Department of Mathematics

Jaypee Institute of Information Technology, Noida

<u>Semester III</u>

Complex Analysis (19M21MA117)

Function of complex variable, analytic functions, Cauchy Riemann equation, Cauchy's integral theorem and formula, Liouville's theorem, maximum modulus principle, analytic continuation, zeros and singularities, Taylor and Laurent series, residues, Cauchy residue theorem and its applications in evaluation of real integrals, conformal transformations, bilinear transformations

Course Description

Course Code	**19M21MA117**	**Semester Odd**	**Semester III Session-** 2023- 2024 **Month from** July -Dec
Course Name	Complex Analysis		
Credits	4	**Contact Hours**	3-1-0
Faculty (Names)	**Coordinator(s)**		
	Teacher(s) (Alphabetically)		

COURSE OUTCOMES		**COGNITIVE LEVELS**
After pursuing the above-mentioned course, the students will be able to:		
C121.1	apply the concepts of differentiability and analyticity for functions of complex variables	Understanding Level (C2)
C121.2	solve the problems of different types of contour integrations.	Applying Level (C3)
C121.3	explain Taylor's and Laurent's series expansion, singularities, residues and apply it to evaluate complex integrals.	Analyzing Level (C4)
C121.4	apply conformal and bilinear transformations to solve related problems.	Applying Level (C3)

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**
1.	Complex Differentiation	Limit, continuity and differentiability, analytic functions, Cauchy Riemann equation, harmonic functions, harmonic conjugate, construction of analytic functions, exponential function, trigonometric and inverse trigonometric functions, logarithmic function, complex powers, branches of multi valued functions	12
2.	Complex Integration	complex line integral, Cauchy-Goursat theorem, independence and deformation of path; Cauchy's integral formulas and their consequences, Cauchy	10

		inequality, Liouville's theorem, fundamental theorem of algebra, Morera's theorem, maximum modulus principle, Schwarz lemma, analytic continuation.	
3.	Power Series and Singularities	Taylor and Laurent series and their convergence. zeros and singularities of complex functions, classification of singularities: removable singularity, poles, essential singularities, residue at a pole and at infinity, Cauchy's residue theorem and its applications in evaluation of real integrals: integration around unit circle, integration over semi-circular contours (with and without real poles), integration around rectangular contours. Argument principle, Rouche's theorem.	12
4.	Conformal Transformations	Conformal transformations, bilinear transformations, critical points, fixed points, problems on cross-ratio and bilinear transformation	8
		Total number of lectures	**42**

Evaluation Criteria

Components	**Maximum Marks**
T1	20
T2	20
End Semester Examination	35
TA	25 (Quiz, Assignments, Tutorials)
Total	**100**

Project based learning: Each student in a group of 3-4 will apply the concepts of conformal transformations to solve some field problems.

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)

1.	**Churchill, R. V. and Brown, J.W.,** Complex Variables and Applications, McGraw-Hill, 1996.
2.	**Spiegel, M. R.,** Complex Variables, McGraw-Hill, 2009.
3.	**Ahlfors , L.V.,** Complex Analysis, McGraw Hill, New York, 1990.
4.	**Lang , S.,** Complex Analysis, Springer-Verlag, 2013.
5.	**Gamelin , T. W.,** Complex Analysis, Springer-Verlag, 2008.

CO-PO-PSO Mapping

	PO1	**PO2**	**PO3**	**PSO1**
C121.1	**3**	**2**	**-**	**1**
C121.2	**3**	**2**	**-**	**2**

C121.3	**3**	**2**	**-**	**1**
C121.4	**3**	**2**	**-**	**2**

Numerical Analysis (19M21MA212)

Concept of Errors, Roots of algebraic and transcendental equations, Iterative methods, rate of convergence, roots of a system of nonlinear equations, System of linear algebraic equations, direct and iterative methods, Eigenvalues and eigenvectors, Interpolation, divided difference, Gauss interpolation, Lagrange's interpolation, spline interpolation, Numerical differentiation and integration, Newton-Cotes Formulae, Romberg integration, Gaussian quadrature rules, Numerical methods for differential equations, Picard's method, Euler's and modified Euler methods, Taylor's series method, Runge-Kutta 2^{nd} and fourth order methods, multistep methods, solution of simultaneous and higher order equations, boundary value problems, finite difference and shooting methods.

