

Reg.No.:

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VIVEKANANDHA COLLEGE OF ENGINEERING FOR WOMEN
[AUTONOMOUS INSTITUTION AFFILIATED TO ANNA UNIVERSITY, CHENNAI]
Elayampalayam – 637 205, Tiruchengode, Namakkal Dt., Tamil Nadu.

Question Paper Code: 20002

B.E. / B.Tech. DEGREE END-SEMESTER EXAMINATIONS - NOV. / DEC. 2024

Third Semester

Electrical and Electronics Engineering

U19MA303 – TRANSFORMS AND PARTIAL DIFFERENTIAL EQUATIONS

(Common to ECE, BT & BME)

(Regulation 2019)

Time : Three Hours

Maximum : 100 Marks

Answer ALL the questions

Knowledge Levels (KL)	K1 – Remembering	K3 – Applying	K5 - Evaluating
	K2 – Understanding	K4 – Analyzing	K6 - Creating

PART – A

(10 x 2 = 20 Marks)

Q.No.	Questions	Marks	KL	CO
1.	Obtain the first term of the Fourier series for the function $f(x) = x^2, -\pi < x < \pi.$	2	K2	CO1
2.	Find the RMS value of $f(x) = (l-x)^2, 0 \leq x \leq l.$	2	K1	CO1
3.	Eliminate the arbitrary function f from $z = f\left(\frac{y}{x}\right).$	2	K2	CO2
4.	Solve $\sqrt{p} + \sqrt{q} = 1.$	2	K1	CO2
5.	Write down the three possible solutions of one dimensional heat equation.	2	K1	CO3
6.	Classify the partial differential equation $y^2 u_{xx} - 2xy u_{xy} + x^2 u_{yy} + 2u_x - 3u_y = 0.$	2	K1	CO3
7.	Find the Fourier cosine transform of $e^{-2x} + 2e^{-x}.$	2	K2	CO4
8.	State Parseval's identity on Fourier transforms.	2	K1	CO4
9.	Find the Z-transform of $\frac{1}{n!}.$	2	K1	CO5

10. If Z transform of a function $f(n)$ is

2 K2 CO5

$$F(z) = \frac{3z^2}{(z-4)(z-5)}, \text{ find } f(0).$$

PART – B

(5 x 16 = 80 Marks)

Q.No. Questions Marks KL CO

11. a) i. Find the Fourier series expansion of $f(x) = \begin{cases} x & \text{for } 0 \leq x \leq \pi \\ 2\pi - x & \text{for } \pi \leq x \leq 2\pi \end{cases}$ of 8 K3 CO1

Deduce that $\frac{1}{1^2} + \frac{1}{3^2} + \frac{1}{5^2} + \dots \infty = \frac{\pi^2}{8}$.

ii. Find the half range sine series $f(x) = lx - x^2$ in $(0, l)$. 8 K3 CO1

(OR)

b) i. Find the Fourier series of $f(x) = x^2$ in $(-\pi, \pi)$. Hence deduce the value of $\sum_{n=1}^{\infty} \left(\frac{1}{n^2}\right)$ 8 K3 CO1

ii. The following table gives the variations of a periodic current over a period T 8 K3 CO1

x	0	$\frac{T}{6}$	$\frac{T}{3}$	$\frac{T}{2}$	$\frac{2T}{3}$	$\frac{5T}{6}$	T
f(x)	1.98	1.3	1.05	1.3	-0.88	-0.25	1.98

Find the fundamental and second harmonics of $f(x)$ to express $f(x)$ in a

Fourier series in the form $f(x) = \frac{a_0}{2} + a_1 \cos \theta + b_1 \sin \theta$, where

$$\theta = 2\pi x/T.$$

12. a) i. Solve the partial differential equation $x(y-z)p + y(z-x)q = z(x-y)$. 8 K3 CO2

ii. Solve $z = px + qy + p^2 - q^2$. 8 K3 CO2

(OR)

b) i. Solve $(D^2 - 5DD' - 6D'^2)z = \sin(x-2y) + e^{2x}$. 8 K3 CO2

ii. Solve $p^2 + q^2 = z^2(x^2 + y^2)$. 8 K3 CO2

13. a) A tightly stretched string of length 'l' is initially at rest in its equilibrium position and each of its points is given the velocity $V_0 \sin^3\left(\frac{\pi x}{l}\right)$. Find the displacement $y(x, t)$. 16 K5 CO3

(OR)

- b) A rod, 30 cm long has its ends A and B kept at 20°C and 80°C respectively, until steady state conditions prevail. The temperature at each end is then suddenly reduced to 0°C and kept so. Find the resulting temperature distribution function $u(x, t)$ taking $x = 0$ at A. 16 K5 CO3
14. a) Find the Fourier transform of $f(x) = \begin{cases} a - |x|, & |x| < a \\ 0, & |x| > a \end{cases}$. Hence evaluate 16 K5 CO4
- $$\int_0^{\infty} \left(\frac{\sin x}{x} \right)^2 dx \text{ and } \int_0^{\infty} \left(\frac{\sin x}{x} \right)^4 dx .$$
- (OR)
- b) i. Find Fourier sine transform of x^{n-1} and hence prove $\frac{1}{\sqrt{x}}$ is self reciprocal under Fourier sine transforms. 8 K3 CO4
- ii. Evaluate $\int_0^{\infty} \frac{dx}{(x^2 + a^2)(x^2 + b^2)}$ using transforms. 8 K3 CO4
15. a) i. Find the Z- Transform of $r^n \cos n\theta$ and $r^n \sin n\theta$. 8 K3 CO5
- ii. Find the inverse Z-transform of $\frac{z}{(z-1)(z-2)}$. 8 K3 CO5
- (OR)
- b) i. Using convolution theorem, find the inverse Z-transform of $\frac{8z^2}{(2z-1)(4z+1)}$. 8 K3 CO5
- ii. Solve the difference equation 8 K3 CO5
- $$y(n+2) + 4y(n+1) + 4y(n) = n \text{ given } y_0 = y_1 = 1.$$