



**CIRCULAR NO.SU/B.Sc./CBC&GS /64/2023**

It is hereby inform to all concerned that, the syllabi prepared by the Board of Studies, Ad-hoc Boards and recommended by the Dean, Faculty of Science & Technology, the Hon'ble Vice-Chancellor has accepted the **following syllabi of Bachelor of Science with Practical Pattern of Question Paper under the scheme of Choice Based Credit & Grading System** in his emergency powers under section 12(7) of the Maharashtra Public Universities Act, 2016 on behalf of the Academic Council as appended herewith.

Sr.No.	Courses	Semester
1.	<b>B.Sc.Mathematics(Optional)</b>	<b>IIIrd &amp; IVth semester</b>
2.	<b>B.Sc. Environmental Science (Optional)</b>	<b>IIIrd &amp; IVth semester</b>
3.	<b>B.Sc. Bioinformatics (Degree)</b>	<b>IIIrd &amp; IVth semester</b>

This is effective from the Academic Year 2023-24 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/2023/29372-79

Date:- 18.05.2023.

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*Deputy Registrar,  
Academic Section*

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Dr. Babasaheb Ambedkar Marathwada University,
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**DR.BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY**

**AURANGABAD-431004 (MS) INDIA**



**Undergraduate Bachelor Degree Program  
in Science and Technology**


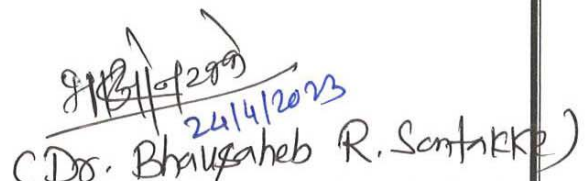
**B.Sc. Mathematics**

**B.Sc.Second Year (Semester-III & IV)**

**Course Structure and Curriculum**

**Choice Based Credit and Grading System**

**(Effective from Academic Year 2023-2024)**

 11/05/23  
Dr. J. A. Nanawase  
 24/4/2023  
Dr. Bhausaheb R. Sontakke  
Chairman,  
Syllabus Committee.

**Dr. Babasaheb Ambedkar Marathwada University**  
Aurangabad-431004 (MS) India

Course Structure of **B.Sc.(Mathematics) Second Year** (Semester-III and Semester-IV)

B.Sc. Second Year (Semester-III)								
	Course Code	Course Title	Total Periods (Teaching Periods /week)	Credits	Scheme of Examination			
					Max. Marks	CIA	UA	Min. Marks
DSC-1C Core Courses	MAT-301 Paper -V	Differential Equations	60(5/week)	3	50	10	40	20
	MAT-302 Paper-VI	Laplace and Fourier Transforms	60(5/week)	3	50	10	40	20
SEC-1 Elective Course (Any One)	MAT-303 Paper- VII	Mechanics-I	60(5/week)	3	50	10	40	20
	MAT-304 Paper- VIII	Graph Theory	60(5/week)	3	50	10	40	20
				9	150	30	120	60
Total Credits for Semester-III: 09								

B.Sc. Second Year (Semester-IV)								
	Course Code	Course Title	Total Periods (Teaching Periods /week)	Credits	Scheme of Examination			
					Max. Marks	CIA	UA	Min. Marks
DSC-1D Core Courses	MAT-401 Paper-IX	Partial Differential Equations	60(5/week)	3	50	10	40	20
	MAT-402 Paper-X	Numerical Analysis	60(5/week)	3	50	10	40	20
SEC-2 Elective Course (Any One)	MAT-403 Paper-XI	Mechanics-II	60(5/week)	3	50	10	40	20
	MAT-404 Paper- XII	Complex Analysis	60(5/week)	3	50	10	40	20
				9	150	30	120	60
Total Credits for Semester-IV: 09								

UA- University Assessment

CIA- Continuous Internal Assessment

Note: CIA : Internal Test -05 Marks and Assignment/Tutorial-05 Marks

(Two internal tests of 05 marks each be conducted and average of the two tests will be considered)

