CBCS SCHEME

15MAT11

First Semester B.E. Degree Examination, July/August 2021

5 Engineering Mathematics - I

Time: 3 hrs.

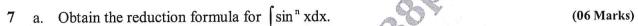
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Max. Marks: 80

Note: Answer any FIVE full questions.

- 1 a. Find the n<sup>th</sup> derivative of cos x cos 3x cos 5x. (06 Marks)
  - b. Obtain the Pedal equation of the curve  $r = 2(1 + \cos \theta)$ . (05 Marks)
    - c. Find the radius of curvature of the curve  $x = a \log(\sec t + \tan t)$ ,  $y = a \sec t$ . (05 Marks)
- 2 a. If  $y = a \cos(\log x) + b \sin(\log x)$ , show that  $x^2y_{n+2} + (2n+1)xy_{n+1} + (n^2+1)y_n = 0$ . (06 Marks)
  - b. Show that the curves  $r^n = a^n \cos n \theta$  and  $r^n = b^n \sin n \theta$  intersect each other Orthogonally.
  - c. Show that for the curve  $r(1 \cos\theta) = 2a$ ,  $\rho^2$  varies as  $r^3$ . (05 Marks)
- 3 a. Obtain the Maclaurin's expansion of  $log(1 + e^x)$  as far as the fourth degree terms.
  - b. Evaluate:  $\lim_{x \to 0} \left[ \frac{1}{x^2} \frac{1}{\sin^2 x} \right]$ . (05 Marks)
  - c. If  $u = f\left(\frac{x}{y}, \frac{y}{z}, \frac{z}{x}\right)$ , prove that  $x \frac{\partial u}{\partial x} + y \frac{\partial u}{\partial y} + z \frac{\partial u}{\partial z} = 0$ . (05 Marks)
- 4 a. Evaluate:  $\underset{x\to 0}{\operatorname{Lt}} \left( \frac{\sin x}{x} \right)^{\frac{1}{x^2}}$ . (06 Marks)
  - b. If  $u = \log \left( \frac{x^4 + y^4}{x + y} \right)$ , show that  $x \frac{\partial u}{\partial x} + y \frac{\partial u}{\partial y} = 3$ . (05 Marks)
  - c. If  $u = x + 3y^2 z^3$ ,  $v = 4x^2yz$ ,  $w = 2z^2 xy$ , find  $\frac{\partial(u, v, w)}{\partial(x, y, z)}$  at (1, -1, 0). (05 Marks)
- 5 a. A particle moves along the curve,  $x = 1 t^3$ ,  $y = 1 + t^2$  and z = 2t 5.
  - i) Determine its velocity and acceleration.
  - ii) Find the components of velocity and acceleration at t = 1 in the direction 2i + j + 2k.

    (06 Marks)
  - b. Find the angle between the surfaces  $x^2 + y^2 + z^2 = 9$  and  $z = x^2 + y^2 3$  at (2, -1, 2).
  - c. Prove that Curl (grade  $\phi$ )  $= \vec{0}$ . (05 Marks)
- 6 a. Find the directional derivatives of  $\phi = x^2yz + 4xz^2$  at (1, -2, -1) along 2i j 2k. (06 Marks)
  - b. Show that  $\vec{F} = 2xyz^2i + (x^2z^2 + z\cos(yz))j + (2x^2yz + y\cos(yz))k$  is a potential field and hence find its scalar potential. (05 Marks)
  - c. Prove that  $div(Curl \vec{A}) = 0$ . (05 Marks)



- b. Show that the family of parabolas  $y^2 = 4a(x + a)$  is self Orthogonal. (05 Marks)
- c. Solve  $y e^{xy} dx + (x e^{xy} + 2y)dy = 0$ . (05 Marks)
- 8 a. Obtain the reduction formula for  $\int \sin^m x \cos^n x \, dx$ . (06 Marks)
  - b. Solve  $\frac{dy}{dx} + \frac{y}{x} = y^2x$ . (05 Marks)
  - c. A body in air at 25°C cools from 100°C to 75°C in 1 minute. Find the temperature of the body at the end of 3 minutes. (05 Marks)
- 9 a. Find the rank of the matrix by elementary row transformation.

$$A = \begin{bmatrix} 2 & -1 & -3 & -1 \\ 1 & 2 & 3 & -1 \\ 1 & 0 & 1 & 1 \\ 0 & 1 & 1 & -1 \end{bmatrix}.$$
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(06 Marks)

- b. Apply Gauss Jordan method to solve the system of equations: 2x + 5y + 7z = 52; 2x + y z = 0; x + y + z = 9. (05 Marks)
- c. Show that the transformation :  $y_1 = 2x_1 x_2 x_3$ ,  $y_2 = -4x_1 + 5x_2 + 3x_3$ ,  $y_3 = x_1 x_2 x_3$  is regular and find the inverse transformation. (05 Marks)
- 10 a. Solve 20x + y 2z = 17; 3x + 20y z = -18; 2x 3y + 20z = 25 by Gauss Seidel method. (06 Marks)
  - b. Find the Eigen values and Eigen vectors of the matrix  $A = \begin{bmatrix} 1 & 1 & 3 \\ 1 & 5 & 1 \\ 3 & 1 & 1 \end{bmatrix}$ . (05 Marks)
  - c. Reduce the quadratic form  $2x_1^2 + 2x_2^2 + 2x_3^2 + 2x_1 x_3$  to Canonical form. (05 Marks)