MLR Institute of Technology

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M-I Assignment questions

Unit –I

1. Show that A= $\begin{bmatrix} 1 & 2 & 3 \\ 2 & -1 & 4 \\ 3 & 1 & 1 \end{bmatrix}$ satisfies the matrix equation $A^3 - A^2 - 18A - 30I = 0$.

2. Find the rank of $\begin{bmatrix} 1 & 2 & 3 & 0 \\ 2 & 4 & 3 & 2 \\ 3 & 2 & 1 & 3 \\ 4 & 8 & 7 & 5 \end{bmatrix}$

3. For what values of λ & μ do the system of equations
   $x + y + z = 6$
   $x + 2y + 3z = 10$
   $x + 2y + \lambda z = \mu$ have
   (a) No solution (b) Unique solution (c) more than one solution

4. Prove that if the equation $x=ay + z$; $y=-2+ax$; $z=x+y$ are consistent then $a^{3+}3=0$

5. Find non –singular matrices P & Q such that PAQ is in the normal form for the matrix A= $\begin{bmatrix} 1 & -1 & -1 \\ 1 & 1 & 1 \\ 5 & 4 & 3 \end{bmatrix}$

6. If A= $\begin{bmatrix} 1 & 1 & 2 \\ 1 & 2 & 3 \\ 0 & -1 & 3 \end{bmatrix}$ Find the non singular matrices P and Q such that PAQ is normal form.

7. Discuss the solution of $x + 2y + 3z = ax$; $3x + y + 2z = ay$; $2x + 3y + z = az$ for all values of a.

8. the system of equations using simple elimination on process
   $x + y + z = 6$ 1. $2x - y + 3z = 4$ $4x + 5y - 10z = 13$

9. Find the inverse in the following
   (a) $\begin{bmatrix} 2 & 4 & 3 \\ 0 & 1 & 1 \\ 2 & 2 & -1 \end{bmatrix}$ (b) $\begin{bmatrix} 1 & 6 & 4 \\ 0 & 2 & 3 \\ 0 & 1 & 2 \end{bmatrix}$

10. Find the inverse of the matrix

    A= $\begin{bmatrix} 1 & -1 & 1 \\ 1 & -2 & 4 \\ 1 & 2 & 2 \end{bmatrix}$ Using Gauss elimination method.

11. Reduce the following matrix to the tridiagonal form by House holder's method.
    a) $\begin{bmatrix} 1 & 3 & 4 \\ 3 & 1 & 2 \\ 4 & 2 & 1 \end{bmatrix}$

12. Solve the system of equations

$$83x + 11y - 4z = 95 \quad 7x + 52y + 13z = 104$$

13. Find Eigen values and Eigen vectors of A= $\begin{bmatrix} -2 & 2 & -3 \\ 2 & 1 & -6 \\ -1 & -2 & 0 \end{bmatrix}$

14. Verify Cayley – Hamilton theorem for A= $\begin{bmatrix} 2 & -1 & 1 \\ 1 & 1 & -1 \\ -1 & -2 & 2 \end{bmatrix}$

15. Diagonalise the matrix A= $\begin{bmatrix} -1 & 1 & 2 \\ 0 & -2 & 1 \\ 0 & 0 & -3 \end{bmatrix}$

16. Using Cayley – Hamilton theorem find the inverse of $\begin{bmatrix} 2 & -1 & 1 \\ -1 & 2 & -1 \\ 1 & -1 & 2 \end{bmatrix}$

17. If A= $\begin{bmatrix} 2+i & 3 & -1+3i \\ -5 & i & 4-2i \end{bmatrix}$ verify that A*A is a Hermitian matrix

18. Reduce $3x^2 + 3z^2 + 4xy + 8xz + 8yz$ into canonical form.

19. Reduce $3x^2 - 3y^2 - z^2 - 4xy + 8xz + 12yz$ into canonical form by orthogonal transformations and also find its rank, index and signature.

20. Find the Eigen values of A=11 $\begin{bmatrix} 0 & 1 & 1 \\ 1 & 0 & 1 \\ 1 & 1 & 0 \end{bmatrix}$ and hence reduce 2xy +2yz +2zx into canonical form.