Course Description

Course Code	**19M21MA212**	**Semester Odd**	**Semester III** **Session-** 2023- 2024 **Month from** July -Dec
Course Name	Numerical Analysis		
Credits	3	**Contact Hours**	3-0-0
Faculty (Names)	**Coordinator(s)**		
	Teacher(s) (Alphabetically)		

COURSE OUTCOMES		**COGNITIVE LEVELS**
After pursuing the above-mentioned course, the students will be able to:		
CO1	explain concepts of errors and find the roots of algebraic and transcendental equations.	Understanding Level (C2)
CO2	solve the system of linear equations using direct & iterative methods and to find eigenvalues and eigenvectors of matrices.	Applying Level (C3)
CO3	explain the concept of interpolation.	Understanding Level (C2)
CO4	apply numerical methods to find differentiation and integration of a function.	Applying Level (C3)
CO5	apply numerical methods to solve ordinary differential equations.	Applying Level (C3)

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**

1.	**Concept of Errors**	Fixed-point and floating-point numbers, truncation, round-off and maximum absolute errors, relative error, accuracy of the numbers.	**2**
2.	**Algebraic and transcendental equations**	Iterative method, Newton-Raphson's method. successive iteration method, rate of convergence, roots of a polynomial: Horner's method, Birge Vita method, Lin's method, Bairstow and Muller's method, Roots of a system of nonlinear equations.	**10**
3.	**System of linear algebraic equations**	Gauss elimination method, Gauss-Jordon method, LU-decomposition method, inverse of matrices, Jacobi and Gauss-Seidal iterative methods, convergence of iteration methods.	**6**
4.	**Eigen values and eigen vectors**	Power's method to find dominant eigen value and eigen vector, Rayleigh method, eigen values and eigen vectors of a symmetric matrix by Jacobi's, Given's and Householder's method.	**6**
5.	**Interpolation**	Newton's divided difference, Gauss forward and backward interpolation, Lagrange's interpolation, spline interpolation.	**3**
6.	**Numerical differentiation and integration**	Approximation of derivatives, Newton-Cotes Formulae-Trapezoidal, Simpson's, Boole's and Weddle' rules of integration with errors, Romberg integration, Gaussian two and three point quadrature rules, double integration by Trapezoidal and Simpson's rules.	**6**
7.	**Differential equations**	Picard's method, Euler's and modified Euler methods, Taylor's series method, Runge-Kutta 2nd and fourth order methods, multistep methods, solution of simultaneous and higher order equations, boundary value problems: finite difference and shooting methods.	**9**
		Total number of lectures	**42**

Evaluation Criteria

Components	**Maximum Marks**
T1	20
T2	20
End Semester Examination	35
TA	25 (Quiz, Assignments, Tutorials)
Total	**100**

Project based learning: A group of 2 to 3 students will be formed. Each group will have a group leader to develop coordination among the group members. A problem of differential equation will be given to each group to find its solution. The group leader will submit a report of findings for the same.

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)

1.	**M. K. Jain, S. R. K. Iyengar and R. K. Jain,** Numerical Methods for Scientific and Engineering Computation, 6th Ed., New Age International, New Delhi, 2014.
2.	**C. F. Gerald and P. O. Wheatley,** Applied Numerical Analysis, 7th Ed., Pearson Education, 2004.
3.	**R. S. Gupta,** Elements of Numerical Analysis, 2nd Ed., Cambridge University Press, 2015.
4.	**S. D. Conte and C. deBoor,** Elementary Numerical Analysis, An Algorithmic Approach, 3rd Ed., McGraw-Hill, New York, 1980.
5.	**S. C. Chapra** and **R. P. Canale**, Numerical Methods for Engineers, 5th Ed., McGraw Hill, 2006.

CO-PO-PSO Mapping

	PO1	PO2	PO3	PSO1
CO1	2	1	-	2
CO2	3	2	-	2
CO3	2	1	-	2
CO4	3	2	-	2
CO5	3	2	-	2

Operations Research (19M21MA213)

Convex set, LPP, graphical solutions, simplex method, Big-M method, two phase method, primal-dual relationship, dual simplex method, sensitivity analysis, transportation problem, north west corner rule, least cost method, Vogel's approximation method, resolution on degeneracy, optimal solution, assignment problems, Hungarian method, optimality condition, travelling salesmen problem, queuing models, steady-state solutions of Markovian queuing models, inventory models, economic order quantity (EOQ), deterministic inventory problems with and without shortage.

