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

Question Paper Code: R2M05

B.E./B.Tech. DEGREE EXAMINATION, MAY 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. Particular Integral of $(D^2 + 4)y = \sin 2x$ CO1-App

(a) $\frac{x}{4}\cos 2x$ (b) $-\frac{x}{4}\cos 2x$ (c) $-\frac{x}{4}\sin 2x$ (d) $\frac{x}{4}\sin 2x$

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

(a) -cosecx (b) -cotx (c) -cosx (d) -sinx

3. $\vec{F} = 3x\vec{i} + 4\vec{yj} - z\vec{k}$ then find $\nabla \circ \vec{F}$ CO2- App

(a) 8 (b)6 (c)7 (d) 0

4. $\nabla \times \vec{r} =$ ____ CO2- R

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

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. L (e^{at} f(t)) = _____ CO3- U

(a) F(s + a) (b)F(s – a) (c)F(s) (d) – F(s)

7. $\cos x$ is a periodic function with CO6 -U

(a) π (b) 2π (c) $\pi/3$ (d) $2\pi/3$

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

(a) π^2 (b) 2π (c) $2\pi^2$ (d) $\frac{\pi^2}{2}$

9. Fourier transform of $\sqrt{2\pi}, -1 < x < 1$ CO5- App

(a) $\frac{\cos s}{s}$ (b) $\sqrt{2\pi}\frac{\cos s}{s}$ (c) $\sqrt{2\pi}\frac{\sin s}{s}$ (d) $\frac{2\sin s}{s}$

10. Fourier Sine transform of e^{-5x} CO5- R

(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 $(D^2+1)y = x^2$ CO1 App

12. If $\vec{F} = (16x - 3y + z)\vec{i} + (x + 2ay - 2z)\vec{j} + (3x + 2y - 2z)\vec{k}$ is solenoid find the value of 'a' CO2 App

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

14. State Dirichlet's conditions CO4 U

15. Define Fourier sine transform pair CO5 App

PART – C (5 x 16= 80 Marks)

16. (a) (i) Solve the method of variation of parameters, $(D^2+1)y = \cot x$ CO1- App (8)

(ii) Solve the differential equation $(D^2+5D+6)y = e^{-x} + \cos 2x$ CO1- App (8)

Or

(b) (i) Solve the differential equation $(D^2+5D+4)y = e^{2x} + \sin 3x$ CO1- App (8)

(ii) Solve the differential equation $(x^2D^2 - 3xD - 5)y = x^2\sin(\log x)$ CO1- App (8)

17. (a) Verify Divergence theorem for $\vec{F} = 5x^2\vec{i} + 4y^2\vec{j} + 7z^2\vec{k}$ over the rectangular parallelepiped $0 \le x \le 1,\ 0 \le y \le 1,\ 0 \le z \le 1$ CO2- App (16)

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) 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)

Or

(b) (i) Find the Laplace transform of f(t) = CO3- App (8)

$$\mathbf{f(t)} = \begin{cases} \mathbf{t}, & \mathbf{0 < t < a} \\ \mathbf{2a - t}, & \mathbf{a < t < 2a} \end{cases}$$

(ii) Solve by using convolution theorem $L^{-1}\left[\frac{s}{(s^2+9)^2}\right]$ CO3- App (8)

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

x	0	1	2	3	4	5	6
y	12	14	15	18.5	13.6	11.6	12

Or

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

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

Or

(b) Compute the Fourier Transform of $f(x) = \begin{cases} 1 - |x| & if\ |x| \le 1 \\ 0 & if\ |x| > 1 \end{cases}$ CO5- App (16)

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