

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) $\theta = \frac{\pi}{6}$

P.T.O.

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) $\theta = 0^\circ$

ii) $\theta = 180^\circ$

iii) $\theta = 90^\circ$

iv) $\theta = 60^\circ$

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 $x^2 y dx - (x^3 + y^3) dy = 0$ [4]
 b) Solve $x \frac{dy}{dx} + y = x^3 y^6$ [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 $\frac{2kx}{m} = \log\left(\frac{a^2}{a^2 - v^2}\right)$ 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]