*J.A.N.*  
Dr. J. A. Nanaware

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VMK

*Dr. B. R. Santak*  
24/4/2023  
(Dr. Bhausaheb R. Santak)  
Chairman  
Syllabus Committee

**Dr. Babasaheb Ambedkar Marathwada University**  
**Aurangabad-431004 (MS) India**

Curriculum of B.Sc. (Mathematics) Second Year (Semester-III and Semester-IV)

**B.Sc. Second Year (Semester-III)**

Course Code: **MAT-301**                      Course Name: **Differential Equations**

Credits                      : **03**                                              Total Periods: **60**

**Course Objectives:**

Student will learn the basic methods of finding solutions of differential equations.

**Course Outcomes:**

**CO1:** Determine solution of first order linear differential equation

**CO2:** Determine solution of exact differential equation

**CO3:** Determine solution of linear equation with constant coefficient using general and short method

**CO4:** Determine solution of linear homogeneous differential equation

**Unit-I: Equations of the First Order and of the First Degree**

Ordinary and partial differential equations, Order and degree, Solution and constant of integration, Derivation of differential equation, Equation of the first order and the first degree, Equations of the form  $f_1(x)dx + f_2(y)dy = 0$ , Equations homogeneous in  $x$  and  $y$ , Non-homogeneous equations of the first degree in  $x$  and  $y$ , Exact differential equations, Condition that an equation of the first order to be exact, Rules for finding the solution of an exact differential equation. Integrating factors, The number of integrating factors is infinite, Integrating factors found by inspections. Rules for finding integrating factors, Rules *I&II*, Rules *III&IV*, Rule *V*, Linear equations, Equation reducible to the linear form.

  
Dr. Bhausaheb R. Santurke  
Chairman

## **Unit-II: Equations of the First Order but not of First Degree**

Equations that can be resolved into component equations of the first degree, Equations that can't be resolved into component equations, Equations solvable for  $y$ , Equation solvable for  $x$ , Equations that do not contain  $x$ , that do not contain  $y$ , Equations homogeneous in  $x$  and  $y$ , Equations of first degree in  $x$  &  $y$ : Clairaut's equation.

## **Unit-III: Linear Equations With Constant Coefficients**

Linear equations defined, The Complementary Function, The particular integral, The complete solution, The linear equation with constant coefficients and second member zero, Case of the auxiliary equation having equal roots, Case of the auxiliary equation having imaginary roots, The symbol  $D$ , Theorem concerning  $D$ , Another way of finding the solution when the auxiliary equation has repeated roots, The linear equation with constant coefficients and a second member a function of  $x$ , The symbolic function  $1/f(D)$ , Methods of finding the particular integral. Short method of finding the particular integrals in certain cases: Integral corresponding to a term of the form  $e^{ax}$ ,  $x^m$ ,  $\sin ax$  or  $\cos ax$  in the second member, Integral corresponding to a term of the form  $e^{ax}V$  and  $xV$  in the second member.

## **Unit-IV: Linear Equations with Variable Coefficients**

The homogeneous linear equation first method of solution, Second method of solution: (A) To find the complementary function, (B) To find the particular integral, The symbolic function  $f(\theta)$  and  $1/f(\theta)$ , Method of finding the particular integral, Integral corresponding to a term of the form  $x^m$  in the second member, Equation reducible to the homogeneous linear form.

### **Recommended Text Book:**

**Daniel A. Murray:** Introductory Course in Differential equations,  
Khosala Publishing House, New Delhi.

### **Scope:**

**Unit I :** Chapter I: Art. 1 to 3, Chapter II: Art. 8 to 21.

**Unit-II :** Chapter III: Art 22 to 28(Complete)

**Unit-III:** Chapter VI: Art 49 to 64

**Unit-IV :**Chapter VII: Art 65 to 71

### **Reference Books:**

1. M.D.Raisinghania: Ordinary and Partial Differential Equations,  
S.Chand and Company Limited.
2. G.Birkhoff and G.C.Rota: Ordinary Differential Equations, John Wiley and Sons.
3. Frank Ayres: Theory and Problems on Differential Equations, McGraw Hill.
4. George F.Simmons: Differential Equations with Applications and  
Historical Notes, Tata McGraw Hill Publishing House Limited.

