DR. BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY,
CHHATRAPATI SAMBHAJINAGAR.

CIRCULAR NO.SU/M.Sc/College./NEP/95/2024

It is hereby inform to all concerned that, the Revised syllabi prepared by the Board of Studies/ Ad-hoc Boards & recommended by the Dean, Faculty of Science & Technology, **Academic Council at its meeting held on 08 April 2024 has accepted** the following Syllabi under the Faculty of Science & Technology **as per Norms of National Education Policy -2020** run at the Affiliated Colleges, Dr.Babasaheb Ambedkar Marathwada University as appended herewith.

Sr.No.	Courses	Semester
1.	**M.Sc.Zoology**	**IIIrd & IVth semester**
2.	**M.Sc. Biotechnology**	**IIIrd & IVth semester**
3.	**M.Sc.Bioinformatics**	**IIIrd & IVth semester**
4.	**M.A./M.Sc.Mathematics**	**IIIrd & IVth semester**

This is effective from the Academic Year 2024-25 and onwards.

All concerned are requested to note the contents of this circular and bring the notice to the students, teachers and staff for their information and necessary action.

University Campus,
Aurangabad-431 004.
REF.NO.SU/2024/26472-80
Date:- 20.05.2024

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Deputy Registrar,
Academic Section

Copy forwarded with compliments to :-

1] **The Principal of all concerned Colleges,**
Dr. Babasaheb Ambedkar Marathwada University,

2] **The Director, University Network & Information Centre, UNIC, with a request to upload this Circular on University Website.**

Copy to :-

1] **The Director, Board of Examinations & Evaluation,** Dr.Babasaheb Ambedkar Marathwada University, Chhatrapati Sambhajinagar.

2] The Section Officer,[M.Sc.Unit] Examination Branch, Dr.Babasaheb Ambedkar Marathwada University, Chhatrapati Sambhajinagar.

3] The Programmer [Computer Unit-1] Examinations, Dr.Babasaheb Ambedkar Marathwada University, Chhatrapati Sambhajinagar.

4] The Programmer [Computer Unit-2] Examinations, Dr.Babasaheb Ambedkar Marathwada University, Chhatrapati Sambhajinagar.

5] The In-charge,[E-Suvidha Kendra], Rajarshi Shahu Maharaj Pariksha Bhavan, Dr.Babasaheb Ambedkar Marathwada University, Chhatrapati Sambhajinagar.

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DR. BABASAHEB AMBEDKAR MARATHWADA

UNIVERSITY, CHHATRAPATI SAMBHAJINAGAR

FACULTY OF SCIENCE & TECHNOLOGY

2 Years P.G. Programme in Science

(M.A./M.Sc.)

As per National Education Policy-2020

Course Structure and Curriculum

For Affiliated Colleges/Institutions

M.A./M.Sc. (Third & Fourth Semester)

Subject: Mathematics

(Effective from 2024- 2025)

J.A. Nanaware

Preamble

Mathematics is an indispensable tool for science, engineering, and technology. It is the basic language for understanding the world and lends precision to scientific thought. Dr.Babasaheb Ambedkar Marathwada University, has decided to adopt the New Education Policy -2020 as per the directives of the University Grants Commission and Government of Maharashtra from the academic year 2023-2024 for the post-graduate programmes run by affiliated colleges of the Dr.Babasaheb Ambedkar Marathwada University. Taking into consideration the rapid growth in science, engineering, and technology and new approaches in different branches of Mathematics and related subjects, Board of Studies in Mathematics with the concern of teachers of Mathematics from affiliated colleges of this University has prepared the syllabus for M.Sc. Mathematics Program as per (NEP-2020). This course provides training in different aspects of Pure Mathematics, equipping you with a range of mathematical skills in problem-solving, project work and presentation. You have the opportunity to learn advanced core pure mathematics topics together with a range of more specialized options, and undertake an independent research project in your chosen area.

Programme Educational Outcomes:

M.Sc. Mathematics is a two-year postgraduate program that deals with a deeper knowledge of advanced mathematics through a vast preference of geometry, calculus, algebra, number theory, dynamical systems, differential equations etc. Banks, universities, share markets, space agencies, research centers, etc., offer good job opportunities for the graduates. Since mathematics has a good job scope worldwide, students get placed in reputed firms.

Program Outcomes:

- To enhance computational skills and Mathematical reasoning among the students.
- To develop the ability to think critically, logically, and analytically.
- To enhance career opportunities in education, research, and industries.
- To develop skills in mathematical softwares.

