Total No. of Questions : 11]

SEAT No. :

PD-5274

[Total No. of Pages : 4

[6401]-2409

F.E.

BSC-151-BES : ENGINEERING MATHEMATICS - II

(2024 Pattern) (Semester - II)

Time : 2½ Hours] *[Max. Marks : 70*

Instructions to the candidates:

1) ***Q.1 is compulsory. Q.2 or Q.3, Q.4 or Q.5, Q.6 or Q.7, Q.8 or Q.9, Q.10 or Q.11.***
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.

a) The value of $\int_0^{\pi/2} \sin^4 x\,dx$ is **[2]**

i) $\frac{\pi}{2}$ ii) $\frac{3\pi}{8}$

iii) $\frac{3\pi}{16}$ iv) $\frac{\pi}{4}$

b) First loop of the curve $r = a\sin 3\theta$ is along **[2]**

i) $\theta = \frac{\pi}{4}$ ii) $\theta = 0$

iii) $\theta = \frac{\pi}{2}$ iv) $\theta = \frac{\pi}{6}$

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c) Area bounded by the curves $y = x^2$ and $y = x$ is **[2]**

i) $\frac{1}{6}$ ii) $\frac{1}{2}$

iii) $\frac{1}{3}$ iv) $\frac{1}{12}$

d) Integrating factor of the linear differential equation $\frac{dy}{dx} - \frac{y}{x} = \frac{-1}{x^2}$ is **[2]**

i) $\log x$ ii) $\frac{1}{x}$

iii) $-\frac{1}{x}$ iv) x

e) Maximum current i_{max} of R-L circuit is **[1]**

i) $\frac{E}{R}$ ii) $\frac{R}{E}$

iii) ER iv) $\frac{-E}{R}$

f) The orthogonal trajectory of a family of curve that intersect each curve of the family at angle **[1]**

i) $\theta = 0°$ ii) $\theta = 180°$

iii) $\theta = 90°$ iv) $\theta = 60°$

Q2) a) Evaluate $\int_0^1 \frac{x^8}{\sqrt{1-x^2}}\,dx$ **[4]**

b) Evaluate $\int_0^\infty x^7 e^{-2x^2}\,dx$ **[4]**

c) Prove that $\int_0^1 \frac{x^a - 1}{\log x}dx = \log(1+a)\ a \geq 0$ **[4]**

OR

Q3) a) Evaluate $\int_0^\infty \frac{x^2}{(1+x^2)^{7/2}} dx$ **[4]**

b) Evaluate $\int_0^1 x^3 (1-x)^5 dx$ **[4]**

c) Prove that $\int_0^\infty \frac{e^{-x} - e^{-ax}}{x \sec x} dx = \frac{1}{2} \log\left(\frac{a^2+1}{2}\right)$, $a > 0$ **[4]**

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

b) Trace the curve $r = a(1 + \cos \theta)$ **[4]**

c) Find the equation of sphere passing through the circle $x^2 + y^2 + z^2 = 4$, $z = 0$ meeting the plane $x + 2y + 2z = 0$ in a circle of radius 3. **[4]**

OR

Q5) a) Trace the curve $r = a\sin 2\theta$ **[4]**

b) Find the equation of the cone with vertex at (1, 2, –3), semi-vertical angle $\cos^{-1}\frac{1}{\sqrt{3}}$ and the line $\frac{x-1}{1} = \frac{y-2}{2} = \frac{z+1}{-1}$ as axis of the cone. **[4]**

c) Find the equation of right circular cylinder of radius 2 whose axis is given by $\frac{x-1}{2} = \frac{y+2}{3} = \frac{z-4}{6}$ **[4]**

Q6) a) Change the order of integration

$$\int_0^5 \int_{2-x}^{2+x} f(x,y)\, dx\, dy$$ **[6]**

b) Find the volume bounded by the cylinder $x^2 + y^2 = 4$ and the plane $y + z = 4$ and $z = 0$ **[6]**

OR

Q7) a) Find the area of one loop of the curve $r = a \cos 2\theta$ **[6]**

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

Q8) a) Solve $(2x - y)\,dx = (x - y)\,dy$ **[4]**

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

c) Solve $\frac{dy}{dx} = y\tan x - y^2 \sec x$ **[4]**

OR

Q9) a) Solve $x^2ydx - (x^3 + y^3)dy = 0$ **[4]**

b) Solve $x\frac{dy}{dx} + y = x^3y^6$ **[4]**

c) Solve $e^y\frac{dy}{dx} + e^{x+y} = e^{2x}$ **[4]**

Q10)a) A body originally at 80°C cools to 60°C in 20 minutes and the temperature of air being 40°C. What will be the temperature of the body after 40 minutes **[4]**

b) A body of mass m falling from rest is subjected to the force of gravity and an air resistance proportional to the square of the velocity (KV^2). If it falls through a distance '*x*' and possesses a velocity '*v*' at that instant, prove that $\frac{2k\,x}{m} = \log\left(\frac{a^2}{a^2 - v^2}\right)$ where $mg = ka^2$ **[4]**

c) A resistance of 100Ω, an inductance of 0.5 henry are connected in series with a battery of 20 volts. Find the current in a circuit as a function of *t*. **[4]**

OR

Q11)a) A circuit consistant of resistance 'R' ohm and a condensor of 'c' farads connected to a constant e.m.f. If $\frac{q}{c}$ is the voltage of the condensor at time '*t*' after closing the circuit. Show that the voltage at time t is $E(1 - e^{-t/Rc})$. **[4]**

b) A bullet is fired into a sand tank. It's retardation is proportional to square root of it's velocity. Show that the bullet will come to rest in time $\frac{2\sqrt{V}}{K}$ where V is initial velocity. **[4]**

c) A pipe 10 cm in diameter contains a steam at 100°C. It is covered with asbestos 5 cm thick for which K = 0.006 and the outside temperature is at 30°C. Find the amount of heat lost per hour from a meter long pipe.**[4]**