



Reg. No. :

Name :

Combined First and Second Semester B.Tech. Degree
Examination, April 2015
(Common to All Branches)
(2008 Scheme)
08-101 : ENGINEERING MATHEMATICS – I
(CMNPHE TARUFBS)

Time : 3 Hours

Max. Marks : 100

PART – A

Answer **all** questions. **Each** question carries **4** marks.

1. Find the n th derivative of $x^3 \log(5x + 2)$.
2. The range R of a projectile which starts with a velocity v at an elevation α is given by $R = \frac{v^2 \sin 2\alpha}{g}$. Find the percentage of error in R due to an error of 1% in v and $\frac{1}{2}\%$ in α .
3. If $x = r \cos \theta$, $y = r \sin \theta$, $z = z$, show that $\frac{\partial(x, y, z)}{\partial(r, \theta, z)} = r$.
4. A particle moves along the curve $x = t^3 - 4t$, $y = t^2 + 4t$, $z = 8t^2 - 3t^3$ where t is the time. Find the magnitudes of the tangential component of acceleration at time $t = 1$.
5. By the method of variation of parameters, solve $\frac{d^2y}{dx^2} + y = \operatorname{cosec} x$.
6. Solve $(D^2 + 5D + 3)y = \sin 3x$.





7. Find the Laplace transform of $te^{-2t} \cos 3t$.
8. Using Cayley-Hamilton theorem, find A^{-1} where $A = \begin{bmatrix} 3 & 1 \\ 1 & 2 \end{bmatrix}$.
9. Find the eigen values of the matrix A if $A^2 = \begin{bmatrix} 19 & 6 \\ 18 & 7 \end{bmatrix}$. Also find the eigen values of A^{-1} .
10. Examine the definiteness of the quadratic expression $3x^2 - 3y^2 - 5z^3 - 2xy - 6xz - 6yz$.

PART - B

Answer **two** question from **each** Module. **Each** question carries **10** marks.

Module - I

11. Show that the evolute of the parabola $y^2 = 4x$ is $27y^2 = 4(x - 2)^3$.
12. a) If $u = \log(x^3 + y^3 + z^3 - 3xyz)$, prove that $\left(\frac{\partial}{\partial x} + \frac{\partial}{\partial y} + \frac{\partial}{\partial z}\right)^2 u = -\frac{9}{(x + y + z)^2}$
- b) Using Maclaurin's series, prove that $\log \sec x = \frac{x^2}{2} + \frac{x^4}{12} + \frac{x^6}{45} + \dots$
13. a) Show that $\vec{F} = (\sin y + z)\vec{i} + (x \cos y - z)\vec{j} + (x - y)\vec{k}$ is irrotational and hence find its scalar potential.
- b) If $\vec{r} = x\vec{i} + y\vec{j} + z\vec{k}$ and $r = |\vec{r}|$, then show that $\nabla^2 r^n = n(n + 1)r^{n-2}$.

Module - II

14. a) Show that the family of parabolas $y^2 = 4a(x + a)$ are self orthogonal.
- b) Solve $x^2 \frac{d^2 y}{dx^2} - x \frac{dy}{dx} - 3y = x^2 \log x$.



15. a) Solve $\frac{dx}{dt} + 2y = \sin 2t$; $\frac{dy}{dt} - 2x = \cos 2t$.

b) Find the inverse Laplace transform of $\log\left(\frac{s-2}{s+3}\right)$.

16. a) Using Laplace transform, solve $y'' - 3y' + 2y = e^{-t}$, given that $y(0) = 0$, $y'(0) = 5$.

b) Find the inverse Laplace transform of $\frac{1}{s(s^2 + a^2)}$.



Module – III

17. Show that the equations $3x + y + z = 8$, $-x + y - 2z = -5$, $x + y + z = 6$ and $-2x + 2y - 3z = -7$ are consistent and solve the same.

18. Find the eigen values and eigen vectors of the matrix $A = \begin{bmatrix} 2 & 0 & 1 \\ 0 & 2 & 0 \\ 1 & 0 & 2 \end{bmatrix}$.

19. a) Show that the vectors $(2, 3, 0)$, $(1, 2, 0)$ and $(8, 13, 0)$ are linearly dependent and find a relation connecting them.

b) Deduce the matrix $A = \begin{bmatrix} 2 & -1 \\ -1 & 2 \end{bmatrix}$ to the diagonal form.