

Periods / Week – 6 Periods  
 Total periods – 90 Periods  
 Examination – 3 Hours

Th – 80  
 IA – 20

**TOPIC WISE DISTRIBUTION OF PERIODS**

Sl. No	Topics	Units	Periods
1.	Algebra	I	8
		II	8
		III	5
		IV	5
		V	4
2.	Trigonometry	VI	25
3.	Two Dimensional Geometry	VII	12
		VIII	08
4.	Vector	IX	15
	<b>Total</b>		<b>90</b>

**OBJECTIVES :**

On completion of study of Engineering Mathematics -1, a student will be able to understand the application in Engineering by learning basic tools and skills in solving equations.

- (a) **Algebra** – Structures of numbers including imaginary quantities are built-up gradually. Practicing methods to solve algebraic inequations / equations without numerical methods, in so far as conventional methods including Matrix inversion method and crammers rule are concerned. Adequate exercise are included to gain the level of skill performance than conceptual development.
- (b) **Trigonometry** – Basic input of graphs of periodic functions and their general method of solution will improve their knowledge to apply in Electrical Circuits. The solutions to trigonometrical equation by conventional method will help immensely in this regard.
- (c) **Plane Geometry** – To study the mechanics of a moving point in different frames of reference concept about 2D plane geometry will enlighten the students to appreciate Engineering Mechanics.
- (d) **Vector** – Engineering Physics can be vividly conceptualized with basic knowledge of vector algebra and application.

**1.0 COMPLEX NUMBERS (8 PERIODS)**

- 1.1 Define real and imaginary number
- 1.2 Define complex numbers, conjugate complex numbers, Modulus and amplitude of a complex number
- 1.3 Explain geometrical representation of complex numbers.
- 1.4 State Properties of complex numbers
- 1.5 Determination of three cube roots of unity and their properties.
- 1.6 De' Moivre's theorem and its application to determination of n<sup>th</sup> roots of unity.
- 1.7 Problems on above (1.1 – 1.6)

**Unit – II : BINOMIAL THEOREM (8 Periods)**

- 2.1 Factorial notation, Permutation, combination. Working formula of P(n, r) & C(n, r)
- 2.2 Establish the following formulae
  - 1.  $P(n, r) = r! C(n, r)$
  - 2.  $C(n, r) = C(n, n - r)$
  - 3.  $C(n, r) + C(n, r - 1) = C(n + 1, r)$
  - 4.  $C(n, 0) = C(n, n) = 1$
  - 5.  $C(n, r) / C(n, r - 1) = (n - r + 1) / r$
- 2.3 Statement of Binomial Theorem for any index
- 2.4 Establish the formula for General terms, middle term/terms and term independent of x.
- 2.5 Establish the relationship between Binomial co-efficients
- 2.6 Problems on above (2.1 – 2.5)

**Unit – III : DETERMINANTS (5 Periods)**

- 3.1 Define determinant (second and third order)
- 3.2 Explain minor ( $M_{ij}$ ) of  $a_{ij}$ , co-factor ( $C_{ij}$ ) of  $a_{ij}$ . Explain  $C_{ij} = (-1)^{i+j} M_{ij}$ .
- 3.3 State properties of determinants
- 3.4 Cramer's Rule; (solutions of simultaneous equations of two and three unknown).
- 3.5 Problems on above (3.1 – 3.4)

**Unit – IV : MATRICES (5 Periods)**

- 4.1 Define matrix and its representation state its order.
- 4.2 State types of matrices with examples
- 4.3 Perform Addition, Subtraction and Multiplication of a matrix with a scalar and multiplication of two matrices (upto third order only).
- 4.4 Define transpose, adjoint and inverse of a matrix upto third order.
- 4.5 Solution of a simultaneous equations by Matrix method (linear equations in two and three unknowns)
- 4.6 Problems on above (4.1 – 4.5)

