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NOIDA INSTITUTE OF ENGINEERING AND TECHNOLOGY, GREATER NOIDA

(An Autonomous Institute Affiliated to AKTU, Lucknow)

B.Tech

SEM: II - THEORY EXAMINATION (2023- 2024)

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. Degree and order of the differential equation $\sqrt{((dy/dx)^2 + 3y)} = (d^2y)/(dx^2)$ is (CO1) 1
- (a) Ord = 2, Deg = 2
 - (b) Ord = 2, Deg = 1
 - (c) Ord = 1, Deg = 2
 - (d) Ord = 1, Deg = 1
- 1-b. The P.I. of the differential equation $(D^2 + 4)y = \sin 3x$ is (CO1) 1
- (a) $(-1/10) \sin 3x$
 - (b) $(-1/5) \sin 3x$
 - (c) $(1/5) \sin 3x$
 - (d) None of these
- 1-c. The coefficient b_n in a Fourier series for the function $f(x) = x \sin x$ in the interval $-\pi < x < \pi$ is (CO2) 1
- (a) π
 - (b) 0
 - (c) 1
 - (d) 2π

- 1-d. For the series $\sum_{n=1}^{\infty} u_n$ of positive terms the Ratio test fails if $\lim_{n \rightarrow \infty} \frac{u_n}{u_{n+1}}$ is 1
(CO2)
- (a) <1
 (b) >1
 (c) $=1$
 (d) none of these
- 1-e. Laplace transform of the function $F(t) = t^n$, where n is a positive integer is 1
(CO3)
- (a) $\frac{n}{s^n + 1}$
 (b) $\frac{1}{s^n + 1}$
 (c) $\frac{1}{s^{n+1}}$
 (d) None of these
- 1-f. Inverse Laplace of the function $f(s) = \frac{1}{(s+1)^2}$ is 1
(CO3)
- (a) te^t
 (b) $\frac{e^{-t}}{t}$
 (c) te^{-t}
 (d) None of these
- 1-g. If $\vec{r} = x\hat{i} + y\hat{j} + z\hat{k}$, then $\text{div}\vec{r}$ equal to 1
(CO4)
- (a) 4
 (b) 8
 (c) 5
 (d) 3
- 1-h. If $\phi = 3x^2y - y^3z^2$ then $\text{grad } \phi$ at the point $(1, -2, -1)$ is 1
(CO4)
- (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-i. A boy has coins in the denominations of ₹ 1 and ₹ 2. If he has total 30 coins and the value of coins is ₹ 48. Find the number of ₹ 1 coins he has. 1
(CO5)
- (a) 18
 (b) 10
 (c) 12

(d) 14

1-j. Introducing a boy, a girl said, “He is the son of the daughter of the father of my uncle.” How is the boy related to the girl? (CO5) 1

- (a) Brother
- (b) Nephew
- (c) Uncle
- (d) Son-in-law

2. Attempt all parts:-

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

2.b. Find Fourier coefficients a_0 , in $(0, 2)$ for $f(x) = \begin{cases} x, & 0 < x < 1 \\ 0, & 1 < x < 2 \end{cases}$ (CO2) 2

2.c. Find Laplace transform of the function $F(t) = \cos h at - \cos at$. (CO3) 2

2.d. Prove that $\vec{V} = 3y^4z^2\hat{i} + 4x^3z^2\hat{j} - 3x^2y^2\hat{k}$ is solenoidal. (CO4) 2

2.e. The ratio between the ages of Kamala and Savitri is 6:5 and the sum of their ages is 44 years. Find the ratio of their ages after 8 years? (CO5) 2

SECTION-B

30

3. Answer any five of the following:-

3-a. Solve the differential equation $x^2 \frac{d^2y}{dx^2} + x \frac{dy}{dx} + y = \sin(\log x^2)$. (CO1) 6

3-b. Solve the differential equation $\frac{d^2y}{dx^2} - 2 \frac{dy}{dx} + y = e^x \sin x$. (CO1) 6