Course Description

Course Code	**19M21MA213**	**Semester Odd**	**Semester III Session-** 2023- 2024 **Month from** July -Dec
Course Name	Operations Research		
Credits	3	**Contact Hours**	3-0-0
Faculty (Names)	**Coordinator(s)**		
	Teacher(s) (Alphabetically)		

COURSE OUTCOMES			COGNITIVE LEVELS
After pursuing the above-mentioned course, the students will be able to:			
CO1	construct mathematical models for optimization problems and solve linear programming problems (LPP) using graphical, simplex method and its variants.		Applying Level (C3)
CO2	utilize duality to analyse the sensitivity of optimal solution of linear programming problems.		Applying Level (C3)
CO3	solve transportation, assignment and travelling salesman problems.		Applying Level (C3)
CO4	classify and solve the problems on queuing and inventory models.		Analyzing Level (C4)
Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**
1.	**Linear Programming Problems (LPP)**	Introduction, definition of operations research, its scope and Application in different areas, Convex sets, formulation of LPP, graphical solutions, Simplex method, big-M method, two phase method, special cases in simplex method.	**10**
2.	**Duality and Sensitivity Analysis**	Primal-Dual relationship, duality, dual simplex method, sensitivity analysis.	**7**
3.	**Transportation Problems**	Mathematical formulation of transportation problem, basic feasible solution-north west corner rule, least cost method, Vogel's approximation method, degeneracy, resolution on degeneracy, optimal solution, maximization case in transportation problem, unbalanced transportation problem.	**7**
4.	**Assignment Problems**	Mathematical formulation of assignment problem, optimality condition, Hungarian method, maximization case in assignment problem, unbalanced assignment problem, travelling salesman problem.	**4**
5	**Elementary Queuing Models**	Markov process, steady-state solutions of Markovian queuing models: M/M/1, M/M/1 with limited waiting space, M/M/C, M/M/C with limited waiting space, M/G/1 model.	**7**
6	**Elementary Inventory Models**	Inventory control models: economic order quantity (EOQ), deterministic inventory problems with and without shortage.	**7**
		Total number of lectures	**42**

Evaluation Criteria

Components	**Maximum Marks**
T1	20

T2	20
End Semester Examination	35
TA	25 (Quiz, Assignments, Tutorials)
Total	**100**

Project based learning: Each student in a group of 2-3 will collect literature on queueing and inventory models to solve some applicational problem. To make the subject application based, the students analyze the optimized way to deal with aforementioned topics.

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)

1.	**H. A. Taha,** Operations Research- An Introduction, 10th Edition, New York Macmillan, 2017.
2.	**G. Hadley,** Linear Programming, Massachusetts, Addition Wesley, 1962.
3.	**F. S. Hiller and G. J. Lieberman,** An Introduction to Operations Research, 10th Edition, San Francisco Holden Day, 2017.
4.	**H. M. Wagner,** Principles of Operations Research with Applications to Managerial Decisions, Prentice Hall of India Pvt. Ltd., 1975.
5.	**N. D. Vohra,** Quantitative Techniques in Management, 5th Edition, TMH, 2017.

CO-PO-PSO Mapping

	PO1	PO2	PO3	PSO1
CO1	3	2	-	2
CO2	3	2	-	2
CO3	3	2	-	3
CO4	3	2	-	2

Operations Research Lab (19M25MA212)

Introduction to MATLAB, linear programming problems (LPP), simplex method, Big-M method, two phase method, dual of a primal problem, dual simplex method, sensitivity analysis, transportation problem, assignment problems, travelling salesmen problem.

Course Description

Course Code	**19M25MA212**	**Semester Odd**	**Semester III Session-** 2023- 2024 **Month from** July -Dec
Course Name	Operations Research Lab		
Credits	1	**Contact Hours**	0-0-2
	Coordinator(s)		

Faculty (Names)	**Teacher(s) (Alphabetically)**	

COURSE OUTCOMES		**COGNITIVE LEVELS**
After pursuing the above-mentioned course, the students will be able to:		
CO1	understand the basics of MATLAB to solve linear programming problems.	Applying Level (C3)
CO2	solve dual problem using MATLAB and perform sensitivity analysis of optimal solution of LPP.	Applying Level (C3)
CO3	solve transportation problems with the help of MATLAB.	Applying Level (C3)
CO4	solve assignment problems with the help of MATLAB.	Applying Level (C3)
CO5	solve travelling salesman using MATLAB.	Applying Level (C3)

Module No.	**Title of the Module**	**List of Experiments**	**CO**
1.	Linear programming problems	1. Construct code to solve linear programming problem (LPP) using Graphical method. 2. Construct code to solve linear programming problem (LPP) using Simplex method. 3. Construct code to solve LPP using Big-M method. 4. Construct code to solve LPP using two phase method.	CO1
2.	Duality and sensitivity analysis	5. Construct code to write the dual of a primal problem. 6. Construct code to solve LPP using dual simplex method. 7. Construct code to analyze the sensitivity of optimal solution if cost coefficients are changed. 8. Construct code to analyze the sensitivity of optimal solution if resource vector components are changed. 9. Construct code to analyze the sensitivity of optimal solution if a constraint is added.	CO2
3.	Transportation problem	10. Construct code to solve transportation problem as a LPP.	CO3
4.	Assignment problem	11. Construct code to solve an assignment problem as a LPP.	CO4
5.	Travelling salesman problem	12. Construct code to solve travelling salesman problem.	CO5