21. Using Cayley – Hamilton theorem find the inverse of $\begin{bmatrix} 2 & -1 & 1 \\ -1 & 2 & -1 \\ 1 & -1 & 2 \end{bmatrix}$

22. Prove that A= $\frac{1}{2}\begin{bmatrix} 1+i & -1+i \\ 1+i & 1-i \end{bmatrix}$ is unitary.

23. Prove that eigen values of Hermitian matrix are real.

Unit –II

1. Verify the Rolle's Theorem for the function $f(x) = (x-a)^m (x-b)^n$ in [a, b].
2. Verify the Rolle's Theorem for following the function.
   a) $f(x)=e^x(\sin x - \cos x)$ in [Π/4,5Π/4] b) $f(x)=x(x+3)e^{-x/2}$ in [-3,0]
3. Using mean value theorems show tha $\pi/4 + 3/25 < \tan^{-1} 4/3 < \pi/4 + 1/6$
4. Find Maclaurin's theorem with Lagrange's form of remainder for f(x) = cosx.
5. A rectangular box open at the top is to have volume of 32 cubic ft. Find the dimensions of the box requiring least material of its construction.
6. Expand $x^2y+3y-2$. in powers of x-y and y+2 upto the terms of 3rd degree. Using taylor's theorem.
7. Find the minimum value of $x^2 + y^2 + z^2$ when ax+by+cz = p.

Unit –III

1. Evaluate ∭xyz dxdydz over the positive octant of the sphere $x^2+y^2+z^2=a^2$

2 Show that $\int_a^b (x-a)^m (b-x)^n \, dx = (b-a)^{m+n+1} \beta(m+1, n+1)$

3. Show that $\int_0^\infty x^4 \, e^{-x^2} dx = \frac{3\sqrt{\pi}}{8}$

4. Show that $\beta(m,n) = \int_0^\infty \frac{y^{n-1}}{(1+y)^{m+n}} dy$

5 Evaluate $\int_0^1 x^3 \sqrt{1-x} dx$ using $\beta - \Gamma$ functions.

Unit –IV

1. Find the equation of the curve passing through the point (0, -1) and whose differential equation is

$(1 + y^2)dx + (1 + x^2)dy = 0$.

2. Eliminate the arbitrary constants and obtain the DE for following.

a.$x^2 + y^2 + 2gx + 2fy + c = 0$ b.tanx tany = c (c).c.x tan(y/x) = c (c).

3. Solve $(x^2 + y^2)dx = 2xy\, dy$.

4. Solve x dy/dx + y = logx.

5. Solve dr + (2r cotθ + sin2θ)dθ=0.

6. Solve x dy/dx + y = $x^3 y^6$.

7. Solve $(1- x^2)$ dy/dx + xy = $y^3 \sin^{-1}x$.

8. Find the Orthogonal trajectories of the following family of curves.

a.$x^2/(a^2+\lambda) + y^2/(b^2+\lambda) = 1$ b.r = 2a/(1+cosθ).

9. The number N of bacteria in a culture grew at a rate proportional to N. The value of N was initially 100 and increased to 332 in one hour what was the value of N after 1½ hours

10. A body is originally at 80°C and cools down to 60°C in 20 minutes. If the temperature of the air is 40°C, find the temperature of the body after 40 minutes

11. Solve $y^{11}+ y^1-2y = 0$ y(0) y(0) = 4, $y^1(0)$-1.

12. Solve $(D^3 +1)y = 3+5e^x$.

13. Solve $y^{11}+4 y^1+4y = 4\cos x+3\sin x$, y(0) = 3.

14 Solve $(x^3D^3+2x^2D^2+2)y = 10(x+1/x)$

15. $(D^2 + 3D+2)y = e^{2x}+x^2$.

16. Solve $(D^3 + 2D^2 + D)y = e^{2x}+ x^2 + x + \sin 2x$.

17. using variation of parameters solve $(D^2+1)y$=cosec2x

Unit –V

1. Find the Laplace transform of the following

   a. $\frac{1-\cos t}{t}$ b. $e^{-3t}\cos 4t$ c. $e^{2t}+4t^3-2\sin 3t+3\cos 3t$ d. Sin (wt+α), α is a constant

2. $(e^{-at}-e^{-bt})/t$

3. $\int_0^t e^t \frac{\sin t}{t} dt$

4 .Find the inverse Laplace transform of the following functions

   i. $\frac{3(s-1)^2}{2s^5}$ ii. $\frac{s^2}{s^4-a^4}$ iii. $\frac{4}{(s-1)(s+2)}$ iv $\frac{1}{s^2+25}$ Sin (wt+α), α is a constant

   v. Log $\frac{s+1}{s-1}$ vi. $Cot^{-1}s$

5. $\frac{s}{(s^2+a^2)(s^2+b^2)}$ by convolution theorem

6. Solve the following boundary value problems by using Laplace transforms

   i. Solve $(D^2+1)x=t\cos 2t$ given x=0, $x^1(t)=0$ at t=0. ii. $y^{111}.+2y^{11}-y^1-2y=0$ with $y(0)=y^1(0)=-0$ and $y^{11}(0)=6$