerly and Scheffer: Mathematical Statistics with applications, Third edition, PWS-KENT, Boston, 1996.**
4	**S. P. Gorden and F.S. Gorden: Contemporary Statistics, a computer approach, 1994**

5	**William Feller: An Introduction to Probability Theory and Its Applications, (Vol.I& II) John Wiley inc.**
6	**K. L. Chung: Elementary Probability Theory With Stochastic Processes, Springer-Verlag New York, Inc, testing of hypotheses, small samples and large samples**

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

Programme Name: MSc. (Applied Mathematics)

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

M.Sc. (Applied Mathematics): Regular Programme

Year	**I**	**Core / ~~Elective / Foundation~~** **AMT 2220 : Functional Analysis**	**Credits / Hours per week**	**05**
Semester	**II**	Year of Introduction: 1974 Year of Syllabus Revision: 2014	**Maximum Marks / Grade**	**100**
Mode of Transaction		Lectures		

Course Outcome (CO)

CO1 Have Good knowledge of topics Normed linear space, Banach space and related theory.
CO2 Describe bounded and unbounded operators on Banach spaces which can be applied in their application areas.
CO3 Have good knowledge of contraction map, fixed point theorem and their application in obtaining solution of various mathematical systems
CO4 Good understanding of the subject and are expected to successfully apply in the domain of its applications like existence of
CO5 Explain the fundamental concepts of inner product spaces/Hilbert spaces and their role in Applied mathematics
CO6 Demonstrate capacity for mathematical reasoning through analyzing, proving and explaining concepts from functional analysis.
CO 7 Apply problem solving using functional analysis technique applied to diverse situations in physics, engineering and other mathematical context.

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	Normed linear spaces, definition and examples, completeness, Banach spaces, Continuous linear mappings, Hahn-Banch theorem (for field of real numbers only).	10	16.7	1,2,4	CO1 CO2	PSO2 PSO9	EMP	G	PE
2	Equivalent norms, Riesz-lemma, compact sets in a normed linear space, Open mapping and closed graph theorem	10	16.7	1,2,4	CO1 CO2 CO4	PSO2 PSO9			

3	Banach's fixed point theorem and its application to solution of linear equations, differential equations and integral equations	8	13.6	1,2,3,4	CO3 CO4	PSO2 PSO9			
4	Hilbert spaces, Orthonormal sets, Orthogonal complements	12	19.6	1,2,3,4	CO5 CO6	PSO2 PSO3 PSO9			
5	Projection theorem, Riesz representation theorem, Bounded operators	10	16.7	1,2,3,4	CO5 CO6 CO7	PSO2 PSO3 PSO9			
6	Adjoint of an operator, normal, unitary and self adjoint operators, compact self-adjoint operators. Application to Sturm-Liouville problem and approximations.	10	16.7	1,2,3,4	CO5 CO6 CO7	PSO2 PSO3 PSO9			

Reference Books

1.	B.V. Limaye : Functional Analysis ,Wiley Eastern Ltd.
2.	G.F. Simmons : Introduction to Topology and Modern Analysis, McGraw – Hill
3.	E. Kreyszig : Functional Analysis and its application, John Wiley and sons.
4.	J.N. Sharma & A Vashistha: Functional Analysis.

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

Programme Name: MSc. (Applied Mathematics)

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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. (Applied Mathematics): Regular Programme			
Year	**I**	**Core / ~~Elective / Foundation~~** **AMT 2205: Mechanics**	**Credits / Hours per week**	**05**
Semester	**II**	Year of Introduction: 1974 Year of Syllabus Revision: 2014	**Maximum Marks / Grade**	**100**
Mode of Transaction		Lectures		

Course Outcome (CO) AMT 2205

CO1 Understand the basic concepts of mechanics in plane as well as in space
CO2 Understand about the behavior of system of particles
CO3 Understand about the generalized coordinates
CO4 Study behavior of kinematics and dynamics of particles and rigid bodies
CO5 Derive study and apply Lagrange's equation of motion.
CO6 Study Hamilton's principle
CO7 Derive study and apply Hamilton's equation of motion.

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	Kinematic Equations of particle motion. Newton's laws of motion. Basic vector & tensor results. General principles of mechanics. Statics: reductions of force Systems. Equilibrium of a system of particles and of rigid bodies.	12	20	2, 3, 4	CO1	PSO3 PSO5	SD	G	PE

2	Generalized coordinates. Eulerian angles. Work, Potential Energy and the Principle of virtual work.	09	15	2, 3, 5	CO2	PSO3			
3	Kinematics of particles and rigid bodies: moments of inertia, kinetic energy and angular momentum	09	15	2, 5	CO3	PSO3 PSO5			
4	Dynamics of particle and a system of particles, moving frames of reference, Dynamics of a rigid body	06	10	2	CO4	PSO3 PSO5			
5	Euler's equation of motion, simple pendulum,spinning top,rigid body with a fixed point moving under no external forces. Work and energy methods applied to the motion of particles & rigid bodies. Impulsive motion and mechanical vibrations. Lagrange and Hamiltonian dynamics: Lagrange's equations for a particle in a plane.	14	23.33	1,2,3,5	CO5 CO6	PSO3 PSO5			
6	Hamilton's principle and principles of least action. Hamilton – Jacobi theory, action – angle variables. Maps & Chaos : Poincare map, logistic map and Poincare- Birkhoff theorem.	10	16.67	1,2,3,5	CO6 CO7	PSO3 PSO5			

Reference Books

1.	A textbook of Quantum Mechanics, P. M. Mathews and K.Venkatesan, Tata McGraw Hill (2007)
2.	Introduction to quantum mechanics, D. J. Griffiths, Pearson Education International (2005)
3.	Feynman Lecture Series: R P Feynman, R B Leighton and M. Sands (2005)
4.	Quantum mechanics (2nd edition), E. Merzbacher, J. Wiley (1970)
5.	Thermodynamics, Kinetic theory and statistical thermodynamics, Sears and Salinger, Narosa Publishing House, 1989.
6.	Statistical Mechanics & Properties of matter: E. R. Gopal.
7.	Fundamentals of Statistical and thermal Physics : F.Reif.
8.	Classical Mechanics, Addison-Wesley Publishing Co.,1980: Herbert Goldstein

AMT 2205. MECHANICS

Dynamics of a rigid body, Euler's equation of motion, simple pendulum,spinning top, rigid body with a fixed point moving under no external forces.
Work and energy methods applied to the motion of particles & rigid bodies.
Impulsive motion and mechanical vibrations.
Lagrange and Hamiltonian dynamics: Lagrange's equations for a particle in a plane.
Hamilton's principle and principles of least action.
Hamilton – Jacobi theory, action – angle variables
Maps & Chaos : Poincare map, logistic map and Poincare- Birkhoff theorem.