Evaluation Criteria

Components	**Maximum Marks**
Lab Test 1	20
Lab Test 2	20
TA	60 (Quiz, Assignments, Tests, Viva)

Total	**100**
Project based learning: Each student in a group of 2-3 will collect literature on travelling salesman problem to develop algorithm and can generate code on the same.	
Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)	
1.	**R. Pratap,** Getting started with MATLAB: A quick introduction for scientists and engineers, Oxford university press, 2016.
2.	**H. A. Taha,** Operations Research - An Introduction, Tenth Edition, Pearson Education, 2017.
3.	**N. Ploskas and N. Samaras,** Linear programming using MATLAB, Springer Optimization and Its Applications 127, Springer, 2017.
4.	**S. K. Mishra and B. Ram,** Introduction to linear programming with MATLAB, CRC Press, 2018.
5.	**R. H. Kwon,** Introduction to linear optimization and extensions with MATLAB, CRC Press, 2014.
6.	**P. Venkataraman,** Applied Optimization with MATLAB programming, John Wiley & Sons, 2002

CO-PO-PSO Mapping

	PO1	PO2	PO3	PSO1
CO1	**3**	**2**	**-**	**2**
CO2	**3**	**2**	**-**	**2**
CO3	**3**	**2**	**-**	**2**
CO4	**3**	**2**	**-**	**2**
CO5	**3**	**2**	**-**	**2**

Numerical Analysis Lab (19M25MA211)

Basic programming concepts of MATLAB, Algebraic/ transcendental equations, system of linear algebraic equations, Lagrange's interpolation, divided difference, differential coefficients, numerical integrals, solution of ordinary differential equations.

Course Description

Course Code	**19M25MA211**	**Semester Odd**		**Semester III Session-** 2023- 2024 **Month from** July -Dec	
Course Name	Numerical Analysis Lab				
Credits	01		**Contact Hours**	0-0-2	
	Coordinator(s)				

Faculty (Names)	**Teacher(s) (Alphabetically)**	

COURSE OUTCOMES		**COGNITIVE LEVELS**
After pursuing the above-mentioned course, the students will be able to:		
CO1	understand the basics of MATLAB to find real roots of algebraic/ transcendental equations.	Applying Level (C3)
CO2	develop the program to solve system of linear algebraic equations using MATLAB.	Applying Level (C3)
CO3	solve interpolation problems using MATLAB.	Applying Level (C3)
CO4	develop the program for derivatives and integrals using MATLAB.	Applying Level (C3)
CO5	construct the program for solutions of ordinary differential equations in MATLAB.	Applying Level (C3)

Module No.	**Title of the Module**	**List of Experiments**	**CO**
1.	Algebraic/ transcendental equations	1. To find a real root of an algebraic/ transcendental equation by using Newton-Raphson method. 2. To find a real root of an algebraic/ transcendental equation by using Successive iteration method. 3. To find a root of an equation by using Muller's method.	CO1
2.	System of linear algebraic equations	4. Implementation of Gauss-Elimination method to solve a system of linear algebraic equations. 5. Implementation of Gauss-Jordon method to solve a system of linear algebraic equations. 6. Implementation of Gauss-Seidel method to solve a system of linear algebraic equations.	CO2
3.	Interpolation	7. Implementation of Lagrange's formula for interpolation. 8. Implementation of Newton's divided difference formula for interpolation.	CO3
	Numerical differentiation and integration	9. To find differential coefficients of 1st and 2nd orders using interpolation formulae. 10. To evaluate integrals by using Trapezoidal rule. 11. To evaluate integrals by using Simpson method.	CO4
4.	Differential equations	12. To compute the solution of ordinary differential equations by using Euler's method. 13. To compute the solutions of ordinary differential equations by using Runge-Kutta methods. 14. To solve two point boundary value problem by shooting and finite difference method.	CO5

Evaluation Criteria

Components	Maximum Marks
Lab Test 1	20
Lab Test 2	20
TA	60 (Quiz, Assignments, Tests, Viva)
Total	**100**

Project based learning: A group of 2 to 3 students will be formed. Each group will have a group leader to develop coordination among the group members. A problem of differential equation will be given to each group to find its solution with the help of MATLAB. The group leader will submit a report of findings with output for the same.

