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Question Paper Code: 93026

B.E./B.Tech. DEGREE EXAMINATION, APRIL 2024

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)

- 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
- The constant term in the Fourier expansion for $f(x) = k$, $(0, 2\pi)$ is CO1- App
(a) $2k$ (b) $3k$ (c) k (d) 0
- $F_s[e^{-ax}] = \underline{\hspace{2cm}}$ 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) $\sqrt{\frac{2}{\pi}} \left(\frac{s^2}{s^2 + a^2} \right)$
- 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) $F(s+a) + F(s-a)$
- 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 $f_n 2^n$ 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. $Au_{xx} + Bu_{xy} + Cu_{yy} + Du_x + Eu_y + Fu = f(x, y)$ is parabolic __. CO6- U
- (a) $B^2 - 4AC < 0$ (b) $B^2 - 4AC = 0$ (c) $B^2 - 4AC > 0$ (d) $B^2 - 4AC \neq 0$

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 = 10 Marks)

11. Find the root mean square value of the function $f(x) = x$ in $(0, 1)$ CO1-App

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

13. State Initial and final value Theorem on Z Transform CO6- U

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

15. Write the constant term in the one dimensional heat equation CO6- U

PART – C (5 x 16 = 80 Marks)

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) Find the Half range cosine series for $f(x) = x(\pi - x)$ in $(0, \pi)$. CO1 - Ana (8)

- (ii) Find the Fourier series for $f(x) = x$ in $(0, 2l)$. CO1 -Ana (8)

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

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

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

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

(ii) Prove that $f(x) = e^{-x^2}$ is self-reciprocal under Fourier series Transform 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 $(3z-4y)p+(4x-2z)q=2y-3x$ CO4-App (8)

(ii) Solve $(D^2 - DD' - 20D'^2)z = e^{5x+y} + \sin(4x - y)$ 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 tightly String with fixed end points $x=0$ and $x=1$ is initially at rest in its equilibrium position. If its set vibrating giving each point at velocity $\lambda(1x-x^2)$. Find the displacement. CO5- App (16)

Or

- (b) The ends A and B of a rod 30cms long have their temperature kept at 20°C and the other at 80°C until Steady state conditions prevail CO5- App (16)
.The Temperature of the end B is then suddenly reduced to 60°C and kept so while the end A is raised to 40°C .Find the temperature distribution in the rod after time t.