Course Code: **MAT-302**

Course Name: **Laplace and Fourier Transforms**

Credits:**03**

Total Periods: **60**

### **Course Objectives:**

Student will learn the fundamental properties of Laplace and Fourier transforms.

### **Course Outcomes:**

**CO1:** Determine Laplace transform for various functions and understand the properties of Laplace transforms

**CO2:** Determine inverse Laplace transform, properties of inverse Laplace Transform, and solve the problems using convolution theorem

**CO3:** Determine Fourier transform and understand the properties of Fourier transform, Fourier sine and cosine transforms

**CO4:** Apply Laplace transform to find solutions of differential equations.

### **Unit I: Beta Function, Gamma Function and Laplace Transforms**

Beta and Gamma functions, Elementary properties of Gamma function, Relation between Beta and Gamma functions. Introduction, Laplace Transform, Important Formulae, Properties of Laplace Transforms, Laplace Transform of the Derivative of  $f(t)$ , Laplace Transform of the Derivative of Order  $n$ , Laplace Transform of Integral of  $f(t)$ , Laplace Transform of  $t.f(t)$  (Multiplication by  $t$ ), Laplace Transform of  $1/t f(t)$  (Division by  $t$ ), Unit Step Function, Second Shifting Theorem, Impulse Function, Periodic Functions, Convolution Theorem, Evaluation of Integrals, Formulae of Laplace Transform, Properties of Laplace Transform.

### **Unit II: Inverse Laplace Transforms**

Inverse Laplace Transforms, Important Formulae, Multiplication by  $s$ , Division by  $s$  (Multiplication by  $1/s$ ), First Shifting Property, Second Shifting Property, Inverse Laplace Transforms of Derivatives, Inverse Laplace Transform of Integrals, Partial Fractions Method, Inverse Laplace Transform by Convolution.

### **Unit III: Solutions of Differential Equations and Integral Transforms**

Solution of Differential Equations by Laplace Transforms, Solution of Simultaneous Differential Equations by Laplace Transforms

### **Unit IV: Fourier Transforms**

Introduction, Integral Transforms, Fourier Integral Theorem, Fourier Sine and Cosine Integrals, Fourier's Complex Integral, Fourier Transforms, Fourier Sine and Cosine Transforms, Properties of Fourier Transforms.

#### **Recommended Text Book:**

1. **J.N.Sharma, A. R.Vasishtha:** Real Analysis, Krishna Prakashan Media Pvt.Ltd., Meerut.
2. **H.K.Dass:** Advanced Engineering Mathematics, S.Chand & Company Ltd.(2004)

#### **Scope:**

**Unit I: (Chapter 14)** Article 9,10,13 [1]

(Chapter13) Articles13.1 to 13.15, Article 13.17 to 13.19 [2]

**Unit II: (Chapter13)** Articles13.20 to 13.29 [2]

**Unit III: (Chapter13)** Articles13.30 to 13.31 [2]

**Unit IV: (Chapter14)** Articles14.1 to 14.8 [2]

#### **Reference Books:**

1. Grove A.C.: An Introduction to Laplace Transforms and Z-Transforms, Prentice Hall 1991.
2. Doetsch G.: Introduction to Theory and Application of Laplace Transforms, Springer Verlag,1990.
3. Murray Spigel: Schaum Outline of Laplace Transforms, Schaum Outline Series, Mc-Graw Hill 2012.
4. Joel L.Schiff: The Laplace Transforms:Theory and Applications, Springer,2008.
5. R.J.Becrends, H.G.Morsche J.C.Vande Berg and E.M.Vande Vrie: Fourier and Laplace Transform,Cambridge Press,2003.