**Unit – V : PARTIAL FRACTIONS (4 Periods)**

- 5.1 Define Algebraic fractions, Partial fractions and types of Partial fractions.
- 5.2 Partial Fraction of a proper fraction having denominator.
  - (i) linear non-repeated (ii) Some Linear factors repeated along with non- repeated factors
  - (iii) Quadratic factors non-repeated (iv) Quadratic factors repeated.
- 5.3 Problems on above (5.1 – 5.2)

**Unit – VI : TRIGONOMETRY (25 Periods)**

- 6.1 Preliminary ideas, Trigonometrical functions, Circular functions and their Identity
- 6.2 Trigonometrical ratios
- 6.3 Compound angles, multiple & sub-multiple angles like  $2A$ ,  $3A$ ,  $A/2$ ,  $A/3$
- 6.4 Trigonometrical equations : Solutions of Trigonometrical equations (principal and general values).
- 6.5 Study properties of triangles and establish Sine, Cosine, Tangent and projection formulae. Establish the relation between angles semi-perimeter, sides and area of the triangle.
- 6.6 Define inverse circular functions and study its characteristic properties.
- 6.7 Problems on above (6.1 – 6.6)

**Unit – VII : ANALYTICAL GEOMETRY IN-TWO DIMENSIONS (STRAIGHT LINE)****(12 Periods)**

- 7.1 Define co-ordinates of a point on a plane in Cartesian and rectangular co-ordinates.
- 7.2 Derive the formula for
  1. Distance between two given points.
  2. Division point in the ratio  $m : n$  between two given points both externally and internally.
  3. Area of the trapezium.
  4. Area of the triangle whose vertices are given.
- 7.3 Define slope of a line and angle between two lines. Conditions of perpendicularity and parallelism of two lines.
- 7.4 Define locus and equation of locus from the given conditions.
- 7.5 Standard forms of straight lines
  1. Slope intercept form.
  2. Slope point form
  3. Two point forms
  4. Intercept form.
  5. Normal / Perpendicular form
  6. General equation of straight line
  7. Transformation of general from  $ax + by + c = 0$  into slope, intercept and normal form.
- 7.6 Determine point of intersection of two straight lines.
- 7.7 Derive equation of straight lines.
  - (a) Passing through a point and parallel to a line
  - (b) Passing through a point and perpendicular to a line
  - (c) Passing through a point of intersection of two straight lines.
- 7.8. Determine perpendicular distance from a point to a line.
- 7.9 Problems on above (7.1 – 7.8)

**Unit – VIII : CIRCLE (8 Periods)**

- 8.1 Find equation of circle with given centre  $(h, k)$  and radius  $r$ .
- 8.2 Derive general equation of a circle and determine its centre and radius.
- 8.3 Find equation of a circle passing through three non-collinear points.
- 8.4 Find equation of a circle, whose end points of a diameter being given.
- 8.5 Problems on above (8.1 – 8.4)

## Unit – IX : VECTOR ALGEBRA (15 Periods)

- 9.1 Define scalar and vector, distinguish between Scalar and vector quantities, give examples and explain geometrical representation of a vectors.
- 9.2 Explain types of vectors.
- 9.3 State magnitude and direction of vector.
- 9.4 Explain addition and subtraction of vectors and Multiplication of a vector by scalar.
- 9.5 Define position vector of a point and derive division formulae.
- 9.6 Explain resolution of a vector into components.
- 9.7 Explain scalar product of two vectors, geometrical meaning of scalar product and properties of scalar product.
- 9.8 Find angle between two vectors, scalar & vector projection in a given direction.
- 9.9 Define vector product of two vectors.
- 9.10 Explain geometrical meaning of vector product and properties of a vector product.
- 9.11 Explain Scalar triple product and deduce condition of co-planarity.
- 9.12 Problems on above (9.1 – 9.11)

### **BOOKS RECOMMENDED :**

- (1) Elements of Mathematics – Vol – I & II  
By Orissa State Bureau of Text Book Preparation & Production

### **Reference Books :**

- (1) Engg. Mathematics – by H. K. Dass, S. Chand Publication
- (2) Intermediate Algebra – by G. Samal
- (3) Higher Secondary Mathematics – Vol - I, Samal, Mohapatra, Jena, Adhikari,  
Vidyapuri Publishers



