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Question Paper Code: 93026

B.E./B.Tech. DEGREE EXAMINATION, MAY 2022

Third Semester

Chemical Engineering

19UMA326- Transform Techniques and Partial Differential Equations

(Regulation 2019)

(Common to Agriculture ,Biomedical and Bio technology)

Duration: Three hours

Maximum: 100 Marks

Answer All Questions

PART A - (10x 1 = 10 Marks)

1. The term $(a_1 \cos x + b_1 \sin x)$ in fourier series is called ----- CO6-U
(a) First harmonic (b) Second harmonic
(c) Third harmonic (d) Fourier Coefficients
2. The root mean square value of $f(x)$ in $(0, l)$ is----- CO1- App
(a) 1 (b) $\frac{1}{2}$ (c) $l/\sqrt{3}$ (d) $2l$
3. $F_s[e^{-ax}] = \underline{\hspace{2cm}}$ CO2- App
(a) $\sqrt{\frac{2}{\pi}} \left(\frac{a}{s^2 + a^2} \right)$ (b) $\sqrt{\frac{2}{\pi}} \left(\frac{s}{s^2 + a^2} \right)$ (c) $\sqrt{\frac{2}{\pi}} \left(\frac{a^2}{s^2 + a^2} \right)$ (d) $\sqrt{\frac{2}{\pi}} \left(\frac{s^2}{s^2 + a^2} \right)$
4. In Modulation property, $F[f(x) \cos ax] = \underline{\hspace{2cm}}$ CO6- U
(a) $\frac{1}{2}[F(s+a) - F(s-a)]$ (b) $\frac{1}{2}[F(s+a) + F(s-a)]$
(c) $[F(s+a) + F(s-a)]$ (d) $F(s+a) + F(s-a)$

5. The difference equation of $z(e^{an})$ CO3- App

(a) $\frac{z}{z + e^a}$ (b) $\frac{z^2}{z + e^a}$ (c) $\frac{z}{z - e^a}$ (d) $\frac{z^2}{z - e^a}$

6. The Z transform of $n2^n$ is ___ CO6- U

a) $\frac{2z}{(z-2)^2}$ b) $\frac{z}{(z-2)^2}$ c) $\frac{2z}{(z+2)^2}$ d) $\frac{z}{(z+2)^2}$

7. The general solution of $2r + 5s - 3t = 0$ is CO4- App

(a) $f_1(y + 3x) + f_2(2y - x)$ (b) $f_1(3y + x) + f_2(y + 2x)$
 (c) $f_1(y - 3x) + f_2(2y - x)$ (d) none of these

8. The particular integral of $(D^2 + 3DD' - 4D'^2)z = \sin y$ is ___ CO4- App

(a) $\frac{1}{2} \sin y$ (b) $\frac{1}{4} \sin y$ (c) $\sin y$ (d) $-\sin y$

9. In a one dimensional wave equation, $c^2 =$ ___ CO6- U

(a) T^2/m^2 (b) T/m (c) T/m^2 (d) T^2/m

10. An insulated rod of length 60 cm has its ends at A and B kept at 20°C and 80°C respectively, then its steady state solution is CO5- App

(a) $x-20$ (b) $4x+20$ (c) $x+20$ (d) $x+60$

PART – B (5 x 2= 10Marks)

11. State Dirichlet's conditions CO6- U

12. Find $F_c[e^{-ax}]$ CO6- U

13. Find $Z\left[\frac{1}{n!}\right]$ CO3-App

14. Solve $\sqrt{p} + \sqrt{q} = 1$ CO4- App

15. Write the three Possible solutions of the one dimensional wave equations CO6- U

PART – C (5 x 16= 80Marks)

16. (a) The table of values of the function $y = f(x)$ is given below: CO1- App (16)

X	0	$\pi/3$	$2\pi/3$	π	$4\pi/3$	$5\pi/3$	2π
y:	1.0	1.4	1.9	1.7	1.5	1.2	1.0

Find a Fourier series up to the third harmonic to represent $f(x)$ in terms of x

Or

- (b) (i) Calculate the Fourier series expansion for $f(x) = x + x^2$ in $(-\pi, \pi)$ CO1 - Ana (8)

- (ii) Find the Fourier Sine Series of $f(x) = x$ in $(0, l)$ CO1 -Ana (8)

17. (a) Show that the Fourier transform of CO2 -App (16)

$$f(x) = \begin{cases} a^2 - x^2 & |x| < a \\ 0 & |x| > a \end{cases} \quad \text{is } 2\sqrt{\frac{2}{\pi}} \left[\frac{\sin sa - sa \cos sa}{s^3} \right] \quad \text{Hence deduce}$$

$$\int_0^{\infty} \frac{\sin t - t \cos t}{t^3} dt = \pi/4$$

Using Parseval's identity show that $\int_0^{\infty} \left(\frac{\sin t - t \cos t}{t^3} \right)^2 dt = \pi/15$

Or

- (b) (i) Evaluate $\int_0^{\infty} \frac{x^2 dx}{(x^2 + a^2)^2}$ CO2 -App (8)

- (ii) Evaluate $\int_0^{\infty} \frac{dx}{(x^2 + 9)(x^2 + 4)}$ CO2 -App (8)

18. (a) (i) Find the $z^{-1} \left[\frac{12z^2}{(3z-1)(4z-1)} \right]$ using convolution theorem CO3- App (8)

- (ii) Solve $y_{n+2} + 6y_{n+1} + 9y_n = 2^n$ given $y_0 = y_1 = 0$ CO3- App (8)

Or

- (b) (i) Evaluate $Z[r^n \cos n\theta]$ and $Z[r^n \sin n\theta]$ CO3- App (8)

- (ii) Evaluate $z^{-1} \left[\frac{z^3}{(z-1)^2(z-2)} \right]$ using partial fraction. CO3- App (8)

19. (a) (i) Solve $x^2(y-z)p + y^2(z-x)q = z^2(x-y)$ CO4-App (8)

- (ii) Solve $(D^2 - 4DD' + 4D'^2)z = e^{2x+y} + \sin(3x + 4y)$ CO4-App (8)

Or

- (b) (i) Solve $z=px+qy+p^2q^2$ CO4 -App (8)
- (ii) Form the partial differential equation by eliminating the arbitrary function f and g in $z = x^2 f(y) + y^2 g(x)$ CO4 -App (8)
20. (a) A String is stretched and fastened to two points l apart .Motion is started by displacing the string into the form $y=K x(1-x)$ from which it is released at $t=0$.Find the displacement of any point at a distance ' x ' at any time ' t '. CO5- App (16)
- Or
- (b) A bar of 10cm long with insulated sides has its ends A and B kept at 20° c and 40° c respectively. Until steady state condition prevails. The temperature at A is then suddenly raised to 50° c and at the same instant B is lower to 10° c and maintained thereafter. Find the subsequent temperature distribution in the bar. CO5- App (16)