Reference Books:

1.	John L. Synge, Byron A.Griffith	:	"Principles of Mechanics", McGraw-Hill Book Co., 1960.
2.	Herbert Goldstein	:	"Classical Mechanics", Addison-Wesley Publishing Co.,1980
3.	R. G. Takwale, P. S. Puranik,	:	"Introduction to Classical Mechanics",Tata McGraw-Hill Publishing Co., 1979
4.	Marion and Thornton	:	"Classical Dynamics of Particles and Systems", Harcourt; 4th edition (January 17, 1995).
5.	Robort C. Hilborn,	:	"Chaos and Nonlinear Dynamics : An Introduction for Scientists and Engineers", Oxford University Press, USA (January 1, 1994)

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

Programme Name: MSc. (Applied Mathematics)

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

M.Sc. (Applied Mathematics): Regular Programme

Year	**I**	**Core / ~~Elective / Foundation~~** **AMT 2203 : PARTIAL DIFFERENTIAL EQUATIONS**	**Credits / Hours per week**	**05**
Semester	**II**	Year of Introduction: 1974 Year of Syllabus Revision: 2014	**Maximum Marks / Grade**	**100**
Mode of Transaction		Lectures		

Course Outcome (CO)

CO1 Able to use knowledge of partial differential equations (PDEs), modelling, and analytic methods for solutions.
CO2 Able to formulate physical problems as PDEs using conservation laws.
CO3 Able to understand analogies between mathematical descriptions of wave phenomena in physics and engineering.
CO4 Able classify PDEs, apply analytical methods, and physically interpret the solutions.
CO5 Able interpret solutions in a physical context, such as identifying travelling waves, standing waves, and shock waves.
CO6 Understanding existence, Uniqueness and other properties of a solution of differential equations
CO7 Know and be able to use fundamental solutions and Greens's function for various types of equations
CO8 Know how to use the maximum principle for Elliptic and Parabolic Partial differential equations and be familiar with distributions, sobolov spaces and Embedding theorems
CO9 Know variation formulations of Elliptic problems and existence theorems for general problems; Lax-Miligram theorem and Energy Estimate, Fredholm alternatives, poincare's inequlity and error estimate(FEM);
CO10 Be familiar with existence theorems for general Parabolic and Hyperbolic PDE and related solutions methods
CO11 Be able to understand the method of characteristics to find the solution of partial differential equations
CO12 Be able to understand weak solution, Shock solution and rarefaction solution of Burger equation and first order scaler Hyperbolic PDE

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.	**Introduction to PDE:** • Modelling Problems related to PDE. • General II order PDE, Classification of PDE -hyperbolic, elliptic and parabolic PDE • Canonical form	8	13.6	1,2,3	CO1 CO4	PSO1 PSO2 PSO4 PSO14 PSO15 PSO16 PSO18	Emp	G	PE
2	**Hyperbolic PDE** • Boundary conditions, well-posed problem, • The Cauchy-Kowalewski theorem for existence and uniqueness of solutions to PDE • Scalar first order Partial differential equations • Method of Characteristics, • Compatible system of I order PDE, • Charpits method, • Weak Solutions.	10	16.7	2,4,5	CO2 CO3 CO10 CO11 CO12	PSO1 PSO2 PSO3 PSO4 PSO9 PSO10 PSO15			
3	**Hyperbolic PDE** • Quasi-linear first order equations and quasi-Linear systems of partial differential equations, • weak solutions, shocks and rerefactions • Burgers equation, • Non-uniqueness and entropy conditions, • Wave equation	10	16.7	2,4,5	CO2 CO3 CO5 CO11 CO12	PSO1 PSO2 PSO3 PSO4 PSO9 PSO10 PSO12 PSO15 PSO16 PSO17			
4	**Elliptic PDE** • Solution of Laplace equation using separable variable technique,	10	16.7	2,4,5	CO7 CO8 CO9	PSO1 PSO2 PSO3 PSO4			

	• Fundamental solution, • Mean value theorem.					PSO9 PSO10 PSO12 PSO15 PSO16 PSO17			
5	• Strong Maximum Principle, • uniqueness and regularity • Energy Methods, • Sobolev spaces and Lax-Milgram lemma.	10	16.7	2,4,5	CO7 CO8 CO9	PSO1 PSO2 PSO3 PSO4 PSO9 PSO10 PSO12 PSO15 PSO16 PSO17			
6	**Parabolic PDE:** • Solution of Heat equation using Fourier Transform method • Mean Value Theorem • Maximum Principle, Regularity, • Uniqueness. • Semigroup approach	12	19.6	2,4,5	CO6 CO10	PSO1 PSO2 PSO3 PSO4 PSO9 PSO10 PSO12 PSO15 PSO16 PSO17			

Reference Books

1.	Strauss W. A: Partial differential equations, An Introduction, Wiley, John and sons 1992.
2.	Renardy and Rogers: An introduction to PDE's, Springer-Verlag, 1999.
3.	Smoller: Shock Waves and reaction-diffusion equations, second edition, 1994.
4.	Kevorkian: Partial Differential equations, Wadsworth and Brooks/ cole
5.	F.John: Partial differential equations
6.	Evans L.C.: Partial differential equations, AMS, 1998.
7.	B. Folland: Lectures on partial differential equations, Tata institute of Fundamental Research, Bombay, 1983.
8.	B.Folland: Introduction to partial differential equations.

9.	M.Junk: Analytical and Numerical Methods for Partial differential equations,
10.	Lecturer notes, University of Kaiserslautern, 1999
11.	D.Gilbarg and N.S. Trudinger: Elliptic Partial differential equations of second order.

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

Programme Name: MSc. (Applied Mathematics)

Programme Specific Outcome (PSO)

PSO1. Solve mathematical problems using analytical as well as numerical methods.
PSO2. Assimilate complex mathematical ideas and arguments.
PSO3. Recognize the relationships between different areas of Mathematics and the connections between Mathematics and other 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.
PSO6. Apply soft computing techniques.
PSO7. Implement various algorithms using advanced Object Oriented Programming languages.
PSO8. Demonstrate facility in computer programming, data processing, numerical simulation, scientific visualization, and virtual experimentation.
PSO9. Describe the study of fundamental and advanced concepts in Mathematical Analysis.
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	The Maharaja Sayajirao University of Baroda **Faculty Technology and Engineering** **Department of Applied Mathematics**	**Academic Year**	**2019-20**

M.Sc. (Applied Mathematics): Regular Programme

Year	**I**	**Core / ~~Elective / Foundation~~** **AMT 2224L : Practicals on Numerical Analysis and Statistical methods**	**Credits / Hours per week**	**03**
Semester	**I**	Year of Introduction: 1973 Year of Syllabus Revision: 2014	**Maximum Marks / Grade**	**50**
Mode of Transaction		Term work, Practical and viva		

Course outcome (CO) AMT2224L

CO1 Study numerically eigenvalues problems and different methods for finding eigenvalues and eigenvectors
CO2 Understand the numerical solution of ODE
CO3 Understand the different techniques of interpolation
CO4 Understand the different techniques of numerical integration
CO5 Learn about different techniques of matrix inversion and solution of system of linear equations
CO6 Learn about different techniques of approximating the given function which is given is discrete form
CO7 Able to compute probabilities using various distributions
CO8 Able to analysis, classify and interpret data to answer questions about the real world problem
CO9 Understand data description, statistical inference, hypothesis testing, analysis of association and variance
CO10 Implement a proficiency in collection, organization, design and drawing inferences from data using appropriate statistical methodology and problem solving skill
CO11 Able to demonstrate the ability to analyze data by appropriately fitting, assessing, and interpreting a variety of statistical models

No.	Practical		Course Code	BT Level	CO	PSO
	<u>NUMERICAL ANALYSIS: (BY USING OBJECT ORIENTED PROGRAMMING)</u>					
1	Interpolation		AMT2224L	1,2,3,5	CO3	PSO1
2	Integration with Newton cote's, Gauss quadrature				CO4	PSO1,PSO6
3	Definition of a class for a matrix with the following members: Number of rows, number of columns and a two dimensional array of numbers as attributes with methods for transpose of the matrix, determinant of the matrix, for finding largest eigen value (power method),etc.				CO1	PSO1,PSO5
4	Implementing matrix inversion by Jordan & Escalator methods in the matrix class.				CO5	PSO1,PSO6
5	Romberg Integration				CO4	PSO1,PSO6
6	Least Square method: fitting a straight line, and second degree curve				CO6	PSO6
7	Solution of ODE through Euler, modified Euler, Runge-kutta and Milne-Simpson's method.				CO2	PSO1