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)

1.	**R. Pratap,** Getting started with MATLAB: A quick introduction for scientists and engineers, Oxford university press, 2016.
2.	**B. S. Grewal**, Numerical Methods in Engineering & Science: With Programs in C, C++ & MATLAB, 11th Ed., Khanna, 2014.
3.	**S. Nomura**, C Programming and Numerical Analysis: An Introduction, 1st Ed, Morgan & Claypool Publishers, 2018.
4.	**S. S. Otto**, Introduction to Programming and Numerical Methods in MATLAB, 1st Ed. Springer, 2005.
5.	**D. Vaughan Griffiths and I. M. Smith,** Numerical Methods for Engineers, 2nd Ed., CRC Press, 2006.
6.	**S. C. Chapra**, Applied Numerical Methods with Matlab for Engineers and Scientists, 2nd Ed. Tata McGraw Hill, New Delhi, 2008.

CO-PO-PSO Mapping

	PO1	PO2	PO3	PSO1
CO1	3	2	-	2
CO2	3	2	-	2
CO3	3	2	-	2
CO4	3	2	-	2
CO5	3	2	-	2

Graph Theory (21M22MA215)

Graphs and related definitions, Different types of graphs, labelled and weighted graphs, Tree and cut sets, fundamental circuit, spanning tree, binary tree, separability, network flows, Planarity of graph, thickness and crossing, modular arithmetic and Galois field, vector and vector spaces, basis, orthogonal vectors and spaces, Matrix representation and graph coloring, enumeration and graph theoretic algorithms.

Course Description

<table>
<tr><td>Course Code</td><td>21M22MA215</td><td colspan="2">Semester Odd</td><td colspan="2">Semester III Session- 2023- 2024
Month from July -Dec</td></tr>
<tr><td>Course Name</td><td colspan="5">Graph Theory</td></tr>
<tr><td>Credits</td><td colspan="2">3</td><td colspan="2">Contact Hours</td><td>3-0-0</td></tr>
<tr><td rowspan="2">Faculty (Names)</td><td>Coordinator(s)</td><td colspan="4"></td></tr>
<tr><td>Teacher(s) (Alphabetically)</td><td colspan="4"></td></tr>
<tr><td colspan="4">COURSE OUTCOMES</td><td colspan="2">COGNITIVE LEVELS</td></tr>
<tr><td colspan="6">After pursuing the above-mentioned course, the students will be able to:</td></tr>
<tr><td>CO1</td><td colspan="3">explain basics of graphs and its types.</td><td colspan="2">Understanding Level (C2)</td></tr>
<tr><td>CO2</td><td colspan="3">explain trees and their applications.</td><td colspan="2">Understanding Level (C2)</td></tr>
<tr><td>CO3</td><td colspan="3">solve problems related to planarity of graphs, Galois field and vector spaces.</td><td colspan="2">Applying Level (C3)</td></tr>
<tr><td>CO4</td><td colspan="3">construct matrix representations and chromatic polynomials.</td><td colspan="2">Applying Level (C3)</td></tr>
<tr><td>CO5</td><td colspan="3">apply graph theoretic algorithms to solve various problems.</td><td colspan="2">Applying Level (C3)</td></tr>
<tr><td>Module No.</td><td>Title of the Module</td><td colspan="2">Topics in the Module</td><td colspan="2">No. of Lectures for the module</td></tr>
<tr><td>1.</td><td>Basic graph terminology</td><td colspan="2">Graphs and related definitions, directed and undirected graph, Konigsberg bridge problem, utility problem, paths and circuits, subgraphs, isomorphism, Euler graph, operations on graph, Hamiltonian graph, travelling salesman problem, labelled and weighted graphs.</td><td colspan="2">7</td></tr>
<tr><td>2.</td><td>Tree and cut set</td><td colspan="2">Definition, distance, centre in a tree, rooted and binary tree, counting trees, fundamental circuit, spanning tree, connectivity, separability. Fundamental cut set and network flows.</td><td colspan="2">8</td></tr>
<tr><td>3.</td><td>Planarity</td><td colspan="2">Planar graph, detection of planarity, geometric and combinatorial dual, thickness and crossings</td><td colspan="2">5</td></tr>
<tr><td>4.</td><td>Vector spaces of a graph</td><td colspan="2">Vector and vector spaces, basis, orthogonal vectors and spaces. Modular arithmetic and Galois field.</td><td colspan="2">6</td></tr>
<tr><td>5.</td><td>Matrix representation and graph coloring</td><td colspan="2">Various matrix representations of the graph. Graph coloring, four color and five color theorem, chromatic number, chromatic polynomial.</td><td colspan="2">7</td></tr>
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6.	Enumeration and graph theoretic algorithms	Types of enumeration, counting labeled trees, Polya's counting theorem, algorithms: connectedness and components. Shortest path algorithm, depth first and breadth first search.	9
		Total number of lectures	**42**

Evaluation Criteria

Components	**Maximum Marks**
T1	20
T2	20
End Semester Examination	35
TA	25 (Quiz, Assignments, Tutorials)
Total	**100**

Project based learning: A group of 2 to 3 students will explore more applications in the said area of employability and will use these to solve the real problems. Their findings will be evaluated on the basis of their report as well as viva voce.

