

F.E. (Semester - II)
ENGINEERING MATHEMATICS - II
(2012 Course)

Time : 2 Hours]

[Max. Marks : 50

Instructions to the candidates:

- 1) Attempt 4 questions : Q.1 or Q.2, Q.3 or Q.4, Q.5 or Q.6, Q.7 or Q.8.
- 2) Neat diagrams must be drawn wherever necessary.
- 3) Figures to the right indicate full marks.
- 4) Use of electronic non-programmable calculator is allowed.
- 5) Assume suitable data whenever necessary.

Q1) a) Solve the following **[8]**

i)
$$\frac{dy}{dx} = \frac{x^2 + y^2 + 1}{2xy}$$

ii)
$$(1 - x^2) \frac{dy}{dx} = 1 + xy$$

- b) An electric circuit contains an inductance of 0.5 henries and a resistance of 100 ohms in series with an e.m.f. of 20 volts. Find the current at any time t , if it is zero at $t = 0$. **[4]**

OR

Q2) a) Solve : **[4]**

$$(2x + 3y - 1)dx = (6x + 9y + 6)dy$$

b) Solve the following : **[8]**

- i) A bullet is fired into sand tank, its retardation is proportional to square root of its velocity. Show that the bullet will come to rest in

time $\frac{2\sqrt{v}}{k}$, where V is initial velocity.

- ii) A pipe 20 cm in diameter contains steam at 150°C and is protected with a covering 5 cm thick for which $k = 0.0025$. If the temperature of the outer surface of the covering is 40°C , find the temperature half-way through the covering under steady state conditions.

P.T.O.

Q3) a) Find the half range cosine series for the function $F(x) = x - x^2, 0 \leq x \leq 1$ [5]

b) Evaluate $\int_2^5 (x-2)^3 (5-x)^2 dx$ [3]

c) Trace the curve (Any One) [4]

i) $x = a(t + \sin t), y = a(1 - \cos t)$

ii) $x^2 y^2 = a^2 (y^2 - x^2)$

OR

Q4) a) If $I_n = \int_0^{\infty} e^{-x} \sin^n x dx$ obtain the relation between I_n and I_{n-2} [4]

b) Show that $\int_a^b e^{-x^2} dx = \frac{\sqrt{\pi}}{2} [\operatorname{erf}(b) - \operatorname{erf}(a)]$ [4]

c) Find the arclength of one loop of Lemniscate $r^2 = a^2 \cos 2\theta$ [4]

Q5) a) Find the equation of right circular cylinder of radius a , whose axis passes through the origin and makes equal angles with the coordinate axes. [4]

b) Lines are drawn from the origin with direction co-sines proportional to $(1,2,2), (2,3,6), (3,4,12)$. Find direction co-sines of the axis of right circular cone through them, and prove that the semivertical angle of cone is

$$\cos^{-1} \frac{1}{\sqrt{3}}. \quad [4]$$

c) Find the equation of the sphere which passes through the points $(1, -4, 3), (1, -5, 2), (1, -3, 0)$ and whose centre lies on the plane $x + y + z = 0$.

[5]

OR

- Q6)** a) A sphere of constant radius K passes through the origin and meets the axes in A, B, C . Prove that the centroid of the triangle ABC lies on the sphere $\mathfrak{S}(x^2 + y^2 + z^2) = 4K^2$ [5]
- b) Find the equation of the right circular cone which has its vertex at the point $(0, 0, 10)$ and whose intersection with the plane XOY is a circle of diameter 10. [4]
- c) Find the equation of the right circular cylinder of radius 3 and axis $\frac{x-1}{2} = \frac{y-3}{2} = \frac{z-5}{-1}$ [4]

Q7) Solve any two:

- a) Evaluate $\iint (x + y)^2 dx dy$ over the area bounded by an ellipse $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$ [7]
- b) Find the volume of the tetrahedron bounded by the co-ordinate planes and the plane $x + y + z = 1$ [6]
- c) Find the moment of inertia about the initial line of the cardioide $r = a(1 + \cos \theta)$ [6]

OR

Q8) Solve any two

- a) Find the area bounded by the parabola $y = x^2$ & the Line $y = 2x + 3$. [7]
- b) Evaluate $\iiint z(x^2 + y^2) dx dy dz$ over the volume of the cylinder $x^2 + y^2 = 1$ intercepted by the planes $z = 2$ and $z = 3$. [6]
- c) Find the x -co-ordinate of center of gravity of an area bounded by the parabola $y^2 = x$ and the line $x + y = 2$. [6]