	STATISTICAL METHODS : (BY USING OCTAVE / MATLAB)					
8	Given a set of data, set up various graphical representation of data, Bar diagram, Histogram, Pie charts, frequency polygon etc				CO8	PSO5, PSO12
9	Given a set of data, calculate the various features of central tendency, measures of dispersion				CO8	PSO6,PSO12
10	Given a large population, take samples from it, using various sampling technique				CO9 CO10	PSO5, PSO12
11	Calculate Correlation Coefficient between two sets of data points, plot regression lines		AMT2224L	1,2,3,5	CO8 CO11	PSO5, PSO12
12	Fitting of curves, Multiple regression techniques to linear and nonlinear problems				CO8 CO11	PSO5, PSO12
13	Testing of Hypothesis: Practical examples				CO9 CO10	PSO5, PSO12
14	Confidence interval for mean, proportions				CO9 CO10	PSO5, PSO12
15	Simulation of Poisson, Binomial and Normal distribution				CO7	PSO5, PSO12
16	Examples with small samples and large samples				CO9	PSO4, PSO12

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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. (Applied Mathematics): Regular Programme

Year	**II**	**Core / ~~Elective / Foundation~~** **AMT2303: Fluid Dynamics**	**Credits / Hours per week**	**05**
Semester	**I**	Year of Introduction: 2001 Year of Revision of Syllabus: 2014	**Maximum Marks / Grade**	**100**
Mode of Transaction		Lectures		

Course Outcome (CO) AMT2303

CO1 To be able to understand the basics for Fluid Dynamics. To be able to Classify and exploit fluids based on the physical of a fluid, To be able to compute the Kinematical properties of a fluid element.

CO2 To be able to apply the conservation principles of mass, linear momentum, and energy to fluid flow systems. To be able to understand flow equations with applications.

CO3 To be able to understand the Navier-Stokes' equation, and Demonstrate the ability to model inviscid, steady fluid flow.

CO4 To be able to understand the complex Potential flow and related applications

CO5 To be able to understand the viscous incrompressible flow using Navier- Stokes equation.

CO6 To be able to understand the Boundary layer and its application

CO7 To be able to solve Industry related flow 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	Review of vector notation and vector operators in various coordinate systems. Brief outline of Cartesian Tensor Analysis. Properties of second order tensors. Fundamental equation of fluid statics and derivation of Hydrostatic equation and Torricelli's Principle.	08	13.36	1, 2	CO1	PSO2 PSO3 PSO4 PSO5 PSO6 PSO9 PSO14 PSO15 PSO16			
2	**Fluid kinematics:** Flow description using Lagrangian and Eulerian methods. Stream lines and path lines. Material derivative and fluid acceleration, vorticity. Equation of continuity in cartesian and general vector form. Expression in cylindrical and spherical coordinates, stream tube flow. Boundary conditions. Euler's equation of motion in general vector form and derivation of Bernouilli's equation. Application to flow through orifices, Pitot's tube and Venturi meter.	10	16.7	1, 2, 3	CO2	PSO2 PSO3 PSO4 PSO5 PSO6 PSO9 PSO14 PSO15 PSO16			
3	**Navier Stokes equations :** General theory of stress and rate of strain in fluid flow. Nature of stresses. Transformation of stress components. Nature of strains. Transformation of rates of strain. Derivation of the Navier-stokes equations. Derivation of Euler's equations as a special case of Navier – Stokes equation. potential, the harmonic oscillator, multiple potential wells, splitting of energy levels, energy bands	10	16.7	1, 2, 3, 5	CO3	PSO2 PSO3 PSO4 PSO5 PSO6 PSO9 PSO14 PSO15 PSO16	EMP	G	PE
4	**Potential flow of ideal fluids :** • Velocity potential and irrotational flow, circulation and Kelvin's theorem, flows with axial symmetry • Three dimensional singularities. Image systems. Stoke's stream function. Singularities in two-dimensional flow. Stream function in two dimensions.	10	16.7	1, 2, 3, 4, 5	CO5	PSO2 PSO3 PSO4 PSO5 PSO6 PSO9 PSO14 PSO15 PSO16			
5	• Complex velocity potential. • Flow net. Superposition of simple flows. Rankine's method	08	13.36	1, 2, 3, 4, 5	CO4	PSO2 PSO3			

	for construction of stream lines. • Indication of the use of complex analysis and conformal transformations in flow problems.					PSO4 PSO5 PSO6 PSO9 PSO14 PSO15 PSO16			
6	• Laminar flow of viscous incompressible fluids. Similarity of flows – Reynold's and Froude number. • Flow between parallel plates – Couette flow and plane Poiseuille flow. • Hagen – Poiseuille flow through pipes.	10	16.7	1, 2, 3, 4, 5	CO5	PSO2 PSO3 PSO4 PSO5 PSO6 PSO9 PSO14 PSO15 PSO16			
7	Laminar boundary layer : • Definition of boundary layer • Boundary layer equations in two- dimensional flow. • Blasius solution for the boundary layer along a flat plate.	04	6.68	1, 2, 3, 4, 5	CO6 CO7	PSO2 PSO3 PSO4 PSO5 PSO6 PSO9 PSO14 PSO15 PSO16			

Reference Books

1.	Foundations of fluid Mechanics, S. W. Yuan, Prentice – Hall International (1970)
2.	Ideal and Incompressible fluid dynamics, M. E. O'Neill and F. Chorlton John Wiley & Sons (1986)
3.	An Introduction to Fluid Dynamics, Batchelor G. K, Cambridge University Press (1999)
4.	Analytical Fluid Dynamics, Emanuel G, CRC Press, Boca Raton, Second edition, FL (1999)
5.	Incompressible Flows, Panton R. L., Wiley Interscience (1984)
6.	Fundamental Mechanics of Fluids, Currie I. G, McGrow-Hill, New-york (1993)
7.	Mathematical introduction to Fluid Mechanics, Chorin, Springer Verlag, Fourth edition
8.	Textbook of Fluid Dynamics, F. Chorlton, Van Nostrand (1967)

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

Programme Name: MSc. (Applied 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. (Applied Mathematics) Regular Programme

Year	**II**	**Core / ~~Elective / Foundation~~** **AMT 2301: Numerical Methods for Partial Differential Equations**	**Credits / Hours per week**	**05**
Semester	**I**	Year of Introduction:2001 Year of Revision of Syllabus: 2014	**Maximum Marks / Grade**	**100**
Mode of Transaction		Lectures		

Course Outcome (CO) AMT 2301

CO1: To learn about finite difference approximation to partial derivatives and the solution of Partial Differential Equation (PDE) using different algorithms using Finite difference of parabolic PDE.

CO2 :To learn about the Solution of hyperbolic and elliptic PDE using finite difference algorithms and their convergence and stability

CO3 : To be able to Understand the general steps of finite element methods, To be able to understand the Engineering aspects for FEM

CO4 : To be able to Understand the basic finite element formulation techniques. To be able to understand the mathematical methods for FEM in one and dimension and three dimension, be able to formulate and solve basic problems in heat transfer, solid mechanics and fluid mechanics.