Course Code: **MAT-303**

Course Name: **Mechanics-I**

Credits:**03**

Total Periods: **60**

**Course Objectives:**

Students will be able to describe forces, resultant of forces, vector moment of forces, moment of couple, laws and rules

**Course Outcomes:**

**CO1:** Describe different types of forces, triangle law of forces, Parallelogram of forces, resultant of forces, sine rule and cosine rule

**CO2:** Explain resultant of several co-planar forces, equation of the line of action of the resultant, equilibrium of a rigid body under three co-planar forces

**CO3:** Explain Lami's theorem and polygon of forces

**CO4:** Explain vector moment of a force and vector moment of couple and describe basic concepts of centre of gravity and its applications

**Unit I : Forces Acting on a Particle**

Particle, Rigid body, Force, The force as a vector, Equilibrium, An Axiom for the equilibrium of two forces, Statics, Resultant of forces, Law of a parallelogram of forces, Principle of transmissibility of forces, Deductions, Resultant of forces  $m.OA$  and  $n.OB$ , Components and resolved parts, The algebraic sum of resolved parts of two forces, To find the magnitude and direction of the resultant of any number of co-planar forces acting at a point, Resultant of parallel forces.

**Unit II: Equilibrium of Forces Acting on a Particle**

Triangle law of forces, Converse of the triangle law of forces, Polygon of forces, Lami's theorem, Conditions of equilibrium of forces acting on a particle.

### **Unit III: Forces Acting on a Rigid Body**

Introduction, Moment of a force, Sum of vector moments of two like parallel forces, Couples, Conditions of equilibrium of forces acting on a rigid body, Trigonometrical Theorems.

### **Unit-IV: Centre of Gravity**

Centroid of weighted points, Centre of gravity, Center of gravity of some uniform bodies.

#### **Recommended Text Book:**

**V.Tulsani, T.V.Warehekar, N.N.Saste:** Mechanics and Differential Geometry Second Edition (1987), S.Chand and Co.(Pvt.)Ltd., New Delhi.

#### **Scope: Part-I : Statics**

**Chapter (1): Complete**

**Chapter (2): Complete**

**Chapter (3): Complete**

**Chapter (4): Articles 4.1 to 4.7**

#### **Reference Books:**

- 1. S.L.Loney:** An Elementary Treatise on Statics, AITBS Publishers and Distributors, New Delhi.
- 2. B.R.Thakur, G.P.Shrivastava :** Mechanics, Ram Prasad and Sons, Agra-3.
- 3. M.L.Khanna:** Statics, Kedarnath Ramnath Prakashan, Meerut.

Course Code: **MAT-304**

Course Name: **Graph Theory**

Credits :**03**

Total Periods: **60**

**Course Objectives:**

Student will be able to analyse the graphs, trees and apply it to solve problems.

**Course Outcomes:**

**CO1:** Describe and identify the type of graphs

**CO2:** Explain isomorphism and connectedness of graphs

**CO3:** Explain and understand the properties of trees

**CO4:** Understand cut-sets , cut-vertices and its properties

**Unit I. Introduction**

What is a Graph?, Application of Graphs, Finite and Infinite Graphs, Incidence and Degree, Isolated Vertex, Pendant Vertex and Null Graph.

**Unit II. Paths and Circuits**

Isomorphism, Subgraphs, Walks, Paths, and Circuits, Connected Graphs, Disconnected Graphs, and Components, Euler Graphs, Operations on Graphs, More on Euler Graphs, Hamiltonian Paths and Circuits, The Traveling Salesman Problem.

**Unit III. Trees and Fundamental Circuits**

Trees, Some Properties of Trees, Pendant Vertices in a Tree, Distance and Centers in a Tree Rooted and Binary Trees, On Counting Trees, Spanning Trees, Fundamental Circuits, Spanning Trees in a Weighted Graph.

**Unit IV. Cut-Sets and Cut-Vertices**

Cut-Sets, Some Properties of a Cut-Set, All Cut-Sets in a Graph, Fundamental Circuits and Cut-Sets, Connectivity and Separability.

