

CBCS Scheme



USN

--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

15MAT11

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.

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 $\lim_{x \rightarrow 0} \left[\frac{1}{x} - \frac{\log(1+x)}{x^2} \right]$ (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)

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 e.g. 42+8 = 50, will be treated as malpractice.



15MAT11

OR

- 6 a. Find the directional derivative of $\phi = x^2yz + 4xz^2$ at $P(1, -2, -1)$ in the direction of $2\mathbf{i} - \mathbf{j} - 2\mathbf{k}$. (06 Marks)
- b. If $\vec{F} = (x + y + 1)\mathbf{i} + \mathbf{j} - (x + y)\mathbf{k}$. Show that $\vec{F} \cdot \text{curl } \vec{F} = 0$. (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)