CO5 : Understanding of FEM Open source software/License software

CO6 : Understanding of application of FEM software to industrial problems related to BVP and IVP-BVP

CO7 : Advantages of FEM over other Methods

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	**<u>FINITE DIFFERANCE METHOD</u>** **Numerical methods for parabolic PDE** • Finite difference method: Explicit methods, implicit methods and Crank- • Nicolson implicit method, Stability, Convergence and error of these methods,Predictor -Corrector methods	14	23.3	1,2,5	CO1	PSO1 PSO6	Emp	G	PE
2	**Numerical methods for hyperbolic PDE** • Explicit methods, implicit methods, stability, convergence and error of these methods, • Method of characteristics, Lax-Wendroff method, method of artificial viscosity, Courant – Friedrichs - Lewy condition. **Numerical Methods for elliptic PDE :** • Numerical solutions of Laplace and Poisson equation using forward difference scheme and its error.	10	16.7	1,2,5	CO2	PSO1, PSO6			
3	**<u>FINITE ELEMENT METHOD</u>** • Introduction, Advantages of FEM over other methods, Basic steps in FEM, Springs in series analogy, Under standing about weak solution, Relay Ritz Method • Different approaches in FEM formulation, Variational and Galerkin's approach. Descretization of problem, Descretization of geometry • Element types, Shape functions, Element equations, Assembly procedure, Imposition of Essential boundary conditions, Properties of assembled matrix, Methodology for solving system of equations. • Formulation of the FEM for elliptic problems	16	26.72	1,2,3,4,5	CO3 CO4 CO5 CO6 CO7	PSO1 PSO2 PSO4 PSO5 PSO6 PSO9 PSO11 PSO14 PSO15 PSO16 PSO17			

	Variational and Glerkian formulation **<u>Finite element discretizations in 1D</u>** • Variational approach • Galerkin approach								
4	**<u>Finite element discretization in 2D</u>** • A FEM for Poisson's equation, steady state heat equation , General second order pde • Galerkin approach Second order pde in different domain with physical parameter's description.	10	16.7	1,2,3,4,5	CO3 CO4 CO5 CO6	PSO1 PSO2 PSO4 PSO5 PSO6 PSO9 PSO11 PSO14 PSO15 PSO16 PSO17			
5	**Formulation of the FEM for elliptic problems** • Variational and Glerkian Formulation	06	10.02	1,2,3,4,5	CO3 CO4 CO5 CO6	PSO1 PSO2 PSO4 PSO5 PSO6 PSO9 PSO11 PSO14 PSO15 PSO16 PSO17			
6	FEM as a tool for solving boundary value problems	04	06.68	1,2,3,4,5		PSO1 PSO2 PSO4 PSO5 PSO6 PSO9 PSO11 PSO14 PSO15 PSO16			

						PSO17			

Reference Books

1.	G.D Smith	:	Numerical solution of Partial Differential Equations: FiniteDiffernce Methods, Third edition, Oxford University Press, 1986.
2.	K. W. Morton and D. F. Mayers	:	Numerical solution of Partial Differential Equations, Cambridge University Press, New York, 1993
3.	A. R. Mitchell and D. F. Griffiths	:	The Finite Difference Methods in Partial Differential Equations, Wiley, April, 2001
4.	A. Quarteroni and A. Valli	:	Numerical Approximation of Partial Differential Equations, Springer, 1994
5.	S. Brenner and L.R.Scott	:	The Mathematical theory of Finite element methods, Springer-Verlag, 1994
6.	C.Johnson	:	Numerical solution of partial differential equations by the FEM, Cambridge University Press, 1994.
7.	Cook, Malkus and Plesha	:	Concepts and Applications of finite element analysis, Third edition , John Wiley and sons, 1989.
8.	B. Szabo and I. Babuska	:	Finite element analysis, Wiley and Sons,1991.
9.	K.H. Huebner	:	The Finite element Method for Engineers, John Wile and Sons, 1975.
10.	J.N Reddy	:	An introduction to Finite Element Method, , MacGrawHill

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

Programme Name: MSc. (Applied Mathematics)

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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. (Applied Mathematics): Regular Programme

Year	**II**	**Core / ~~Elective / Foundation~~** **AMT 2304:OPTIMIZATION I**	**Credits / Hours per week**	**05**
Semester	**I**	Year of Introduction: 2001 Year of Syllabus Revision: 2014	**Maximum Marks / Grade**	**100**
Mode of Transaction		Lectures		

Course Outcome (CO) : AMT 2304

CO1: Able to formulate and choose appropriate methodology to solve an optimization problem according the classification in terms of Linear/Non-Linear, Single Variable/Multi-Variable, With Constraint/Without Constraint.

CO2: Understand and can successfully apply the classical theory of optimization, to solve various problems which belongs to classes; viz. single/multivariate problems without constraints, Lagrange method for problems having equality constraints and theory of Kuhn-Tucker for problems having inequality constraints.

CO3: Able to choose and apply an appropriate method from various methods designed for single variable optimization problems.

CO4: Develops an ability to choose appropriately from various available methods designed for solving Multivariable optimization problems (Unconstrained and Constrained) and apply them successfully for desired solution.

CO5: Apply optimization methods to various real life areas, engineering problems , industrial problems

CO6: Interpreting results and effects of change in the structure or parameters of Optimization problems.

CO7:Understand and apply constrained optimization theory for continuous problems, involving integer solutions or including the Kuhn-Tucker conditions for quadratic programming.

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

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1	**Optimization problems in engineering and industries** Optimization problem formulation Classification of optimization problem **Classical optimization techniques** Single variable optimization, Multivariable optimization, Constrained optimization: Lagrangain multiplier method, Khun-Tucker conditions.	16	26	1,3,4	CO1 CO2	PSO2 PSO4 PSO5	Emp SD	G	PE
2	**Single variable optimization techniques** Bracketing method - Exchaust search Region elimination method - Interval halving method, Golden section method, Interpolation method - Quadratic interpolation method, Gradient based methods – Newton's method, bisection method.	10	17	2,3,5	CO3	PSO5 PSO9 PSO12			
3	**Multivariable optimization techniques (Unconstrained and Constrained)** Univariate method, Direct Search method - Simplex search method, Powell's conjugate direction method, Gradient based methods - steepest descent (Cauchy) method , conjugate gradient (Fletcher-Reeves) method. Box complex method, Sequential linear programming method, Interior and Exterior Penalty function methods	10	17	3,4,5	CO4	PSO9 PSO15 PSO12			
4	**Constraint linear optimization problem** Overview of linear optimization problem Sensitivity analysis	10	17	2,4,5	CO5	PSO12 PSO14			
5	**Quadratic programming** Wolf's modified simplex method Balyes methods	08	13	1,2,5	CO6	PSO12			
6	**Integer programming problem** Gomoreys cutting plane method branch and bound techniques	06	10	1,2,3,5	CO7	PSO12			

Reference Books

1. Rangrajan K. Sundaram: A first Course in Optimization Theory, Cambridge University Press, First edition,1996.
2. S. S. Rao: Engineering Optimization (Theory and Practice), New Age International Publishers, New Delhi, Third edition,2001.
3. Edwin K. P. Chong, Stanislaw H. Zak, An Introduction to Optimization, Wiley-India publishers, Second edition,2001.

