: Engineering Mathematics – II

: MA8251

: Part – A questions

: R2017

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Unit – I (Matrices)

1. Find the sum and product of the eigenvalues of a 3×3 matrix A whose characteristic equation is $\lambda^3-7\lambda^2+36=0$.

2. Find the sum and product of all the eigenvalues of $\begin{pmatrix} 8 & -6 & 2 \\ -6 & 7 & -4 \\ 2 & -4 & 3 \end{pmatrix}$.

   Text Book Page No.: 1.8

3. Given : $A=\begin{pmatrix} -1 & 0 & 0 \\ 2 & -3 & 0 \\ 1 & 4 & 2 \end{pmatrix}$. Find the eigenvalues of A^2. (Text Book Page No.: 1.7)

4. Find the eigenvalues of A^{-1} where $A=\begin{pmatrix} 3 & 1 & 4 \\ 0 & 2 & 6 \\ 0 & 0 & 5 \end{pmatrix}$. (Text Book Page No.: 1.8)

5. Find the eigenvalues of the inverse of the matrix $A=\begin{pmatrix} 2 & 1 & 0 \\ 0 & 3 & 4 \\ 0 & 0 & 4 \end{pmatrix}$.

6. If 3 and 6 are two eigenvalues of $A=\begin{pmatrix}1&1&3\\1&5&1\\3&1&1\end{pmatrix}$, write down all the eigenvalues of A^{-1}. (Text Book Page No.: 1.9)

7. Two eigenvalues of the matrix $A=\begin{bmatrix}8&-6&2\\-6&7&-4\\2&-4&3\end{bmatrix}$ are 3 and 0. What is the third eigenvalue? What is the product of the eigenvalues of A?

8. If 1 and 2 are the eigenvalues of a 2 X 2 matrix A, what are the eigenvalues of A^2 and A^{-1}?

9. The product of two eigenvalues of the matrix $A=\begin{pmatrix}6&-2&2\\-2&3&-1\\2&-1&3\end{pmatrix}$ is 16. Find the third eigenvalue of A. (Text Book Page No.: 1.10)

10. If 2, 3 are the eigenvalues of $\begin{pmatrix}2&0&1\\0&2&0\\b&0&2\end{pmatrix}$, then find the value of b.

11. If $2,-1,-3$ are the eigenvalues of the matrix A, then find the eigenvalues of the matrix A^2-2I.

12. If the sum of two eigenvalues and trace of a 3 X 3 matrix A are equal, find the value of $|A|$. (Text Book Page No.: 1.10)

13. If the eigenvalues of the matrix A of order 3 X 3 are 2, 3 and 1, then find the eigenvalues of adjoint of A.

14. If the eigenvalues of the matrix A of order 3 X 3 are 2, 3 and 1, then find the determinant of A.

15. If λ is the eigenvalue of the matrix A, then prove that λ^2 is the eigenvalue of A^2.

16. If $\lambda\ (\neq 0)$ is an eigenvalue of a square matrix A, then show that λ^{-1} is an eigenvalue of A^{-1}.

17. State Cayley- Hamilton theorem. (Text Book Page No.: 1.41)

18. Find the constants a and b such that the matrix $\begin{bmatrix} a & 4 \\ 1 & b \end{bmatrix}$ has 3 and -2 as its eigenvalues.

19. Use Cayley- Hamilton theorem to find $\left(A^4 - 4A^3 - 5A^2 + A + 2I\right)$ when $A = \begin{pmatrix} 1 & 2 \\ 4 & 3 \end{pmatrix}$.

Text Book Page No.: 1.54

20. Write down the quadratic form corresponding to the matrix $A = \begin{bmatrix} 0 & 5 & -1 \\ 5 & 1 & 6 \\ -1 & 6 & 2 \end{bmatrix}$.

Text Book Page No.: 1.93

21. Check whether the matrix B is orthogonal? Justify. $B = \begin{pmatrix} \cos\theta & \sin\theta & 0 \\ -\sin\theta & \cos\theta & 0 \\ 0 & 0 & 1 \end{pmatrix}$.

Text Book Page No.: 1.57

22. Can $A = \begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix}$ be diagonalized? Why?

23. Find the nature of the Quadratic Form $x_1^2 + 2x_2^2 + x_3^2 - 2x_1x_2 + 2x_2x_3$.

Text Book Page No.: 1.94

24. Write down the matrix of the quadratic form $2x^2 + 8z^2 + 4xy + 10xz - 2yz$.

Text Book Page No.: 1.94

25. Give the nature of a quadratic form whose matrix is $\begin{pmatrix} -1 & 0 & 0 \\ 0 & -1 & 0 \\ 0 & 0 & -2 \end{pmatrix}$.

26. Find the symmetric matrix A, whose eigenvalues are 1 and 3 with corresponding eigenvectors $\begin{pmatrix} 1 \\ -1 \end{pmatrix}$ and $\begin{pmatrix} 1 \\ 1 \end{pmatrix}$. (Text Book Page No.: 1.88)

Unit – II (Vector Calculus)

1. Find the value of m so that the vector $\vec{F}=(x+3y)\vec{i}+(y-2z)\vec{j}+(x+mz)\vec{k}$ is solenoidal. (Text Book Page No.: 1.49)
2. Find λ such that $\vec{F}=(3x-2y+z)\vec{i}+(4x+\lambda y-z)\vec{j}+(x-y+2z)\vec{k}$ is solenoidal.