**Recommended Text Book :**

**Narsingh Deo** : Graph Theory with Applications to Engineering and Computer Science, Printice-Hall of India Pvt. Lt. New Delhi.(2010)

**Scope:** Unit 1 : Chapter 1: Sec.1.1 to 1.5

Unit 2: Chapter 2: Sec. 2.1 to 2.2, 2.4 to 2.10

Unit 3: Chapter 3: Sec. 3.1 to 3.8, 3.10

Unit 4: Chapter 4 : Sec. 4.1 to 4.5

**Reference books:**

1. John Clark and Derek Holton: A First Look at Graph Theory (Allied Publishers)
2. C.L.Liu: Elements of Discrete Mathematics, Tata Mc-Graw Hill, Fourth Edition
3. Robin J. Wilson: Introduction to Graph Theory, Fourth Edition (low price edition)
4. Douglas West: Introduction to Graph Theory, Second edition.
5. R.Balakrishnan, K.Ranganathan: A Textbook of Graph Theory

## B.Sc. Second Year (Semester-IV)

Course Code: MAT-401

Course Name: **Partial Differential Equations**

Credits:03

Total Periods: 60

### Course Objectives:

Student will learn the methods of finding solutions of partial differential equations.

### Course Outcomes:

**CO1:** Solve Lagrange's equation

**CO2:** Find different types of solutions like complete integral, Singular integral and general integral

**CO3:** Determine the solution of partial differential equations using Charpit's Method

**CO4:** Describe Monge's Method, Method of transformation

### Unit I:

Partial differential equation (PDE), Order and method of forming PDE, solution of equations by direct integration, Lagrange's linear equations, method of multipliers.

### Unit II:

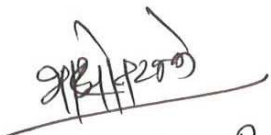
Partial differential equations non-linear in  $p$  and  $q$ , Charpit's method, Linear homogeneous PDE of  $n^{\text{th}}$  order with constant coefficients, Rules for finding the complementary functions, Rules for finding the particular integral.

### Unit III:

Non-homogeneous linear equations, Monge's method, Method of separation of variables, Equations of vibrating strings, Solution of the wave equation by D'Almberts method.

### Unit IV:

One-dimensional heat flow, Two-dimensional heat flow, Laplace equations in polar co-ordinates, Transmission line equations.

  
Dr. Bhausaheb R. Sontakre  
Chairman.

### **Recommended Text Book:**

**H.K.Dass:** Advanced Engineering Mathematics, S.Chand and Company Ltd.(2004).

### **Scope:**

**Unit I:** Chapter 9 : 9.1,9.2,9.3,9.4,9.5,9.6,9.7.

**Unit II:** Chapter 9 : 9.8,9.9,9.10,9.11,9.12.

**Unit III:**Chapter 9 : 9.13,9.14,9.15,9.16,9.17,9.18.

**Unit IV:** Chapter 9 : 9.19,9.20, 9.21, and 9.22.

### **Reference Books:**

1. D.A.Murray: Introductory course in Differential equation, NewYork Longmans and Green Co. London and Bombay.
2. M.D.Raisinghania: Ordinary and Partial Differential equations, S.Chand and Co.
3. T.M.Karade: Lectures on Differential equation, Sonu-Nilu Pub. Nagpur.
4. I.N.Sneddon: Elements of Partial Differential Equation, McGraw Hill co.
5. Peter Olver: Introduction to Partial Differential equation Springer Cham Heidelberg NewYork Dordrecht London.
6. A.Singaravelu: Engineering Mathematics, Engineering Mathematics, Meenakshi Agency Chennai.
7. W.E.Williams: Partial Differential equations, Claredon Press Oxford.
8. M.E.Taylor: Partial Differential equations, Springer Cham Heidelberg NewYork Dordrecht London.

Course Code: **MAT-402**

Course Name: **Numerical Analysis**

Credits: **03**

Total Periods: **60**

**Course Objectives:**

Student will learn the finite differences, interpolating methods and numerical methods to solve differential equations.

