# MODEL QUESTION PAPER

## Subject: Engineering Mathematics II

**Max Marks: 100 Marks**                                    **Time: 3 Hrs**

## PART A

### (Answer all questions. 2 Marks each)

**I**

1. Find a unit vector in the direction of $\vec{a} = 2\hat{\imath} + 3\hat{\jmath} + \hat{k}$ .
2. If $\begin{vmatrix} x^2 & 3 \\ 4 & 1 \end{vmatrix} = \begin{vmatrix} 9 & 4 \\ 8 & 5 \end{vmatrix}$, find $x$.
3. $A = \begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix}$, $B = \begin{bmatrix} 0 & -2 \\ -3 & -3 \end{bmatrix}$ Find $(A + B)^T$.
4. Evaluate $\int_0^1 \frac{1}{1+x^2} dx$.
5. Solve $\frac{dy}{dx} = \frac{y}{x}$.

                                                    **(5 x 2Marks = 10 Marks)**

## PART B  (Answer any 5 questions. 6 Marks each)

**II**

1. If $\vec{a} = 2\hat{\imath} + 2\hat{\jmath} - \hat{k}$ , $\vec{b} = 6\hat{\imath} - 3\hat{\jmath} + 2\hat{k}$ Find (i) $\vec{a}.\vec{b}$ and (ii) $\vec{a} \times \vec{b}$ .
2. Find the middle terms in the expansion of $\left(3x - \frac{x^3}{6}\right)^7$.
3. Solve the following system of equations using determinants.  $3x - 2y + 3z = 8$, $2x + y - z = 1, 4x - 3y + 2z = 4$.
4. Find the inverse of $\begin{bmatrix} 2 & 3 & 1 \\ 1 & 2 & 3 \\ 3 & 1 & 2 \end{bmatrix}$.
5. Evaluate $\int_0^{\pi/4} x^2 \sin 2x \, dx$ .
6. Find the volume of a sphere of radius '$r$' using integration.
7. Solve $(1 + x^2)\frac{dy}{dx} + y = e^{\tan^{-1}x}$.

                                                    **(6 x 5 Marks = 30 Marks)**

## PART C  (Answer one full question from each module. 15 Marks each)

### Module I

**III**

1. Find the dot product and angle between the pairs of vectors $3\hat{\imath} + 4\hat{\jmath} - 5\hat{k}$   and $\hat{\imath} - 3\hat{\jmath} + 2\hat{k}$ .                                    **5**

2. Find the area of a triangle whose vertices are $A(\hat{i} - \hat{k})$, $B(2\hat{i} + \hat{j} + 5\hat{k})$, and $C(\hat{j} + 2\hat{k})$.  **5**

3. Expand $\left(\frac{y}{3} - \frac{6}{y^6}\right)^5$ binomially.  **5**

<center>*OR*</center>

IV 1. Obtain the coefficient of $x^{12}$ in $\left(x^2 - \frac{1}{x^2}\right)^{10}$.  **5**

2. Find the workdone in moving an object from '$A$' with position vector $2\hat{i} - 6\hat{j} + 7\hat{k}$ to the point '$B$' with position vector $3\hat{i} - \hat{j} + 5\hat{k}$ by a force $\vec{F} = \hat{i} + 3\hat{j} - \hat{k}$.  **5**

3. Find the projection of the line joining (1,-2,-1) to (3,1,1) on the vector $4\hat{i} - 3\hat{j} + 12\hat{k}$.  **5**

<center>**Module II**</center>

V 1. If $\begin{vmatrix} 2 & 1 & x \\ 3 & -1 & 2 \\ 1 & 1 & 6 \end{vmatrix} = \begin{vmatrix} 4 & x \\ 3 & 2 \end{vmatrix}$ Find $x$.  **5**

2. If $A = \begin{bmatrix} 0 & -3 & 1 \\ 2 & -1 & 1 \\ 2 & -1 & 1 \end{bmatrix}$, $B = \begin{bmatrix} 0 & -1 & 1 \\ 0 & 1 & -1 \\ 0 & 3 & -3 \end{bmatrix}$ Find AB and BA. Do A and B Commute?  **5**

3. Solve the system of equations by finding the inverse of the coefficient matrix $x - y + z = 4, 2x + y - 3z = 0, x + y + z = 2$.  **5**

<center>*OR*</center>

VI 1. Solve $\frac{2}{x} + \frac{5}{y} = 3, \frac{6}{x} + \frac{7}{y} = 5$ using determinants.  **5**

2. If $A = \begin{bmatrix} 3 & 1 & -1 \\ 0 & 1 & 2 \end{bmatrix}$ find $AA^T$ and $A^TA$ and hence show that both $AA^T$ and $A^TA$ are symmetric matrices.  **5**

3. Find A and B if $A + 2B = \begin{bmatrix} 3 & 1 & 0 \\ 1 & -1 & 2 \end{bmatrix}$, and $2A + 3B = \begin{bmatrix} 1 & 2 & -1 \\ 2 & 0 & 1 \end{bmatrix}$.  **5**

<center>**Module III**</center>

VII 1. Evaluate (i) $\int \frac{3\cos x + 4}{\sin^2 x} dx$ (ii) $\int \sin^2 x \, dx$  **3+2**

2. Evaluate (i) $\int \frac{x}{1+x^4} dx$ (ii) $\int \frac{\sin(\log x)}{x} dx$.  **3+2**

3. Evaluate $\int_1^e \log x \, dx$  **5**

*OR*

**VIII  1.** Evaluate $\int_0^{\pi/4} cos4x cos2x dx$ .                               5

   **2.** Evaluate  if (i) $\int xsec^2x dx$   (ii) $\int \frac{1}{1-4x} dx$ .                    3+2

   **3.** Evaluate $\int_0^{\pi/2} \sqrt{1+sin2x}\, dx$                               5

**Module IV**

**IX   1.** Find the area bounded by the curve $y = x^2 + x$  and the X- axis.        5

   **2.** Obtain the volume of the solid obtained by rotating one arch of the curve
$y = 2sin3x$  about the X- axis.                                              5

   **3.** Solve $\frac{dy}{dx} + ycotx = 2cosx$                                   5

*OR*

**X    1.** Find the area bounded by the curve $y = 6x - 2x^2$ and the line $y = 3x$.   5

   **2.** Solve $\frac{d^2y}{dx^2} = sec^2x$.                                     5

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