Program Specific Outcomes:

- To formulate, analyze, and solve problems through application of fundamental mathematical techniques.
- To develop the ability to determine the validity of a given argument, develop mathematical thinking and be able to solve mathematical problems and construct mathematical proofs independently.
- To demonstrate an understanding of the foundations of various branches of mathematics and apply the same to formulate and develop mathematical arguments in a logical manner
- Apply knowledge and mathematical skills to translate information presented into mathematical form, select and use appropriate mathematical formulae or techniques in order to process the information and draw the relevant conclusion.
- Investigate and apply mathematical solutions in a variety of contexts related to science, technology, business and industry, and illustrate these solutions using symbolic, numeric, or graphical methods.
- Build a solid foundation for higher studies in mathematics and other disciplines requiring quantitative techniques and enhancing their career prospects through success in competitive examinations.

Two-Year Post-graduate Program

Course and Credits Distribution of Two years/One Year PG/Master's Degree Program with Entry & Exit Option

Faculty of Science & Technology

Year / level	Semester	Major subject		RM	OJT /FP	RP	Credits	Degree
		DSC Core Mandatory	DSE (Elective)					
First year 6.0	I	3(4) +2=14	4	4			22	PG Diploma (after 3 years degree)
	II	3(4) +2=14	4		4 Complete during Summer break		22	
Cum. Cr. For PG Diploma		28	08	4	4		44	
Exit option with Post-graduate Diploma (44 credits) after first year or two semester with completion of courses equivalent to 44 credits								
Second Year 6.5	III	3(4)+2=14	4			4	22	PG Degree after 3 years UG or PG Degree after 4 years UG
	IV	3(4)=12	4			6	22	
Cum. Cr. For 1 year PG Degree		26	8			10	44	
Cum. Cr. For 2 years PG Degree		54	16	4	4	10	88	
2 Years -4 sem.PG Degree (88 credits) after three year UG Degree or 1 Year -2 sem. PG Degree (44 credits) after four year UG degree								

Note- DSC-is based on specialization

ABBREVIATION:

Major – Comprising Mandatory –is based on specialization

DSE- Discipline Specific Elective

OJT – On-the- Job Training

FP – Field Project (Corresponding to the Major (Core) Subject)

RP – Research Project (Corresponding to the Major (Core) Subject)

Internship/Apprenticeship - (Corresponding to the Major (Core) Subject)

AS PER NEP 2020

Credit distribution structure for Two Years/One Year Programme with Multiple Entry and Exit options

Effective from AY 2024-2025

Discipline Specific Core in **Mathematics**

Class: M.A./ M.Sc. Second Year (IIIrd Semester) Subject: Mathematics

Course type	Course Code	Course Name	Teaching Scheme (Hrs./ week)		Credits Assigned		Total Credits
			Theory	Practical	Theory	Practical	
Major Mandatory DSC	MAT/MJ/508T	Functional Analysis	4	-	4	-	14
	MAT/MJ/509T	Partial Differential Equations	4	-	4	-	
	MAT/MJ/510T	Numerical Analysis	4	-	4	-	
	MAT/MJ/511P	Python Programming	-	4	-	2	
DSE (Choose any one from pool of courses)	MAT/DSE/512T	Fluid Mechanics-I	4	-	4	-	4
	MAT/DSE/513T	Operation Research-I					
	MAT/DSE/514T	Difference Equations					
RP	MAT/RP/515P	Research Project-I	-	8	-	4	4
			16	12	16	6	22 credits

Class: M.A./M.Sc. Second Year (IVth Semester) **Subject: Mathematics**

Course type	Course Code	Course Name	Teaching Scheme (Hrs./ week)		Credits Assigned		Total Credits
			Theory	Practical	Theory	Practical	
Major Mandatory DSC	MAT/MJ/558T	Linear Integral Equations	4	-	4	-	12
	MAT/MJ/559T	Mechanics	4	-	4	-	
	MAT/MJ/560T	Fractional Calculus	4	-	4	-	
DSE (Choose any one from pool of courses)	MAT/DSE/561T	Fluid Mechanics-II	4	-	4	-	4
	MAT/DSE/562T	Operation Research-II					
	MAT/DSE/563T	Fuzzy Mathematics					
		NPTEL/SWAYAM/MOOC					
RP	MAT/RP/564P	Research Project-II	-	12	-	6	6
			16	12	16	6	22 credits

Semester-III

Course Code :MAT/DSC/508T	**DSC (Major) : Functional Analysis**
Total Credits : 4 Maximum Marks : 100	Total Contact Hours : 60 Hrs

Learning Objectives of the Course:

To introduce Banach and Hilbert Spaces and their properties.

Course Outcomes (COs) : The students will be able :

To study various fixed point theorems.
To study spectrum of normal and self-ad joint operators.
To study open mapping theorem and closed graph theorem.
To prove the existence of solutions of various equations.

