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NOIDA INSTITUTE OF ENGINEERING AND TECHNOLOGY, GREATER

NOIDA

(An Autonomous Institute Affiliated to AKTU, Lucknow)

B.Tech/ 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 question paper with 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. The degree of a differential equation $\frac{d^2y}{dx^2} + 7 \sin x = -3$ is 1

(CO1,K1)

- (a) 1
- (b) 2
- (c) 3
- (d) 4

1-b. The P.I. of the differential equation differential $\frac{d^2y}{dx^2} + 6 \frac{dy}{dx} + 9y = 1$

 $5e^{3x}$ is (CO1,K1)

- (a) $\frac{2x}{36} e^{3x}$
- (b) $\frac{1}{36} e^{3x}$

(c) $\frac{5x}{36}e^{3x}$

(d) $\frac{5}{36}e^{3x}$

1-c. The coefficient a_0 in the Fourier series for the function $f(x) = x + x^3$ with interval $-\pi < x < \pi$ is (CO2, K1) 1

(a) π

(b) 2π

(c) 0

(d) $-\pi$

1-d. Raabe's test fails if $\lim_{n \rightarrow \infty} n \left(\frac{u_n}{u_{n+1}} - 1 \right)$ is equal to (CO2, K1) 1

(a) 1

(b) 2

(c) -1

(d) 0

1-e. The Laplace transform of Unit step function $u(t - a)$ is (CO3, K1) 1

(a) e^{-as}

(b) $\frac{e^{-as}}{s}$

(c) se^{-as}

(d) $\frac{e^{as}}{s}$

1-f. The inverse Laplace transform of $\frac{1}{\sqrt{s+a}}$ is (CO3, K1) 1

(a) e^{-at}/t

(b) $e^{-at}/\sqrt{\pi t}$

(c) $e^{-at}/\sqrt{\pi - t}$

(d) None of these

1-g. Divergence of the vector field $x^2z\hat{i} + xy\hat{j} - yz^2\hat{k}$ at $(1,-1,1)$ is (CO4, K1) 1

(a) 0

(b) 2

(c) 5

(d) 4

- 1-h. If $\vec{F}$ denotes velocity of fluid, then $\oint_C \vec{F} \cdot \overrightarrow{dr}$ represents 1
(CO4, K1)
(a) Work done
(b) Circulation
(c) flux
(d) None of these
- 1-i. The ratio of number of girls and boys participating in sports of a school is 1:5. If the number of girls is 249, the number of boys participating in the sports are (CO5,K1) 1
(a) 1245
(b) 1265
(c) 1275
(d) 1235
- 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) 7 m
2. Attempt all parts:-
- 2.a. Find the solution of the differential equation $\frac{d^3y}{dx^3} - 7\frac{dy}{dx} - 6y = 0$ 2
. (CO1,K1)
- 2.b. Expand for $f(x)=k$ for $0 < x < 2$ in a half range sine series. 2
(CO2,K2)
- 2.c. Find the Laplace transform of $te^{-t} \sin t$. 2
(CO3,K2)
- 2.d. State Green's theorem in a Plane. 2
(CO4,K1)
- 2.e. Pointing to a photograph of a boy Suresh said, "He is the son of the only son of my mother." How is Suresh related to that boy? 2
(CO5,K1)

