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

Question Paper Code: R2M05

B.E./B.Tech. DEGREE EXAMINATION, APRIL / MAY 2025

Second Semester

Electrical and Electronics Engineering

R21UMA205 - CALCULUS AND TRANSFORMS TECHNIQUES

(Regulations R2021)

Duration: Three hours | Maximum: 100 Marks

Answer ALL Questions

PART A - (10 x 2 = 20 Marks)

1.	Solve the Euler Cauchy's equation $(x^2D^2 + xD)y = 0$	CO1-App
2.	Transform $(x^2D^2 - 3xD - 5)y = x^2 \sin(\log x)$ into linear equation with constant coefficient	CO1-App
3.	Show that $\vec{F} = x^2\vec{i} + y^2\vec{j} + z^2\vec{k}$ is a conservative vector field.	CO2- App
4.	If $\phi = x^2 + y^2 - z - 10$, then find $\lvert\nabla\phi\rvert$ at (1, -1, 1).	CO2-App
5.	Compute $L\left[t^{\frac{3}{2}}\right]$	CO3-U
6.	State and Prove the Initial value theorem.	CO3 -U
7.	State Dirichlet's conditions	CO4 -U
8.	Compute the root mean square value of the function $f(x) = x$ in $(0,1)$	CO4-App
9.	Define Fourier cosine transform pair	CO5-App
10.	State convolution theorem for Fourier transform.	CO6 -U

PART – B (5 x 16= 80 Marks)

11.	(a)	(i) Solve the method of variation of parameters $(D^2 + 4)y = Sec\ 2x$	CO1- App	(8)
		(ii) Solve the differential equation $(D^2 - D - 6)y = 3e^{4x} + 5$	CO1-App	(8)

Or

(b) (i) If the population of a country double in 50 years, in how many years will it triple under the assumption that the rate of increase is proportional to the number of inhabitants? CO1- App (8)

(ii) Solve the differential equation $(x^2D^2 + 4xD + 2)y = x\log x$ CO1- App (8)

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

Or

(b) Verify Green's theorem in XY plane for, $\int_C (x^2 + y^2)dx - 2xydy$ CO2-App (16)

where C is boundary of the region $x = 0, y = 0, x = a, y = a$.

13. (a) (i) Find the Laplace transform of CO3- App (8)

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

(ii) Compute $L\left[\frac{e^{-at} - e^{-bt}}{t}\right]$ CO3- App (8)

Or

(b) (i) Solve by using L.T. $y'' - 3y' + 2y = e^{-t}$ given that if $y(0) = 1, y'(0) = 0$ CO3- App (8)

(ii) Solve by the convolution theorem CO3- App (8)

$$L^{-1}\left[\frac{s^2}{(s^2 + a^2)(s^2 + b^2)}\right]$$

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

x	0	π/3	2π/3	π	4π/3	5π/3	2π
y	1.8	0.3	0.5	2.16	1.3	1.76	1.8

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

Or

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

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

$$f(x) = \begin{cases} a - |x| & if\ |x| \le a \\ 0 & if\ |x| > a \end{cases}$$ 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) Evaluate (i) $\int_0^\infty \frac{dx}{(x^2+1)(x^2+4)}$ (ii) $\int_0^\infty \frac{dx}{(x^2+36)^2}$ using Fourier transform CO5-App (16)