Reg. No. : | | | | | | | | | | | | |

Question Paper Code: R2M05

B.E./B.Tech. DEGREE EXAMINATION, NOV 2024

Second Semester

Electrical and Electronics Engineering

R21UMA205- CALCULUS AND TRANSFORM TECHNIQUES

(Regulations R2021)

Duration: Three hours | Maximum: 100 Marks

Answer ALL Questions

PART A - (10 x 1 = 10 Marks)

1. $\int \frac{\sin x}{\cos^2 x} dx =$ CO6-U

(a) secx (b) tanx (c) sinx (d) -sinx

2. Particular Integral of $(D^2)y = 6x$ CO1-App

(a) $3x^3$ (b) $-3x^3$ (c) x^3 (d) $\frac{1}{x^3}$

3. Value of $\nabla \bar{r}$ = ____ CO2-U

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

4. If $\vec{F} = (5x - 6y)\vec{i} - (13y - 3z)\vec{j} + (3x + \lambda z)\vec{k}$ is solenoid then the value of 'λ'. CO2- App

(a) 18 (b)-8 (c)0 (d) 8

5. Laplace transforms of CO3- U

$L\left[t^3\right]$

(a) $\frac{3}{s^2}$ (b) $\frac{6}{s^2}$ (c) $\frac{3}{s^3}$ (d) $\frac{6}{s^3}$

6. $L^{-1}\left[\frac{1}{(s-3)^3}\right]$ = _____ CO3- App

(a) e^{-3t} (b) e^{3t} (c) $\frac{e^{-3t}t^2}{2!}$ (d) $\frac{e^{-3t}t^3}{3!}$

7. If a function f(x) is even, its Fourier expansion contains only ------- terms CO6- U

(a) Sine (b) Cosine (c) tan (d) None of these

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

(a) π (b) 2π (c) 3π (d) 4π

9. A function is called self - reciprocal under Fourier transform, if CO6- U

(a) it is reciprocal to itself (b) Its Fourier transform is the same function

(c) Its Fourier transform is its reciprocal (d) None of the above

10. 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) $\frac{1}{a}F\left(\frac{a}{s}\right)$

PART – B (5 x 2= 10 Marks)

11. Compute the Particular Integral of $(D^3 - 3D)y = 4e^{-x}$ CO1-App

12. Verify $\vec{F} = yz\vec{i} + zx\vec{j} + xy\vec{k}$ is irrotational or not. CO2-App

13. Compute $L\left[(t+1)^2\right]$ CO3-U

14. Compute the constant term in the Fourier series expansion of $f(x) = x$ in $(0, 2\pi)$ CO4-App

15. Define Fourier cosine transform pair CO5-App

PART – C (5 x 16= 80Marks)

16. (a) (i) Solve the differential equation CO1- App (8)

$$[(x+5)^2 D^2 - 4(x+5)D + 4]y = 6\sin 3[\log(x+5)]$$

(ii) Solve the differential equation CO1- App (8)

$(x^2D^2 - 3xD - 5)y = x^2 \sin(\log x)$

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)

$$[(x+5)^2 D^2 - 4(x+5)D + 4]y = 6\sin 3[\log(x+5)]$$

17. (a) Verify Divergence theorem for CO2- App (16)

$\vec{F} = 3x^2\vec{i} + 4y^2\vec{j} + 5z^2\vec{k}$ over the rectangular parallelepiped $0 \le x \le 1,\ 0 \le y \le 1,\ 0 \le z \le 1$

Or

(b) Verify Green's theorem in the XY plane for $\int_C (3x^2 - 8y^2)\,dx + (4y - 6xy)dy$ where C is the boundary of the region defined by $x = y^2, y = x^2$. CO2- App (16)

18. (a) (i) Find the Laplace transform of f(t) = CO3- App (8)

$$\begin{cases} k & ,0 < t < a \\ -k & ,a < t < 2a \end{cases}$$

(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. $y'' - 8y' + 7y = e^{-2t}$ given that if $y(0) = 0,\ y'(0) = 0$ CO3- App (8)

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

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

Or

(b) (i) Compute first three harmonics of the Fourier series for the following data. CO4- App (16)

x	0	2	4	6	8	10	12
y	9.0	18.2	24.4	27.8	27.5	22.0	9.0

20. (a) Compute the Fourier Transform of CO5- App (16)

$$f(x) = \begin{cases} 1 - x^2 & |x| < 1 \\ 0 & otherwise \end{cases}$$ and hence evaluate the value of (i)

$\int_0^\infty \frac{\sin t - t\cos t}{t^3}\,dt$ $\int_0^\infty \left(\frac{\sin t - t\cos t}{t^3}\right)^2 dt$

Or

(b) Evaluate CO5- App (16)

(i) $\int_0^{\infty} \frac{dx}{(x^2+1)(x^2+4)}$ (ii) $\int_0^{\infty} \frac{x^2 dx}{(x^2+9)^2}$ using Fourier transform