Total No. of Questions—**8**] [Total No. of Printed Pages—**4**

Seat No.	

[5558]-108

F.E. EXAMINATION, 2019

ENGINEERING MATHEMATICS—II

(2015 PATTERN)

Time : Three Hours **Maximum Marks : 60**

N.B. **:—** (*i*) Attempt Q. No. **1** *or* Q. No. **2**, Q. No. **3** *or* Q. No. **4**, Q. No. **5** *or* Q. No. **6**, Q. No. **7** *or* Q. No. **8**.

(*ii*) Neat diagrams must be drawn wherever necessary.

(*iii*) Figures to the right indicate full marks.

(*iv*) Use of electronic pocket calculator is allowed.

(*v*) Assume suitable data, if necessary.

1. (*a*) Solve the following differential equations :

(*i*) $ye^{x/y}\ dx = (xe^{x/y} + y^2)\ dy$ [4]

(*ii*) $(1 + xy^2)\ dx + (1 + x^2y)\ dy = 0.$ [4]

(*b*) A particle of mass m is projected vertically upward with velocity V_0. Assuming that the air resistance is k times the velocity, show that particle will reach maximum height in time $\frac{m}{k}$ log $\left(1+\frac{kv_0}{mg}\right)$. [4]

P.T.O.

Or

2. (*a*) Solve : $xy - \frac{dy}{dx} = y^3 e^{-x^2}$. [4]

(*b*) (*i*) A body originally at 80°C cools to 60°C in 20 minutes, the temperature of air being 40°C, what will be the temperature of the body after 40 minutes. [4]

(*ii*) A circuit consists of resistance R ohms and condenser of ε farads connected to a constant e.m.f. ε volts. If q/c is the voltage of condenser at time t after closing the circuit, show that : [4]

$$q/c = \varepsilon(1 - e^{-t/RC}).$$

3. (*a*) Find half-range cosine series for $f(x) = x^2$, $0 \leq x \leq \pi$. [5]

(*b*) Evaluate : $\int_0^\infty \frac{dx}{3^{4x^2}}$. [3]

(*c*) Trace the curve (any *one*) : [4]

(*i*) $y^2(a^2 - x^2) = a^3 x$

(*ii*) $r = a \cos 2\theta$.

Or

4. (*a*) Evaluate : $\int_0^{2a} x^{7/2} (2a - x)^{-1/2} \, dx$. [4]

(*b*) Using DUIS, show that : [4]

$$\int_0^\infty \frac{e^{-x} - e^{-ax}}{x \sec x} \, dx = \frac{1}{2} \log \left(\frac{a^2 + 1}{2} \right), \; a > 0.$$

(*c*) Find the perimeter of cardioide $r = a(1 + \cos \theta)$. [4]

5. (*a*) Find the centre and radius of the circle $x^2 + y^2 + z^2 - 2x + 4y + 2z - 6 = 0$, $x + 2y + 2z - 4 = 0$. [5]

(*b*) Find the equation of right circular cone with vertex at (0, 0, 2), direction ratios of the generator are 0, 3, – 2 and the axis is *z*-axis. [4]

(*c*) Find the equation of right circular cylinder of radius '*a*', whose axis passes through the origin and makes equal angles with the coordinates axes. [4]

Or

6. (*a*) Find the equation of the sphere through the circle $x^2 + y^2 + z^2 = 4$, $z = 0$ and cutting the sphere $x^2 + y^2 + z^2 + 10y - 4z - 8 = 0$ orthogonally. [5]

(*b*) Find the equation of right circular cone whose vertex is at (0, 0, 0), semi-vertical angle $\frac{\pi}{4}$ and axis along the line $x = -2y = z$. [4]

(*c*) Find the equation of right circular cylinder of radius 2 whose axis is the line : [4]

$$\frac{x-1}{2} = \frac{y}{3} = \frac{z-3}{1}.$$

7. Attempt any *two* of the following :

(*a*) Evaluate : $\int_0^1 \int_0^{\sqrt{1+x^2}} \frac{dx\,dy}{1+x^2+y^2}$. [6]

(*b*) Evaluate : $\int_0^{\log 2} \int_0^x \int_0^{x+y} e^{x+y+z}\,dx\,dy\,dz$. [7]

(*c*) Find the C.G. of one loop of $r = a \sin 2\theta$. [6]

Or

8. Attempt any *two* of the following :

(*a*) Find the area bounded by the parabola $y = x^2$ and the line $y = x$. [6]

(*b*) Find the volume of the paraboloid $x^2 + y^2 = 4z$ cut-off by the plane $z = 4$. [7]

(*c*) Find the moment of inertia of the portion of the parabola $y^2 = 4ax$, bounded by the x-axis and the latus rectum, about X-axis if density at each point varies as the cube of the abscissa. [6]