| Seat No. | |
|---|---|

**SQ - 09**

**Total No. of Pages : 4**

# S.Y.B.Tech. (Semester – III) (CBCS)
# Examination - May 2025
# (Mechanical Engg.)
# ENGINEERING MATHEMATICS - III
# Sub. Code : 73203/63350/77734



**Day and Date : Monday, 05/05/2025** **Total Marks : 70**

**Time : 10.30 am to 01.30 pm**

**Instruction :**
1) **Attempt any three questions from each section.**
2) **Figures to the right indicate full marks.**
3) **Use of Non-Programmable calculator is allowed.**
4) **Assume suitable data if necessary.**

## Section - A

**Q. 1. Solve the following LD equations.**

a) $(D^2 + 6D + 5)y = e^{-2x} + 3$ **[6]**

b) $(D^2 + 1)y = (1 + x^2)$ **[6]**

**Q. 2. Solve the following**

a) Following are the results of Height (X) and weight (Y) of the students. Calculate coefficient of correlation and write conclusion. **[6]**

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **X** | 4.6 | 5.5 | 5.8 | 5.8 | 5.7 | 5.6 | 6.0 | 5.4 | 5.9 | 5.7 |
| **Y** | 58 | 67 | 67 | 60 | 65 | 68 | 65 | 66 | 68 | 66 |

b) Fit a straight line $y = a + bx$ to the following data. **[5]**

| ***x*** | 1.6 | 1.7 | 1.8 | 1.9 | 2.0 |
|---|---|---|---|---|---|
| ***y*** | 1.8 | 1.9 | 2.0 | 2.1 | 2.2 |

**Q. 3. Solve the following.**

a) Evaluate **[5]**

$$\int_0^{\infty} e^{-6t} sin^2\, t\, dt$$

b) Find inverse Laplace transform of **[6]**

$$\frac{s + 29}{s^3 + 4s^2 + 9s + 36}$$

**Q. 4. Attempt any two from the following.**

a) Solve. **[6]**

$$x^3 \frac{d^3y}{dx^3} - x^2 \frac{d^2y}{dx^2} + 2x \frac{dy}{dx} - 2y = x + 3x^2$$

b) Fit the exponential curve $y = ab^x$ to the following data. **[6]**

| *x* | 1.0 | 1.1 | 1.2 | 1.3 | 1.4 |
|---|---|---|---|---|---|
| *y* | 0.5 | 0.466516 | 0.435275 | 0.406126 | 0.378929 |

c) Solve following LD equation using Laplace transform assuming **[6]**

$y(0) = 1$ and $y'(0) = 2$.

$$\frac{d^2y}{dt^2} - \frac{dy}{dt} - 2y = 20 \sin 2t$$

## Section - B

**Q. 5. Attempt the following questions.**

a) Prove that $\vec{V} = (z^2 + 2x + 3y)\vec{i} + (3x + 2y + z)\vec{j} + (y + 2.xz)\vec{k}$ is irrotational. Find a scalar potential function $\emptyset$ such that $\nabla\emptyset = \vec{V}$. **[6]**

b) Find the directional derivative of $f = x^2 - y^2 + 2z^2$ at the point $P(1, 2, 3)$ in the direction of the line $PQ$, where $Q$ is the point (5, 0, 4). **[5]**

**Q. 6. Attempt the following questions.**

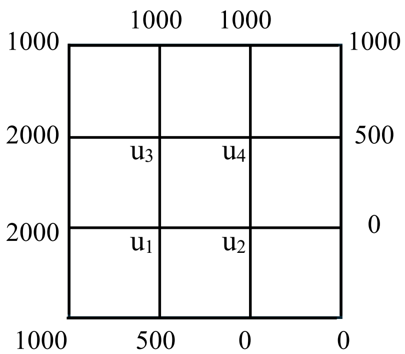
a) Find the Fourier series for the function $f(x) = x^2, -\pi < x < \pi$. Hence show that $\frac{1}{1^2} - \frac{1}{2^2} + \frac{1}{3^2} - \frac{1}{4^2} + \cdots = \frac{\pi^2}{12}$. **[7]**

b) Find the Fourier half-range cosine series of the function **[5]**

$$f(x) = \begin{cases} 2x, & 0 < x < 1 \\ 4 - 2x, & 1 < x < 2 \end{cases}$$

**Q. 7. Attempt any one from the following.**

a) Solve the Laplace equation $u_{xx} + u_{yy} = 0$ for the following square mesh with boundary values as shown in the figure by Gauss-Seidel method. (Carry out three iterations by taking $u_4$ =1000). **[11]**



b) Solve the differential equation $\frac{\partial u}{\partial t} = \frac{\partial^2 u}{\partial x^2}$ subject to the following conditions. **[11]**

i) $u$ is finite for all $t$.

ii) $u = 0$ for $x = 0, \pi$ for all $t$.

iii) $u = \pi x - x^2$ for $t = 0$ and between $x = 0$ and $x = \pi$

**Q. 8. Attempt any two from the following.**

a) If $\vec{a}$ is a constant vector and $\vec{r} = x\vec{i} + y\vec{j} + z\vec{k}$ then prove that $\nabla \times [(\vec{a} \cdot \vec{r})\vec{r}] = \vec{a} \times \vec{r}$. **[6]**

b) Find the Fourier series for $f(x) = \begin{cases} \pi x, & 0 < x < 1 \\ 0, & 1 < x < 2 \end{cases}$. **[6]**

c) Eliminate the arbitrary functions $f$ and $g$ from the relation $z = f(x + iy) + g(x - iy)$, where $i^2 = -1$ to obtain a partial differential equation. **[6]**