3-c. Show that the series $1 + \frac{1}{2^2} + \frac{2^2}{3^2} + \frac{3^2}{4^2} + \dots$ is divergent. (CO2) 6

3-d. Expand $f(x) = \pi x - x^2$ as a Fourier half range sine series in $0 < x < \pi$ upto the first three terms. (CO2) 6

3.e. Find the inverse Laplace Transform of the function $f(s) = \frac{s^2 + 2s - 3}{s(s-3)(s+2)}$. (CO3) 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) 6

3.g. (i) 12 yr ago the ratio between the ages of A and B was 3:4 respectively. The present age of A is 3 times of C's present age. If C's present age is 10 yr, then what is B's present age? 6

(ii) The ratio of the present ages of a mother and daughter is 7:1 Four years ago the ratio of their ages was 19:1 what will be the mother's age four years from now? (CO5)

SECTION-C

50

4. Answer any one of the following:-

4-a. Solve the following differential equation by changing to independent variable 10

$$x \frac{d^2y}{dx^2} + (4x^2 - 1) \frac{dy}{dx} + 4x^3y = 2x^3. \quad (\text{CO1})$$

4-b. Solve $\frac{dx}{dt} + 2x - 3y = t$, $\frac{dy}{dt} - 3x + 2y = e^{2t}$. 10
(CO1)

5. Answer any one of the following:-

5-a. Obtain the Fourier series to represent function $f(x) = 4 - x^2$ in the interval $-2 \leq x \leq 2$. 10

Hence show that $1 - \frac{1}{2^2} + \frac{1}{3^2} - \frac{1}{4^2} + \dots = \frac{\pi^2}{12}$

5-b. $f(x) = x \cos x$ 10

Obtain the Fourier Series to represent the function in the interval $-\pi < x < \pi$. (CO2)

6. Answer any one of the following:-

6-a. Solve the following differential equation by using Laplace transform 10

$$\frac{d^2x}{dt^2} - 2 \frac{dx}{dt} + x = e^t, \text{ Given that } x = 2, \frac{dx}{dt} = -1 \text{ at } t = 0. \quad (\text{CO3})$$

6-b. Using Convolution Theorem find the inverse Laplace transform of 10

$$L^{-1} \left\{ \frac{s}{(s^2 + 1)(s^2 + 4)} \right\}. \quad (\text{CO3})$$

7. Answer any one of the following:-

7-a. Evaluate $\oint_C \vec{F} \cdot d\vec{r}$, by stokes theorem where $\vec{F} = y^2 \hat{i} + x^2 \hat{j} - (x+z) \hat{k}$ and C is the 10

boundary of the triangle with vertices at $(0,0,0)$, $(1,0,0)$ and $(1,1,0)$. (CO4)

7-b. 10

Verify Divergence theorem for $\vec{F} = 4xz \hat{i} - y^2 \hat{j} + yz \hat{k}$ taken over the cube bounded by the planes

$$x = 0, x = 1, y = 0, y = 1, z = 0, z = 1. \quad (\text{CO4})$$

8. Answer any one of the following:-

8-a. (i) Two numbers are in the ratio 3: 5. If 9 be subtracted from each, then they are 10
in the ratio of 12:23. Find the second number ?

(ii) Alloy A contains 40% gold and 60% silver. Alloy B contains 35% gold and 40% silver and 25% copper. Alloy A and B are mixed in the ratio of 1:4. What is the ratio of gold and silver in the newly formed alloy? (CO5)

8-b. (i) Vinod starts from his house and travels 4 km in East direction after that he 10

turns towards left and moves 4 km. Finally, he turns towards left and moves 4 km. At what distance and in which direction he finally stands from his starting point?

(ii) A person moves 15 km in East direction then turns towards North and moves 4 km. From here he turns towards West and travels 12 km. How far and in which direction is he from his starting point? (CO5)

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