# <u>UTKALMANI GOPABANDHU INSTITUTE OF</u> <u>ENGINEERING, ROURKELA</u>





**DEPARTMENT OF MATH&SC** 



#### **MODULE-I**

#### 1) VECTOR ALGEBRA

- a) Introduction
- b) Types of vectors (null vector, parallel vector, collinear vectors)(in component form )
- c) Representation of vector
- d) Magnitude and direction of vectors
- e) Addition and subtraction of vectors
- f) Position vector
- g) Scalar product of two vectors
- h) Geometrical meaning of dot product
- i) Angle between two vectors
- j) Scalar and vector projection of two vectors
- k) Vector product and its geometrical interpretation.( area of triangle and parallelogram)

#### **Objectives:**

Student can able to distinguish between scalar and vector quantities. They can able to find the angle between two vector, area of a triangle and parallelogram etc using concepts of dot and cross product.

Lecture no	Topics to be covered	PRIMARY REFERENCE (BOOKS/NOTES)			
1	Introduction to vector and types of vector.	Т			
2	Representation of a vector, magnitude and	Т			
	direction of a vector. Operation on vectors,				
	position vector.				
3	Resolution of vectors in 2D and 3D. Operations on	Т			
	vectors in component form.				
4	Uint vector in the direction of a particular vectors.	Т			
	Problem discussion on previous topics.				
5	Problems on previous discussed topics of vector.	T,R1,R2			
6	Problems on previous discussed topics of vector.	T,R1,R2			
	Angle between two non zero vectors . Dot product	T,R1,R2			
	of two vectors. Geometrical meaning of dot				
7	product and properties of dot product.				
8	Problems on Dot product.	T,R1,R2			
9	Problems on Dot product.	T,R1,R2			
	Vector product or cross product. Geometrical	T,R1,R2			
10	meaning of cross product.				
11	Problems on cross product.	T,R1,R2			
	Condition of parallelism and perpendicularity	T,R1,R2			
12	using dot product and cross product.				
	Area of triangle and parallelogram using cross	T,R1,R2			
13	product.				
14	Problem on cross product.	T,R1,R2			
15	Discussion problem on whole vector topic.	T,R1,R2			

### **MODULE-II**

### 2) LIMITS AND CONTINUITY

- a) Definition of function, based on set theory
- b) Types of functions
- i) Constant function
- ii) Identity function

iii) Absolute value function  
iv) The Greatest integer function  
v) Trigonometric function  
vi) Exponential function  
vii)Logarithmic function  
c) Introduction of limit  
d) Existence of limit  
e) Methods of evaluation of limit  
i) 
$$\lim_{x\to a} \frac{x^n - a^n}{x - a} = na^{n-1}$$
  
ii)  $\lim_{x\to 0} \frac{a^x - 1}{x} = \log_e a$   
iii)  $\lim_{x\to 0} \frac{e^x - 1}{x} = 1$   
iv)  $\lim_{x\to 0} (1 + x)^{\frac{1}{x}} = e$   
v)  $\lim_{x\to 0} (1 + \frac{1}{x})^x = e$   
vi)  $\lim_{x\to 0} \frac{\log(1+x)}{x} = 1$   
vii)  $\lim_{x\to 0} \frac{\sin x}{x} = 1$   
viii)  $\lim_{x\to 0} \frac{\tan x}{x} = 1$ 

f) Definition of continuity of a function at a point and problem based on it.

#### **Objectives:**

Students can able to evaluate limits and test continuity of a function .

Lecture no	Topics to be covered	PRIMARY REFERENCE		
		(BOOKS/NOTES)		
16	Introduction to Relation and function. Types of function	Т		
	Classification of function and Introduction to limit.	Т		
17	Definition of limit and Existency of limits.			
	Algebra of limt and formulas on limit. Evaluation of	Т		
	algebraic limits using substitution, factorization and			
18	rationalization.			
19	Evaluation of infinite limits.	T,R1		
20	Evaluation of limits using formulas.	T,R2		
21	Evaluation of limits.	T,R1,R2		
22	Evaluation of limits by substitution method.	T,R1,R2		
23	Evaluation of RHL and LHL and testing existency of limits.	T,R1,R2		
	Define continuity of a function at a point. Testing continuity of a	T,R1,R2		
24	function at a point.			
25	Solving problem on testing continuity of a function at a point.	T,R1,R2		
26	Solving problem on testing continuity of a function at a point	T,R1,R2		
	Revision of the whole topic and problem discussion on the T,R1,R2			
27	whole topic.			

