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Printed Page:-4 **Subject Code:- CAS0203C**

Roll. No:

NOIDA INSTITUTE OF ENGINEERING AND TECHNOLOGY, GREATER NOIDA

(An Autonomous Institute Affiliated to AKTU, Lucknow)

B.Tech

SEM: II - THEORY EXAMINATION (2025 - 2026)

Subject: Differential Equations and Numerical Techniques

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:-

(1.1) Particular Integral of the differential equation $(D^2+4)y = Cos2x$ is (CO1, K2) 1

(a) $\frac{x}{4}\cos 2x$

(b) $\frac{x}{4}\sin 2x$

(c) $x\cos 2x$

(d) None of these

(1.2) If the roots of an auxiliary equation are 3, 3, 3 then the Auxiliary equation is : (CO1, K1) 1

(a) $(m+3)^3=0$

(b) $(m-3)^3=0$

(c) $(m+9)^2=0$

(d) None of these

(1.3) The series $1+\frac{1}{3}+\frac{1}{3^2}+\frac{1}{3^3}+\frac{1}{3^4}+\dots$ is (CO2, K2) 1

(a) convergent

(b) divergent

(c) oscillatory

(d) none of these

(1.4) Let $f(x)=x^2,\ -\pi\le x\le\pi$ in the Fourier series expansion of f(x), what is the value of b_n (CO2, K1) 1

(a) $b_n = 0$

(b) $b_n = \frac{\pi^2}{8}$

(c) $b_n = \frac{\pi^2}{6}$

(d) none of these

(1.5) Inverse Laplace of the function $f(s) = \frac{1}{2s+3}$ is (CO3,K2) 1

(a) $-\frac{1}{2}e^{-3t/2}$

(b) $-\frac{1}{2}e^{3t/2}$

(c) $\frac{1}{2}e^{-3t/2}$

(d) None of these

(1.6) Laplace transform of te^{-t} is (CO3,K2) 1

(a) $\frac{1}{(s+1)^2}$

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

(c) $\frac{1}{(s-1)^2}$

(d) None of these

(1.7) **The degree of the equation $z^2 = pqxy$ is** (CO4,K2) 1

(a) 1

(b) 2

(c) 3

(d) None of these

(1.8) **The Auxiliary equation of the partial differential equation** 1

$(x^2 - y^2 - z^2)p + 2xyq = 2xz$ is (CO4,K1)

(a) $\frac{dx}{x^2+y^2+z^2} = \frac{dy}{2xy} = \frac{dz}{2xz}$

(b) $\frac{dx}{x^2-y^2-z^2} = \frac{dy}{2xz} = \frac{dz}{2xy}$

(c) $\frac{dx}{x^2-y^2-z^2} = \frac{dy}{2xy} = \frac{dz}{2xz}$

(d) None of these

(1.9) The Regula - Falsi method can be applied to a function f(x) if (CO5, K1) 1

(a) f(x) is continuous on the given interval and $f(a).f(b)<0$

(b) f'(x) is differentiable on the given interval

(c) $f(a).f(b)>0$

(d) No sign change in the interval

(1.10) The Iterative formula for Newton Raphson method is given (CO5, K1) 1

(a) $x_1 = x_0 - \frac{f(x_0)}{f'(x_0)}$ (b) $x_1 = x_1 - \frac{f(x_0)}{f'(x_0)}$

(c) $x_0 = x_1 - \frac{f(x_0)}{f'(x_0)}$ (d) None of these

2. Attempt all parts:-

(2.1) Solve $(D^2 - 3D + 2)y = 0$. (CO1, K2) 2

(2.2) Write the statement of D'Alembert test for the series $\sum u_n$. (CO2,K1) 2

(2.3) Express the following function in terms of unit step function 2

$$f(t) = \begin{cases} \sin t & 0 < t < \pi \\ \sin 2t & \pi < t \end{cases}$$ (CO 3 , k2)

(2.4) Solve the partial differential equation $DD'(D - 2D' - 3)z = 0$. (CO4,K3) 2

(2.5) Write the formula for Simpson's one − third and Simpson's three − eighth rule.(CO5, K1) 2