Module No.	Topics / actual contents of the syllabus	Contact Hours
I	Definition of normed linear spaces, Banach spaces, continuity of norm, joint continuity of vector addition and scalar multiplication in nor med linear spaces, quotient spaces, Continuous linear transformations and different criterions of continuity of linear transformations on nor med linear spaces, space of bounded linear transformations, isometric isomorphism.	**15**
II	Conjugate spaces, Hahn-Banach theorem and its consequences, natural imbedding of normed linear space into its second conjugate, The Open Mapping theorem, the Closed graph theorem, the Uniform Boundedness theorem, conjugate of an operator.	**15**
III	Inner product spaces, Schwarz's inequality, joint continuity of an inner product, parallelogram law in inner product spaces, Hilbert spaces, Orthogonal complements.	**15**
IV	Orthonormal sets and complete orthonormal sets, conjugate space of a Hilbert space, ad joint of an operator, self-ad joint operators, normal and unitary operators.	**15**
Text Books	**G. F. Simmons**: Introduction to Topology and Modern Analysis, Tata McGraw Hill Edition, 2004	
Reference Books	**Martin Schechter**: Principal of Functional Analysis, American Mathematical Society, 2002	

Course Code :MAT/DSC/509T **DSC (Major) : Partial Differential Equations**

Total Credits : 4 Total Contact Hours : 60 Hrs
Maximum Marks : 100

Learning Objectives of the Course:

To know fundamentals of DE and PDE
To know general analysis of PDE
To study Jacobi's method and Charpit's Method

Course Outcomes (COs) : Student will be able to :

To find the solutions of PDE
To analyze and classify the second order PDE
To find the general solution of PDE by using Jacobi's method and Charpit's Method.
To find the canonical forms

Module No.	Topics / actual contents of the syllabus	Contact Hours
I	First order partial differential equation, linear equation of the first order, internal surface passing through a curve, surfaces orthogonal to a given system of surfaces.	**15**
II	Non-linear partial differential equations of the first order, Cauchy's method of characteristics, compatible system of first order equations (condition of compability), Charpit's method.	**15**
III	Special types of first order equations, solutions satisfying given conditions, Integral surface through a curve, Derivation of one complete integral from another, Integral surfaces circumscribing a given surfaces, Jocobi's method for solving $F(x,y,z,p,q) = 0$.	**15**
IV	The origin of second order equations, linear partial differential equations with constant coefficients, intermediate integrals or first integrals, Monge's method of integrating $Rr + Ss + Tt = V$, classification of second order partial differential equation (Canonical form).	**15**
Text Books	**I.N.Sneddon**:Elements of Partial Differential Equation, Dover Publication, McGraw - Hill Book Company, New York, 1957. (Chapters 2, 3, 5 and 6)	
Reference Books	**(1) T. Amarnath:** An elementary course in partial differential equation Narosa Publishing House 2003. **(2) M.D. Raisighania:** Ordinary and Partial Differential Equation, S. Chand & Company Ltd, New Delhi.	

Course Code :MAT/DSC/510T **DSC (Major) : Numerical Analysis**

Total Credits : 4 Total Contact Hours : 60 Hrs
Maximum Marks : 100

Learning Objectives of the Course:

To know the various numerical iterative methods for solving a given equation
To know the various numerical iterative methods for solving a given system of equations
To study various interpolating methods for finding interpolating polynomials
To study numerical differentiation and integration of the various interpolating polynomials..

Course Outcomes (COs) : Student will be able :
To find solutions of a given equation as well as given system of equations.
To find interpolating polynomials using the various interpolating methods.
To apply methods of differentiation and integration.

Module No.	Topics / actual contents of the syllabus	Contact Hours
I	Solution of algebraic and transcendental equations: Introduction; Bisection method: Iteration methods based on first degree equations: Newton Raphson method; Secant and Regular falsi methods, Rate of convergence for secant method and Newton Raphson method; General iteration methods.	**15**
II	System of Linear Algebraic equations: Introduction; Linear system of Equations: Direct methods; Gauss Elimination method; Gauss -Jordan Elimination method; Triangularization method; Iteration methods; Jacobi iteration method; Gauss seidal iteration method; successive over Relaxation (SOR) method.	**15**
III	Interpolation and approximation: Introduction; Langrange and Newton Interpolations; Finite difference operators; Interpolating polynomial using finite difference; Hermite interpolation; piecewise and spline interpolation.	**15**
IV	Differentiation and integration: Introduction; Numerical Differentiation; Numerical Integration; Methods based on interpolation; Trapezoidal rule, Simpson's 1/3 rule, Simpson's 3/8 rule.; Composite Integration methods; Gauss quadrature methods; Gauss-Legendre Integration methods; Gauss-Legendre Formulas.	**15**
Text Book	**Jain, Iyengar and Jain**: Numerical methods for scientific and engineeringcomputation. (4th Edition) New Age Pub. New Delhi.	
Reference Books	1. **S. S. Sastry**: Introductory methods of Numerical Analysis (4TH edition) Prentice Hall 2. **J. I. Buchaman and P. R. Turner**: Numerical method & Analysis (PHI)	

Course Code :MAT/DSC/511P **DSC(Major) : Python Programming**

Total Credits : 2 Total Contact Hours : 60 Hrs
Maximum Marks : 100

Learning Objectives of the Course:

To introduce the Python programming language to tackle mathematical problems.

