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# INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

B.Tech II Semester End Examinations (Regular) - May, 2017

Regulation: IA-R16

**MATHEMATICAL TRANSFORM TECHNIQUES**

(Electronics and Electrical Engineering)

Time: 3 Hours

Max Marks: 70

Answer ONE Question from each Unit

All Questions Carry Equal Marks

All parts of the question must be answered in one place only

## UNIT – I

1. (a) Find the Fourier Series of  $f(x) = \begin{cases} 4 - x, & 3 < x < 4 \\ x - 4, & 4 < x < 5 \end{cases}$  [7M]

(b) Find the Cosine Series of  $f(x) = \sin x$  in  $(0, \pi)$ . [7M]

2. Obtain the Fourier series for  $f(x) = \begin{cases} 0 & \text{for } -\pi < x < 0 \\ \sin x & \text{for } 0 < x < \pi \end{cases}$  in  $(-\pi, \pi)$  [14M]

## UNIT – II

3. (a) Find the Fourier transform of  $f(x) = \begin{cases} 1 - |x|, & |x| \leq 1 \\ 0, & |x| > 1 \end{cases}$  and hence deduce that  $\int_0^{\infty} \frac{\sin^2 t}{t^2} dt = \frac{\pi}{2}$ . [7M]

(b) Solve the integral equation,  $\int_0^{\infty} f(\theta) \cos(\theta\alpha) d\theta = \begin{cases} 1 - \alpha, & 0 \leq \alpha \leq 1 \\ 0, & \alpha > 1 \end{cases}$  [7M]

4. (a) Find the Fourier Cosine transform of  $e^{-ax}$  and hence that the Fourier Cosine transform of  $e^{-ax}$ . Further evaluate  $\int_0^{\infty} \frac{\cos \pi x}{x^2 + a^2} dx$  [7M]

(b) Find the Fourier transform of,  $f(x) = \begin{cases} 1, & |x| \leq a \\ 0, & |x| > a \end{cases}$  where  $a$  is a Positive Constant hence evaluate  $\int_{-\infty}^{\infty} \frac{\sin ax \cos \alpha x}{x} dx$  [7M]

## UNIT – III

5. (a) Find the Laplace transform of [7M]

- $\frac{\cos 2t - \cos 3t}{t}$
- $t \sin at$

(b) Given  $f(t) = \begin{cases} E, & 0 < t < a/2 \\ -E, & a/2 < t < a \end{cases}$ ,  $f(t+a) = f(t)$

Show that  $L\{f(t)\} = \frac{E}{s} \tanh(as/4)$

6. (a) Find  $L^{-1}\left\{\frac{5S+3}{(S-1)(S^2+2S+5)}\right\}$  [7M]

(b) Verify Convolution theorem for  $f(t) = t$  and  $g(t) = \cos t$  [7M]

**UNIT – IV**

7. (a) Using Partial fraction method, find the inverse Z – transform of  $\frac{Z^3-20Z}{(Z-2)^3(Z-4)}$  [7M]

(b) Using Z – transform solve  $Y_{n+2} + 2Y_{n+1} + Y_n = n, Y_0 = Y_1 = 0$  [7M]

8. (a) Using Convolution theorem, find the inverse Z – transform of  $\left(\frac{Z}{Z-2}\right)^3$  [7M]

(b) Using Z – transform, solve,  $Y_{n+2} + 4Y_{n+1} + 4Y_n = 7, Y_0 = 1, Y_1 = 2.$  [7M]

**UNIT – V**

9. (a) Solve  $4\frac{\partial u}{\partial x} + \frac{\partial u}{\partial y} = 3u$  and  $u = e^{-5y}$  when  $x=0$  for all values of  $y$ . [7M]

(b) Solve the partial differential equation  $x(y-z)p + y(z-x)q = z(x-y)$ . [7M]

10. The ends A and B of a rod of 20 cm long, have the temperature at and until steady state prevails. The temperature of the ends are changed to  $40^\circ C$  and  $60^\circ C$  respectively. Find the temperature distribution in the rod at time. [14M]