**Course Outcomes:**

**CO1:** Describe Finite Differences and apply Newton's Formulae for Interpolation

**CO2:** Explain and apply Lagrange's and Newton divided difference formula for interpolation

**CO3:** Apply Gauss interpolation formulae, Stirling's and Bessel's formulae for interpolation

**CO4:** Apply numerical differentiation and numerical quadrature formulae.

**Unit I: Finite Differences and Interpolation with Equal Intervals**

Finite Differences: Introduction, Differences, Theorem, Factorial Notation, Factorial Function, The operator E, The operators D and  $\nabla$  Interpolation: Interpolation with equal intervals, Newton-Gregory Formula for forward interpolation, Newton-Gregory formula for Backward interpolation, Equidistant terms with one or more missing terms.

**Unit II: Interpolation with Unequal Intervals**

Introduction, Interpolation with unequal arguments, Divided differences with unequal arguments, Divided differences when two or more arguments are same or coincident, Properties of divided differences (Theorem 3 and Theorem 4 statements only), Newton's formula for unequal intervals, Lagrange's interpolation formula for unequal intervals.

### **Unit III: Central Differences Interpolation Formulae**

Introduction, Operators  $\nabla$ ,  $\delta$ ,  $\sigma$  and  $\mu$ , Gauss's central difference formula, Stirling's formula, Bessel's formula.

### **Unit IV: Numerical Differentiation and Numerical Integration**

Introduction, Approximate expressions for the derivative of a function, Introduction, A general quadrature formula for equidistant ordinates, Some important approximate quadrature formulae: The Trapezoidal rule, Simpson's one third rule, Simpson's three eighth rule, Weddle's rule.

#### **Recommended Text Book:**

**H.C.Saxena:** Finite Differences and Numerical Analysis, S.Chand & Co. New Delhi. Fourteenth Revised edition (1998).

#### **Scope:**

**Unit-I:** Chapter 1:1.1,1.2,1.3,1.5.1,1.5.3,1.6,1.6.1,1.6.2,1.7,1.8,1.8.1,1.8.2, 1.8.3.

**Unit-II:** Chapter 2:2.1,2.1.1,2.2 (Theorem 3 and Theorem 4 statements only),2.3,2.4.1

**Unit-III:** Chapter 3: 3.1, 3.2, 3.3, 3.4, 3.5

**Unit-IV:** Chapter 5:5.1,5.2,5.3

Chapter 6:6.1,6.2,6.3,6.3.1,6.3.2,6.3.3,6.3.4.

#### **Reference Books:**

1. S.S.Sastry: Introductory Methods of Numerical Analysis, Prentice-Hall of India Private Ltd.(Second Edition)1997.
2. E.V. Krishnamurthi & Sen: Numerical Algorithm,Affiliate East, West press Private Limited 1986.
3. M.K.Jain,SRK Iyengar,R.K.Jain:Numerical Methods for Scientific and Engineering Computations, New Age International Limited



Course Code: **MAT-403**

Course Name: **Mechanics-II**

Credits: **03**

Total Periods: **60**

**Course Objectives:**

Students will be able to find the velocity, acceleration, speed, angular momentum, field of force and motion under gravity.

**Course Outcomes:**

**CO1:** Find velocity and acceleration in terms of vector derivatives, curvature, Angular speed and angular velocity

**CO2:** Describe Radial and Transverse components of velocity and acceleration, areal speed and velocity

**CO3:** Explain Newton's Law of motion, angular momentum, work, energy, vector point function, Field of force.

**CO4:** Describe motion under gravity, projectile, Motion of projectile, Parabola of safety, motion in resisting medium, areal velocity of central orbit, Pedal's equation.

**Unit-I: Kinematics and Dynamics of a Particle in two Dimensions**

Introduction, Definitions, Velocity and acceleration in terms of vector derivatives, Tangent and unit vector along the tangent, Rate of change of unit vector moving in a plane, Curvature, principal normal, Tangential and normal components of velocity and acceleration, Angular speed and angular velocity, Radial and transverse components of velocity and acceleration, Areal speed and areal velocity.

