

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. 2025

Third Semester

Electrical and Electronics Engineering

U23MA303 – TRANSFORMS AND PARTIAL DIFFERENTIAL EQUATIONS

(Common to ECE, BME, BT, AE and CE)

(Regulation 2023)

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.	Explain the Dirichlet's conditions for a function $f(x)$ to have Fourier series expansion.	2	K2	CO1
2.	Find the value of $a_1$ from $f(x) = x + x^2$ in $(0, 2\pi)$ .	2	K1	CO1
3.	Find the partial differential equations of all spheres whose centers lie on the X- axis.	2	K2	CO2
4.	Solve $\frac{\partial^2 z}{\partial y^2} = \sin y$ .	2	K2	CO2
5.	Classify the equation $f_{xx} - 2f_{yy} = 0$ .	2	K2	CO3
6.	List all three possible solutions of steady state two dimensional heat equations.	2	K1	CO3
7.	Define the Fourier integral theorem.	2	K1	CO4
8.	Define the convolution theorem in Fourier transforms.	2	K1	CO4
9.	Find the Z – transform of unit step sequence .	2	K1	CO5
10.	Form the difference equation for $y_n = a + b(3^n)$ .	2	K2	CO5

PART – B

(5 x 16 = 80 Marks)

Q.No.	Questions	Marks	KL	CO														
11. a)	i. Construct the Fourier series for the function $f(x) = x(2\pi - x)$ in $(0, 2\pi)$ .	8	K3	CO1														
	ii. Find the function $f(x) = x \cos x$ as a Fourier series in the interval $(-\pi, \pi)$ .	8	K1	CO1														
(OR)																		
b)	i. Construct the Fourier cosine series expansion for $f(x) = x$ in $(0, 4)$ and hence deduce the value $\frac{1}{1^4} + \frac{1}{3^4} + \frac{1}{5^4} + \dots$	8	K3	CO1														
	ii. Find the Fourier series as far as the second harmonic to represent the function given in the following data.	8	K1	CO1														
<table border="1" style="margin: auto;"> <tr> <td>x</td> <td>0</td> <td>1</td> <td>2</td> <td>3</td> <td>4</td> <td>5</td> </tr> <tr> <td>f(x)</td> <td>9</td> <td>18</td> <td>24</td> <td>28</td> <td>26</td> <td>20</td> </tr> </table>					x	0	1	2	3	4	5	f(x)	9	18	24	28	26	20
x	0	1	2	3	4	5												
f(x)	9	18	24	28	26	20												
12. a)	i. Form the PDE by eliminating the arbitrary functions “f” and “g” in $z = f(2x + y) + g(3x - y)$	8	K3	CO2														
	ii. Solve $z = px + qy + \sqrt{1 + p^2 + q^2}$ .	8	K3	CO2														
(OR)																		
b)	i. Solve the equation $(x^2 - y^2 - z^2)p + 2xyq = 2zx$ .	8	K3	CO2														
	ii. Solve $(D^2 - 2DD')z = e^{2x} + x^3y$	8	K3	CO2														
13. a)	A uniform string is stretched and fastened to two points “l” apart. Motion is started by displacing the string into the form of the curve $y = k(lx - x^2)$ and then releasing it from this position at time $t = 0$ . Determine the displacement of the point of the string at a distance of $x$ from one end at time $t$ .	16	K5	CO3														
(OR)																		
b)	A rod of length 20 cm has its ends A and B kept at temperature $30^\circ\text{C}$ and $90^\circ\text{C}$ respectively, until steady state conditions prevail. If the temperature at each end is then suddenly reduced to $0^\circ\text{C}$ and maintained so, determine the temperature $u(x, t)$ at a distance $x$ from A at time $t$ .	16	K5	CO3														

14. a) i. Determine the Fourier transform of 8      K5      CO4  

$$f(x) = \begin{cases} a^2 - x^2 & \text{in } |x| \leq a \\ 0 & \text{in } |x| > a > 0 \end{cases}$$
 and Hence find the value  
of  $\int_0^{\infty} \frac{\sin t - t \cos t}{t^3} dt$ .
- ii. Show that  $e^{-\frac{x^2}{2}}$  is self-reciprocal under Fourier Transform. 8      K2      CO4  
(OR)
- b) i. Determine  $I = \int_0^{\infty} \frac{x^2}{(x^2 + 4)(x^2 + 25)} dx$  by using Fourier 8      K5      CO4  
Transforms.
- ii. Find the Fourier cosine Transform of  $\frac{e^{-ax}}{x}$  and hence 8      K2      CO4  
find  $F_c \left( \frac{e^{-ax} - e^{-bx}}{x} \right)$ .
15. a) i. Find  $z\{r^n \cos n\theta\}$  and  $z\{r^n \sin n\theta\}$ . 8      K1      CO5  
ii. Construct the value of  $f(0)$  and  $f(\infty)$  if 8      K3      CO5  
 $Z \left[ \frac{5z}{(z-2)(z-3)} \right]$ .
- (OR)
- b) i. Find  $Z^{-1} \left[ \frac{8z^2}{(2z-1)(4z+1)} \right]$  by using Convolution 8      K1      CO5  
theorem.
- ii. Solve  $y_{n+2} - 5y_{n+1} + 6y_n = 4^n$  given that 8      K3      CO5  
 $y(0) = 0, y(1) = 1$  by Z-transforms.