4.	Mohan C. Joshi, Kannan M. Moudgalya: Optimization (Theory and Practice),Narosa Publishing House, First edition,2004.
5.	Kalyanmoy Deb: Optimization for Engineering Design (Algorithms andExamples), Prentice-Hall of India Private Limited, New Delhi,1995.
6.	Kantiswarup, P.K.Gupta and Manmohan: Operations Research , Sultan chand andSons.
7.	S.D. Sharma: Operations Research (Theory, Methods and Applications), Kedar Nath, Ram Nath & Co., Fifteenth edition,2005.
8	H.A. Taha :Operation research an Introduction, Prentice-Hall of India PrivateLimited, New Delhi, Sixth edition,2001.
9	B.E. Gillet : Introduction to Operations Research-Computer OrientedAlgorithm.
10	K. V. Mittal, Chandra Mohan: Optimization Methods in Operations Research and System Analysis, New-Age international Publishers,2008.
11	J. C. Pant: Introduction to Optimization: Operations Research, Jain Brothers, NewDelhi, 2010.
12	Wayne L. Wilson: Operations Research: Applications and Algorithms, Cengage Learning India Pvt. Ltd.,2011.

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PSO6. Apply soft computing techniques.

PSO7. Implement various algorithms using advanced Object Oriented Programming languages.

PSO8. Demonstrate facility in computer programming, data processing, numerical simulation, scientific visualization, and virtual experimentation.

PSO9. Describe the study of fundamental and advanced concepts in Mathematical Analysis.

PSO10. Select appropriate methods for solving ordinary and partial differential equations which is arising in Mathematical modelling of problem.

PSO11. Use appropriate software to solve practical problems.

PSO12. Employ advanced statistical and optimisation techniques.

PSO13. Build, Manage and Lead a team to successfully complete an industrial project and communicate across teams and organizations to achieve professional objectives.

PSO14. Formulation of mathematical models and simulation of the problems in real world.

PSO15. Inculcate their skills to deal with industrial problems.

PSO16. Advanced understanding to qualify for various competitive exams to build their academic as well as industrial career.

PSO17. Electives in the final year which elaborate prerequisite of the research field.

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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. (Applied Mathematics): Regular Programme

Year	**II**	**Core / ~~Elective / Foundation~~** **AMT2313: Simulation and Mathematical Modelling**	**Credits / Hours per week**	**05**
Semester	**I**	Year of Introduction: 2007 Year of Syllabus Revision: 2014	**Maximum Marks / Grade**	**100**
Mode of Transaction		Lectures		

Course Outcome (CO) AMT2313

CO1 Understand different methods for random number generation.
CO2 Have a clear understanding of the need for the development process to initiate the real problem.
CO3 Have a clear understanding of principle and techniques of mathematical and simulation methods
CO4 Be able to describe the components of continuous and discrete systems and simulate them.
CO5 Be able to model any system from different fields .
CO6 Be able to implement numerical algorithm to solve the mathematical model that meet the real life requirements.
CO7 Be able to discuss the simulation methods and select the suitable technique to apply on the several problems.
CO8 Know how to simulate any system.
CO9 Have a clear understanding of the system to be studied.

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	Random numbers: Generating uniform random variables: Pseudo – random numbers, congruential generators and their properties, alternative approaches. Testing random numbers: empirical and theoretical tests or sequences of uniform random numbers, General methods: Inversion method, acceptance-	10	16.66	1,2,3,6	CO1	PSO2 PSO4 PSO8 PSO11	SD	G	PE

	rejection, composition methods. Particular methods for non–uniform random variables, Box–Muller methods to generate normal variates. Exponential, Binomial and Poisson variates.								
2	Discrete Event simulation modeling: Introduction to simulation modeling, Queuing models, Simulation of queueing systems, Output analysis of short and long term performance, Verification and validation, Statistical simulations: Monte-Carlo simulation, Variance reduction technique: Arithmetic variables, conditioning, control variates, importance sampling and common random numbers, Simulation inference.	10	16.66	1,3,4,5	CO3 CO4 CO8	PSO3 PSO5 PSO10 PSO11			
3	Needs and Techniques of mathematical modeling: Idea of mathematical modeling, need for mathematical modeling, steps in mathematical modeling, Characteristics of mathematical modeling, Interpretation. Models in mechanical vibration :Spring mass system, pendulum problems. Models in population dynamics:One species model, logistic model, growth model in time delays, Predator-Prey models, Volterra-Lotka models.	10	16.66	1,2,3,4,5,6	CO2 CO5 CO6 CO9	PSO1 PSO3 PSO5 PSO10			
4	Models of chemical processes, Electrical network and Diffusion processes, Partial Differential Equations models, Traffic flow models and different pde models pertaining to human physiology. Models of chemical processes, Electrical network and Diffusion processes	10	16.66	3,4,5,6	CO5 CO6 CO9	PSO1 PSO3 PSO5 PSO10			
5	Modeling dynamical systems: differential equations and their numerical solution, linear and non–linear dynamics, stability, convergence, attractors. Physical systems: System types and characteristics behaviour, Continuous-time,discrete – time and discrete -event systems, linear and non linear systems.	10	16.66	2,4,5	CO7 CO8 CO9	PSO3 PSO5 PSO9 PSO10			
6	Exploration of behaviour through simulation: developing simulations of dynamical systems using Matlab : representation and visualization of simulation experiments, analyzing behavioural characteristics for a range of classes of physical and computational systems eg. Predictor- prey models, evolutionary systems and cellular systems	10	16.7	3,4,5,6	CO7 CO8 CO9	PSO5 PSO6 PSO8 PSO11			

Reference Books

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

3.	H. Neunzert and A.H. Siddiqu: Topics in Industrial Mathematics, Kluwer Academic Publishers, London, 2000
4.	P. E. Wellstead: Introduction to Physical system modeling, Academic Press, 1979.
5.	Richard Haberman: Mathematical Models, Practice- Hall Inc., NJ, 1979.
6.	Jery Banks, John S., Carson II, Barry Nelson and David M.Nicol: Discrete – Event system simulation , Prentice hall, 2001
7.	J.N.Kapoor: Mathematical modeling in biology & medicine, Eastwest press

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

Programme Name: MSc. (Applied Mathematics)

Programme Specific Outcome (PSO)

PSO1. Solve mathematical problems using analytical as well as numerical methods.
PSO2. Assimilate complex mathematical ideas and arguments.
PSO3. Recognize the relationships between different areas of Mathematics and the connections between Mathematics and other disciplines.
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Electives in the final year which elaborate prerequisite of the research field.
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Syllabus of Course:

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

M.Sc. (Applied Mathematics)Industrial Mathematics: Regular Programme

Year	**II**	**Core / ~~Elective / Foundation~~** **AMT2329L : Practicals on Numerical methods for PDE, Wavelets and Image Processing and Optimization**	**Credits / Hours per week**	**03**
Semester	**I**	Year of Introduction: 2001 Year of Syllabus Revision: 2014	**Maximum Marks / Grade**	**50**
Mode of Transaction		Term Work, Practical & Viva		