**TH – 1****ENGINEERING MATHEMATICS – II****Periods / Week – 6 Periods****Th – 80****Total periods – 90 Periods****IA – 20****Examination – 3 Hours****TOPIC WISE DISTRIBUTION OF PERIODS**

Sl. No	Topics	Units	Periods
1.	Differential Calculus Partial differentiation	I II	25 08
2.	Integral Calculus	III	25
3.	Differential Equation	IV	07
4.	Three dimensional Geometry	V	15
5.	Statistics	V	05
6.	Probability	V	05
	<b>Total</b>		<b>90</b>

**OBJECTIVES :**

Principle and applications in Engineering are firmly ground on abstract mathematical structures. Students passing from secondary level need familiarization with such structure with a view to develop their knowledge, skill and perceptions about the applied science. Calculus is the most important mathematical tool in forming Engineering application into mathematical models. Wide application of calculus makes it imperative to develop methods of solving differential equations. The knowledge of limit, derivative and anti derivative needs to be exhaustively practiced. To help a systematic growth of skill in solving equation by calculus method will be the endeavour of this course content. Understand the concept of co-ordinate system in 3D in case of lines, planes and sphere and it's use to solve Engineering problems. After completion of the course the student will be equipped with basic knowledge to form equations and solve them competently.

**Unit – I : DIFFERENTIAL CALCULUS (30 Periods)****1.0 LIMITS AND CONTINUITY**

- 1.1. Define variables, constants, function of real variables, domain and range
- 1.2 Explain Graphical representation of functions
  1. Absolute value function ( $|x|$ )
  2. Greatest integer function  $[x]$ ,
  3. Trigonometric function.
  4. Inverse circular function
  5. Exponential function ( $e^x$ )
  6. Logarithmic function ( $\log x$ )
  7. Signum function

1.3 Define limit of a function, Right Hand Limit, Left Hand Limit & Existence of Limits.  
Methods of evaluating limit, when  $x \rightarrow \infty$  (Infinite limits)

1.4 State fundamental theorem on limits. Find the standard limits.

1. Algebraic limits

$$(a) \lim_{x \rightarrow a} \frac{x^n - a^n}{x - a} = na^{n-1}$$

$$(b) \lim_{x \rightarrow 0} \frac{a^x - 1}{x} = \log_e a$$

$$(c) \lim_{x \rightarrow 0} \frac{e^x - 1}{x} = 1$$

$$(d) \lim_{x \rightarrow 0} (1 + x)^{1/x} = e$$

$$(e) \lim_{x \rightarrow 0} \frac{\log(1 + x)}{x} = 1$$

2. Trigonometric limits :  $\frac{\sin x}{x} = 1, \quad \frac{\tan x}{x} = 1$

1.5 Define continuity of functions at a point in the domain of the function say at  $(x = a)$

1.6 Problems on above (1.1 – 1.5)

## 2.0 DERIVATIVES

2.1 Define derivatives of functions at a given point  $(x = c)$

2.2 Differentials  $dx, dy$  etc. Establish geometrical and physical meaning of  $\frac{dy}{dx}$

Differential coefficient / quotient,  $\frac{dy}{dx}$ , differential operator ( $D = d/dx$ )

Derivative as rate measure and extension of concept of limits. Fundamental theorem on derivative viz (addition rule, subtraction rule, product rule and quotient rule).

2.3 Standard derivative of functions such as  $x^n, a^x, \log_a x, e^x, \log_e x, \sin x, \cos x, \tan x, \sin^{-1} x, \cos^{-1} x, \tan^{-1} x$ , from first principle methods.

2.4 Perform derivative of composite function

2.5 Perform logarithmic differentiation, Differentiation of parametric function, Differentiation of implicit function, Differentiation of a function with respect to another function.

2.6 Define successive differentiation (up to 2nd order).

2.7 Define maxima and minima, turning points, find the condition and interpret the critical points and points of inflexions.

