A **Reg. No. :** | | | | | | | | | | | | |

Question Paper Code: R2M04

B.E./B.Tech. DEGREE EXAMINATION, APRIL / MAY 2025

Second Semester

Electronics and Communication Engineering

R21UMA204- CALCULUS,COMPLEX ANALYSIS AND NUMERICAL METHODS

(Regulations R2021)

Duration: Three hours Maximum: 100 Marks

Answer ALL Questions

PART A - (10 x 1 = 10 Marks)

1. The Particular integral of y''+4y'+3y=0 is CO1- App

   (a) $Ae^{-x} + Be^{-3x}$ (b) $(A+Bx)e^{3x}$ (c) $Ae^{-x} + Be^{-4x}$ (d) $(A+Bx)e^{4x}$

2. $\frac{1}{D^4}(\cos x)$ CO1- App

   (a) -sin x (b) - cos x (c) cos x (d) tan x

3. Div $\bar{r}$ CO2- App

   (a) 0 (b) 1 (c) 3 (d) $\bar{r}$

4. If $\varphi = x^2 + y^2 - z - 10$ then $|\nabla \varphi|$ at (1, 1, 1) is CO2- App

   (a) $2(\vec{i} + \vec{j} + \vec{k})$ (b) $2\vec{i}+4\vec{j}-\vec{k}$ (c) 3 (d) 3

5. The function $f(z) = \frac{1}{z^2+4}$ is not analytic at z = ____ CO3- App

   (a) 2 (b) -2 (c) 2i (d) $\pm 2i$

6. The transformation w=cz is known as _____ CO6-U

   (a) Rotation (b) reflection (c) translation (d) rotation and magnification

7. Simple pole is a pole of order _____ CO6- U

   (a) 1 (b) 2 (c) 3 (d) 4

8. If f(z) is analytic at all points inside and on a simple closed curve c, then $\int_C f(z)dz$ = ------ CO4- App

(a) 2πi (b) -2πi (c) 4πi (d) 0

9. Order of convergence of iteration method is CO6-U

(a) 1 (b)2 (c)3 (d) 0

10. Newton's method is also called method of _____ CO6-U

(a) tangents (b) slope (c) secants (d) false

PART – B (5 x 2= 10 Marks)

11. Solve CO1-App

$\left(D^3+D^2+4D+4\right)y=0$

12. Show that the vector CO2-App

$\vec{F} = (y^2 - Z^2 + 3yz - 2x)\vec{i} + (3xz + 2xy)\vec{j} + (3xy - 2xz + 2z)\vec{k}$

is solenoidal

13. Show that the function $e^x \sin y$ is harmonic CO3- App

14. Using Cauchy's integral formula, evaluate $\int_c \frac{z}{z-2}dz$ where C is $|z| = 1$ CO4- App

15. Using Newton's Raphson for two steps $x^3 - 2x - 5 = 0$ by taking $x_0 = 2.3$ CO5- App

PART – C (5 x 16= 80 Marks)

16. (a) (i) Solve: $(D^2 + 3D + 2)y = \sin x + e^x$ CO1-App (8)

(ii) Using method of variation of parameters solve $(D^2 + a^2)y = \tan ax$ CO1-App (8)

Or

(b) (i) Solve:$(D^2 - 4D - 5)y = \cos x + e^{-x}$ CO1-App (8)

(ii) Solve: $(x^2D^2 - xD + 1)y = \left(\frac{\log x}{x}\right)^2$ CO1-App (8)

17. (a) Verify Gauss Divergence theorem for $\vec{F} = x^2\vec{i} + y^2\vec{j} + z^2\vec{k}$ where S is the surface of the cuboid formed by the planes $x = 0, x = a, y = 0, y = a, z = 0$ & $z = a$. CO2-App (16)

Or

(b) Verify Stoke's theorem for $\vec{F} = (x^2 + y^2)\vec{i} - 2xy\vec{j}$ taken around the rectangle bounded by the lines $x = \pm a, y = 0, y = b$. CO2-App (16)

18. (a) (i) Prove that both the real part and the imaginary part of an analytic function satisfies laplace equation — CO3-App — (8)

(ii) Determine the bilinear transformation which maps z = 1,i,-1 respectively onto w = i,0,-i — CO3-App — (8)

Or

(b) (i) Determine the analytic function whose real part is $y + e^x \cos y$ — CO3-App — (8)

(ii) Determine the image of the infinite strips $\frac{1}{4} < y < \frac{1}{2}$ under the mapping $w = \frac{1}{z}$ — CO3-App — (8)

19. (a) (i) Evaluate $f(z) = \int_C \frac{\cos \pi z^2 + \sin \pi z^2}{(z+1)(z+2)} dz$ by using Cauchy's Integral formula where C is $|z| = 3$ — CO4-App — (8)

(ii) Expand $\frac{z-1}{(z+2)(z+3)}$ as Laurent's series valid in the region $2 < |z| < 3$ — CO4-App — (8)

Or

(b) Using Contour integration, evaluate $\int_0^{2\pi} \frac{1}{5+4\sin\theta} \, d\theta$ — CO4-App — (16)

20. (a) (i) Using Newton's Raphson method find the real positive root of $x^4 - x - 10 = 0$. — CO5-App — (8)

(ii) Solve 28x+4y-z = 32; x+3y+10z = 24 ; 2x+17y+4z = 35 by Gauss - Seidel method — CO5-App — (8)

Or

(b) (i) Using Power method find numerically largest Eigen value of $\begin{pmatrix} 9 & 1 & 8 \\ 7 & 4 & 1 \\ 1 & 7 & 9 \end{pmatrix}$ — CO5-App — (8)

(ii) Compute the real positive root of 5x-cosx=6 by Iterative method. — CO5-App — (8)