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Question Paper Code : X 60767

B.E./B.Tech. DEGREE EXAMINATIONS, NOV./DEC. 2020

Second/Third Semester

Civil Engineering

MA 2211/10177 MA 301/MA 1201 A/080100008/080210001/ MA 31

– TRANSFORMS AND PARTIAL DIFFERENTIAL EQUATIONS

(Common to all Branches)

(Regulations 2008/2010)

(Also Common to PTMA2211 for B.E.(Part-Time) Second Semester-All
Branches - Regulations 2009)

Time : Three Hours

Maximum : 100 Marks

Answer ALL questions.

PART – A

(10×2=20 Marks)

1. Find the value of a_0 in the Fourier series expansion of $f(x) = e^x$ in $(0, 2\pi)$.
2. Find the half range sine series expansion of $f(x) = 1$ in $(0, 2)$.
3. State Fourier integral theorem.
4. Find the Fourier sine transform of $f(x) = e^{-x/2}$.
5. Form the PDE from $(x - a)^2 + (y - b)^2 + z^2 = r^2$.
6. Find the complete integral of $p + q = pq$.
7. What is the basic difference between the solutions of one dimensional wave equation and one dimensional heat equation with respect to the time ?
8. Write down the partial differential equation that represents steady state heat flow in two dimensions and name the variables involved.
9. Find the Z-transform of a^n .
10. Solve $y_{n+1} - 2 y_n = 0$, given that $y(0) = 2$.



PART – B

(5×16=80 Marks)

11. a) i) Find the Fourier series of x^2 in $(-\pi, \pi)$ and hence deduce that

$$\frac{1}{1^4} + \frac{1}{2^4} + \frac{1}{3^4} + \dots = \frac{\pi^4}{90}. \quad (8)$$

- ii) Obtain the Fourier cosine series of $f(x) = \begin{cases} kx, & 0 < x < \frac{1}{2} \\ k(l-x), & \frac{1}{2} < x < l \end{cases}$.
(OR) (8)

- b) i) Find the complex form of Fourier series of $\cos ax$ in $(-\pi, \pi)$, where “a” is not an integer. (8)

- ii) Obtain the Fourier cosine series of $(x-1)^2$, $0 < x < 1$ and hence show that $\frac{1}{1^2} + \frac{1}{2^2} + \frac{1}{3^2} + \dots = \frac{\pi^2}{6}$. (8)

12. a) i) Find the Fourier transform of $f(x) = \begin{cases} 1-|x| & \text{if } |x| < 1 \\ 0, & \text{if } |x| > 1 \end{cases}$ and hence

evaluate $\int_0^{\infty} \frac{\sin^4 t}{t^4} dt$. (8)

- ii) Find the Fourier transform of $f(x) = \begin{cases} a^2 - x^2, & |x| \leq a \\ 0, & |x| > a > 0 \end{cases}$. Hence deduce that $\int_0^{\infty} \frac{\sin t - t \cos t}{t^3} dt = \frac{\pi}{4}$.
(OR) (8)

- b) i) Find the Fourier cosine and sine transforms of $f(x) = e^{-ax}$, $a > 0$ and hence deduce the inversion formula. (8)

- ii) Find the Fourier cosine transform of $e^{-a^2 x^2}$, $a > 0$. Hence show that the function $e^{-x^2/2}$ is self-reciprocal. (8)

13. a) i) From the PDE by eliminating the arbitrary functions f_1, f_2 from the relation $Z = xf_1(x+t) + f_2(x+t)$. (8)

- ii) Solve $\left(\frac{p}{2} + x\right)^2 + \left(\frac{q}{2} + y\right)^2 = 1$.
(OR) (8)

- b) i) Solve $x^2 p + y^2 q = z(x+y)$. (8)

- ii) Solve $(r+s-6t) = y \cos x$. (8)



14. a) A tightly stretched string with fixed end points $x = 0$ and $x = l$ is initially in a position given by $y(x, 0) = K(lx - x^2)$. It is released from rest from this positions. Find the expression for the displacement at any time 't'. (16)

(OR)

- b) Find the solution to the equation $\frac{\partial u}{\partial t} = a^2 \frac{\partial^2 u}{\partial x^2}$ that satisfies the conditions,

$$u(0, t) = 0, u(l, t) = 0 \text{ for } t > 0 \text{ and } u(x, 0) = \begin{cases} x, & 0 \leq x \leq l/2 \\ l-x, & l/2 < x < l \end{cases} \quad (16)$$

15. a) i) Find $Z[n(n-1)(n-2)]$. (8)

- ii) Using Convolution theorem, find the inverse Z-transform of

$$\frac{8z^2}{(2z-1)(4z-1)}. \quad (8)$$

(OR)

- b) i) Solve the difference equation $y(k+2) + y(k) = 1, y(0) = y(1) = 0$, using Z-transform. (8)

- ii) Solve $y_{n+2} + y_n = 2^n \cdot n$, using Z-transform. (8)
