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Question Paper Code: U2M05**B.E./B.Tech. DEGREE EXAMINATION, MAY 2024****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)**

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

8. The fourier constant term a_0 of $f(x) = (2\pi - x)$ in $(0, 2\pi)$ CO4-App

- (a) π^2 (b) 3π (c) -3π (d) 2π

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. Transform $[(x+2)^2 D^2 + 3(x+2)D + 5]y = 20$ into linear equation with constant coefficient CO1-App

12. f $\vec{F} = (4x - 5y)\vec{i} + (3y + 5z)\vec{j} + (8x + \lambda z)\vec{k}$ is solenoidal find the value of ' λ '. CO2-App

13. Compute $L[(t+1)^2]$ CO3-App

14. State Dirichlet's conditions CO4-R

15. Find the Fourier cosine transform of e^{-ax} , $a > 0$ CO5-App

PART – C (5 x 16= 80Marks)

16. (a) (i) Solve the method of variation of parameters, CO1-App (8)

$$(D^2 + 1)y = \cos x$$

(ii) Solve the differential equation $(D^2 - 3D - 4)y = e^x \sin x$ CO1- App (8)

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 $\vec{F} = 5x^2 \vec{i} + 4y^2 \vec{j} + 7z^2 \vec{k}$ 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 $f(x) = x^2$ as a Fourier series of period 2π 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 $f(x) = \begin{cases} 1-|x| & \text{if } |x| \leq 1 \\ 0 & \text{if } |x| > 1 \end{cases}$ 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 CO5- App (16)
 $\frac{1}{\sqrt{x}}$ is self reciprocal under Fourier sine & cosine transform