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Subject Code:- BAS0204

Roll. No:

NOIDA INSTITUTE OF ENGINEERING AND TECHNOLOGY, GREATER NOIDA

(An Autonomous Institute Affiliated to AKTU, Lucknow)

B.Tech

SEM: II - THEORY EXAMINATION (2023 - 2024)

Subject: Mathematical Foundations – 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. Value of the integral $\int_0^1 x^5(1-x^3)^3 dx$ is (CO1) 1

(a) 1/50

(b) 1/60

(c) 1/30

(d) -1/30

1-b. The volume $\int\int\int_R dxdydz$ of the region R bounded by $-1 \le x \le 1, -2 \le y \le 2, -3 \le z \le 3$ is (CO1) 1

(a) 24

(b) 48

(c) -24

(d) -48

1-c. General solution of the second order linear differential equation $\frac{d^2y}{dx^2} - 8\frac{dy}{dx} + 16y = 0$ is : (CO2) 1

(a) $(A + Bx)e^{4x}$

(b) $Ae^{-4x} + Be^{-4x}$

(c) $A + Be^{4x}$

(d) None of these

1-d. The P. I of the differential equation $(D^2+4)y = \cos 2x$ is : (CO2) 1

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

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

(c) $x\cos 2x$

(d) None of these

1-e. 1

The linear partial differential equation $2\frac{\partial^2 u}{\partial t^2}+4\frac{\partial^2 u}{\partial x \partial t}+3\frac{\partial^2 u}{\partial x^2}=0$ is (CO3)

(a) Parabolic

(b) Elliptic

(c) Hyperbolic

(d) None of these

1-f. The Particular Integral of the partial differential equation 1
$(D^2 - DD' + D' - 1) z = \sin(x + 2y)$ is (CO3)

(a) $-\frac{1}{2}\cos(x+2y)$

(b) $\frac{1}{2}\cos(x+2y)$

(c) $\frac{1}{2}\sin(x+2y)$

(d) $-\frac{1}{2}\sin(x+2y)$

1-g. 1

Inverse Laplace of the function $f(s) = \frac{e^{-2s}}{s}$ (CO4)

(a) $u(t-2)$

(b) $u(t+2)$

(c) $-u(t+2)$

(d) $-u(t-2)$

1-h. Laplace transform of t^3e^{-3t} is (CO4) 1

(a) $\frac{6}{(s+3)^4}$

(b) $\frac{6}{(s-3)^4}$

(c) $\frac{3}{(s-3)^4}$

(d) None of these

1-i. The interest earned by Rs.4800 in 2 years and 3 months at the rate of 8.5%p.a. 1
,then simple interest is (CO5)

(a) 918

(b) 922
(c) 925
(d) 928

1-j. If P : Q = 2 : 3 , Q : R = 4 : 5 and R : S = 6 : 7 , then P : S is (CO5) 1

(a) 18:25
(b) 17:25
(c) 16:35
(d) 8:11

2. Attempt all parts:-

2.a. Evaluate the value of $\int_0^\infty x^{1/4} e^{-\sqrt{x}}\, dx$. (CO 1) 2

2.b. Find the particular integral of differential equation $(D^2 - 2D + 2)y = \sinh x$.(CO2) 2

2.c. Solve the partial differential equation yzp+zxq = xy (CO3) 2

2.d. 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 4)

2.e. The prices of a scooter and a television set are in the ratio 3:2 . If a scooter costs Rs.6000 more than the television set, then find the price of the television set ? (CO5) 2

SECTION-B 30

3. Answer any five of the following:-

3-a. Find by the double integration area of the region enclosed by the curves $x^2 + y^2 = a^2$, x + y = a in the first quadrant. (CO 1) 6

3-b. Apply Dirichlet's Integral to find the volume and mass contained in the solid region in the first octant of the ellipsoid $\frac{x^2}{a^2} + \frac{y^2}{b^2} + \frac{z^2}{c^2} = 1$, if the density at any point is $\rho(x,y,z) = kxyz$ (CO 1) 6

3-c. Solve : $\frac{dx}{dt} + y = \sin t$, $\frac{dy}{dt} + x = \cos t$, given that $x = 2$ and $y = 0$ when $t = 0$. (CO2) 6

3-d. Solve the differential equation: $(D^2 - 2D - 3)y = 2e^{2x} + 10\sin 3x$, given that $y(0) = 2$, $y'(0) = 4$.(CO2) 6

3.e. Solve the differential equation $x^2 (y - z)p + y^2 (z - x)q = z^2 (x - y)$. (CO3) 6

3.f. Evaluate the value of the integral $\int_0^\infty e^{-2t} \sin^3 t \, dt$. (CO 4) 6

3.g. Two solutions of milk and water are combined in the ratio 2:3 by volume. The resultant solution is a 40% milk solution. Find the milk concentration in the first solution if the concentration of milk in the second is 60%? (CO5) 6

SECTION-C 50

4. Answer any one of the following:-

4-a. Evaluate by changing the order of integration:. $\int_0^2 \int_{x^2/4}^{3-x} xy\,dy\,dx$ (CO 1) 10

4-b. Evaluate by changing the variables , $\int\int_R (x+y)^2 dx\,dy$ where R is the region bounded by the parallelogram x+y =0 , x+y =2, 3x-2y = 0 and 3x-2y =3. (CO1) 10

5. Answer any one of the following:-

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

$\frac{d^2y}{dx^2} - 2\frac{dy}{dx} = e^x \sin x$. (CO2)

5-b. Solve the following differential equation by changing to independent variable: 10

$x\frac{d^2y}{dx^2} + (4x^2 - 1)\frac{dy}{dx} + 4x^3y = 2x^3$. (CO2)

6. Answer any one of the following:-

6-a. Solve : $(D + D' - 1)(D + D' - 3)(D + D')z = e^{x+y} \sin(2x + y)$. (CO3) 10

6-b. Solve the linear partial differential equation $\frac{\partial^2 z}{\partial x^2} + \frac{\partial^2 z}{\partial x \partial y} - 2\frac{\partial^2 z}{\partial y^2} = (y-1)e^x$ (CO3) 10

7. Answer any one of the following:-

7-a. Solve the following differential equation by using Laplace transformation 10

$\frac{d^2x}{dt^2} + 2\frac{dx}{dt} + x = t\,e^{-t}$, Given that $x(0) = 1$, $x'(0) = 2$. (CO4)

7-b. Apply convolution theorem to evaluate $L^{-1}\left\{\frac{s^2}{(s^2+a^2)(s^2+b^2)}\right\}$ (CO 4) 10

8. Answer any one of the following:-

8-a. (i) Vinod starts from his house and travels 4 km in East direction after that he 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? 10
(ii) Arjun lent out a sum of money at compound interest rate of 30% per annum for 2 years .It would fetch ₹500 more if interest is compounded half –yearly. Find the sum. (CO5)

8-b. (i) Prerna invested Rs x for 6 months, Ankita Rs 2400 for 10 months and Pavneet Rs 3900 for 8 months. If Ankita got Rs 6000 out of a total profit of Rs 19,200, then what is the money? 10
(ii)) In an open ground, Rakesh walks 20 m towards North, turns left and goes 40 m. He turns to his left again to walk 50 m. How far is he from starting point? (CO5)