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

Question Paper Code: U2M10

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

Second Semester

Computer Science and Design

21UMA210- DIFFERENTIAL EQUATIONS, FOURIER SERIES & TRANSFORMS

(Regulations 2021)

(Common to Artificial Intelligence and Data Science)

Duration: Three hours Maximum: 100 Marks

Answer ALL Questions

PART A - (10 x 1 = 10 Marks)

1. The complete solution of $(x^2D^2 - 3xD - 5)y = 0$ is _____. CO1-App

   (a) $Ae^{-z} + B e^{5z}$ (b) $Ae^{z} + B e^{5z}$ (c) $Ae^{z} + B e^{-5z}$ (d) $Ae^{-z} + B e^{-5z}$

2. $\frac{1}{D^2}(\cos x)$ = _____ CO6-R

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

3. L (sin h at) = _____ CO2-App

   (a) $\frac{s}{s^2 - a^2}$ (b) $\frac{a}{s^2 - a^2}$ (c) $\frac{s}{s^2 + a^2}$ (d) $\frac{a}{s^2 + a^2}$

4. $L(te^{-3t})$ CO2-App

   (a) $-z\frac{d}{dz}F(Z)$ (b) $z\frac{d}{dz}F(Z)$ (c) $\frac{d}{dz}F(Z)$ (d) $z^n\frac{d}{dz}F(Z)$

5. Z [n f(n)] = _____ CO3- App

   (a) $-z\frac{d}{dz}F(Z)$ (b) $z\frac{d}{dz}F(Z)$ (c) $\frac{d}{dz}F(Z)$ (d) $z^n\frac{d}{dz}F(Z)$

6. The Z transform of $n2^n$ is _____ CO3- App

   (a) $\frac{2z}{(z-2)^2}$ (b) $\frac{z}{(z-2)^2}$ (c) $\frac{2z}{(z+2)^2}$ (d) $\frac{z}{(z+2)^2}$

7. The root mean square value of $f(x) = x^2$ in (0, l) is ---------. CO4-App

(a) l (b)½ (c)$1/\sqrt{3}$ (d) 2

8. The constant term in the Fourier expansion for f(x) = k, (0, 2π) is CO4-App

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

9. Convolution theorem on Fourier Transform is F[f(x)*g(x)]= CO6-U

_____

(a) F(s).G(s) (b) f(s).g(s) (c) F(s)*G(s) (d) f(s)*g(s)

10. $F[xf(x)]$ = _____ CO5-App

(a) $-F_c[f(x)]$ (b)$-\frac{d}{ds}\{F_s[f(x)]\}$ (c)$-F_s[f(x)]$ (d) $-\frac{d}{ds}\{F_c[f(x)]\}$

PART – B (5 x 2= 10Marks)

11. Find Particular integral for CO1-App

$(D^2 - 2D + 1)y = \cosh x$.

12. Evaluate $L[\cos at]$ CO2-App

13. Evaluate $Z\left(\frac{1}{n+1}\right)$ CO3-App

14. Give the expression for the Fourier series coefficient b_n for the function $f(x) = x^2$ defined in $-2 \le x \le 2$. CO4-App

15. Find the Fourier Sine Transform of $f(x) = e^{-x}$,x>0 CO5-App

PART – C (5 x 16= 80Marks)

16. (a) (i) Solve $x^2(y-z)p + y^2(z-x)q = z^2(x-y)$ CO1-App (8)

(ii) Solve $(D^2 + 2D + 2)y = e^{-2x} + \cos 2x$ CO1- App (8)

Or

(b) (i) Solve $(D^2 - 3D + 2)y = 2e^x + 2\cos 2x$ CO1- App (8)

(ii) Solve $(3z - 4y)p + (4x - 2z)q = 2y - 3x$ CO1- App (8)

17. (a) Find the Laplace transform of $f(t) = \begin{cases} t, & 0 < t < a \\ 2a - t, & a < t < 2a \end{cases}$ and $f(t + 2a) = f(t)$ CO2-App (16)

Or

(b) Solve by the convolution theorem $L^{-1}\left[\frac{s^2}{(s^2+5^2)(s^2+4^2)}\right]$ CO2 -App (16)

Using Laplace Transforms

18. (a) Using convolution theorem find the inverse Z-transform CO3-App (16)

$Z^{-1}\left(\frac{8z^2}{(2z-1)(4z-1)}\right)$

Or

(b) (i) Evaluate $Z[a^n \cos n\theta]$ *and* $Z[a^n \sin n\theta]$ CO3-App (8)

(ii) Evaluate CO3-App (8)

$Z^{-1}\left[\frac{z}{z^2+4z+3}\right]$

19. (a) Find the Fourier series of $f(x) = x^2$ in $(-\pi, \pi)$ of periodicity 2π. CO4-App (16)

Or

(b) (i) The table of values of the function $y = f(x)$ is given below: CO4-App (8)

x:	0	1	2	3	4	5
Y:	4	8	15	7	6	2

Find a Fourier series up to the third harmonic to represent $f(x)$ in terms of x.

(ii) Find the half range sine series for $f(x) = x^2$ in $(0, l)$ CO4-App (8)

20. (a) Show that the Fourier transform of CO5-App (16)

$f(x) = \begin{cases} a^2 - x^2 & |x| < a \\ 0 & |x| > a > 0 \end{cases}$ is $2\sqrt{\frac{2}{\pi}}\left[\frac{\sin sa - sa\cos sa}{s^3}\right]$ Hence deduce $\int_0^\infty \frac{\sin t - t\cos t}{t^3} dt = \pi/4$ and $\int_0^\infty \left(\frac{\sin t - t\cos t}{t^3}\right)^2 dt = \pi/15$

Or

(b) (i) Find the Fourier sine & cosine transform of e^{-ax} CO5-App (8)

(ii) Evaluate $\int_0^\infty \frac{dx}{(x^2+25)^2}$ CO5-App (8)