### MODULE-III 3)DERIVATIVES

- a) Derivative of a function at a point
- b) Algebra of derivative
- c) Derivative of standard functions
- $x^n, a^x, \log_a x, e^x, \sin x, \cos x, \tan x, \cot x, \sec x, \csc x$ 
  - x, sin<sup>-1</sup> x, cos<sup>-1</sup> x,tan<sup>-1</sup> x, cot<sup>-1</sup> x, sec<sup>-1</sup> x, cosec<sup>-1</sup>

d) Derivative of composite function (Chain Rule )

- e) Methods of differentiation of
  - i) Parametric function
  - ii) Implicit function
  - iii) Logarithmic function
  - iv) a function with respect to another function
  - f) Applications of Derivative
  - i) Successive Differentiation (up to second order)
  - ii) Partial Differentiation (function of two variables up to second order)
  - g) Problems based on above

**Objectives:** Student can able to find the derivative of a functions and find the slope of the tangent to a curve. Student can able to find partial derivatives of a function with more than one variable and use Euler's theorem to solve problems on partial differentiation.

Lecture no	Topics to be covered	PRIMARY REFERENCE		
20	Derivative of function at a point. Algebra of derivatives	(BOOKS/NOTES) T		
28	Derivative of function at a point. Algebra of derivatives.			
29	problems on it.	1,82		
30	Chain rule for composite function. Discussion of problems based on chanin rule.	T,R2		
31	Discussion of problems based on chanin rule.	T,R2		
32	Derivative of functions in parametric form and discussion of problems on it.	T,R1,R2		
33	Discussion of problems on parametric form.	T,R1,R2		
34	Discussion of problems on parametric form.	T,R1,R2		
35	Derivative of Implicit function. Problems on finding derivative of Implicit functions.	T,R1,R2		
36	Problems on finding derivative of Implicit functions.	T,R1,R2		
37	Derivative of some functions using logarithm.	T,R1,R2		
38	Problems on derivatives using logarithm.	T,R1,R2		
39	Discussion of problems on all the previously discussed topics of derivative chapter	T,R1,R2		
40	Derivative of function with respect to another function.T,R1,R2Discussion of problem on it			
41	Discussion of problem on derivative of a function with respect to another function	T,R1,R2		
42	Successive differentiation on functions. Problem on it.	T,R1,R2		
43	Discussion of problems on successive differentiation.	T,R1,R2		
44	Discussion of problems on successive differentiation.	T,R1,R2		
45	Introduction to partial derivatives of functions of two T,R1,R2 variable upto 2 <sup>nd</sup> order.			
46	Problem on finding partial derivatives of functions with more than one variable.	T,R1,R2		
47	State Euler's theorem . Verification of Euler's theorem. Problems on Euler's theorem	T,R1,R2		
48	Discussion of miscellaneous problems on derivative topic.	T,R1,R2		

## **4) INTEGRATION**

- a)Definition of integration as inverse of differentiation
- b) Integrals of standard functions
- c) Methods of integration
  - i) Integration by substitution
  - ii) Integration by parts
- d) Integration of the following forms

i) 
$$\int \frac{dx}{x^2 + a^2}$$
 ii)  $\int \frac{dx}{x^2 - a^2}$  iii)  $\int \frac{dx}{a^2 - x^2}$  iv)  $\int \frac{dx}{\sqrt{x^2 + a^2}}$  v)  $\int \frac{dx}{\sqrt{x^2 - a^2}}$  vi)  $\int \frac{dx}{\sqrt{a^2 - x^2}}$ 

vii) 
$$\int \frac{dx}{x\sqrt{x^2-a^2}}$$
 viii)  $\int \sqrt{a^2-x^2}dx$  ix)  $\int \sqrt{a^2+x^2}dx$  x)  $\int \sqrt{x^2-a^2}dx$ 

e) Definite integral, properties of definite integrals

$$i) \int_{0}^{a} f(x) dx = \int_{0}^{a} f(a - x) dx \quad ii) \int_{a}^{b} f(x) dx = -\int_{b}^{a} f(a - x) dx$$
  

$$ii) \int_{a}^{b} f(x) dx = \int_{a}^{c} f(x) dx + \int_{c}^{b} f(x) dx \quad , \ a < c < b$$
  

$$iii) \int_{-a}^{a} f(x) dx = \begin{cases} 0 & if \ f(x) \ is \ odd. \\ 2 \int_{0}^{a} f(x) dx & if \ f(x) \ is \ even \end{cases}$$

f) Application of integration

iii) Area enclosed by a curve and X – axis iv)Area of a circle with centre at origin

