CBCS SCHEME

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15MAT11

First Semester B.E. Degree Examination, Aug./Sept.2020
Engineering Mathematics – I

Time: 3 hrs. Max. Marks: 80

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

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.

Module-1

1 a. Find the n^{th} derivatives of $\frac{x^2-4x+1}{(x+2)(x^2-1)}$. **(06 Marks)**

b. Find the angle of intersection between the curves $r = ae^{\theta}$ and $re^{\theta} = b$ **(05 Marks)**

c. Obtain the pedal equation of the curve $r = a(1 + \cos\theta)$. **(05 Marks)**

OR

2 a. If $y = \sin^{-1}x$ prove that $(1-x^2)y_{n+2} - (2n+1)xy_{n+1} - n^2y_n = 0$ **(06 Marks)**

b. Find the pedal equation of the curve $r^n \operatorname{cosec} n\theta = a^n$. **(05 Marks)**

c. For the curve $y = \frac{ax}{a+x}$ show that $\left(\frac{2\rho}{a}\right)^{2/3} = \left(\frac{x}{y}\right)^2 + \left(\frac{y}{x}\right)^2$. **(05 Marks)**

Module-2

3 a. Expand sinx in powers of $\left(x - \frac{\pi}{2}\right)$. Hence find the value of Sin91° correct to four decimal places. **(06 Marks)**

b. Evaluate $\underset{x \to \frac{\pi}{2}}{\text{Lt}} (\text{Sin}x)^{\tan x}$ **(05 Marks)**

c. If $u = \text{Sin}^{-1}\left(\frac{x^2+y^2}{x+y}\right)$ prove that $x\frac{\partial u}{\partial x} + y\frac{\partial u}{\partial y} = \tan u$ **(05 Marks)**

OR

4 a. Obtain the Maclaurin's expansion of the function $\log_e(1+x)$ up to fourth degree terms and hence find $\log_e(1-x)$. **(06 Marks)**

b. If $u = f(2x - 3y, 3y-4z, 4z - 2x)$ prove that $\frac{1}{2}\frac{\partial u}{\partial x} + \frac{1}{3}\frac{\partial u}{\partial y} + \frac{1}{4}\frac{\partial u}{\partial z} = 0$ **(05 Marks)**

c. If $u = \frac{yz}{x}$, $v = \frac{zx}{y}$, $w = \frac{xy}{z}$ show the $\frac{\partial(u\,v\,w)}{\partial(x\,y\,z)} = 4$. **(05 Marks)**

Module-3

5 a. A particle moves along the curve $x = 1 - t^3$, $y = 1 + t^2$ and $z = 2t - 5$. Also find the velocity and acceleration at $t = 1$ in the direction $2i + j + 2k$. **(06 Marks)**

b. Find the directional derivative of $f(x, y, z) = xy^3 + yz^3$ at the point (2, -1, 1) in the duration of the vector $\hat{i} - 2\hat{j} + 2\hat{k}$. **(05 Marks)**

c. Find constants a and b such that $\vec{F} = (axy + z^3)i + (3x^2 - z)j + (bxz^2 - y)k$ is irrotational. **(05 Marks)**

OR

6 a. Show that the vector $\vec{v} = (x+3y)i + (y-3z)j + (x-2z)k$ is a solenoidal vector. Also find Curl $\vec{v}$. **(06 Marks)**

b. If $\vec{F} = (x+3y+1)i + j - (x+y)k$ show that $\vec{F}.\text{curl}\vec{F} = 0$ **(05 Marks)**

c. Prove that $\nabla \times (\phi\vec{A}) = \phi(\nabla \times \vec{A}) + \nabla\phi \times \vec{A}$. **(05 Marks)**

Module-4

7 a. Obtain the reduction formula for $\int \sin^n x\,dx$ and evaluate $\int_0^{\pi/2} \sin^n x dx$. **(06 Marks)**

b. Solve $(y\cos x + \sin y + y)dx + (\sin x + x\cos y + x)dy$. **(05 Marks)**

c. Find the orthogonal trajectories of the family of asteroids $x^{2/3} + y^{2/3} = a^{2/3}$. **(05 Marks)**

OR

8 a. Evaluate $\int_0^a \frac{x^7}{\sqrt{a^2 - x^2}} dx \to 06$. **(06 Marks)**

b. Solve $\frac{dy}{dx} + \frac{y}{x} = y^2 x$ **(05 Marks)**

c. A body in air at 25°C cools from 100°C to 75°C in one minute. Find the temperature of the body at the end of 3 minutes. **(05 Marks)**

Module-5

9 a. Solve the following system of equations by Gauss elimination method:

$x + y + z = 6$
$x - y + z = 2$
$2x - y + 3z = 9$ **(06 Marks)**

b. Use power method to find the largest eigen value and the corresponding eigen vector of the matrix A, taking [1, 0, 0]T as initial eigen vector. Perform three iterations.

$$A = \begin{bmatrix} 25 & 1 & 2 \\ 1 & 3 & 0 \\ 2 & 0 & -4 \end{bmatrix}$$ **(05 Marks)**

c. Show that the transformation $y_1 = 2x_1 + x_2 + x_3$, $y_2 = x_1 + x_2 + 2x_3$, $y_3 = x_1 - 2x_3$ is regular. Find the inverse transformation. **(05 Marks)**

OR

10 a. Solve the following system of equations by Gauss Seidal method

$10x + y + z = 12$
$x + 10y + z = 12$
$x + y + 10z = 12$ with $x_0 = y_0 = z_0 = 0$ **(06 Marks)**

b. Reduce the following matrix to the diagonal form

$$\begin{bmatrix} -1 & 3 \\ -2 & 4 \end{bmatrix}$$ **(05 Marks)**

c. Reduce the quadratic form $2x_1^2 + 2x_2^2 + 2x_3^2 + 2x_1x_3$ to the canonical form by orthogonal transformation. **(05 Marks)**

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