

rmitkoni

CBCS SCHEME

USN



17MAT11

First Semester B.E. Degree Examination, June/July 2019
Engineering Mathematics – I

Time: 3 hrs.

Max. Marks: 100

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-I

- 1 a. Find the n^{th} derivative of $\sin 2x \sin 3x$. (06 Marks)
- b. Find the angle between the two curves $r = \frac{a}{1 + \cos \theta}$ and $r = \frac{b}{1 - \cos \theta}$ (07 Marks)
- c. Find the radius of curvature for the curve $x^3 + y^3 = 3xy$ at $(3/2, 3/2)$. (07 Marks)

OR

- 2 a. If $y = \cos(m \log x)$ then prove that $x^2 y'' + (2n + 1)xy' + (m^2 + n^2)y = 0$. (06 Marks)
- b. With usual notation prove that $\tan \theta = r \frac{dr}{dt}$. (07 Marks)
- c. Find the pedal equation of the curve $rm = a' \cos m\theta$. (07 Marks)

Module-2

- 3 a. Find the Taylor's series of $\log(\cos x)$ in powers of $(x - \pi/3)$ upto fourth degrees terms. (06 Marks)
- b. If $u = \tan^{-1} \frac{x^3 + y^3}{x + y}$ then prove that $x \frac{\partial u}{\partial x} + y \frac{\partial u}{\partial y} = \sin 2u$ by using Euler's theorem. (07 Marks)
- c. If $u = \frac{yz}{x}, v = \frac{xz}{y}, w = \frac{xy}{z}$ then find $\frac{a(uvw)}{a(xyz)}$. (07 Marks)

OR

- 4 a. Evaluate $\lim_{x \rightarrow 0} \frac{\tan x}{x}$. (06 Marks)
- b. Using Maclaurin's series, prove that $\sin 2x = 2x - \frac{(2x)^3}{3!} + \frac{(2x)^5}{5!} - \dots$. (07 Marks)
- c. If $u = 4x^2 - 3y, 3y = 4z - 2x$ then prove that $\frac{1}{x} \frac{\partial u}{\partial x} + \frac{1}{y} \frac{\partial u}{\partial y} + \frac{1}{z} \frac{\partial u}{\partial z} = 0$. (07 Marks)

Module-3

- 5 a. A particle moves along the curve $r = (C - 40t^2 + 40t + (8t^2 - 3t^3))k$. Find the components of velocity and acceleration in the direction of $i - 3j + 2k$ at $t = 0$. (06 Marks)
- Find the constant a and b such that $F = (axy + z^3)i + (3)(x^2 - z)j + (bxz - y)k$ is irrotational and find scalar potential function ϕ such that $F = \nabla \phi$. (07 Marks)

- c. Prove that $\text{curl}(\text{grad } \phi) = 0$. (07 Marks)

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OR

- 6 a. Show that vector field $F = \frac{x\hat{i} + y\hat{j}}{x^2 + y^2}$ is both solenoidal and irrotational. (06 Marks)
- b. If $F = (x + y + 1)\hat{i} + j - (x + y)\hat{i}$ then prove that $\text{curl} F = 0$. (07 Marks)
- c. Show that $\text{div}(\text{curl } A) = 0$. (07 Marks)

Module-4

- 7 a. Obtain reduction formula for $\int \sin^n x \, dx$ ($n > 0$). (06 Marks)
- b. Solve the differential equation $\frac{dy}{dx} + y \cot x = \cos x$ (07 Marks)
- c. Find the orthogonal trajectory of the curve $r = a(1 + \sin \theta)$. (07 Marks)

OR

- 8 a. Evaluate $\int_0^{\pi/2} \sin^7 \theta \cos^5 \theta \, d\theta$ (06 Marks)
- b. Solve the differential equation : $(2xy + y - \tan y)dx + (x^2 - x \tan y + \sec^2 y)dy = 0$. (07 Marks)
- c. If the temperature of air is 30°C and the substance cools from 100°C to 70°C in 15 mins. Find when the temperature will be 40°C . (07 Marks)

Module-5

- 9 a. Find the rank of the matrix $\begin{vmatrix} 1 & 1 & 1 & 6 \\ 1 & -1 & 2 & 5 \\ 3 & 1 & 1 & 8 \\ 2 & -2 & 3 & 7 \end{vmatrix}$ by reducing to Echelon form. (06 Marks)
- b. Find the largest eigen value and eigen vector of the matrix $\begin{vmatrix} 6 & -2 & 2 \\ -2 & 3 & -1 \\ 2 & -1 & 3 \end{vmatrix}$ by taking initial vector as $[1 \ 1 \ 1]^T$ by using Rayleigh's power method. Carry out five iteration. (07 Marks)
- c. Reduce $8x^2 + 7y^2 + 3z^2 - 12xy + 4xz - 8yz$ into canonical form, using orthogonal transformation. (07 Marks)

OR

- 10 a. Solve the system of equations
 $10x + y + z = 12$
 $x + 10y + z = 12$
 $x + y + 10z = 12$
 by using Gauss-Seidel method. Carry out three iterations. (06 Marks)
- b. Diagonalise the matrix $A = \begin{bmatrix} 5 & 4 \\ 4 & 5 \end{bmatrix}$ (07 Marks)
- c. Show that the transformation
 $x_1 + 2x_2 + 5x_3$
 $y_2 = 2x_1 - 4x_2 + 11x_3$
 $y_3 = -x_2 + 2x_3$
 is regular. Write down inverse transformation. (07 Marks)

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