No.	**Experiment**		**Course Code**	**BT Level**	**CO**	**PSO**
1	Programs for Solution of Heat equation using Explicit scheme and implicit scheme		AMT2326	1, 2, 3, 5	CO1	PSO1,PSO6
2	Introduction to symbolic toolbox, Optimization toolbox of MATLAB useful for Optimization		AMT2304	1, 2	CO3	PSO6
3	Programs for Solution of Heat equation using Fully implicit scheme and Crank- Nicolson scheme		AMT2326	1, 2, 3, 5	CO1	PSO1,PSO6
4	Programs for finding maxima or minima of function of one/two variables using Necessary and sufficient condition		AMT2304	1, 2, 4, 5	CO1 CO2	PSO2,PO4, PSO5
5	Programs for Solution of wave equation from Finite difference method using Explicit method (by taking forward difference / central difference for the initial condition with derivatives)		AMT2326	1, 2, 3, 4, 5	CO2	PSO1,PSO6
6	Programs for finding maxima or minima with constraint using Lagrangian multiplier method		AMT2304	1, 2, 4, 5	CO1 CO2	PSO2,PO4, PSO5
7	Programs for Solution of PDE using Lax – Wendroff scheme		AMT2326	1, 2, 3, 5	CO1 CO2	PSO1,PSO6
8	Programs for finding minimum of function of one variable using Exhaustive search method, Interval Halving method, Golden Section method		AMT2304	1, 2, 4, 5	CO3	PSO5,PO9, PSO12
9	Programs for Solution of Elliptic partial differential equation (Laplace equation) using Standard 5 point formula		AMT2326	1, 2, 3, 5	CO2	PSO1,PSO6
10	Programs for finding minimum of function of one variable using Bisection method, Newton's method, Fibonacci method		AMT2304	1, 2, 4, 5	CO3	PSO5,PO9, PSO12
11	Programs for Solution of Elliptic partial differential equation (Poisson equation) using Standard 5 point formula		AMT2326	1, 2, 3, 5	CO2	PSO1,PSO6
12	Programs for finding minimum of function of two variables using Univariate method, Steepest Descent method, Powell's method		AMT2304	1, 2, 4, 5	CO4	PSO9,PO12, PSO15

13	Basic Inbuilt commands of Image Processing, Programs on Image Processing		AMT2305	1,2,3	CO6 CO7 CO8	PSO4,PSO5, PSO6,PSO9
14	Basic Inbuilt commands of Wavelets, Programs on Wavelet Transforms and its application on signals.		AMT2305	1,2,3,4	CO4	PSO2,PSO3, PSO8

Syllabus of Courses

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

M.Sc. (Applied Mathematics)Industrial Mathematics: Regular Programme

Year	**II**	**Core / ~~Elective / Foundation~~** **AMT2305: Wavelets and Image Processing**	**Credits / Hours per week**	**05**
Semester	**I**	Year of Introduction: 2001 Year of Syllabus Revision: 2014	**Maximum Marks / Grade**	**100**
Mode of Transaction		Lectures		

Course Outcome (CO) AMT2305

CO1 A deeper understanding of limitations of Fourier analysis in signal processing and why wavelets are better for digital signal processing.
CO2 Understand about windowed Fourier transform and difference between windowed Fourier transform and wavelet transform.
CO3 Importance of Multi Resolution Analysis(MRA) and construction of wavelets from MRA.
CO4 Implement decomposition and reconstruction of signal using detailed wavelet coefficient and justify the basis of the application of wavelet transforms to different fields.
CO5 Understand Wavelet packets.
CO6 Describe basic image related concepts.
CO7 Explain various image enhancement and restoration techniques.
CO8 Describe colour image processing, image compression, image segmentation and representation.

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	Fourier theory, sampling, signal processing, time-frequency representations. Short time Fourier transform and Continuous wavelet transform, admissibility condition, some well-known wavelets.	12	20	1,2	CO1 CO2	PSO4 PSO5	SD	G	PE
2	Multiresolution Analysis Process, Analysis of Haar expansion of discrete -time signals, Wavelet transform and filter banks, Multichannel Filter Banks, Decomposition and Reconstruction scheme,	14	23	1,2,3	CO3 CO4	PSO4 PSO9			
3	Othonormal Wavelets, Biorthogonal Wavelets. Construction by lifting scheme: "next-generation wavlets", Mallat's MRA and Wavlet-Packets, Multidimentional Wavelets.	10	17	1,2,3,6	CO1 CO5	PSO5 PSO6			
4	Introduction to image processing: Fundamental steps in image processing, Digital image modelling, Image sampling and quantization-spatial and grey level resolution, zoomimg and shrinking digital images, relationship between pixels, Labelling connected components. Image enhancement in special domains: Basic grey level transformations, Image negatives, Histogram processing, Enhancement using arithmetic logic operations, Image averaging, Basics of special filtering, smoothing and sharpening filters, combining spatial enhancement methods.	9	15	1,2,3	CO7	PSO2 PSO3			
5	Image enhancement in frequency domain: 1-D and 2-D Fourier transforms and its inverse, 1-D and 2-D DFT and its inverse, Filtering in frequency domain, smoothing and sharpening frequency domain filters. Colour image image processing: Colour fundamentals, colour image models, pseudo colour image processing, colour transformations, colour complements, colour slicing.	9	15	3,4,5	CO6 CO7 CO8	PSO3 PSO8			
6	Image segmentation: Detection of discontinuities, Edge linking and boundary detection, global processing via Hough transform. Segmentation by Morphological water shades.	06	10	3,4,5,6	CO5 CO6 CO7	PSO2 PSO3 PSO8			

Reference Books

1.	C.K. Chui: An Introduction to wavelets, Academic Press.
2.	S. Malat: An Introduction to wavelets, Academic Press.
3.	S. Malat: A Wavelet Tour of Signal Processing,Academic Press,1998.
4.	Adhemar Bultheal: Learning to swim in a sea of wavelets.
5.	Ingrid Daubechies: Ten Lectures on Wavelets, Soc. For Industrial and Applied Mathematics, Philadelphia, 1992
6.	Rafael C. Gonzalez and Richard E. Woods: Digital Image Processing, Pearson Education (Asia) 2002.

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

Programme Name: MSc. (Applied Mathematics)

Programme Specific Outcome(PSO)

PSO1. Solve mathematical problems using analytical as well as numerical 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. (Applied Mathematics)Industrial Mathematics: Regular Programme

Year	**II**	**Core / ~~Elective / Foundation~~** **AMT2417: Computational Fluid Dynamics**	**Credits / Hours per week**	**04**
Semester	**II**	Year of Introduction: 2001 Year of Revision of Syllabus: 2014	**Maximum Marks / Grade**	**100**
Mode of Transaction		Lectures		

Course Outcome (CO) AMT2417

CO1 To be able to understand the basic concepts of CFD and basic fluid dynamics model
CO2 To be able to understand finite difference methods with different approaches for scalar & vector conservation laws as well as Burger's equation.
CO3 To be able to understand the differences between different discretisation technique.
CO4 To be able to design your own software to solve simple fluid dynamic problems.
CO5 To be able to design your own software to solve simple fluid dynamic problems.
CO6 To be able to understand finite volume methods with different approaches
CO7 To be able to use commercial fluid dynamic software packages

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	Introduction to CFD, Applications	02	4	1, 3	CO1	PSO2 PSO3 PSO4 PSO5 PSO6 PSO9 PSO14 PSO15 PSO16	EMP	G	PE
2	Governing equations and assumptions, Equation types, Model equations, potential flow, Heat conduction, Wave equation, Burgers equation, Euler equations	06	13	1, 2, 4	CO1	PSO2 PSO3 PSO4 PSO5 PSO6 PSO9 PSO14 PSO15 PSO16			
3	Finite Differences, Algorithms, Errors and Accuracy, Consistency, Stability and Convergence, Finite Volumes, Explicit algorithms, Implicit algorithms, Numerical boundary conditions, Method of lines, Shock Jump Relations, Shock capturing	28	58	1, 2 3,5	CO1 CO2 CO3 CO4 CO5 CO7	PSO2 PSO3 PSO4 PSO5 PSO6 PSO9 PSO14 PSO15 PSO16			
4	One dimensional Euler equations, Lax – Wendroff Scheme, Mc-Cormack Scheme, Implicit - method, Pseudo One Dimensional Euler Equations, boundary conditions, Flux – Splitting, Artificial viscosity, Flux limiters	06	13	1, 2 3,5	CO1 CO2 CO3 CO4 CO5 CO7	PSO2 PSO3 PSO4 PSO5 PSO6 PSO9 PSO14 PSO15 PSO16			
5	Multidimensional Euler equations, Lax- Wendroff and Mc-Cormack schemes, stability of multidimensional schemes, Operator splitting Implicit algorithms, Beam - Warming algorithm.	06	13	1, 2 3,5	CO2	PSO2 PSO3 PSO4 PSO5 PSO6			

