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

Question Paper Code: U2M04

B.E./B.Tech. DEGREE EXAMINATION, NOV 2025

Second Semester

Electronics and communication Engineering

21UMA204- CALCULUS,COMPLEX ANALYSIS AND NUMERICAL METHODS

(Regulations 2021)

Duration: Three hours Maximum: 100 Marks

Answer ALL Questions

PART A - (10 x 1 = 10 Marks)

1. $\frac{1}{(D-m)^2}e^{mx}$ = _____ CO6-U

(a) $) xe^{mx}$ (b) x^2e^{mx} (c) $\frac{x^2}{2}e^{mx}$ (d) $\frac{x^2}{m}e^{mx}$

2. The complementary function of $(4D^2- 3D-1)y=2 \sin 2x$ is _____ CO6-U

(a) $Ae^{x} + Be^{-\frac{x}{4}}$ (b) $Ae^{-x}+Be^{5x}$ (c) $(A+Bx)e^{2x}$ (d) $Ae^{x}+Be^{4x}$

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

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

4. Divergence of vector $x^2\bar{i} + y^2\bar{j} + z^2\bar{k}$ at (1, 2, -3) is _____ CO2-App

(a) 8 (b)4 (c)-3 (d) 0

5. The critical point of the transformation $w = z + \frac{1}{z}$ are ____ CO3- App

a) ± 1 b) ± 2 c) $\pm i$ d) $-i$

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

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

7. If f(z) is analytic at all points inside and on a simple closed curve c, then $\int_C f(z)dz$ = ------ CO6-U

(a) 2πi (b) -2πi (c) 4πi (d) 0

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

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

9. Iteration method converges if $|g^1(x)|$ _____ CO6-U

(a) >1 (b)<1 (c)=0 (d) >0

10. Order of convergence of iteration method is CO5-U

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

PART – B (5 x 2= 10Marks)

11. Find Particular integral for $(D^2 - 2D + 1)y = \cosh x$. CO1-App

12. Find $\nabla\varphi$, if $\varphi = x^2 + y^2 + z^2$ at (1, -1, 1). CO2-App

13. Find the fixed point of $w = \frac{2z-5}{z+4}$ CO3-App

14. Evaluate $\int_c \frac{z}{z-2}dz$ where C is $|z| = 2$ CO4-App

15. State Newton's Iterative formula CO5-U

PART – C (5 x 16= 80Marks)

16. (a) (i) Using method of variation of parameters solve $(D^2 + a^2)y = \sec ax$ CO1-App (8)

(ii) At the start of an experiment, there are 100 bacteria. If the bacteria follow an exponential growth pattern with rate k = 0.02. What will be the population after 5 hours? How long will it take for the population to double? CO1- App (8)

Or

(b) (i) Solve: $(x^2D^2 - xD + 4)y = x^2 \sin(\log x)$ CO1- App (8)

(ii) Solve: $(D^2 - 4D + 3)y = \cos 2x + e^{2x}$ 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 $x = 0, x = a,$ $y = 0, y = b, z = 0$ & $z = c$. CO2-App (16)

Or

(b) Verify Green's theorem for $\int_C x^2 dx + xy dy$, whereC is bounded by CO2 -App (16)

x = 0,
x = a, y = 0, y = a

18. (a) (i) Find the image of $|z - 3i| = 3$ under the transformation $w = \frac{1}{z}$ CO3-App (8)

(ii) If f(z) = u +iv is a regular function of z in a domain D the following relation hold in D. $\nabla^2|f(z)|^2 = 4|f'(z)|^2$. CO3-App (8)

Or

(b) (i) Find the bilinear transformation from -i,0,i to -1,i,1. CO3-App (8)

(ii) Find the analytic functions f(z) = u +iv given that $2u + v = e^x(\cos y - \sin y)$ CO3-App (8)

19. (a) (i) Evaluate using Cauchy's Residue theorem for CO4-App (8)

f(z) = $\int_C \frac{3z^2 + z - 1}{(z^2 - 1)(z - 3)} dz$, where 'C' is the circle $|z| = 2$.

(ii) Evaluate $f(z) = \frac{1}{(z+1)(z+3)}$ in Laurent series valid for the region CO4-App (8)

$1 < |z| < 3$.

Or

(b) Using contour integration, to find the value of $\int_0^{2\pi} \frac{d\theta}{13 - 5\cos\theta}$ CO4-App (16)

20. (a) (i) Solve for a positive root of 3x – cos x - 1 =0 by Newton's Raphson method . CO5-App (8)

(ii) Solve 4x + 2y +z = 14, x + 5y -z = 10, x + y + 8z =20 by Gauss Elimination method CO5- App (8)

Or

(b) (i) Using Power method find numerically largest Eigen value of CO5- App (8)

$$\begin{pmatrix} 25 & 1 & 2 \\ 1 & 3 & 0 \\ 2 & 0 & -4 \end{pmatrix}$$

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