**Unit-II: Kinetics of a Particle**

Introduction, Newton's law of motion, Matter, Linear momentum, Angular momentum, An Impulsive force and its impulse, Conservation of linear momentum, Impact of two bodies, Work, Energy, Scalar point function, Vector point function, Field of force, Conservative field of force.

### **Unit-III : Motion of a Projectile and Motion in a Resisting Medium**

Rectilinear motion, Motion under gravity, Projectile, Motion of projectile, Range on an inclined plane, Parabola of safety, Projectile to pass through a given point, Motion in a resisting medium, Motion of a body moving under gravity and in a medium whose resistance varies as velocity.

### **Unit-IV: Central Orbits**

Definitions, Areal velocity in central orbit, Differential equation of central orbit, Apses, Law of force, Pedal equation of some curves.

### **Recommended Text Book:**

**V.Tulsani, T.V.Warehekar, N.N.Saste:** Mechanics and Differential Geometry Second Edition (1987) , S.Chand and Co.(Pvt.)Ltd., New Delhi.

### **Scope: Part-II : Dynamics of a Particle**

**Chapter (1): Complete**

**Chapter (2): Complete**

**Chapter (3): Complete**

**Chapter (4): Articles 4.01 to 4.10**

### **Reference Books:**

- 1. S.L.Loney:** An Elementary Treatise on Statics, AITBS Publishers and Distributors, New Delhi.
- 2. B.R.Thakur, G.P.Shrivastava :** Mechanics, Ram Prasad and Sons, Agra-3.
- 3. M.L.Khanna:** Dynamics, Kedarnath Ramnath Prakashan, Meerut.

Course Code: **MAT- 404**

Course Name: **Complex Analysis**

Credits:**03**

Total Periods: **60**

**Course Objectives:**

To make students aware of generalization of real number system and calculus. This course improves mathematical skill and ability to solve various integration.

**Course Outcomes:**

**CO1:** Understand the concept of analytic function, Cauchy Riemann Equations

**CO2:** Understand the concept of harmonic functions

**CO3:** Understand the concept of complex integration and residues

**CO4:** Understand the concept of contour integration.

**Unit-I: Complex Numbers**

Complex numbers, Geometrical representation of imaginary numbers, Argand diagram, Modulus and argument, Exponential and circular functions of complex variables, Formulae of hyperbolic functions, De Moivre's theorem, Roots of a complex number.

**Unit-II: Functions of Complex Variables**

Introduction, Complex variable, Function of complex variable, Limits of complex variable, Continuity, Differentiability, Analytic functions, The Necessary and sufficient conditions for analytic functions, Cauchy Riemann equations in polar form, Orthogonal curves, Harmonic functions, Method to find a conjugate functions.

**Unit-III: Complex Integration**

Complex integration, Simply connected region, Cauchy's integral theorem, Cauchy's integral formulae, Morera's theorem, Cauchy's inequality, Liouville's theorem.

#### **Unit-IV: Singularities and Residues**

Singular point, Residues, Method of finding residues, Residue theorem, Evaluation of real definite integrals by contour integration, Integration round the unit circle.

#### **Recommended Text book:**

**H.K.Dass:** Advanced Engineering Mathematics, S.Chand and Co. Ltd, New Delhi (2004)

#### **Scope:**

**Unit-I.** Chapter 6: Article 6.1 to 6.4, 6.7 to 6.10

**Unit-II.** Chapter 7: Article 7.1 to 7.13

**Unit-III.** Chapter 7: Article 7.29 to 7.31, 7.33 to 7.37

**Unit-IV.** Chapter 7: Article 7.41 to 7.46

#### **Reference Books:**

1. Shanti Narayan: Theory of Functions of Complex Variables, S.Chand and Company, New Delhi.
2. Complex Variables: Schaum's Outline Series.
3. S.K.Sharma and R.K.Sharma: Complex Analytic Functions: Theory and Applications, New Age International Publishers

  
Dr. Bhausaheb R. Sontakke)  
Chairman  
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