CBCS Scheme

15MAT11

USN

First Semester B.E. Degree Examination, Dec.2017/Jan.2018
Engineering Mathematics – I

Time: 3 hrs. Max. Marks: 80

Note: ***Answer 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} derivative of $y = e^{-x}\sin x\cos 2x$. **(06 Marks)**

b. Show that the curves $r = a(1+\cos\theta)$ and $r = b(1-\cos\theta)$ cut each other orthogonally. **(05 Marks)**

c. Find the radius of curvature of the curve $x^2y = a(x^2+y^2)$ at the point (-2a, 2a). **(05 Marks)**

OR

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

b. Find the pedal equation of $r = 2(1+\cos\theta)$. **(05 Marks)**

c. Find the radius of curvature of $r^n = a^n \sin n\theta$. **(05 Marks)**

Module-2

3 a. Expand $\tan^{-1}x$ in powers of $(x-1)$ upto the fourth degree term. **(06 Marks)**

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

c. If $z = f(x+ct) + g(x-ct)$, prove that $\frac{\partial^2 z}{\partial t^2} = C^2 . \frac{\partial^2 z}{\partial x^2}$. **(05 Marks)**

OR

4 a. Obtain the Maclaurin's series expansion of $e^{\sin x}$ upto the form containing x^4. **(06 Marks)**

b. If $z = \log\left(\frac{x^4+y^4}{x+y}\right)$, show that $x\frac{\partial u}{\partial x} + y\frac{\partial u}{\partial y} = 3$. **(05 Marks)**

c. If $u = x^2+y^2+z^2$, $v = xy+yz+zx$, $w = x+y+z$, show that $\frac{\partial(u,v,w)}{\partial(x,y,z)} = 0$. **(05 Marks)**

Module-3

5 a. A particle moves along the curve whose parametric equations are $x = t^3+1$, $y = t^2$ and $z = 2t+5$. Find the components of its velocity and acceleration at time t = 1 in the direction of $i+j+3k$. **(06 Marks)**

b. If $\phi = 2x^3y^2z^4$, find $\text{Div}(\text{Grad}\,\phi)$. **(05 Marks)**

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

OR

6 a. Find the directional derivative of $\phi = x^2yz + 4xz^2$ at P(1, –2, –1) in the direction of $2i - j - 2k$. **(06 Marks)**

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

c. If $\vec{F} = \nabla(xy^3z^2)$, find $\text{div}\,\vec{F}$ and $\text{curl}\,\vec{F}$ at the point (1, –1 , 1). **(05 Marks)**

Module-4

7 a. Obtain the reduction formula for $\int \cos^n x dx$. **(06 Marks)**

b. Solve $ye^{xy}dx + (xe^{xy} + 2y)dy = 0$. **(05 Marks)**

c. Find the orthogonal trajectories of the family of curves $y^2 = Cx^3$. **(05 Marks)**

OR

8 a. Evaluate $\int_0^1 x^{3/2}(1-x)^{3/2}dx$. **(06 Marks)**

b. Solve $\frac{dy}{dx} - \frac{2}{x}y = \frac{y^2}{x^3}$. **(05 Marks)**

c. A body is heated to 110°C and placed in air at 10°C. After one hour its temperature becomes 60°C. How much additional time is required for it to cool to 30°C? **(05 Marks)**

Module-5

9 a. Find the rank of the matrix $A = \begin{bmatrix} 4 & 0 & 2 & 1 \\ 2 & 1 & 3 & 4 \\ 2 & 3 & 4 & 7 \\ 2 & 3 & 1 & 4 \end{bmatrix}$. **(06 Marks)**

b. Solve the following system of equations by Gauss Jordan method:
$x + 2y + z = 3$, $2x + 3y + 3z = 10$, $3x - y + 2z = 13$ **(05 Marks)**

c. Reduce the matrix $A = \begin{bmatrix} -1 & 3 \\ -2 & 4 \end{bmatrix}$ to the diagonal form. **(05 Marks)**

OR

10 a. Solve the following system of equations by Gauss-Seidal method:
$20x + y - 2z = 17$, $3x + 20y - z = -18$, $2x - 3y + 20z = 25$. Perform three iterations. **(06 Marks)**

b. Show that the transformation, $y_1 = 2x_1 - 2x_2 - x_3$, $y_2 = -4x_1 + 5x_2 + 3x_3$, $y_3 = x_1 - x_2 - x_3$ is regular and find the inverse transformation. **(05 Marks)**

c. Reduce the quadratic form,
$3x^2 + 3y^2 + 3z^2 + 2xy - 2yz + 2zx$ into the canonical form. **(05 Marks)**

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