CBCS SCHEME

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15MAT11

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

Time: 3 hrs. Max. Marks: 80

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

Module-1

1 a. Find the n^{th} derivative of $\frac{7x+6}{2x^2+7x+6}$ (05 Marks)

b. Find the angle between the radius vector and the tangent for the curve $r^m = a^m(\cos m\theta + \sin m\theta)$. (05 Marks)

c. Show that the radius of curvature at any point θ on the cycloid $x = a(\theta + \sin\theta)$, $y = a(1 - \cos\theta)$ is $4a\cos(\theta/2)$ (06 Marks)

OR

2 a. If $x = \sin t$ and $y = \cos mt$, prove that $(1-x^2)y_{n+2} - (2n+1)xy_{n+1} + (m^2 - n^2)y_n = 0$. (05 Marks)

b. Find the pedal equation of the curve $r^2 = a^2 \sec 2\theta$. (05 Marks)

c. Prove with usual notation $\tan\phi = \frac{rd\theta}{dr}$. (06 Marks)

Module-2

3 a. Expand $e^{\sin x}$ using Maclaurin's series upto third degree term. (05 Marks)

b. Evaluate $\lim_{x\to 0}\left[\frac{1}{x^2} - \frac{1}{\sin^2 x}\right]$. (05 Marks)

c. If $u = e^{(ax+by)} f(ax - by)$, prove that $b\frac{\partial u}{\partial x} + a\frac{\partial u}{\partial y} = 2abu$ (06 Marks)

OR

4 a. Expand sin x in ascending power of $\pi/2$ upto the term containing x^4. (05 Marks)

b. If $u = \tan^{-1}\left(\frac{x^3+y^3}{x-y}\right)$, show that $x u_x + y u_y = \sin 2u$. (05 Marks)

c. If $u = \frac{yz}{x}, v = \frac{zx}{y}, w = \frac{xy}{z}$. Find $\frac{\partial(u,v,w)}{\partial(x,y,z)}$. (06 Marks)

Module-3

5 a. Find the angle between the surfaces $x^2 + y^2 + z^2 = 9$ and $x^2 + y^2 - z = 3$ at the point $(2, -1, 2)$. (05 Marks)

b. Show that $\vec{F} = (y+z)i + (x+z)j + (x+y)k$ is irrotational. Also find a scalar function ϕ such that $\vec{F} = \nabla\phi$. (05 Marks)

c. Prove that $\nabla \cdot (\phi\vec{A}) = \phi(\nabla \cdot \vec{A}) + \nabla\phi \cdot \vec{A}$. (06 Marks)

OR

6 a. Prove that $\text{Curl}\,(\phi\vec{A}) = \phi(\text{Curl}\,\vec{A}) + \text{grad}\phi \times \vec{A}$ (05 Marks)

b. A particle moves along the curve C ; $x = t^3 - 4t$, $y = t^2 + 4t$, $z = 8t^2 - 3t^3$ where 't' denotes the time. Find the component of acceleration at t = 2 along the tangent. (05 Marks)

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

c. Show that $\vec{F} = (2xy^2 + yz)i + (2x^2y + xz + 2yz^2)j + (2y^2z + xy)k$ is a conservative force field. Find its scalar potential. **(06 Marks)**

Module-4

7 a. Obtain the reduction formula for $\int \sin^n x\, dx$. **(05 Marks)**

b. Solve $(y^2e^{xy^2} + 4x^3)dx + (2xye^{xy^2} - 3y^2)dy = 0$. **(05 Marks)**

c. Find the orthogonal trajectories of $r = a(1+\sin\theta)$. **(06 Marks)**

OR

8 a. Evaluate $\int_0^2 x\sqrt{2x - x^2}\, dx$ **(05 Marks)**

b. Solve $(y^3 - 3x^2y)dx - (x^3 - 3xy^2)dy = 0$. **(05 Marks)**

c. A bottle of mineral water at a room temperature of 72°F is kept in a refrigerator where the temperature is 44°F. After half an hour, water cooled to 61°F

i) What is the temperature of the mineral water in another half an hour?

ii) How long will it take to cool to 50°F? **(06 Marks)**

Module-5

9 a. Find the rank of the matrix

$$A = \begin{bmatrix} 2 & -1 & -3 & -1 \\ 1 & 2 & 3 & -1 \\ 1 & 0 & 1 & 1 \\ 0 & 1 & 1 & -1 \end{bmatrix}$$ **(05 Marks)**

b. Find the largest eigen value and corresponding eigenvector of the matrix

$$A = \begin{bmatrix} 6 & -2 & 2 \\ -2 & 3 & -1 \\ 2 & -1 & 3 \end{bmatrix}$$ by power method taking $X^{(0)} = [1, 1, 1]^1$ **(05 Marks)**

c. Reduce the matrix $A = \begin{bmatrix} -1 & 3 \\ -2 & 4 \end{bmatrix}$ to the diagonal form. **(06 Marks)**

10 a. Use Gauss elimination method to solve

$2x + y + 4z = 12$

$4x + 11y - z = 33$

$8x - 3y + 2z = 20$ **(05 Marks)**

b. Find the inverse transformation of the following linear transformation.

$y_1 = x_1 + 2x_2 + 5x_3$

$y_2 = 2x_1 + 4x_2 + 11x_3$

$y_3 = -x_2 + 2x_3$ **(05 Marks)**

c. Reduce the quadratic form $2x_1^2 + 2x_2^2 + 2x_3^2 + 2x_1x_3$ to the Cannonical form. **(06 Marks)**

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