SECTION-B 30

Answer any one of the following:-

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

(3.2) Solve the differential equation $x^2\frac{d^2y}{dx^2} + x\frac{dy}{dx} + y = 4\cos(\log x)$ (CO1, K3) 6

Answer any one of the following:-

(3.3) Express $\sin x$ as a cosine series in the interval $0 < x < \pi$. (CO2,K3) 6

(3.4) Show that the $1 + \frac{1}{2^2} + \frac{2^2}{3^2} + \frac{3^2}{4^2} + \ldots\ldots\ldots\ldots$ is divergent .(CO2,K3) 6

Answer any one of the following:-

(3.5) Find inverse Laplace Transform of the function $f(s) = \log\frac{s(s+1)}{s^2+4}$. (CO 3 , K3) 6

(3.6) Evaluate the value of the integral $\int_0^\infty \frac{e^{-t}\sin t}{t}dt$. (CO 3 , K3) 6

Answer any one of the following:-

(3.7) Solve the linear partial differential equation $(D^2 + 2DD' + D'^2)z = e^{2x+3y}$.(CO4, K3) 6

(3.8) Solve the linear partial differential equation $(D+1)(D+D'-1)z = \sin(x+2y)$. (CO4, K3) 6

Answer any one of the following:-

(3.9) Find the positive value of $48^{\frac{1}{3}}$ correct upto 3 decimal places using Newton Raphson method.(CO5, K3) 6

(3.10) Find the value of $y(0.8)$ correct to four decimal places 6

if $y' = y - x^2$, $y(0.6) = 1.7379$, using Runge Kutta method of order 4. (CO5,K3)

SECTION-C 50

4. Answer any one of the following:-

(4.1) Solve the following differential equation by changing the independent variable: 10

$$\frac{d^2y}{dx^2} - \frac{1}{x}\frac{dy}{dx} + 4x^2y = x^4$$.(CO1,K3)

(4.2) 10

Solve by the method of variation of parameters $\frac{d^2y}{dx^2} + a^2 y = \tan ax$. (CO1, K3)

5. Answer any one of the following:-

(5.1) Obtained the fourier series for the function $f(x) = 4 - x^2$ in the interval $-2 \le x \le 2$. 10

Hence show that

$$1 - \frac{1}{2^2} + \frac{1}{3^2} - \frac{1}{4^2} + \ldots\ldots\ldots = \frac{\pi^2}{12}$$.(CO2,K3)

(5.2) Obtain the fourier series for the function $f(x) = |x|$ in the interval $-\pi \le x \le \pi$ 10

. Hence show that

$$\frac{1}{1^2} + \frac{1}{3^2} + \frac{1}{5^2} + \ldots\ldots\ldots = \frac{\pi^2}{8}$$.(CO2,K3)

6. Answer any one of the following:-

(6.1) Solve the following differential equation by using Laplace transform 10

$$\frac{d^2y}{dt^2} + 9y = \cos 2t, \quad \text{Given that } y(0) = 1,\ y(\pi/2) = -1.$$ (CO3,K3)

(6.2) 10

Apply Convolution theorem to evaluate $L^{-1}\left\{\frac{s}{(s^2+a^2)^2}\right\}$. (CO 3 , K3)

7. Answer any one of the following:-

(7.1) Solve the following partial differential equation 10

$(x^2 - y^2 - yz)p + (x^2 - y^2 - zx)q = z(x - y)$. (CO4,K3)

(7.2) Solve the linear partial differential equation $\frac{\partial^2 z}{\partial x^2} + \frac{\partial^2 z}{\partial x \partial y} - 6\frac{\partial^2 z}{\partial y^2} = y\cos x$. 10

(CO4, K3)

8. Answer any one of the following:-

(8.1) Apply Gauss elimination method to solve the equations:(CO5, K3) 10

$3x + y + z = 6;\ x + 2y + 3z = 8;\ 2x + y + 4z = 8$.

(8.2) The velocity of a car which starts initially from the rest 10

at interval of two minutes are given below:(CO5, K3)

Apply Simpson's 3/8th rule to find the distance covered by the car.

Time (minutes)	0	2	4	6	8	10	12
Velocity(Km/h)	0	22	30	27	18	7	0