Course Outcomes (COs) : The students will be able:

To write string, list, tuple
To write Input output functions.
To use looping statements and conditional statements.
To apply matrices in Python Programming language.

Module No.	Topics / actual contents of the syllabus	Contact Hours
I	Installation of Python, Values and types: int, float and str., The Print Function: Print basics, Variables: assignment statements, printing variable values, types of variables, Operators, operands and precedence:+, -/, *, **, PEMDAS(Rules of precedence), String operations: + :Concatenation, * : Repetition, Boolean operator, Comparison operators: —, =, >, <=, Logical operators: and, or, not, Mathematical functions from math, cmath modules, Keyboard input: input() statement,	**15**
II	Calculus: Differentiation, Integration, Limit and Series, Strings: Length (Len function), String traversal: Using while statement, Using for statement, String slice, Comparison operators (>, <, ==), Lists: List operations, Use of range function, Accessing list elements, List membership and for loop, List operations, Updating list: addition, removal or updating of elements of a list, Tuples: Defining a tuple, Index operator. Slice operator. Tuple assignment, Tuple as a return value, Dictionary, Boolean, Sets	**15**
III	Conditional and alternative statements, Chained and Nested Conditionals: if, if-else. If-elif-else, nested if, nested if-else, Looping statements such as while, for etc, Tables using while. Functions: Calling functions: type, id, Type conversion: int, float, str., Composition of functions, User defined functions, Parameters and arguments,	**15**
IV	Matrix construct, eye(n), zeros(n,m) matrices, Addition, Subtraction, Multiplication of matrices, powers and invers of a matrix, Accessing Rows and Columns, Deleting and Inserting Rows and Columns, Determinant, reduced row echelon form, null space, column space, Rank, Solving systems of linear equations (Gauss Elimination Method, Gauss Jordan, Method, LU-decomposition Method), Eigenvalues, Eigenvectors, and Diagonalization	**15**
Reference Books	1 **Kalyanrao Takale, Amjad Shaikh, Krishna Ghode,, Shrikisan Gaikwad, S. R. Patil**:Programming in Python –I, Nirali Prakashan, 2021. 2. **Lambert K. A.**, Fundamentals of Python - First Programs, Cengage Learning India, 2015. 3. **Guzdial, M. J.**, Introduction to Computing and Programming in Python, Pearson India. 4 **Perkovic, L.**, Introduction to Computing Using Python, 2/e, John Wiley, 2015. 5 **Zelle, J.**, Python Programming: An Introduction to Computer Science, Franklin, Beedle & amp; Associates Inc.	

Course Code :MAT/DSE/512T **DSE(Elective) : Fluid Mechanics-I**

Total Credits : 4 Total Contact Hours : 60 Hrs
Maximum Marks : 100

Learning Objectives of the Course:

To know fundamentals of fluids
To know general analysis of fluid motions and fluid pressure.
To know fundamentals of motion and fundamentals of two dimensional flows.

Course Outcomes (COs) : Student will be able :

To identify real and ideal fluids and fluid motion.
To find acceleration of a fluid.
To solve Euler's equation of motion and solve problems of two dimensional flows.

Module No.	Topics / actual contents of the syllabus	Contact Hours
I	Review of vector Analysis, Kinematics: Lagrangian and Eulerian methods (Rathy) Real and ideal fluids, velocity at a point, streamlines, path lines, streak lines, velocity potential, irrotational and rotational motions (Rathy), vorticity and circulation, Local and particle rates of change, The equation of continuity.	**15**
II	Acceleration of a Fluid, Conditions at rigid boundary, General analysis of fluid motion, Pressure at a point in a fluid at rest and moving fluid, conditions at a boundary of two inviscid immiscible fluids, Euler's equation of motion, Bernoulli's equation.	**15**
III	Steady motion under conservative body forces, Potential Theorems, Axial symmetric flows, some two dimensional flows. Impulsive motion, some aspects of vortex motion. sources, sinks, doublets and their images.	**15**
IV	Some two dimensional flows: Meaning of two dimensional flow, use of cylindrical polar coordinates, The stream function, The complex potential for two dimensional irrotational, incompressible flow, complex velocity potentials for standard two dimensional flows. Text Books:	**15**
Text Book	1.**R. K. Rathy**, An Introduction to Fluid Dynamics, IBH, New Delhi, 1976 Chapter III: Article 3.1,3.5,3.6 2.**F. Chorlton**, Text Book of Fluid Dynamics, C.B.S. Publishers and Distributors, Delhi, 1985. Chapter - 2: Article 2.1 to 2.10, Chapter - 3 Article 3.1 to 3.12, Chapter - 4: Article 4.1 to 4.3, Chapter - 5: Article 5.1 to 5.10	
Reference Books	1.**M. D. Raisighania:** Fluid Dynamics, 11/e, S. Chand Publications. 2 **S. W. Yuan:** Foundations of Fluid Mechanics, Prentice Hall of India Pvt.Ltd, New Deli,1976.	