SECTION – B

30

3. Answer any five of the following-

- 3-a. Obtain general solution of the differential equation 6

$$x^2 \frac{d^2y}{dx^2} + x \frac{dy}{dx} + y = 4 \cos(\log x) \quad (\text{CO1, K1})$$
- 3-b. Solve : $\frac{dx}{dt} + 4x + 3y = t$, $\frac{dy}{dt} + 2x + 5y = e^t$ 6
 (CO1,K2)
- 3-c. Test for convergence or divergence of the series $1 + \frac{1}{2^2} + \frac{2^2}{3^3} + \frac{3^3}{4^4} + \dots$ 6
 (CO2,K2)
- 3-d. Show that $\int_0^\infty t^2 e^{-4t} \sin 2t \, dt = \frac{11}{500}$. 6
 (CO3,K3)
- 3-e. Find the Laplace transform of $\int_0^t \frac{\sin t}{t} \, dt$. 6
 (CO3,K2)
- 3-f. Find the directional derivative of $\phi = (x^2 + y^2 + z^2)^{-1/2}$ at the point P(3,1,2) in the direction of vector $yz\hat{i} + zx\hat{j} + xy\hat{k}$. 6
 (CO4,K2)
- 3-g. Rasik walked 20 m towards north. Then he turned right and walks 30 m. Then he turns right and walks 35 m. Then he turns left and walks 15 m. Finally, he turns left and walks 15 m. In which direction and how many metres is he from the starting position? 6
 (CO5,K1)

SECTION – C

50

4. Answer any one of the following-

- 4-a. Solve by changing the independent variable: 10

$$\frac{d^2y}{dx^2} + (3 \sin x - \cot x) \frac{dy}{dx} + 2y \sin^2 x = e^{-\cos x} \sin^2 x$$

 (CO1,K3)
- 4-b. Solve by method of variation of parameters : 10

$$\frac{d^2y}{dx^2} - y = \frac{2}{1+e^x} \quad (\text{CO1,K3})$$

5. Answer any one of the following-

- 5-a. Test for convergence of series $\frac{x}{1} + \frac{1}{2} \cdot \frac{x^3}{3} + \frac{1.3}{2.4} \cdot \frac{x^5}{5} + \frac{1.3.5}{2.4.6} \cdot \frac{x^7}{7} + \dots$ 10
 (CO2,K2)
- 5-b. Find the Fourier Series for the function $f(x) = x + x^2$, $-\pi < x < \pi$. Hence Show that $\frac{\pi^2}{6} = 1 + \frac{1}{2^2} + \frac{1}{3^2} + \frac{1}{4^2} + \dots$ 10
 (CO2,K3)

6. Answer any one of the following-

- 6-a. Use Convolution theorem to find $L^{-1} \left\{ \frac{1}{s^3(s^2+1)} \right\}$ 10
(CO3,K2)
- 6-b. Solve by Laplace transform; $\frac{d^2x}{dt^2} + 2\frac{dx}{dt} + 5x = e^{-t} \sin t$, where 10
 $x(0) = 0, x'(0) = 1$.
(CO3,K3)
7. Answer any one of the following-
- 7-a. Verify Gauss's divergence theorem for $\vec{F} = (2x - z)\hat{i} + x^2y\hat{j} -$ 10
 $xz^2\hat{k}$ taken over the region bounded by $x = 0, x = 1, y = 0, y =$
 $1, z = 0, z = 1$. (CO4,K3)
- 7-b. Apply Stoke's theorem to evaluate 10
 $\int_C [(x + y) dx + (2x - z)dy + (y + z) dz]$, where C is the
boundary of the triangle with vertices
(2,0,0), (0,3,0) and (0,0,6) (CO4,K3)
8. Answer any one of the following-
- 8-a. (i) Two vessels contain milk and water in the ratio 3: 2 and 7: 3. 10
Find the ratio in which the contents of the two vessels have to be
mixed to get a new mixture in which the ratio of milk and water
is 2: 1.
(ii) The ratio of Rohan's age 4 years ago and Rahul's age after 4
years is 1: 1. If at present, the ratio of their ages is 5: 3, then find
the ratio between Rohan's age 4 years hence and Rahul's age 4
years ago. (CO5,K1)
- 8-b. (i) A, B, C started a business with their investments in the ratio 10
3:6:5. After 8 months, A invested the same amount as before and
both B and C withdrew half of their investments. Find the ratio of
their profits at the end of the year?
(ii) A sum of money becomes Rs.6690 after three years and
Rs.10035 after 6 years on compound interest. Find the sum?
(CO5,K1)