2.8 Define local extremum, Absolute maxima / minima.

2.9 Problems on above (2.1 – 2.8)

## Unit – II : PARTIAL DIFFERENTIATION (8 Periods)

3.1 Explain functions of several variables.

3.2 State partial derivatives upto three independent variables

3.3 State homogeneous function of two variables and Euler's theorem on Homogeneous function for two variables.

3.4 Problems on above (3.1 – 3.3)

### Unit – III : INTEGRAL CALCULUS (INTEGRATION) (20 Periods)

- 4.1 Define integration as inverse process of differentiation.
- 4.2 Define indefinite and definite integral.
- 4.3 State integrals of standard functions.
- 4.4 Establish formula for the following :

$$\int \frac{dx}{x^2 + a^2}, \quad \int \frac{dx}{x^2 - a^2}, \quad \int \frac{dx}{x^2 + a^2}, \quad \int \frac{dx}{x^2 - a^2}, \quad \int \frac{dx}{x^2 + a^2}, \quad \int \frac{dx}{x^2 - a^2},$$

- 4.5 Explain methods of integration
  - (i) Integration by substitution
  - (ii) Integration by decomposition of integrand
  - (iii) Integration by parts
  - (iv) Integration by Partial Fraction
- 4.6 Integration of some more trigonometric function.

- 4.7 Definite integrals, properties of definite integrals.
- 4.8 Find area bounded by the function  $y = f(x)$  ordinate  $x = a$  to  $x = b$  and  $x$  axis and the area bounded by the function  $x = f(y)$ , abscissa,  $y = c$  to  $y = d$  and  $y$  - axis  
Area bounded by two curves.
- 4.9 Problems on above (4.1 – 4.8)

### Unit – IV : DIFFERENTIAL EQUATION (7 Periods)

- 5.1 Define differential equation. Order and Degree of differential equation.
- 5.2 Formation of first order first degree differential equation.
- 5.3 Solution of first order and first degree differential equation by the following methods
  - 1. Separation of variables.
  - 2. Homogeneous.
  - 3. Linear
  - 4. Exact.
- 5.4 Problems on above (5.1 – 5.3)

### Unit – V : ANALYTICAL GEOMETRY IN THREE DIMENSIONS (15 Periods)

- 6.1 Describe co-ordinates of a point in rectangular co-ordinate system.
- 6.2 Derive distance formula, Division formula.
- 6.3 Explain, DCS & DRS of a line, the formula for angle between two lines with given DRS. Conditions of perpendicularity and parallelism.
- 6.4 State Equation of a plane.
- 6.5 Find equation of a plane under different conditions.
  - 1. General form.  $ax + by + cz + d = 0$ , where  $a, b, c$  are DRS normal to a plane.
  - 2. Intercept form  $(x/a + y/b + z/c = 1)$
  - 3. Normal form
  - 4. Passing through point of intersection of two planes.
- 6.6 Find angle between two planes.
- 6.7 Find perpendicular distance from a point to a plane.

6.8 Problems on above (6.1 – 6.7)

## 7.0 SPHERE

7.1 Define sphere, equation of a sphere

7.2 Find the equation of a sphere whose centre and radius is given

7.3 Derive general equation of a sphere, equation of a sphere on a given diameter and equation of a sphere passing through four non-coplanar points.

7.4 Problems on above (7.1 – 7.3)

## 8.0 STATISTICS (UNIT – VI)

8.1 Measures of central tendency (Mean, Median & Mode)

8.2 Formulae for determination of Mean, Median & Mode.

8.3 Measure of dispersion, formulae for mean deviation, Standard deviation and variance.

8.4 Problems on above (8.1 – 8.3)

## 9.0 PROBABILITY (UNIT – VII)

9.1 Experiment, outcome, sample space, event and probability of an event.

9.2 Equally likely, mutually, exclusive independent event.

9.3 Theorems on probability,

(a)  $P(A \cup B) = P(A) + P(B) - P(A \cap B)$ , (b)  $P(A) + P(A^c) = 1$

9.4 Problems on above (9.1 – 9.3)

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- (3) Higher Secondary Mathematics – Vol - II, Samal, Mohapatra, Jena, Adhikari,

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