						PSO9 PSO14 PSO15 PSO16			

Reference Books

1.	Numerical methods for conservation Laws, R. J. Leveque, Birkhauser Verlag, Basel (1992)
2.	Computation Fluid dynamics, J. D. Anderson Mc-Graw – Hill, New York (1995)
3.	An Introduction to Computational Fluid Dynamics: The finite volume method, H. K. Versteeg and W. Malasekera, Longman Scinetific and technical Essex, England1(1995)
4.	A Mathematical Introduction to Fluid Mechanics, A. J. Chorin and J. E. Marsden
5.	hyperbolic systems of conservation laws and mathematical theory of shock waves, P. D. Lax (1973)

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

Programme Name: MSc. (Applied Mathematics) – Industrial Mathematics

Programme Specific Outcome (PSO)

PSO1. Solve mathematical problems using analytical as well as numerical 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. (Applied Mathematics) Industrial Mathematics: Regular Programme

Year	**II**	**Core / ~~Elective / Foundation~~** **AMT2418.Neural Networks And Fuzzy Systems**	**Credits / Hours per week**	**04**
Semester	**II**	Year of Introduction: 2003 Year of Syllabus Revision: 2014	**Maximum Marks / Grade**	**80**
Mode of Transaction		Lectures		

Course Outcome (CO) AMT2418

CO1 Understand the fundamental theory and concepts of artificial neural networks
CO2 Understand the differences between networks for supervised and unsupervised learning
CO3 Design single and multi-layer feed-forward neural networks
CO4 Identify different neural network algorithms and their limitations
CO5 Develop and train Back Propagation, Hopfield and radial-basis function networks
CO6 Implement the applications of ANN in several fields like classification, pattern recognition, regression, control theory etc.
CO7: Understand the concept of fuzziness involved in various systems and fuzzy set theory.
CO8: Analyze the application of fuzzy logic control to real time systems.

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	Definition and brief history of Artificial neural networks. Structure and function of a Single Neuron, Biological Neuron and artificial Neuron Models **Architectures and Neural Networks:** • Fully connected • Layered networks • Feed forward • A cyclic and modular networks • Supervized and Unsupervized networks	05	10.4	1,2	CO1 CO2 CO3	PS03	EMP SD	G	PE
2	**Learning Algorithms:** Correlation learning ,Competitive learning ,Habbian rule , Perceptron rule ,Delta rule ,Back propagation algorithm **Hopfield Networks:** • Continuous and Discrete , • Energy function and its properties • Capacity of Hopfield Networks. • Radial Basis Function Networks, Cover's theorem.	12	24.96	1,2,3,4	CO4 CO5	PSO5 PSO6 PSO11			
3	**Application of Neural Networks** • Classification • Clustering • Pattern association • Function Approximation • Forecasting • Control application • Optimization	07	14.56	2,3.4,5,6	CO5 CO6	PSO5 PS06 PSO11			
4	**Fuzzy Systems** Uncertainties and their importance in science and	14	29.12	1,2,4	CO7	PSO6, PSO5			

	technology Fuzzy sets, standard operation on fuzzy sets, fuzzy operations and their properties, fuzzy numbers and their arithmetic Construction of fuzzy sets and operations on fuzzy sets								
5	**Fuzzy logic** : Multivalued Logics, Fuzzy Propositions, Fuzzy quantifiers, Linguistic Hedges and inference	05	10.4	1,2,3,6	CO7	PSO6, PSO5			
6	**Fuzzy systems**: Fuzzy controls,Fuzzy systems and neural network,fuzzy neural network	05	10.4	1,2,3,6	C07 C08	PSO6, PSO5			

References

1.	Dino Mandrioli & Carlo Ghezzi	Theoretical Foundations of ComputerScience.
2.	H.R. Lewis & C.H. Papadimitriou	Element of Theory of Computations
3.	Mervin Minsky	“computation :Finite and Infinite Machines".
4.	V.J. Rayward Smith	A first course in computability.
5.	Martin D. Davis and E.J. Weynker	Computability, Complexity and Langurges.
6.	George J Tourlakis :	Computability

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

Programme Name: MSc. (Applied Mathematics)

Programme Specific Outcome(PSO)

PSO1. Solve mathematical problems using analytical as well as numerical 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. (Applied Mathematics)Industrial Mathematics: Regular Programme

Year	**II**	**Core / ~~Elective / Foundation~~** **AMT 2416: OPTIMIZATION – II** **(Industrial Mathematics)**	**Credits / Hours per week**	**04**
Semester	**II**	Year of Introduction: 2001 Year of Syllabus Revision: 2014	**Maximum Marks / Grade**	**80**
Mode of Transaction		Lectures		

Course Outcome (CO) AMT 2416

CO1: According to the nature of the problem, can apply various type of algorithms to solve variety type of multivariate constrained optimization problems.
CO2: Understands and can successfully apply non-traditional methods viz. Genetic Algorithms and Simulated Annealing to solve multivariable non-linear programming problems.
CO3: Be able to apply technique for solving Stochastic LPP as well as NLPP.
CO4: Apply optimization techniques for solving multistage continuous or discrete problems.
CO5: Understand and apply project evaluation techniques using PERT and CPM on network models.
CO6: Formulate and solve multi objective LPP 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	**General Constrained optimization problem** Direct search method, Random search method, Monte Carlo method, Sequential Quadratic Programming technique, Feasible direction methods-Zoutendijk's method, Rosen's Gradient projection method, Augmented Lagrangian method.	12	25	2,3,5	CO1	PSO2 PSO5	Emp SD	G	PE
2	**Non traditional optimization algorithms** Genetic algorithms, Simulated annealing method.	08	17	3,4,5	CO2	PSO2 PSO9			
3	**Stochastic Optimization** Stochastic LPP, Stochastic NLPP	04	8	2,3,4	CO3	PSO5 PSO12			
4	**Multi-objective Optimization** Utility function method ,Inverted Utility function method Global criteria method	04	8	1,2,5	CO6	PSO12			
5	**Multistage optimization problems** Dynamic programming problems techniques	10	21	2,4,5	CO4	PSO12 PSO14			
6	**Project scheduling problems** bar charts mile stone charts fulkersons rule Critical Path Method(CPM) project evaluation and review techniques (PERT)	10	21	2,3,4,5	CO5	PSO5 PSO12 PSO14			

Reference Books

1.	S. S. Rao: Engineering Optimization(Theory and Practice), NewAge International Publishers, New Delhi, Third edition,2001.
2.	Kalyanmoy Deb: Optimization for Engineering Design(Algorithms and Examples), Prentice-Hall of India Private Limited, New Delhi,1995.
3.	S. Rajsekaran, G. A. VijayalakshmiPai: Neural Networks, Fuzzy logic,and Genetic Algorithms, Prentice-Hall of India Private Limited, New Delhi,2003.
4.	Kantiswarup, P.K.Gupta and Manmohan: Operations Research ,Sultanchand andSons.
5.	S.D. Sharma: Operations Research (Theory, Methods and Applications), KedarNath, Ram Nath& Co., Fifteenth edition,2005.
6.	B.E. Gillet : Introduction to Operation Research, Computer Orientedalgorithm.
7.	H.A. Taha :Operation research an Introduction, Prentice-Hall of India Private Limited, New Delhi, Sixth edition,2001.
8.	Srinath L.S.:PERT and CPM : Principles and Applications , 2nd edition,1975.

