Total No. of Questions : 6]

SEAT No. :

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S.E. (Mechanical Engineering)/(Automation & Robotics)/ (Mechanical (Sandwich))

MDM-205-MEC (MDM 221 AUR) : Engineering Mathematics - III (2024 Pattern) (Semester - III)

Time : 2½ Hours] *[Max. Marks : 70*

Instructions to the candidates :

1) *All questions are compulsory.*
2) *Figures to the right indicate full marks.*
3) *Neat diagrams must be drawn wherever necessary.*
4) *Use of electronic non programmable calculator is allowed.*
5) *Assume suitable data, if necessary.*

Q1) Write the correct option for the following multiple choice questions : [10]

i) The solution of differential equation $\frac{d^3y}{dx^3} + 2\frac{d^2y}{dx^2} + \frac{dy}{dx} = 0$ is _____ **[2]**

a) $c_1 + c_2 e^x + c_3 e^{-x}$ b) $c_1 + e^x (c_2 x + c_3)$

c) $c_1 + e^{-x} (c_2 x + c_3)$ d) $c^{-x} (c_2 x + c_3)$

ii) A throw is made with two dice. The probability of getting a score of at least 10 points is _____ **[2]**

a) $\frac{1}{4}$ b) $\frac{1}{12}$

c) $\frac{5}{6}$ d) $\frac{1}{6}$

iii) A root of the equation $x \log_{10} x = 1.2$ by using bisection method lies between _____ **[2]**

a) 0 and 1 b) 2 and 3

c) 1 and 2 d) 0.5 and 1

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iv) Differential equation $\frac{dy}{dx} = x + y$, with $y(0) = 0, h = 0.2$ is to be solved by using Euler's method. The value of y at $x = 0.4$ is given by _____ **[2]**

a) 0.2 b) 0.04

c) 0 d) 0.4

v) If $\bar{r} = \bar{a}\, e^{5t} + \bar{b}\, e^{-5t}$, Where $\bar{a}$ & $\bar{b}$ are constant vectors then $\frac{d^2\bar{r}}{dt^2} - 25\bar{r}$ is equal to **[2]**

a) 1 b) 2

c) 0 d) 5

Q2) **Solve any Three of the following :**

a) $(D^2 - 1)y = x \sin x + 2^x$. **[4]**

b) $(D^2 + 1)\, y = \tan x$ (Use method of variation of parameter). **[4]**

c) $(2x+1)^2 \frac{d^2y}{dx^2} - 6(2x+1)\frac{dy}{dx} + 16y = 8(2x+1)^2$. **[4]**

d) Solve the Simultaneous equations **[4]**

$$\frac{dx}{dt} + y = e^t$$
$$\frac{dy}{dt} - x = e^{-t}$$

e) A body of weight W = 1 N is suspended from a spring stretches it 4 cm. If the weight is pulled down 8 cm below the equillibrium position and then released. Find the position and velocity as a function of time. **[4]**

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Q3) Solve (Any Three) of the following : **[12]**

a) Calculate the coefficient of variation for the data given as follows. **[4]**

36, 15, 25, 10 and 14

b) First four moments of a distribution about the value 2 are 1, 2.5, 5.5 and 16. Find first four moments about the mean, β_1 & β_2. **[4]**

c) Obtain regression lines for the following data. **[4]**

x	6	2	10	4	8
y	9	11	5	8	7

d) The number of accidents per week on a highway follows a poisson distribution with mean 0.5. Find the probablity that during a week there will be at the most one accident. **[4]**

e) In certain city 4000 tube lights are installed. If the lamps have average life of 1500 burning hours with standard deviation 100 hours. Assuming normal distribution. How many lamps will fail in first 1400 hours. How many lamps will last beyond 1600 hours. (Given : A(1) = 0.3413). **[4]**

Q4) Solve (any three) of the following : **[12]**

a) Using Newton's Raphson method to Find the real root of the equation $3x = \cos x + 1$ upto two iterations. Use $x_0 = 0.6$. **[4]**

b) Apply Gauss elimination method to solve the equations $2x_1 + x_2 + x_3 = 10$, $3x_1 + 2x_2 + 3x_3 = 18$, $x_1 + 4x_2 + 9x_3 = 16$. **[4]**

c) Find a real root of $2x - \log_{10} x = 7$ correct to three decimal places using iteration method. **[4]**

d) Solve the following system by Cholesky's method **[4]**

$4x_1 + 2x_2 + 14x_3 = 14$

$2x_1 + 17x_2 - 5x_3 = -101$

$14x_1 - 5x_2 + 83x_3 = 155$

e) Solve the following system of equations by Gauss - Seidal method [show 2 iterations] **[4]**

$27x_1 + 6x_2 - x_3 = 85$

$6x_1 + 15x_2 + 2x_3 = 72$

$x_1 + x_2 + 54x_3 = 110$

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Q5) Solve (any three) of the following : **[12]**

a) Using Newton's forward difference formula, Calculate F(3, 5). **[4]**

x	2	3	4	5	6	7	8	9
y	19	48	99	178	291	444	643	894

b) Using Lagrange's interpolation formula, Find F(1.1) **[4]**

x	1	1.2	1.3	1.4
$f(x)$	1	1.095	1.140	1.183

c) A curve is drawn to pass through the points given by the following table. **[4]**

x	1	1.5	2	2.5	3	3.5	4
y	2	2.4	2.7	2.8	3	2.6	2.1

Estimate the area bounded by the curve, the x axis and the ordinates $x = 1$, $x = 4$.

d) Use Modified Euler's method to solve $\frac{dy}{dx} = x - y^2, y(0) = 1$ to calculate $y(0.2)$ taking h = 0.2 correct upto two decimal places. **[4]**

e) Use Runge - Kutta method of order four to solve the differential equation $\frac{dy}{dx} = x^2 + y^2, y(0) = 0$ estimate $y(0.2)$. **[4]**

Q6) Solve (any three) :

a) Find the directional derivative of $\phi = xy^2 + yz^3$ at the point (1, –1, 1), toward the point (2, 1, –1). **[4]**

b) Show that $\overline{F} = (6xy + z^3)i + (3x^2 - z)j + (3xz^2 - y)k$ is irrotational. Also find the scalar potential ϕ such that $\overline{F} = \nabla \phi$. **[4]**

c) Find the workdone in moving a particle along the straight line from the point (1, 2, 2) to (3, 4, 4) under the field of force given by **[4]**
$\overline{F} = x^2 i + yzj + zk$

d) For the solenoidal vector field $\overline{F}$, show that curl curl curl curl $\overline{F} = \nabla^4 \overline{F}$. **[4]**

e) Evaluate $\iint_S \overline{r} . \hat{n}\, ds$ over the surface of the sphere of radius '1' with centre (0, 0, 0). **[4]**



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