Printed Page:-04 **Subject Code:- BMIAS0203**

Roll. No:

NOIDA INSTITUTE OF ENGINEERING AND TECHNOLOGY, GREATER NOIDA

(An Autonomous Institute Affiliated to AKTU, Lucknow)

M.Tech (Integrated)

SEM: II - THEORY EXAMINATION (2024- 2025)

Subject: Engineering Mathematics-II

Time: 3 Hours **Max. Marks: 100**

General Instructions:

IMP: *Verify that you have received the question paper with the correct course, code, branch etc.*

1. *This Question paper comprises of* ***three Sections -A, B, & C.*** *It consists of Multiple Choice Questions (MCQ's) & Subjective type questions.*

2. *Maximum marks for each question are indicated on right -hand side of each question.*

3. *Illustrate your answers with neat sketches wherever necessary.*

4. *Assume suitable data if necessary.*

5. *Preferably, write the answers in sequential order.*

6. *No sheet should be left blank. Any written material after a blank sheet will not be evaluated/checked.*

SECTION-A 20

1. Attempt all parts:-

1-a. 1

The value for $\frac{1}{D-2}\sin 2x$ is : (CO1, K2)

(a) $e^{2x}\int e^{2x}\sin 2x\,dx$

(b) $e^{2x}\int e^{-2x}\sin 2x\,dx$

(c) $e^{-2x}\int e^{2x}\sin 2x\,dx$

(d) None of these

1-b. The complementary function of the second order linear differential equation $x^2y'' - xy' = 0$ is : (CO1,K1) 1

(a) $c_1 + xc_2$

(b) $c_1 + x^2c_2$

(c) $c_1 + e^x c_2$

(d) None of these

1-c. 1

For the series $\sum_{n=1}^{\infty} u_n$ of positive terms the Raabe's test fail if $\lim_{n\to\infty} n\left(\frac{u_n}{u_{n+1}} - 1\right)$ is (CO2,K1)

(a) <1

.

(b) >1

(c) = 1

(d) none of these

1-d. The coefficient a_0 in a Fourier series for the function $f(x) = x + x^3$ in the interval $-\pi < x < \pi$ is (CO2,K2) 1

(a) π

(b) 2π

(c) 0

(d) none of these

1-e. Inverse Laplace of the function $f(s) = \frac{1}{(s+1)^2}$ is (CO3,K1) 1

(a) te^t

(b) $\frac{e^{-t}}{t}$

(c) te^{-t}

(d) None of these

1-f. Laplace transform of $f(t) = 5e^{2t} + 2$ is (CO3,K2) 1

(a) $\frac{5}{s-2} - \frac{1}{s}$

(b) $\frac{5}{s-2} + \frac{1}{2s}$

(c) $\frac{5}{s-2} + \frac{2}{s}$

(d) None of these

1-g. If $\emptyset = 3x^2y - y^3z^2$ then grad $\emptyset$ at the point $(1, -2, -1)$ is (CO4,K2) 1

(a) $-12\hat{i} - 9\hat{j} - 16\hat{k}$

(b) $12\hat{i} + 9\hat{j} + 16\hat{k}$

(c) $\hat{i} + \hat{j} + \hat{k}$

(d) $\hat{i} + \hat{j}$

1-h. If $\vec{F} = (y+z)\,\hat{i} + (z+x)\,\hat{j} + (x+y)\,\hat{k}$, curl of $\vec{F}$ equal to (CO4,K1) 1

(a) 0

(b) $\hat{i} + \hat{j} + \hat{k}$

(c) 3

(d) None of these

1-i. Rs 4200 is divided among Jay, Sanjay and Vijay in the ratio of 2: 4: 6 . Find the amount received by Sanjay (CO5,K1) 1

(a) ₹1200

(b) ₹1300

.

(c) ₹1400

(d) ₹1500

1-j. If the volume and base area of cuboid are 144 m^3 and 18 m^2 respectively. Then height is (CO5,K1) 1

(a) 6 m

(b) 10 m

(c) 8 m

(d) None of these

2. Attempt all parts:-

2.a. Solve the differential equation : $(D^3-3D^2+4)y=0$.(CO1,K1) 2

2.b. Find the Fourier coefficient a_0 for $f(x)=x^2-2$ in the interval $-2<x<2$. (CO2,K1) 2

2.c. Find the Laplace transform of the function $F(t) = (t-1)^2\, u\,(t-1)$. (CO3,K2) 2

2.d. Show that vector $\vec{V}=(x+3y)\hat{i}+(y-3z)\hat{j}+(x-2z)\hat{k}$, is solenoidal. (CO4,K2) 2