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)

1.	**N. Deo,** Graph Theory with Applications to Engineering and Computer Science, Dover publications, 2016.
2.	**R. Balakrishnan and K. Ranganathan,** A Textbook of Graph Theory, Springer, 2012.
3.	**A. Bickle,** Fundamentals of Graph Theory, American Mathematical Society, 2020.
4.	**V. K. Balakrishnan,** Graph Theory, Discrete Mathematics with Applications, Tata McGraw Hill Publishing Co. Ltd. 2004.
5.	**C. Vasudev,** Graph Theory with Applications, New Age International, 2006.

CO-PO-PSO Mapping

	PO1	**PO2**	**PO3**	**PSO1**
CO1	**3**	**1**	**-**	**2**
CO2	**3**	**2**	**-**	**2**
CO3	**3**	**3**	**-**	**2**
CO4	**3**	**3**	**-**	**2**
CO5	**3**	**3**	**-**	**3**
Avg	**3**	**3**	**-**	**2**

Fluid Dynamics (22M22MA211)

Equation of continuity, velocity potential and stream function, incompressible flows, circulation, Equations of motion, Bernoulli’s theorem, Kelvin’s theorem, vortex motion, Irrotational motion in two-dimensions, sink and doublets, circle theorem, conformal mapping, theorem of Blasius, Strokes stream function, motion of a sphere, Navier-Stokes equations, flow between two coaxial cylinders, energy equation, dynamical similarity, Boundary layer thickness, Prandlt’s boundary layer, Blasius solution, solution by Karman- Pohlhausen methods, dimensional analysis, large Reynold’s numbers, temperature distribution in Couette flow.

Lecture-wise Breakup

Course Code	**22M22MA211**	**Semester Odd**	**Semester III** **Session-** 2023- 2024 **Month from** July -Dec
Course Name	Fluid Dynamics		
Credits	3	**Contact Hours**	3-0-0
Faculty (Names)	**Coordinator(s)**		
	Teacher(s) (Alphabetically)		

COURSE OUTCOMES		**COGNITIVE LEVELS**
After pursuing the above mentioned course, the students will be able to:		
CO1	explain the basic principle of continuity equation and different types of fluid motions.	Understanding Level (C2)
CO2	identify the fluid properties and different forms of momentum equation.	Applying Level (C3)
CO3	explain the theorems on potential flows and solve related problems.	Applying Level (C3)
CO4	solve problems on laminar flows in different geometries.	Applying Level (C3)
CO5	explain and analyse the concepts of boundary layer flows and its applications.	Analyzing Level (C4)

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures**
1.	**Kinematics**	Lagrangian and Eulerian descriptions, equation of continuity, stream lines, path lines and streak lines, vorticity, velocity potential and stream function, compressible and incompressible flows, circulation, rotational and irrotational motions.	8
2.	**Dynamics**	Equations of motion, inviscid case, Bernoulli’s theorem, Kelvin’s theorem,	8

		constancy of circulation, equations referred to moving axes, impulsive actions, vortex motion and its elementary properties, motions due to circular and rectilinear vortices.	
3.	**Potential Flow**	Irrotational motion in two-dimensions, complex-velocity potential sources, stream function, source, sink and doublets, circle theorem, method of images, conformal mapping, theorem of Blasius, Strokes stream function, motion of a sphere.	8
4.	**Laminar Flow**	Stress components in a real fluid, Navier-Stokes equations, plane Poiseiuille and Couette flows between two parallel plates, flow through a pipe of uniform cross section in the form of circle, flow between two coaxial cylinders, energy equation, dynamical similarity.	9
5.	**Boundary Layer Flows**	Boundary layer thickness, displacement thickness, Prandlt's boundary layer, laminar boundary layer equations, Blasius solution, solution by Karman- Pohlhausen methods, separation of boundary layer flow, dimensional analysis, large Reynold's numbers, similar solutions, flow past a flat plate, temperature distribution in Couette flow and in flow past a flat plate.	9
		Total number of lectures	**42**

Evaluation Criteria

Components	**Maximum Marks**
T1	20
T2	20
End Semester Examination	35
TA	25 (Quiz, Assignments, Tutorials)
Total	**100**

Project based learning: Students in small groups will be assigned the problem of boundary layer flows and its applications.