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

Programme Name: MSc. (Applied Mathematics))

Programme Specific Outcome(PSO)

PSO1. Solve mathematical problems using analytical as well as numerical methods.

PSO2. Assimilate complex mathematical ideas and arguments.

PSO3. Recognize the relationships between different areas of Mathematics and the connections between Mathematics and other 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.

PSO6. Apply soft computing techniques.

PSO7. Implement various algorithms using advanced Object Oriented Programming languages.

PSO8. Demonstrate facility in computer programming, data processing, numerical simulation, scientific visualization, and virtual experimentation.

PSO9. Describe the study of fundamental and advanced concepts in Mathematical Analysis.

PSO10. Select appropriate methods for solving ordinary and partial differential equations which is arising in Mathematical modelling of problem.

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Syllabus of Course:

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

M.Sc. (Applied Mathematics) Industrial Mathematics: Regular Programme

Year	**II**	**Core / ~~Elective / Foundation~~** **AMT2428L : Practicals on Computational Fluid Dynamics**	**Credits / Hours per week**	**01**
Semester	**II**	Year of Introduction: 2001 Year of Syllabus Revision: 2014	**Maximum Marks / Grade**	**20**
Mode of Transaction		Term Work, Practical & Viva		

No.	**Experiment**		**Course Code**	**BT Level**	**CO**	**PSO**
1	Programs for Solution of Elliptic equation (Laplace and Poisson) using Standard five point formula		AMT2417	1, 2, 5	CO2, CO4	PSO1, PSO5, PSO18
2	Programs for Solution of Elliptic equation (Laplace and Poisson) using Standard nine point formula			1, 2, 5	CO2, CO4	PSO1, PSO5, PSO18
3	Programs for Solution of Parabolic equations using explicit schemes using FTCS method, Richardson method, Dufort-Frankel method.			1, 2, 4, 5	CO2, CO3, CO4	PSO1, PSO5, PSO18
4	Programs for Solution of Parabolic equations using implicit schemes using Laasonen Method, Crank-Nicolson Method, Beta method			1, 2, 4, 5	CO2, CO3, CO4	PSO1, PSO5, PSO18
5	Programs for Solution of Hyperbolic equation using explicit schemes using FTFS method, FTCS method, FTBS method			1, 2, 4, 5	CO2, CO3, CO4	PSO1, PSO5, PSO18
6	Programs for Solution of Hyperbolic equation using explicit schemes using Lax method, Midpoint Leapfrog method, Lax-wendroff method			1, 2, 4, 5	CO2, CO3, CO4	PSO1, PSO5, PSO18
7	Programs for Solution of Hyperbolic equation using implicit schemes using Euler's FTCS			1, 2, 5	CO2, CO4	PSO1, PSO5, PSO18
8	Programs for Solution of Hyperbolic equation using implicit schemes using Crank Nicholson method			1, 2, 5	CO2, CO4	PSO1, PSO5, PSO18
9	Programs for Solution of nonlinear first order hyperbolic equation using Lax method, Lax-Wendroff method			1, 2, 4, 5	CO2, CO3, CO4	PSO1, PSO5, PSO18
10	Programs for Solution of nonlinear first order hyperbolic equation using MacCormack method			1, 2, 5	CO2, CO4	PSO1, PSO5, PSO18
11	Programs for Solution of nonlinear first order hyperbolic equation using Beam-Warming Implicit Method			1, 2, 5	CO2, CO4	PSO1, PSO5, PSO18
12	Programs for Solution of Burger's equation			1, 2, 5	CO2, CO4	PSO1, PSO5, PSO18

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Syllabus of Course:

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

M.Sc. (Applied Mathematics) Industrial mathematics: Regular Programme

Year	**II**	**Core / ~~Elective / Foundation~~** **AMT2429L : Practicals on Neural Networks and Fuzzy Systems**	**Credits / Hours per week**	**01**
Semester	**II**	Year of Introduction: 2001 Year of Syllabus Revision: 2014	**Maximum Marks / Grade**	**20**
Mode of Transaction		Term Work, Practical & Viva		

No.	**Experiment**		**Course Code**	**BT Level**	**CO**	**PSO**
1	Programs to check the outputs of different logic gates.		AMT2329L	2,3	CO4 CO5 CO6	PSO5 PSO6 PSO11
2	Program for implementing Hebbian Algorithm using bipolar and continuous activation functions.			2,3		
3	Program for implementing Perceptron Learning Rule.			2,3		
4	Program for implementing Delta Learning Rule.			2,3		
5	Program for implementing Widroff's Learning Rule.			2,3		
6	Program for implementing Back Propogation Algorithm			2,3		
7	Introduction to Neural Network Toolbox, Application of ANN in function approximation			2,3		
8	Programs to find Union and Intersection of discrete fuzzy sets.			2,3	CO7 CO8	
9	Programs to find Union and Intersection of continuous fuzzy sets.			2,3		
10	Programs to verify different laws on discrete as well as on continuous fuzzy sets.			2,3		
11	Program to find complement of discrete as well as of continuous fuzzy set.			2,3		
12	Programs to find alpha cut, support of given fuzzy set for both discrete and continuous.			2,3		
13	Programs to find addition, subtraction, multiplication of given fuzzy sets.			2,3		
14	Programs to solve fuzzy algebraic equations.			2,3		
15	Introduction to Fuzzy Toolbox.			2,3,6		
16	Programs related to Fuzzy Controller			2,3,6		

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

Programme Name: MSc. (Applied Mathematics))

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Syllabus of Course:

	The Maharaja Sayajirao University of Baroda **Faculty Technology and Engineering** **Department of Applied Mathematics**	**Academic Year**	**2019-20**
M.Sc. (Industrial Mathematics): Regular Programme			
Year **II**	**Core / ~~Elective / Foundation~~** AMT 2427 : Practicals on optimization-II	**Credits / Hours per week**	**01**
Semester **II**	Year of Introduction: 2001 Year of Syllabus Revision: 2014	**Maximum Marks / Grade**	**20**
Mode of Transaction	Term work, Practical and viva		

No.	**Practical**		**Course Code**	**BT Level**	**CO**	**PSO**
	General Constraint optimization problem:		AMT2427	1,2,3,5		
1	Direct search method (1) Box Complex Method (2) Sequential Linear Programming techniques				C01	PSO2,PSO5
2	Random search method				C01	PSO2,PSO5
3	Monte Carlo method				C01	PSO2,PSO5
4	Sequential Quadratic Programming techniques				C01	PSO2,PSO5
5	Feasible direction methods-Zoutendijk's method, Rosen's Gradient projection method Augmented Lagrangian method,Non traditional optimization algorithms:				C01	PSO2,PSO5
6	Non-Traditional Optimization Algorithms: (1) Genetic algorithms (2) Simulated anneling methods				CO2	PSO2,PSO9
	Project scheduling problems :					
7	Project Evaluation and Review Techniques (PERT)				CO5	PSO5,PSO12,PSO14
8	Critical Path Method(CPM)				CO5	PSO5,PSO12,PSO14
	Multistage optimization problems:					
9	Discrete Dynamic programming problems techniques				CO4	PSO12,PSO14
10	Continuous Dynamic programming problems techniques				CO4	PSO12,PSO14
11	**Stochastic Optimization:** (1) Stochastic LPP (2) Stochastic NLPP				CO3	PSO5,PSO12
12	**Multi-objective Optimization:** (1) Utility function method (2) Inverted Utility function method (3) Global criteria method				CO6	PSO12