



Reg. No. :

Name :

**Combined First and Second Semester B.Tech. Degree Examination,
 April 2014
 (2013 Scheme)
 13.101 – ENGINEERING MATHEMATICS – I (ABCEFHMNPRSTU)**

Time : 3 Hours

Max. Marks : 100

PART – A

Answer all questions. Each question carries 4 marks.



1. If $y = \frac{\sin^{-1} x}{\sqrt{1-x^2}}$, show that $(1-x^2)y_{n+1} - (2n+1)xy_n - n^2y_{n-1} = 0$.

2. If $u = \log\left(\frac{x^4 + y^4}{x+y}\right)$ show that $x \frac{\partial u}{\partial x} + y \frac{\partial u}{\partial y} = 3$.

3. Evaluate $\iint_R e^{2x+3y} dx dy$ over the triangle bounded by $x = 0, y = 0$ and $x + y = 1$.

4. Find the inverse Laplace Transform of $\frac{1}{s(s+1)^3}$.

5. Prove that the inverse of an orthogonal matrix is orthogonal and its transpose is also orthogonal.

PART – B

Answer one full question from each Module. Each question carry 20 marks.

Module – 1

6. a) Show that the evolute of the tractrix $x = a (\cos t + \log \tan t/2), y = a \sin t$ is the catenary $y = a \cosh \frac{x}{a}$.



b) If $x = e^{r \cos \theta} \cdot \cos(r \sin \theta)$ and $y = e^{r \cos \theta} \sin(r \sin \theta)$, prove that $\frac{\partial x}{\partial r} = \frac{1}{r} \frac{\partial y}{\partial \theta}$,

$$\frac{\partial y}{\partial r} = \frac{-1}{r} \frac{\partial x}{\partial \theta} \text{ and hence deduce that } \frac{\partial^2 x}{\partial r^2} + \frac{1}{r} \frac{\partial x}{\partial r} + \frac{1}{r^2} \frac{\partial^2 x}{\partial \theta^2} = 0.$$

7. a) Evaluate $\lim_{x \rightarrow 0} \left(\frac{\tan x}{x} \right)^{1/x^2}$.

b) Show that the rectangular solid of maximum volume that can be inscribed in a given sphere is a cube.

Module - 2

8. a) Evaluate $\iint \sqrt{\frac{1-x^2-y^2}{1+x^2+y^2}} dx dy$ over +ve quadrant of the circle $x^2 + y^2 = 1$ by changing in to polar coordinates.

b) Find the volume of the ellipsoid $\frac{x^2}{a^2} + \frac{y^2}{b^2} + \frac{z^2}{c^2} = 1$.

9. a) Evaluate $\int_0^1 \int_{4y}^4 e^{x^2} dx dy$ by changing the order of Integration.

b) Find the area lying between the parabola $y = 4x - x^2$ and the line $y = x$.

Module - 3

10. a) If $L\left(\frac{\sin t}{t}\right) = \tan^{-1}\left(\frac{1}{s}\right)$. Find $L\left(\frac{\sin at}{t}\right)$.

b) Solve $\frac{d^2 y}{dx^2} - 4y = x \sinh x$.



11. a) Apply convolution theorem to evaluate $L^{-1} \frac{s}{(s^2 + a^2)^2}$.

b) Solve the equation $y'' - 3y' + 2y = 4t + e^{3t}$ given $y(0) = 1, y'(0) = -1$.

Module - 4

12. a) Solve $5x - 2y + z = 4, 7x + y - 5z = 8, 3x + 7y + 4z = 10$ using LU factorization method.

b) Diagonalise the matrix $\begin{bmatrix} -1 & 2 & -2 \\ 1 & 2 & 1 \\ -1 & -1 & 0 \end{bmatrix}$ and obtain the modal matrix.

13. a) Find A^{-1} using Cayley Hamilton theorem for the matrix $\begin{bmatrix} 1 & 0 & -2 \\ 2 & 2 & 4 \\ 0 & 0 & 2 \end{bmatrix}$.

b) Reduce $3x^2 + 3z^2 + 4xy + 8xz + 8yz$ in to canonical form.