Course Code :MAT/DSE/513T	**DSE(Elective) : Operation Research-I**
Total Credits : 4 Maximum Marks : 100	Total Contact Hours : 60 Hrs

Learning Objectives of the Course:

To understand linear programming problem.
To learn methods of solution of LPP.
To study transportationa nd assignment problems.

Course Outcomes (COs) : Student will be able :

To identify the type of LPP.
To find the solution of LPP.
To solve assignment and transportation problems in industry.

Module No.	Topics / actual contents of the syllabus	Contact Hours
I	Operations research and its scope, Necessity of operations research in industry, Linear programming problems, convex sets, feasible solutions, formulation of L.P.P. method for solution of LPP.	**15**
II	Graphical solution of L.P.P, Simplex method; theory and problems. Computational procedure, artificial variables inverse of a matrix using simplex method.	**15**
III	Duality in L.P.P., Concept of duality, properties, dual simplex method. its algorithm. Parametric linear programming.	**15**
IV	Transportation and assignment problems, various methods.	**15**
Text Books	.1.**Kanti Swarup, P.K. Gupta and Man Mohan**: Operations Research, S. Chand; & Sons, New Delhi. Chapter- 0 (Related concepts) Chapter 1, 2,3,4,6,7,9, **2. Mittal, K. V**.: Optimization methods, Wiley, New Delhi.	
Reference Books	1.**H. A.Taha**: Operations Research- An introduction, Macmillan, New York, **2. N.S. Cambo**, Mathematical- programming Techniques. Affiliated East- West Press, New Delhi	

Course Code :MAT/DSE/514T **DSE(Elective) : Difference Equations**

Total Credits : 4 Total Contact Hours : 60 Hrs
Maximum Marks : 100

Learning Objectives of the Course:

To study the difference operators
To solve the difference equation by given methods.
To study the stability results.

Course Outcomes (COs) : Student will be able :

To identify and apply the properties of difference operators.
To solve linear difference equations.
To find the solution of nonlinear difference equations.
To test the stability of solutions of difference equations.

ModuleNo.	Topics / actual contents of the syllabus	Contact Hours
I	Introduction, Difference Calculus-The Difference Operator summation, Generating functions and approximate summation,	**15**
II	Linear difference Equations- first order equations, General results for linear equations. Equations with constant coefficients	**15**
III	Application, Equations with variable coefficients nonlinear equations, which can be linearized, The Z transform	**15**
IV	Stability Theory- Initial value problems for linear systems. Stability of linear systems Stability of nonlinear systems chaotic behaviors	**15**
Text Book	**Walter G. Kelley and Allan C. Peterson**: Difference Equations -An Introduction with Applications. Academic Press, Harcourt Brace Jouranovich Pub. 1991.	
Reference Books	**Calvin Ahlbrandt and Allan C. Peterson**: Discrete Hamiltonian Systems Difference Equations, Continued Fractions and Riccati Equations, Kulwer, Boston 1996.	

Course Code :MAT/RP/515P	**RP : Research Project-I**
Total Credits : 4	Total Contact Hours : 90 Hrs
Maximum Marks : 100	

Learning Objectives of the Course:

To learn and apply the knowledge gained in discipline specific/elective courses.

Course Outcomes (COs) :

To apply the method to solve the considered real world problems.

To write a report on the project to various agencies.

Instructions	1. Title of the project shall be based on the discipline specific/elective courses. 2. Collection of data/survey shall be done on the topic of project. 3. Record of each activity shall be maintained properly and produced as and when required /asked 4.Project report shall be submitted at the end of the semester for evaluation.