2.e. The product of the ages of Asha and Nithi is 540. If twice the age of Asha is more than Nithi's age by 6 years, then find Asha's age? (CO5,K1) 2

SECTION-B 30

3. Answer any five of the following:-

3-a. Solve the differential equation: $(D-1)^2y=xe^x\sin x$.(CO1,K3) 6

3-b. Solve the differential equation: $(D^2-2D-3)y=2e^{2x}+10\sin 3x$, given that $y(0)=2$, $y'(0)=4$.(CO1,K2) 6

3-c. Test the convergence of the series 6

$$\frac{1}{1.2.3}+\frac{3}{2.3.4}+\frac{5}{3.4.5}+\frac{7}{4.5.6}+\ldots\ldots \quad (CO2,K2)$$

3-d. Express $\sin x$ as a cosine series in the interval $0<x<\pi$. (CO2,K1) 6

3.e. Evaluate the value of $\int_0^\infty \frac{\cos 6t-\cos 4t}{t}dt$. (CO 3,K2) 6

3.f. Find the total work done by a force $\vec{F}=(x^2+y^2)\,\hat{i}-2xy\,\hat{j}$ in moving a point from (0,0) to (a,b) along the rectangle bounded by the lines x=0, x=a, y=0, and y=b. (CO4,K3) 6

3.g. A container has 80 L of milk, from this container 8 L of milk was taken out and replaced by water.The process was further repeated twice .What is the value of milk in the container after that ? (CO5,K2) 6

SECTION-C 50

4. Answer any one of the following:-

4-a. Solve the differential equations by method of variation of parameters: 10

$x^2\frac{d^2y}{dx^2}+x\frac{dy}{dx}-y=x^3e^x$. (CO1,K2)

4-b. Solve the differential equation by reducing it into normal form (removal of first derivative) : $\frac{d^2y}{dx^2}-4x\frac{dy}{dx}+(4x^2-1)y=-3e^{x^2}\sin 2x$. (CO1,K3) 10

5. Answer any one of the following:-

5-a. Obtain the Fourier series for the function $f(x)=\begin{cases} x, & -\pi<x<0 \\ -x, & 0<x<\pi \end{cases}$. Hence show that $\frac{1}{1^2}+\frac{1}{3^2}+\frac{1}{5^2}+\ldots\ldots\ldots\ldots=\frac{\pi^2}{8}$. (CO2,K2) 10

5-b. Test the convergence of the series $1+\frac{x}{2}+\frac{1.3}{2.4}x^2+\frac{1.3.5}{2.4.6}x^3+\ldots\ldots\ldots\ldots, x>0$ (CO2,K1) 10

6. Answer any one of the following:-

6-a. Solve the following differential equation by Laplace transform $\frac{d^2x}{dt^2}+2\frac{dx}{dt}+5x=e^{-t}\sin t$, *Given that* $x=0, \frac{dx}{dt}=1$ *at* $t=0$. (CO3,K3) 10

6-b. Use Convolution theorem to evaluate: (CO3,K2) 10

$L^{-1}\left\{\frac{s}{(s^2+a^2)(s^2+b^2)}\right\}$

7. Answer any one of the following:-

7-a. Evaluate the Green's Theorem $\int_C (e^{-x}\sin y\,dx+e^{-x}\cos y\,dy)$, where C is the rectangle with vertices $(0,0), (\pi,0), (\pi,\pi/2), (0,\pi/2)$ and hence verify Green's Theorem. (CO4,K2) 10

7-b. Verify Stoke's theorem for the function $\vec{F}=x^2\hat{i}+xy\hat{j}$ integrated round the square whose sides are $x=0, y=0, x=a, y=a$ in the plane $z=0$. (CO4,K3) 10

8. Answer any one of the following:-

8-a. (i) Shreya started from point P and 2 m towards West. She then took a right turn and walked 3 m before taking left turn and walking 5 m. She finally took a left turn, walked 3 m and stopped at a point Q. How far is point Q from point P?
(ii) Ratio of ages of Reena and Prerna is 2 : 3 and the ratio of ages of Tiya and Reena is 3 : 1. If the ratio of age of Prerna four years hence to age of Tiya three years hence is 5 : 9, what is the total of the ages of all three? (CO5,K1) 10

8-b. (i) Pointing to a photograph Lata says, "He is the son of the only son of my grandfather." How is the man in the photograph related to Lata?
(ii) The milk and water in a mixture are in the ratio 7:5. When 15 L of water are added to it, the ratio of milk and water in the new mixture becomes 7:8. Find the total quantity of water in the new mixture . (CO5,K1) 10