   Text Book Page No.: 1.26
3. Find the values of a,b,c so that the vector (Text Book Page No.: 1.26)
   $\vec{F}=(x+y+az)\vec{i}+(bx+2y-z)\vec{j}+(-x+cy+2z)\vec{k}$ may be irrotational.
4. Find the directional derivative of $\phi(x,y,z)=xy^2+yz^2$ at the point $(2,-1,1)$ in the direction of the vector $i+2j+3k$. (Text Book Page No.: 1.18)
5. Find the directional derivative of $\phi=xyz$ at $(1,1,1)$ in the direction of $\vec{i}+\vec{j}+\vec{k}$.

   Text Book Page No.: 1.16
6. Is the position vector $\vec{r}=x\vec{i}+y\vec{j}+z\vec{k}$ irrotational? Justify. (Text Book Page No.: 1.49)
7. Find $curl\vec{F}$ if $\vec{F}=xy\vec{i}+yz\vec{j}+zx\vec{k}$.
8. Prove that $\vec{F}=yz\vec{i}+zx\vec{j}+xy\vec{k}$ is irrotational. (Text Book Page No.: 1.25)
9. Find grad (r^n) where $\vec{r}=x\vec{i}+y\vec{j}+z\vec{k}$ and $r=|\vec{r}|$. (Text Book Page No.: 1.3)
10. Evaluate $\nabla^2 \log r$.
11. Find the unit normal to the surface $x^2+xy+z^2=4$ at $(1,-1,2)$. (Text Book Page No.: 1.4)
12. Find the unit normal vector to the surface $x^2+y^2=z$ at $(1,-2,5)$. (Text Book Page No.: 1.18)
13. Prove that $div\ \vec{r}=3$ and $curl\ \vec{r}=0$. (Text Book Page No.: 1.24)
14. Prove that $curl(grad\phi)=0$. (Text Book Page No.: 1.40)
15. State Stoke's theorem. (Text Book Page No.: 1.20)
16. State Green's theorem. (Text Book Page No.: 1.72)
17. State Gauss divergence theorem. (Text Book Page No.: 1.93)

18. Prove by Green's theorem that the area bounded by a simple closed C curve is $\frac{1}{2}\int_C (xdy - ydx)$. (Text Book Page No.: 1.90)

Unit – III (Analytic Functions)

1. Verify $f(z) = z^3$ is analytic or not. (Text Book Page No.:4.10)
2. Show that $|z|^2$ is not analytic at any point. (Text Book Page No.:4.11)
3. Are $|z|, \mathrm{Re}(z), \mathrm{Im}(z)$ analytic? Give reason. (Text Book Page No.:4.8)
4. Verify whether $f(z) = \bar{z}$ is analytic function or not. (Text Book Page No.:4.8)
5. Is the function $f(z) = e^z$ analytic.
6. Find the constants a, b if $f(z) = x + 2ay + i(3x + by)$ is analytic. (Text Book Page No.:4.18)
7. Define harmonic function. (Text Book Page No.:4.21)
8. Show that $u = 2x - x^3 + 3xy^2$ is harmonic. (Text Book Page No.:4.35)
9. Verify whether the function $u = x^3 - 3xy^2 + 3x^2 - 3y^2 + 1$ is harmonic.

   Text Book Page No.:4.37
10. Define Conformal mapping. (Text Book Page No.:4.59)
11. Find the map of the circle $|z| = 3$ under the transformation $w = 2z$. (Text Book Page No.:4.59)
12. Find the image of the line $x = k$ under the transformation $w = \frac{1}{z}$. (Text Book Page No.:4.61)
13. State the Cauchy-Riemann equation in polar coordinates satisfied by an analytic function.

    Text Book Page No.:4.7
14. Prove that a bilinear transformation has at most two fixed points. (Text Book Page No.:4.82)
15. Find the fixed points of mapping $w = \frac{6z - 9}{z}$. (Text Book Page No.:4.83)
16. Find the invariant points of the transformation $w = \frac{2z + 6}{z + 7}$. (Text Book Page No.:4.83)

17. Find the invariant points of the transformation $w = \frac{z-1}{z+1}$. (Text Book Page No.:4.84)

18. Find the fixed point of the bilinear transformation $w = \frac{1}{z}$.

19. Find the invariant points of a function $f(z) = \frac{z^3 + 7z}{7 - 6zi}$.

20. Find the invariant points of $f(z) = z^2$. (Text Book Page No.:4.82)

21. Find the critical points of the transformation $w = 1 + \frac{2}{z}$. (Text Book Page No.:4.78)

22. Find the critical points of the transformation $w^2 = (z-\alpha)(z-\beta)$. (Text Book Page No.:4.79)

Unit – IV (Complex Integration)