Semester-IV

Course Code :MAT/DSC/558T Total Credits : 4 Maximum Marks : 100	**DSC (Major) : Linear Integral Equations** Total Contact Hours : 60 Hrs	
Learning Objectives of the Course: To know the linear integral equations. To know the techniques of solving various types of linear integral equations. **Course Outcomes (COs) :** The students will be able: To identify the the type of linear integral equations. To apply and solve the various types of linear integral equations.		
Module No.	Topics / actual contents of the syllabus	Contact Hours
I	Definition of Integral Equations and Linear Integral Equations, Types of Linear Integral Equations, Special kinds of Kernels: Separable or degenerate kernel, symmetric kernel, convolution-type kernels, Eigenvalues and Eigen functions of kernels, Solution of linear integral equations, Verification of solution of linear integral equations, Conversion of Boundary Value Problem to integral equations and vice-versa, conversion of Initial Value Problems to integral equations and vice-versa.	**15**
II	Methods of obtaining solution for Fredholm integral equations, Fredholm integral equations with separable kernels, Approximating kernels by separable kernels, Method of successive approximation, Iterated kernel method for Fredholm integral equations, Resolvant kernels and their properties, Methods of solutions for Volterra integral equations. Volterra type kernel. Method of differentiation, Method of successive approximations, Method of iterative kernels, Resolvant kernels and its use to solve Volterra integral equations.	**15**
III	Symmetric kernel, trace of a kernel, Fredholm operator, Fundamental properties of symmetric kernels, Eigen values and Eigen functions of symmetric kernel and their properties, normalized Eigen functions, Iterated kernel of symmetric kernels and their properties, Truncated kernel of symmetric kernel and necessary and sufficient condition for symmetric kernel to be separable, The Hilbert-Schmidt theorem, Method of Solution for Integral equations with symmetric kernels.	**15**
IV	Integral Transform Methods, Recall of Laplace and Fourier Transforms, Application of Laplace transform to Volterra integral equations with convolution-type kernel and examples, Application of Fourier transform to some singular integral equations and examples.	**15**
Text Book	**R. P. Kanwal**: Linear Integral Equations Theory and Applications, Academic Press, 1971	
Reference Books	1. **Shanti Swarup:** Integral Equations, Krishna Publication 2.**M. D. Raisinghania**: Integral Equations and Boundary Value Problems, S. Chand & Company Pvt. Ltd. 2007	

Course Code :MAT/DSC/559T	**DSC(Major) : Mechanics**
Total Credits : 4 Maximum Marks : 100	Total Contact Hours : 60 Hrs

Learning Objectives of the Course:

To study the fundamentals of equation of motion.
To analyze Lagranges equation and study fundamentals and applications of Hamilton's equation.
To learn fundamentals of calculus of variation.

Course Outcomes (COs) : Student will be able :

To classify the equation of motions, Hamilton's equations and principle of least action.
To find theo extremals of the functional by using Euler's equation.

Module No.	Topics / actual contents of the syllabus	Contact Hours
I	Mechanics of system of particles, generalized coordinates, holonomic & nonholonimic system, Scleronomic & Rheonomic system, D' Alemberts's Principle and Lagrange's equation of motion, different forms of Lagrange's equation, Generalized potential, conservative fields and its energy equation, application of Lagrange's formulation.	**15**
II	Functional, Linear functional. Fundamental lemma of Calculus of Variations simple variational problems, The variation of functional, the extermum of functional, necessary condition for extreme, Euler's equation, Euler's equation of several variables, invariance of Euler's equation. Motivating problems of calculus of variation, Shortest distance, Minimum surface of revolution. Brachistochrone Problem, Isoperimetric problem, Geodesic.	**15**
III	The fixed end point problem for unknown functions, variational problems in parametric form, Generalization of Euler's equation to (i) 'n' dependent functions (ii) higher order derivatives. Variational problems with subsidiary conditions,	**15**
IV	Hamilton's principle, Hamilton's canonical equations, Lagrange's equation from Hamilton's principle Extension of Hamilton's Principle to nonholonomic systems, Application of Hamilton's formulation (Hamiltonian) cyclic coordinates & conservation theorems, Routh's procedure, Hamilton's equations from variational principle, The principle of least action. Kepler's law of planetary motion.	**15**
Text Book	1.**H. Goldstein, Charles Poole, John Safko**: Classical Mechanics, Pearson 3rd Education, 2002. Ch..-1 , Ch.. - 2 (2.1 to 2.4), Ch. (8.2-8.6) Ch. 4 (4.1 to 4.6) 2.**I. M. Gelfand & S. V. Fomin**: Calculus of Variations, Prentice-Hall Chapter -1 (1,2,3,4.5.6) Chapter-2 (9.10,11,12)	
Reference Books	1. **N. Rana and B. Joag**: Classical Mechanics, Tata McGraw Hill 1991. 2. **F. Gantmacher**, Lectures in Analytic Mechanics, NIR Publishing House, New Delhi	