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)

1.	**S. W. Yuan,** Foundation of Fluid Mechanics, 3rd Ed., Prentice Hall, 1976.
2	**F. Chorlton,** Textbook of Fluid Dynamics, C.B.S. Publishers, 2005.
3.	**P. K. Kundu and I. M. Cohen,** Fluid Mechanics, Academic Press, 2005.
4.	**Frank M. White,** Fluid Mechanics, 6th Ed., Tata McGraw-Hill, New Delhi, 2008.

5.	**H. Schlichting and K. Gersten,** Boundary Layer Theory, 9 th Ed., Springer, 2017.
6.	**R. W. Fox and A.T. McDonald,** Introduction to Fluid Mechanics, Wiley, 1985.

CO-PO and CO-PSO Mapping:

CO	PO1	PO2	PO3	PSO1
CO1	2	2	-	2
CO2	2	2	-	2
CO3	2	2	-	2
CO4	3	2	-	3
CO5	3	2	-	3
Avg	2	2		3

Wave Propagation (22M22MA212)

Analysis of stress and strain, Mohr's circle diagram, Generalized Hook's Law, different types of symmetry, Plane waves, Principle of superposition, D'Alembert's formula, Spherical waves, Poisson and Helmholtz's formula, P and S waves and their characteristics, Reflection and refraction of plane P, SV and SH waves at an interface, Surface waves: Rayleigh, Love, Torsional and Stoneley waves, Interior structure of the Earth, Location and causes of Earthquake, Earthquake magnitude.

Course Description

Course Code	22M22MA212	**Semester Odd**	**Semester III Session-** 2023- 2024 **Month from** July -Dec
Course Name	Wave Propagation		
Credits	3	**Contact Hours**	3-0-0
Faculty (Names)	**Coordinator(s)**		
	Teacher(s) (Alphabetically)		
COURSE OUTCOMES			**COGNITIVE LEVELS**
After pursuing the above-mentioned course, the students will be able to:			
CO1	explain the concepts of mechanics, stress-strain relation and material symmetry.		Analyzing Level (C4)

CO2	analyze elastic waves and solve wave equation.		Analyzing Level (C4)
CO3	determine the reflection and refraction profile of seismic waves at different interfaces.		Evaluating Level (C5)
CO4	explain internal structure of Earth and causes of earthquake.		Evaluating Level (C5)
Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures**
1.	**Mechanics of solids**	Analysis of stress, principal stresses, principal planes, maximum shearing stresses, Mohr's circle diagram, equations of deformation and strain, strain in form of displacement, compatibility concept, need and physical significance, stress strain relation, generalized Hook's Law, different types of symmetry, density function, Airy's stress function.	13
2.	**Elastic waves**	General form of progressive waves, harmonic waves, plane waves, the wave equation, principle of superposition, progressive types solutions of wave equation, stationary type solutions of wave equation in Cartesian, Cylindrical and Spherical coordinates systems, exponential form of harmonic waves, D'Alembert's formula, inhomogeneous wave equation, spherical waves. Expansion of a spherical wave into plane waves, Sommerfield's integral. Kirchoff's solution of the wave equation, Poisson and Helmholtz's formula.	13
3.	**Equation of motion**	Reduction of equation of motion to wave equations, P and S waves and their characteristics, polarization of plane P and S waves, Snell's law of reflection and refraction. reflection of plane P and SV waves at a free surface, partition of reflected energy, reflection at critical angles, reflection and refraction of plane P, SV and SH waves at an interface, special cases of liquid-liquid interface, liquid-solid interface and solid-solid interface, surface waves, Rayleigh, Love, Torsional and Stoneley waves.	12
4.	**Introduction to Seismology**	Interior structure of the earth, earthquakes, location of earthquakes, causes of earthquakes, observation of earthquakes, aftershocks and foreshocks, earthquake magnitude, seismic moment, energy released by earthquakes.	4
		Total number of lectures	**42**
Evaluation Criteria			

Components	**Maximum Marks**
T1	20
T2	20
End Semester Examination	35
TA	25 (Quiz, Assignments, Tutorials)
Total	**100**

Project based learning: Students in small groups will be assigned the problem of seismic waves to explore the different characteristics in various geomedia.

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc.(Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)

1.	**Bath M.,** Mathematical Aspects of Seismology, Elsevier Publishing Company, 2013.
2.	**Ewing W. M.,** Elastic Waves in Layered Media, Creative Media Partners LLC, 2015.
3.	**Achenbach J. D.,** Wave Propagation in Elastic Solids, North Holland Publishing Company, New York, 2016.
4.	**Stein S., and Wysession M.,** An Introduction to Seismology, Earthquakes and Earth Structure, Blackwell Publishing Ltd., 2013.
5.	**Bullen K. E., and Bolt B. A.,** An Introduction to the Theory of Seismology, Cambridge University Press, 1985.

