Total No. of Questions : 11]

SEAT No. :

PE-12146

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[6581]-2401

F.E.

BSC-151-BES: ENGINEERING MATHEMATICS - II

(2024 Pattern) (Semester - I/II)

Time : 2½ Hours] *[Max. Marks : 70*

Instructions to the candidates :

1) *Q. 1 is compulsory, Q2 or Q3, Q4 or Q5, Q6 or Q7, Q8 or Q9, Q10 or Q11.*
2) *Neat diagrams must be drawn wherever necessary.*
3) *Figures to the right indicate full marks.*
4) *Use of Electronic pocket calculator is allowed.*
5) *Assume suitable data, if necessary.*

Q1) Write the correct option :

i) $\int_0^{\pi/2} \sin^3 x \, dx$ is equal to _____ [2]

a) $\frac{2}{3}$ b) $\frac{1}{4}$

c) $\frac{2}{3}, \frac{\pi}{2}$ d) $\frac{1}{3}$

ii) The equation of tangents to the curve at origin, it exists, represented by the equation $y^2(2a - x) = x^3$ is _____. [2]

a) $x = 0, x = 2a$ b) $y = 0, y = 0$

c) $x = 0, x = 0$ d) $y = x$

iii) The value of integral $\int_0^{\pi/2} \int_0^{\pi/2} \sin(x + y) \, dx dy$ is _____ [2]

a) π b) 0

c) $\pi/2$ d) 2

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iv) The value of λ for which the differential equation $(xy^2 + \lambda x^2y)dx + (x^3 + x^2y)dy = 0$ is exact is _____ [2]

a) -3 b) 2

c) 3 d) -2

v) The differential equation of orthogonal trajectories of family of straight lines $y = mx$ is _____ [1]

a) $\frac{dx}{dy} = \frac{x}{y}$ b) $\frac{dx}{dy} = -\frac{x}{y}$

c) $\frac{dy}{dx} = m$ d) $\frac{dy}{dx} = \frac{y}{x}$

vi) A circuit containing resistance R and inductance L in series with voltage source ε. By Kirchhoff's law, differential equation for current i is _____ [1]

a) $Li + R\frac{di}{dt} = \varepsilon$ b) $L\frac{di}{dt} + Ri = \varepsilon$

c) $L\frac{di}{dt} + Ri = 0$ d) $L\frac{di}{dt} + \frac{q}{c} = \varepsilon$

Q2) a) Evaluate $\int_0^\infty x^2 e^{-4x^2} dx$ [4]

b) Evaluate $\int_0^\infty \frac{x^3}{(1+3x)^6} dx$ [4]

c) Prove that of $a > 0$ $\int_0^\infty \frac{1}{x^2}\log(1+ax^2)dx = \pi\sqrt{a}$ [4]

OR

Q3) a) Evaluate $\int_0^1 x^4(\log x)^3 \, dx$ [4]

b) Evaluate $\int_2^7 (x-2)^4(7-x)^3 \, dx$ [4]

c) Prove that $\int_0^\infty \frac{\tan^{-1}(ax)}{x(1+x^2)} dx = \frac{\pi}{2}\log(a+1)$ [4]

Q4) a) Trace the curve $x^2y^2 = a^2(y^2 - x^2)$ [4]

b) Trace the curve $r = a \cos 2\theta$. [4]

c) Show that the plane $4x - 3y + 6z - 35 = 0$ is tangential to the sphere $x^2 + y^2 + z^2 - y - 2z - 14 = 0$ and find the point of contact. [4]

OR

Q5) a) Trace the curve $r = a(1 + \sin\theta)$ [4]

b) Find the Equation of the right circular cone which passing through the point (1, 1, 2) has its axis at the line $6x = -3y = 4z$ and vertex at origin. [4]

c) Find the Equation of right circular cylender of radius 2 whose axis passes through (1, 2, 3) and has direction cosines proportional to 2, – 3, 6. [4]

Q6) a) Evaluate $\int_{-1}^{1}\int_{0}^{1-x} x^{1/3} y^{-1/2} (1 - x - y)^{1/2}\, dxdy$. [6]

b) Evaluate $\iiint \frac{dxdydz}{(1+x+y+z)^3}$ over the volume of tetrahedron bounded by $x = 0, y = 0, z = 0, x + y + z = 1$. [6]

OR

Q7) a) Find the area between the curve $y^2 = 4x$ and $2x - 3y + 4 = 0$. [6]

b) Find the centre of gravity of the area bounded by $y^2 = x$ and $x + y = 2$. [6]

Q8) a) Solve $\frac{dy}{dx} = \frac{x - 2y + 5}{2x + y - 1}$. [4]

b) Solve $(xy - 2y^2)\, dx + (3xy - x^2)\, dy = 0$. [4]

c) Solve $x^2 \frac{dy}{dx} = 3x^2 - 2xy + 1$. [4]

OR

Q9) a) Solve $(x^2 + y^2 + x)\, dx + xy\, dy = 0$. [4]

b) Solve $\cos x \frac{dy}{dx} + y = \sin x$. [4]

c) Solve $xy + x^2y^3 = \frac{dx}{dy}$. [4]

Q10) a) A body originally at 85° C cools to 65° C in 25 minutes, the temperature of air being 40° C, what will be teh temperature of the body after 40 minutes. [4]

b) In an electric circuit containing inductance and resistance in series with constant emf E gives the differential equation $L\frac{di}{dt} + Ri = E$. If initial current is zero, find the current at any time 't'. [4]

c) Find orthogonal trajectories of the family of curves $x^2 + y^2 = c$. [4]

OR

Q11) a) A particle of mass 'm' is projected upward with velocity 'v'. Assuming the air resistances 'k' times its velocity. Write the equation of motion and show that it will reach maximum height in time $\frac{m}{k}\log\left(1+\frac{kV}{gm}\right)$. [4]

b) The charge Q on the plate of a condenser of capacity 'C' charged through a resistance R by a steady voltage 'V' If Q = 0, at $t = 0$, find the charge as a function of 't'. [4]

c) A steam pipe 20 cm in diameter is protected with covering 6 cm thick for which co-efficient of thermal conductivity is k = 0.0003 cal/cms. in steady state. Find the heat loss per hour through a meter length of the pipe if the inner surface of the pipe is at 200° and the outer surface of covering is at 30°C. [4]