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)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)

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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.

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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