CO-PO and CO-PSO Mapping:

COs	**PO1**	**PO2**	**PO3**	**PSO1**
CO1	2	2	-	2
CO2	3	3	-	3
CO3	3	3	-	3
CO4	3	3	-	3
Avg	3	3		3

Data Structures (22M22MA213)

Course Description

Course Code	**22M22MA213**	**Semester Odd**	**Semester III Session-** 2023- 2024 **Month from** July -Dec
Course Name	Data Structures		
Credits	3	**Contact Hours**	2-0-2

<table>
<tr><td rowspan="2">Faculty (Names)</td><td colspan="2">Coordinator(s)</td><td colspan="2"></td></tr>
<tr><td colspan="2">Teacher(s) (Alphabetically)</td><td colspan="2"></td></tr>
<tr><td colspan="4">COURSE OUTCOMES</td><td>COGNITIVE LEVELS</td></tr>
<tr><td colspan="5">After pursuing the above-mentioned course, the students will be able to:</td></tr>
<tr><td>CO1</td><td colspan="3">understand and apply the linear structure such as linear list, stack and queues in various practical problems.</td><td>Applying Level (C3)</td></tr>
<tr><td>CO2</td><td colspan="3">construct hash function for data security and compression.</td><td>Applying Level (C3)</td></tr>
<tr><td>CO3</td><td colspan="3">analyze efficiency of various operations using trees.</td><td>Analyzing Level (C4)</td></tr>
<tr><td>CO4</td><td colspan="3">analyze the concepts of data structures using graphs.</td><td>Analyzing Level (C4)</td></tr>
<tr><td>Module No.</td><td colspan="2">Title of the Module</td><td>Topics in the Module</td><td>No. of Lectures for the module</td></tr>
<tr><td>1.</td><td colspan="2">Linear lists</td><td>Sequential and linked representations of linear list, comparison of insertion, deletion and search operations for sequential and linked lists, doubly linked lists, circular lists. Sorting of linked list-insertion sort, exchange sort, selection sort.</td><td>5</td></tr>
<tr><td>2.</td><td colspan="2">Stacks and queues</td><td>Sequential and linked implementations of stacks, Applications of stacks in parenthesis matching. Sequential and linked implementations of Queues.</td><td>4</td></tr>
<tr><td>3.</td><td colspan="2">Hashing</td><td>One way hashing functions and their properties, hashing as a search structure, hash table, uses of hash tables in text compression and cryptography.</td><td>4</td></tr>
<tr><td>4.</td><td colspan="2">Trees</td><td>Binary trees and their properties, tree traversal methods and algorithms, heaps as priority queues, heap implementation, insertion and deletion operations.</td><td>5</td></tr>
</table>

5.	Search trees	Binary search trees, search efficiency, insertion and deletion operations, importance of balancing.	4
6.	Graphs	Directed and undirected graphs, properties, connectivity in graphs, applications, implementation -adjacency matrix and linked adjacency chains, graph traversal – breadth first and depth first, spanning trees.	6
Total number of lectures			**28**

<u>List of Practical</u>

Write C++ programs to implement the following:

1. Traversal, insertion, deletion in a linear array.
2. Traversal, insertion, deletion in a linked list.
3. Doubly linked list.
4. Circular linked list.
5. Sorting- insertion sort, exchange sort, selection sort.
6. Stacks and queues using linked list.
7. Binary tree traversal.
8. Insertion and deletion in heap.
9. Insertion and deletion in binary search tree.
10. Adjacency matrix representation.
11. Graph traversal-breadth first and depth first.

Evaluation Criteria

Components	**Maximum Marks**
T1	20
T2	20
End Semester Examination	35
TA	25 (Quiz, Assignments)
Total	**100**

Project based learning: Students in small groups will be assigned the problem of security and confidentiality of data using hashing; a data of practical use to design their tree or graph for information retrieval. They will prepare corresponding computer programs.

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)

1.	**E. Horowitz, S. Sahni and D. Mehta,** Fundamentals of Data Structures in C++, 2nd Ed., University Press, 2016.
2.	**S. Sahni,** Data Structures, Algorithms, and Applications in C++, WCB/McGraw-Hill, 2005.
3.	**A. M. Tenenbaum,** Data Structures Using C, Pearson Ed, India, 1990.

4.	**N. Dale,** C++ Plus Data Structures, Jones & Bartlett Learning; 5th Ed. 2011
5.	**A. Drozdek,** Data Structures and Algorithms in C++, 4th Ed., Cengage Learning, 2013.

CO-PO and CO-PSO Mapping:

CO	PO1	PO2	PO3	PSO1
CO1	2	3	-	2
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CO3	3	3	-	3
CO4	3	3	-	3
Avg	3	3		3