

CBCS SCHEME



USN

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

17MAT11

First Semester B.E. Degree Examination, June/July 2018 Engineering Mathematics – I

Time: 3 hrs.

Max. Marks: 100

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

Module-1

- 1 a. Find the n^{th} derivative of $\frac{x}{(x+1)(2x-3)}$. (06 Marks)
- b. Prove that the curves $r^n = a^n \cos n\theta$ and $r^n = b^n \sin n\theta$ intersect orthogonally. (07 Marks)
- c. Find the Pedal equation of the curve $r = a(1 + \cos \theta)$. (07 Marks)

OR

- 2 a. If $x = \tan y$ prove that $(1+x^2)y_{n+2} + 2(n+1)xy_{n+1} + n(n+1)y_n = 0$. (06 Marks)
- b. With usual notation, prove that $\tan \phi = r \frac{d\theta}{dr}$. (07 Marks)
- c. Find the radius of curvature of the curve $y^2 = \frac{a^2(a-x)}{x}$ at the point $(a, 0)$. (07 Marks)

Module-2

- 3 a. Find the Taylor's series of $\log_e x$ about $x = 1$ upto the term containing fourth degree. (06 Marks)
- b. If $u = \sin^{-1} \left[\frac{x^2 y^2}{x+y} \right]$ then show that $x \frac{\partial u}{\partial x} + y \frac{\partial u}{\partial y} = 3 \tan u$. (07 Marks)
- c. If $u = x + 3y^2 - z^3$, $v = 4x^2 yz$, $w = 2z^2 - xy$, find $\frac{\partial(u, v, w)}{\partial(x, y, z)}$ at $(1, -1, 0)$. (07 Marks)

OR

- 4 a. Evaluate $\lim_{x \rightarrow 0} \left(\frac{a^x + b^x + c^x + d^x}{4} \right)^{1/x}$. (06 Marks)
- b. Find the Maclaurin's expansion of $\sqrt{1 + \sin 2x}$ upto fourth degree term. (07 Marks)
- c. If $u = f\left(\frac{x}{y}, \frac{y}{z}, \frac{z}{x}\right)$ prove that $x \frac{\partial u}{\partial x} + y \frac{\partial u}{\partial y} + z \frac{\partial u}{\partial z} = 0$. (07 Marks)

Module-3

- 5 a. A particle moves along the curve $\vec{r} = (t^3 - 4t)\hat{i} + (t^2 + 4t)\hat{j} + (8t^2 - 3t^3)\hat{k}$ where t denotes time. Find the velocity and acceleration at $t = 2$. (06 Marks)
- b. If $\vec{f} = (x + y + az)\hat{i} + (bx + 2y - z)\hat{j} + (x + cy + 2z)\hat{k}$ is irrotational find a, b, c . Hence find the scalar potential ϕ such that $\vec{f} = \nabla\phi$. (07 Marks)
- c. Prove that $\text{curl}(\text{grad } \phi) = 0$. (07 Marks)



17MAT11

OR

- 6 a. If $\vec{f} = (x + y + 1)\hat{i} + \hat{j} - (x + y)\hat{k}$ show that $\vec{f} \cdot \text{curl } \vec{f} = 0$. (06 Marks)
- b. If $\vec{f} = \text{grad}(x y^3 z^2)$ find $\text{div } \vec{f}$ and $\text{curl } \vec{f}$. (07 Marks)
- c. Prove that $\text{div}(\text{curl } \vec{A}) = 0$ (07 Marks)

Module-4

- 7 a. Evaluate $\int_0^a x \sqrt{ax - x^2} dx$ (06 Marks)
- b. Solve $r \sin \theta - \cos \theta \frac{dr}{d\theta} = r^2$ (07 Marks)
- c. Show that the family of parabolas $y^2 = 4a(x + a)$ is self orthogonal. (07 Marks)

OR

- 8 a. Obtain the reduction formula for $\int_0^{\pi/2} \cos^n x dx$. (06 Marks)
- b. Solve $(x^2 + y^2 + x) dx + xy dy = 0$. (07 Marks)
- c. Water at temperature 10°C takes 5 minutes to warm upto 20°C in a room temperature 40°C . Find the temperature after 20 minutes. (07 Marks)

Module-5

- 9 a. Find the rank of the matrix
- $$\begin{bmatrix} 0 & 1 & -3 & -1 \\ 1 & 0 & 1 & 1 \\ 3 & 1 & 0 & 2 \\ 1 & 1 & -2 & 0 \end{bmatrix}$$
- by reducing it to echelon form. (06 Marks)
- b. Find the largest eigen value and the corresponding eigen vector for
- $$A = \begin{bmatrix} 2 & 0 & 1 \\ 0 & 2 & 0 \\ 1 & 0 & 2 \end{bmatrix}$$
- taking $(1 \ 0 \ 0)^T$ as initial vector by using power method. (Carry out six iterations) (07 Marks)
- c. Show that the transformation $y_1 = 2x - 2y - z$, $y_2 = -4x + 5y + 3z$ and $y_3 = x - y - z$ is regular and find the inverse transformation. (07 Marks)

OR

- 10 a. Solve the equations $20x + y - 2z = 17$; $3x + 20y - z = -18$, $2x - 3y + 20z = 25$ by using Gauss-Seidel method. (Carry out 3 iterations) (06 Marks)
- b. Diagonalise the matrix $A = \begin{bmatrix} -1 & 3 \\ -2 & 4 \end{bmatrix}$ (07 Marks)
- c. Reduce the quadratic form $3x^2 - 2y^2 - z^2 + 12yz + 8xz - 4xy$ into canonical form, using orthogonal transformation. (07 Marks)
