

**DIPLOMA EXAMINATION IN ENGINEERING/TECHNOLOGY/  
MANAGEMENT/COMMERCIAL PRACTICE, NOVEMBER – 2020**

**ENGINEERING MATHEMATICS – II**

[Maximum Marks: 75]

[Time: 2.15 Hours]

**PART-A**

(Answer **any three** questions in one or two sentences. Each question carries 2 marks)

I.

1. Find the value of  $x$  for which  $x(\hat{i} + \hat{j} + \hat{k})$  is a unit vector

2. Find the numerical value of  $\begin{vmatrix} \cos \frac{\pi}{8} & \sin \frac{\pi}{8} \\ \sin \frac{\pi}{8} & \cos \frac{\pi}{8} \end{vmatrix}$

3. If  $A$  is a square matrix, prove that  $AA^T$  is a symmetric matrix

4. Find  $\int \sec x dx$

5. Solve  $\frac{dy}{dx} + 3y = 0$  (3 x 2 = 6)

**PART-B**

(Answer **any four** of the following questions. Each question carries 6 marks)

II

1. a) Show by vector method that the points with position vectors  $2\hat{i} - \hat{j} + 3\hat{k}$ ,  $3\hat{i} - 5\hat{j} + \hat{k}$  and  $-\hat{i} + 11\hat{j} + 9\hat{k}$  are collinear.

b) if  $|\vec{a}| = \sqrt{26}$ ,  $|\vec{b}| = 7$  and  $|\vec{a} \times \vec{b}| = 35$ , find  $\vec{a} \times \vec{b}$ .

2. Find the middle terms in the expansion of  $(3x + \frac{5}{x})^{11}$ .

3. If  $A = \begin{bmatrix} 1 & 4 & 3 \\ -4 & 0 & 1 \end{bmatrix}$ ,  $B = \begin{bmatrix} 1 & 2 \\ 0 & 5 \\ -1 & 1 \end{bmatrix}$ , verify that matrix multiplication is non-commutative.

4. Find (a)  $\int \frac{4\cos x + 7}{\sin^2 x} dx$ . (b)  $\int \frac{x^2}{(1+x^3)^4} dx$

5. Evaluate  $\int_0^{\frac{\pi}{2}} \cos^3 x dx$ .

6. Find the area enclosed between the curves  $y = x^2$  and  $2x + y - 3 = 0$ .

7. Solve  $(1 + x^2) \frac{dy}{dx} + y = e^{\tan^{-1} x}$ . (4 x 6 = 24)

**PART-C**

(Answer *any of the three units* from the following. Each full question carries 15 marks)

**UNIT - I**

III. 1. Show that each of the given three vectors is a unit vector:

$$\frac{1}{7}(2\hat{i} + 3\hat{j} + 6\hat{k}), \frac{1}{7}(3\hat{i} - 6\hat{j} + 2\hat{k}), \frac{1}{7}(6\hat{i} + 2\hat{j} - 3\hat{k})$$

Also, show that they are mutually perpendicular to each other. (6)

2. Find  $\mu$  and  $\lambda$  if  $(2\hat{i} + 6\hat{j} + 27\hat{k}) \times (\hat{i} + \lambda\hat{j} + \mu\hat{k}) = 0$ . (4)

3. Find the coefficient of  $x^{10}$  in the expansion of  $\left(2x^2 - \frac{3}{x}\right)^{11}$  (5)

**OR**

IV 1. The constant forces  $2\hat{i} - 5\hat{j} + 6\hat{k}$ ,  $-\hat{i} + 2\hat{j} - \hat{k}$  and  $2\hat{i} + 7\hat{j}$  act on a particle displaces it from the position  $4\hat{i} - 3\hat{j} - 2\hat{k}$  to  $6\hat{i} + \hat{j} - 3\hat{k}$ . Find the total work done. (5)

2. The two adjacent sides of a parallelogram are  $2\hat{i} - 4\hat{j} + 5\hat{k}$  and  $\hat{i} - 2\hat{j} - 3\hat{k}$ . Find a unit vector parallel to its diagonal. Also, find its area. (5)

3. Find the constant term in the expansion of  $\left(3x^2 + \frac{1}{2x^3}\right)^{10}$  (5)

**UNIT - II**

V 1. Solve using Cramer's rule:

$$x - y + z = 4, 2x + y - 3z = 0, x + y + z = 2. \quad (5)$$

2. If  $A = \begin{bmatrix} 5 & -3 \\ 2 & -2 \end{bmatrix}$ ,  $B = \begin{bmatrix} 7 & 5 \\ 4 & 3 \end{bmatrix}$  show that  $(AB)^{-1} = B^{-1}A^{-1}$ . (6)

3. Find the values of  $x, y$  and  $z$  if  $2 \begin{bmatrix} x^2 \\ -y \\ z \end{bmatrix} + \begin{bmatrix} 0 \\ x \\ -y \end{bmatrix} = \begin{bmatrix} 0 \\ z \\ \frac{-5}{2} \end{bmatrix}$  (4)

**OR**

VI 1. Solve  $x$  if  $\begin{vmatrix} 3 & 1 & 9 \\ 2x & 2 & 6 \\ x^2 & 3 & 3 \end{vmatrix} = 0$ . (4)

2. If  $A = \begin{bmatrix} 1 & 0 & 0 \\ -2 & 1 & -1 \\ 3 & 0 & 1 \end{bmatrix}$ , prove that  $A^3 - 3A^2 + 3A - I = 0$ . (6)

3. Solve the following system of equations by finding the inverse of the coefficient matrix:

$$x + y + z = 1, \quad 2x + 2y + 3z = 6, \quad x + 4y + 9z = 3 \quad (5)$$

**UNIT - III**

VII 1. Find  $\int \tan^2 x \, dx$  (3)

2. Find  $\int \sqrt{5x + 4} \, dx$  (3)

3. Find  $\int_0^{\frac{\pi}{4}} \frac{\sec^2 x}{\sqrt{1-\tan x}} \, dx$  (4)

4.  $\int_0^2 x^2 \log x \, dx$  (5)

**OR**

VIII 1. Evaluate  $\int \frac{3x+2}{\sqrt{x}} \, dx$  (3)

2. Evaluate  $\int \frac{e^{2x}}{1+e^{2x}} \, dx$  (3)

3. Evaluate  $\int_0^{\pi} \frac{1-\sin x}{(x+\cos x)^2} \, dx$  (4)

4. Evaluate  $\int_0^{\frac{\pi}{2}} x \cos 3x \, dx$  (5)

**UNIT - IV**

IX 1. Obtain the area bounded by the curve  $y = x + \sin x$ , the x-axis and the ordinates at  $x = 0$  and  $x = \frac{\pi}{2}$ . (5)

2. Find the volume of the ellipsoid when the ellipse  $\frac{x^2}{9} + \frac{y^2}{4} = 1$  is rotated about the x-axis. (5)

3. Solve  $\frac{dy}{dx} + \sqrt{\frac{1-y^2}{1-x^2}} = 0$ . (5)

**OR**

X 1. Find the area enclosed between the parabola  $y = x^2 - x - 2$  and the x-axis. (5)

2. Find the volume obtained by rotating one arch of the curve  $y = 3 \sin 2x$  about the x-axis. (5)

3. Solve:  $3e^x \tan y \, dx + (1 - e^x) \sec^2 y \, dy = 0$ . (5)