ourse Code :MAT/DSC/560T	**DSC(Major) : Fractional Calculus**	
Total Credits : 4 Maximum Marks : 100	Total Contact Hours : 60 Hrs	
Learning Objectives of the Course: To introduce the fractional calculus. To introduce the fractional differential equations To introduce the methods of solution of fractional differential equations. **Course Outcomes (COs) :** Student will be able : To find fractional derivative and integrals of some elementary functions. To find the solution of fractional differential equations . To prove the existence and uniqueness results.		
Module No.	Topics / actual contents of the syllabus	Contact Hours
I	Special functions: Gamma function, Mittag-Leffler functions,Fractional Derivatives and Integrals: Grunwald_Letnikov Fractional Derivatives, Riemann-Liouville Fractional Derivatives, Caputo's Fractional Derivatives, Sequential Fractional Derivatives, Left and Right Fractional Derivatives, Properties of Fractional Derivatives,	**15**
II	Laplace transform of Fractional Derivatives, Fourier Transform of Fractional Derivatives, Mellin Transform of Fractional Derivatives.	**15**
III	Existence And Uniqueness Theorems: Linear Fractional Differential Equations. General form of Fractional Differential Equations, Method of solutions, Dependence on initial conditions.	**15**
IV	The Laplace Transform Method: Standard Fractional Differential Equations, Sequential Fractional Differential Equations.	**15**
Text Book	**1. Igor Podlubny:** Fractional Differential Equations, Academic Press, San Diego, California,USA. **2. Anatoly A.Kilba, Hari M.Srivastav, Juan J.Trujillo**: Theory and Applications of Fractional Differential Equation, Elsevier, Newyork.(2006)	
Reference Books	1. **Oldham, Keith B.; Spanier, Jerome** (1974). The Fractional Calculus; Theory and Applications of Differentiation and Integration to Arbitrary Order. Mathematics in Science and Engineering. **V.** Academic Press. ISBN 978-0-12-525550-9. 2. **Miller, Kenneth S.; Ross, Bertram, eds.** (1993). An Introduction to the Fractional Calculus and Fractional Differential Equations. John Wiley & Sons. ISBN 978-0-47158884-9. 3. **Samko, S.; Kilbas, A.A.; Marichev, 0.** (1993). Fractional Integrals and Derivatives: Theory and Applications. Taylor & Francis Books.ISBN	

Course Code :MAT/DSE/561T	**DSE(Elective) : Fluid Mechanics - II**
Total Credits : 4	Total Contact Hours : 60 Hrs
Maximum Marks : 100	

Learning Objectives of the Course:

To know the concepts of viscous flow, stress and strain, viscosity and laminar flow.
To study viscous incompressible fluid and solve problems of viscous flow with heat transfer.

Course Outcomes (COs) : Student will be able:

To understand and apply the knowledge of viscous flow, stress and strain.
To solve Navier Stoke's equations and the energy equation.

Module No.	Topics / actual contents of the syllabus	Contact Hours
I	Viscous flows, stress components in a real fluid, Relation between Cartesian components of stress, translations motion of a fluid element, rate of strain quadric and principal stresses, properties of the rate of strain quadric, Stress Analysis in Fluid Motion, relation between stress and rate of strain, the coefficient of viscosity and laminar flow, the Navier Stock's equations, [1]	**15**
II	The energy equation, [2], [3], Equations in Cartesian, cylindrical or spherical polar coordinates for a viscous incompressible fluid: - Statements only without proof; [2] [3], Diffusion of velocity and dissipation of energy due to viscosity, [1],Some Solvable Problems in viscous flow with heat transfer: - Flow between parallel Plates velocity and temperature distribution [2], [3] steady flow through a tube of uniform circular cross section.	**15**
III	Velocity and Temperature Distribution, [2], [3], Distribution, [2], steady flow between concentric rotating cylinders, velocity and temperature distribution, [2],[3], Flow in tubes of arbitrary but uniform cross section, equations for velocity and Temperature in a steady flow, [1], [2], [3] Uniqueness Theorem for the velocity and Temperature , [1], Velocity distribution for tubes having equilateral triangular or elliptic cross section, [1] Velocity distribution for the flow through a tube of rectangular cross section [2], [3].	**15**
IV	Flow between two porous Plates, plane Couett of plane poisseuille flow - velocity and temperature distribution, [2], Flow through a convergent or divergent channel, [2], [3], Flow of two immiscible fluids between parallel Plates, [2], Flow due to a Plane wall suddenly set in motion or due to an oscillating plane wall, [3].	**15**
Text Books	1.**F. Chorlton**: Textbook of Fluid Dynamics, C.B.S. Pub. Delhi, 1976, Ch. 8 **2.R. K. Rathy**: An Introduction to Fluid dynamics, I.B.H. Pub. Co, New Delhi 1976, (§ 6.5,6.6a to 6.6c, 8.2 to 8.2c, 8.2e, 8.3 to 8.5b, 8.10a, **11.1,** 11.2,11.4,11.6,11.9, 11.9a, 119b, 11,10, 11.10a, 12.2, 12.3d,).	

	3.**J. L. Bansal**: Viscous Fluid Dynamics, Oxford and IBH Pub. Co. 1977. (§ 2.5, 2.6, Tables 2.2, 2.4, 2.6, § 4.2 to 4.7, 4.12, 4.13, 5.1 to 5.3, 5.6, 6.1, 6.2. 4.**O. K. Batchelor**: An Introduction to Fluid Mechanics, Foundation book New Delhi, 1994, (§ 4.2, § 4.8)
Reference Books	1. **M. D. Raisighania**, Fluid Dynamics, 11/e, S. Chand Publications. 2. **S. W. Yuan**: Foundations of Fluid Mechanics Prentice Hall, of India, New Dehli, 1976. 3. **W. H. Besaut and A. S. Ramsay**: A Treatise on I lydrowecouies part 11, CBS Pub. Delhi 1988.