### **Objectives:**

Student will able to evaluate integrals and able to find the area under a curve using definite integral concept.

Lecture	Topics to be covered	PRIMARY		
no		REFERENCE		
		(BOOKS/NOTES)		
	Integration of function as reverse process of	Т		
	differentiation.Some integration of standard functions.			
49	Problem solving on direct formulas.			
50	Substitution method and discussion of problems on finding Integration of some functions.	Т		
51	Problems on substitution method.	T,R2		
52	Problem on integration of some trigonometric functions.	T,R1,R2		
	Integration of functions in the form $\int \frac{dx}{x^2+a^2}$ , $\int \frac{dx}{\sqrt{x^2-a^2}}$	T,R1,R2		
53	using substitution method.			
54	Problems on integration.	T,R1,R2		
55	Integration by parts rule explanation and problems on it.	T,R1,R2		
	Problem of finding integration of functions $\sqrt{a^2 - x^2}$ $\sqrt{a^2 + x^2}$ using by parts.	T,R1,R2		
56				
	Problems on Integration by parts. Discussion of problems on	T,R1,R2		
57	whole topic.			
	Introduction to definite integral, Fundamental theorem of	Т		
58	Calculus. Problems on definite integral.			
59	Properties of Definite integral.	T,R2		
60	Solving problems of definite integral using properties.	T,R2		
61	Solving problems of definite integral using properties.	T,R2		

67	Use of definite Intergral in finding area under a curve. Determination of area under a curve bounded by curve , X axis	Т
02		
63	Determination of area of a circle using definite integral.	T,R2

# MODULE-V

# **5) DIFFERENTIAL EQUATION**

a) Order and degree of a differential equation

b) Solution of differential equation

i) 1st order and 1st degree equation by the method of separation of variables

ii) Linear equation  $\frac{dy}{dx} + Py = Q$ , where P,Q are functions of x

# **Objectives:**

Students will able to solve problems of differential equation and convert engineering problems into differential equation problems and then solve them.

Lecture	Topics to be covered	PRIMARY	
no		REFERENCE	
		(BOOKS/NOTES)	
	Define differential equation. Order and degree of a differential	Т	
64	equation.		
	Linear differential equation. Meaning of solution of a differential	Т	
65	equation.		
	Finding solution of differential equation by variable and separable	Т	
66	method.		
67	Problems on variable and separable method.	T,R2	
68	Problems on variable and separable method	T,R2	
	Linear differential equation of 1 <sup>st</sup> order. Method of finding	Т	
69	solution of linear diff equation.		
70	Solving problems on linear differential equation.	T,R2	
71	Solving problems on linear differential equation.	T,R2	
72	Solving problems on linear differential equation.	T,R1,R2	
73	Solving problems on linear differential equation.	T,R1,R2	
74	Discussion of problems on the whole topic.	T,R1,R2	
75	Solving differential equation problems and doubt clearing.	T,R1,R2	

# **Course Delivery Plan**

Week	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
MODU LE	Ι	Ι	Ι	Π	Π	II,III	Ш	III	III	III,IV	IV	IV,V	IV,V	V	v

#### **BOOKS FOR REFERENCE:**

#### **TEXT BOOKS**

T: Elements of Mathematics \_ Vol. \_ 1 & 2 (Odisha State Bureau of Text Book preparation & Production)

#### REFERENCE

R1: Mathematics Part- I & Part- II- Textbook for Class XII, NCERT Publication

R2 : Text book of Engineering Mathematics Part-I by Chittaranjan Mallick and Susmita Mallick.

	Prepared by	Approved by
Signature		
Name	Jajatendu Keshari Chand	Jajatendu Keshari Chand
Designation	Lecturer Mathematics	Lecturer Mathematics.
Date		