1. Define Singular point (or) singularity of a function $f(z)$.

2. Define and give an example of essential singular points. (Text Book Page No.:5.65)

3. Expand $f(z) = \frac{1}{z^2}$ as a Taylor series about the point $z = 2$.

4. Expand $f(z) = \sin z$ in a Taylor series about origin. (Text Book Page No.:5.63)

5. Find the Taylor series for $f(z) = \sin z$ about $z = \frac{\pi}{4}$. (Text Book Page No.:5.38)

6. State Cauchy's integral theorem. (Text Book Page No.:5.5)

7. State Cauchy's residue theorem. (Text Book Page No.:5.83)

8. Evaluate $\int_c \tan z \, dz$ where C is $|z| = 2$. (Text Book Page No.:5.34)

9. Evaluate $\int_c \sin z \, dz$ where C is the entire complex plane.

10. Evaluate $\int_c \left(\frac{3z^2 + 7z + 1}{z+1} \right) dz$, where C is $|z| = \frac{1}{2}$. (Text Book Page No.:5.8)

11. Evaluate $\int_C \frac{z\,dz}{(z-1)(z-2)}$, where C is the circle $|z| = 1/2$.

12. Using Cauchy's integral formula, evaluate $\int_C \frac{\sin \pi z^2 + \cos \pi z^2}{(z+1)(z+2)} dz$, where C is $|z| = \frac{1}{2}$.

13. Evaluate $\int_C \frac{z+4}{z^2+2z} dz$, where C is the circle $\left|z - \frac{1}{2}\right| = \frac{1}{3}$. (Text Book Page No.:5.8)

14. Evaluate $\int_C \frac{z}{z-2} dz$, where C is (a) $|z| = 1$ (b) $|z| = 3$. (Text Book Page No.:5.34)

15. If $f(z) = \frac{-1}{z-1} - 2\left[1 + (z-1) + (z-1)^2 + \ldots\right]$, find the residue of $f(z)$ at $z = 1$.

Text Book Page No.:5.71

16. Identify the type of singularities of the following function: $f(z) = e^{\frac{1}{z-1}}$.

Text Book Page No.:5.71

17. Identify the type of singularity of function $\sin\left(\frac{1}{1-z}\right)$. (Text Book Page No.:5.72)

18. Calculate the residue of $f(z) = \frac{e^{2z}}{(z+1)^2}$ at its pole. (Text Book Page No.:5.69)

19. Find the residue of the function $f(z) = \frac{4}{z^3(z-2)}$ at a simple pole. (Text Book Page No.:5.67)

20. Find the residue of $f(z) = \frac{z^2}{(z-2)(z+1)^2}$ at $z = 2$. (Text Book Page No.:5.68)

21. Find the residue of $\frac{1-e^{2z}}{z^4}$ at $z = 0$. (Text Book Page No.:5.70)

Unit – V (Laplace Transform)

1. State the conditions under which Laplace transform of $f(t)$ exists. (Text Book Page No.:3.1)
2. Find the Laplace transform of unit step function. (Text Book Page No.:3.9)
3. State the first shifting theorem on Laplace transforms. (Text Book Page No.:3.9)
4. Evaluate $\int_0^\infty te^{-2t}\sin t\,dt$ using Laplace transform.
5. Find $L\left(e^{-3t}\sin t\cos t\right)$. (Text Book Page No.:3.14)
6. Find the Laplace transform of $e^{-t}\sin 2t$. (Text Book Page No.:3.12)
7. Find the Laplace transform of $\frac{t}{e^t}$. (Text Book Page No.:3.13)
8. Find the Laplace transform of $\frac{1-\cos t}{t}$. (Text Book Page No.:3.18)
9. Find $L\left[\frac{\sin t}{t}\right]$. (Text Book Page No.:3.19)
10. Find Laplace transform of $t\sin 2t$. (Text Book Page No.:3.15)
11. State initial and final value theorem. (Text Book Page No.:3.36)
12. State convolution theorem on Laplace transforms. (Text Book Page No.:3.99)
13. Verify the final value theorem for $f(t)=3e^{-t}$. (Text Book Page No.:3.30)
14. Verify initial value theorem for the function $f(t)=ae^{-bt}$. (Text Book Page No.:3.38)
15. Find $L^{-1}\left[\frac{1}{s^2+4s+4}\right]$. (Text Book Page No.:3.62)
16. Find $L^{-1}\left[\frac{1}{s^2+6s+13}\right]$. (Text Book Page No.:3.63)
17. Find the inverse Laplace transform of $\frac{1}{(s+1)(s+2)}$. (Text Book Page No.:3.65)

18. Find $f(t)$ if the Laplace transform of $f(t)$ is $\frac{s}{(s+1)^2}$. (Text Book Page No.:3.63)

19. Find $L^{-1}\{\cot^{-1}(s)\}$. (Text Book Page No.:3.88)

20. Find $L^{-1}\left(\log\frac{s}{s-a}\right)$.

Textbook for Reference:

"ENGINEERING MATHEMATICS - II"

Publication: Sri Hariganesh Publications **Author: C. Ganesan**

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