Course Code :MAT/DSE/562T **DSE(Elective) : Operations Research - II**

Total Credits : 4 Total Contact Hours : 60 Hrs
Maximum Marks : 100

Learning Objectives of the Course:

To study fundamentals of Dynamic programming, Nonlinear Programming
To study Replacement problems, Network scheduling and PERT &CPM.

Course Outcomes (COs) : Student will be able:

To solve the dynamic Programming and nonlinear Programming problems.
To solve replacement problems, network scheduling and PERT &CPM.
To find the shortest path and critical path for a given problem.

Module No.	Topics / actual contents of the syllabus	Contact Hours
I	Dynamic programming, computational procedure, solution of LPP by dynamic programming.	**15**
II	Nonlinear Programming introduction, general nonlinear programming problems, problem of constrained maxima and minima, graphical solution Kuhn-Tucker conditions, Quadratic programming. Integer programming	**15**
III	Replacement problems, Applications to industrial problems.	**15**
IV	Network scheduling and PERT- CPM.	**15**
Text Books	**Kanti Swarup P.K. Gupta and Manmohan**: Operations Research, S. Chand and Sons, New Delhi.(Fourteenth Edition:2008) **Scope:** Chapter - 10,11,12 (sections 12.1 to 12.5),13 (sections 13.1 to 13.4), **18** (sections 18.1 to 18.5), 25 (sections 25.1 to 25.6 and 25.8),27. (Sections 27.1 to 27.5),28 (Section 28.1 to 28.4)	
Reference Books	1. **H. A. Taha**: Operations Research- An introduction, Macmillan, New York, 2. **S.S. Rao**: Optimization Theory and Applications, Wiley, New Delhi. 3. **N. S. Kambo**: Mathematical-programming Techniques. Affiliated East- West Press, New Delhi.	

Course Code :MAT/DSE/563T **DSE(Elective) : Fuzzy Mathematics**

Total Credits : 4 Total Contact Hours : 60 Hrs
Maximum Marks : 100

Learning Objectives of the Course:

To introduce the theory of fuzzy sets as a measure of uncertainty and a ambiguity.
To introduce the various operations on fuzzy sets and fuzzy Arithmetic operations.

Course Outcomes (COs) : Student will be able :

To distinguish between Classical and fuzzy approach of Mathematics.
To apply fuzzy sets in real world /industrial problems.

Module No.	Topics / actual contents of the syllabus	Contact Hours
I	From classical (crisp) sets to fuzzy sets; Introduction: crisp sets: An overview; Basic concepts in fuzzy sets; convex fuzzy sets (Theorems and exercises)	**15**
II	Fuzzy sets versus crisp sets: Additional properties of a - cuts; Representation of fuzzy sets; Decomposition Theorems. Operations on Fuzzy sets; Types of operations; Fuzzy complement (Axioms and theorems)	**15**
III	Operations on Fuzzy Sets: Types of operations; Fuzzy Complements; Fuzzy intersections: t- norms; fuzzy unions: t — co norms; Combinations of operations; Aggregation of operations.	**15**
IV	Fuzzy Arithmetic: fuzzy numbers; Linguistic Variables; Arithmetic operations on intervals of real numbers; Arithmetic operations on fuzzy numbers. Fuzzy relations: Introduction; fuzzy Relations; operations on fuzzy relations; a - cuts of a fuzzy relation: composition of fuzzy Relations; fuzzy relation on a domain.	**15**
Text Books	1.**Klir George J. and Yuan Bo:** Fuzzy sets and fuzzy logic. Theory and applications.Prentice Hall of India Pvt. Ltd. New Delhi. 1997. 2.**M. Ganesh:** Introduction to Fuzzy sets and Fuzzy logic, (OHI), New Delhi, 2006.	
Reference Books	1. **Kaufmann A and Gupta M. M.:** Introduction to Fuzzy arithmetic, Van Nostrand, 1989. 2. **Zimmermann H. J.**:Fuzzy set theory and its applications, 1997.	

Course Code :MAT/RP/564P	**RP : Research Project-II**
Total Credits : 6	Total Contact Hours : 120 Hrs
Maximum Marks : 100	

Learning Objectives of the Course:

To learn and apply the knowledge gained in discipline specific/elective courses.

Course Outcomes (COs) :

To apply the method to solve the considered real world problems.
To write a report on the project to various agencies.

Instructions	1. Title of the project shall be based on the discipline specific/elective courses. 2. Collection of data/survey shall be done on the topic of project. 3. Record of each activity shall be maintained properly and produced as and when required /asked 4.Project report shall be submitted at the end of the semester for evaluation.