

**A**

**Reg. No. :**

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**Question Paper Code: U2M05**

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

Second Semester

Electrical and Electronics Engineering

21UMA205- CALCULUS AND TRANSFORM TECHNIQUES

(Regulations 2021)

Duration: Three hours

Maximum: 100 Marks

Answer ALL Questions

PART A - (10 x 1 = 10 Marks)

- $\int \frac{\sin x}{\cos^2 x} dx =$  CO1-App  
(a)  $\sec x$                       (b)  $\tan x$                       (c)  $\sin x$                       (d)  $-\sin x$
- Complementary function of  $(D^2 - 2D + 1)y = \cosh 2x$  CO1-App  
(a)  $(A + Bx)e^{2x}$               (b)  $(A + Bx)e^{-2x}$               (c)  $Ae^{-x} + Bxe^{-x}$               (d)  $Ae^x + Bxe^x$
- If  $\vec{F} = (9x + y)\vec{i} + (7y - 2z)\vec{j} + (2x - \lambda z)\vec{k}$  is solenoidal then the value of ' $\lambda$ '. CO2-App  
(a) 0                      (b) 1                      (c) 3                      (d)  $\vec{r}$
- $\vec{F} = 3x\vec{i} + 4y\vec{j} - z\vec{k}$  then find  $\nabla \circ \vec{F}$  CO2-App  
(a) 8                      (b) 6                      (c) 7                      (d) 0
- Laplace transforms of  $L[4t]$  CO3- U  
(a)  $\frac{4}{s}$                       (b)  $\frac{4}{s^2}$                       (c)  $\frac{4}{s} + \frac{4}{s^2}$                       (d)  $\frac{4}{s} - \frac{4}{s^2}$
- Laplace transforms of  $L[e^{-2t}]$  CO3- U  
(a)  $\frac{1}{s-2}$                       (b)  $\frac{s}{s-2}$                       (c)  $\frac{s}{s+2}$                       (d)  $\frac{1}{s+2}$
- The fourier constant term  $a_0$  of  $f(x) = x$  in  $(0, 2\pi)$  CO4-App  
(a)  $\pi$                       (b)  $2\pi$                       (c)  $3\pi$                       (d)  $4\pi$

8. The fourier constant term  $a_0$  of  $f(x) = (2\pi - x)$  in  $(0, 2\pi)$  CO4-App  
 (a)  $\pi^2$  (b)  $3\pi$  (c)  $-3\pi$  (d)  $2\pi$
9. If  $F[f(x)] = F(s)$ , then  $F[ax]$ ,  $a > 0$  CO6-U  
 (a)  $aF\left(\frac{a}{s}\right)$  (b)  $\frac{1}{a}F\left(\frac{s}{a}\right)$  (c)  $aF\left(\frac{s}{a}\right)$  (d)  $\frac{1}{a}F\left(\frac{a}{s}\right)$
10. Fourier Sine transform of  $e^{-5x}$  CO5-U  
 (a)  $\sqrt{\frac{2}{\pi}} \frac{5}{s^2 + 25}$  (b)  $\sqrt{\frac{2}{\pi}} \frac{s}{s^2 - 25}$  (c)  $\sqrt{\frac{2}{\pi}} \frac{s}{s^2 + 25}$  (d)  $\sqrt{\frac{2}{\pi}} \frac{5}{s^2 - 25}$

PART – B (5 x 2= 10Marks)

11. Compute the Particular Integral of  $(D^3 - 3D)y = 4e^{-x}$  CO1-App
12. If  $\vec{F} = (4x - 5y)\vec{i} + (3y + 5z)\vec{j} + (8x + \lambda z)\vec{k}$  is solenoidal find the value of ' $\lambda$ '. CO2-App
13. Compute  $L[(t + 1)^2]$  CO3-App
14. State Dirichlet's conditions CO4-U
15. Define Fourier sine transform pair CO5-App

PART – C (5 x 16= 80Marks)

16. (a) (i) Solve the method of variation of parameters, CO1-App (8)  
 $(D^2 + 4)y = \sec 2x$   
 (ii) Solve the differential equation CO1- App (8)  
 $[(x + 1)^2 D^2 - 4(x + 1)D + 6]y = \cos[\log(x + 1)]$   
 Or
- (b) (i) Solve the differential equation  $(D^2 + 5D + 6)y = e^{-x} + \cos 2x$  CO1- App (8)  
 (ii) Solve the differential equation CO1- App (8)  
 $(x^2 D^2 - 5xD - 8)y = x^2 \cos(\log x)$
17. (a) Verify Divergence theorem for  $\vec{F} = 3x^2\vec{i} + 4y^2\vec{j} + 5z^2\vec{k}$  CO2-App (16)  
 over the rectangular parallelepiped  $0 \leq x \leq 1, 0 \leq y \leq 1, 0 \leq z \leq 1$   
 Or

- (b) Verify Green's theorem for  $\int_C (3x - 8y^2)dx + (4y - 6xy)dy$ , C is bounded by  $X = 0, Y = 0, X + Y = 1$ . CO2 -App (16)

18. (a) (i) Find the Laplace transform of  $f(t) = \begin{cases} k & , 0 < t < a \\ -k & , a < t < 2a \end{cases}$  and  $f(t + 2a) = f(t)$  CO3-App (8)

- (ii) Solve by the convolution theorem  $L^{-1} \left[ \frac{s}{(s^2 + a^2)^2} \right]$ . CO3-App (8)

Or

- (b) (i) Solve by using L.T.  $y'' - 5y' + 6y = e^{-t}$  given that if  $y(0) = 0, y'(0) = 0$  CO3-App (8)

- (ii) Solve by using convolution theorem  $L^{-1} \left[ \frac{s^2}{(s^2 + a^2)(s^2 + b^2)} \right]$  CO3-App (8)

19. (a) Express  $f(x) = (\pi - x)^2$  as a Fourier series of period  $2\pi$  in the interval  $0 < x < 2\pi$ . CO4-App (16)

Or

- (b) (i) Compute first two harmonics of the Fourier series for the following data. CO4-App (8)

|   |    |    |    |    |    |    |    |
|---|----|----|----|----|----|----|----|
| x | 0  | 2  | 4  | 6  | 8  | 10 | 12 |
| y | 10 | 12 | 20 | 24 | 26 | 17 | 10 |

- (ii) Find the Half range sine series for  $f(x) = x$  in  $(0, \pi)$  CO4-App (8)

20. (a) Compute the Fourier Transform of  $f(x) = \begin{cases} a - |x| & \text{if } |x| \leq a \\ 0 & \text{if } |x| > a \end{cases}$  CO5-App (16)

and hence evaluate i)  $\int_0^{\infty} \left( \frac{\sin x}{x} \right)^4 dx$  ii)  $\int_0^{\infty} \left( \frac{\sin x}{x} \right)^2 dx$

Or

- (b) Find Fourier sine & cosine transform  $x^{n-1}$  and hence Show that  $\frac{1}{\sqrt{x}}$  is self reciprocal under Fourier sine & cosine transform CO5- App (16)

