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**Question Paper Code : X 10659**

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

Third Semester

Civil Engineering

MA 8353 – TRANSFORMS AND PARTIAL DIFFERENTIAL EQUATIONS

(Common to Aeronautical Engineering/Aerospace Engineering/Agriculture Engineering/Automobile Engineering/Electrical and Electronics Engineering/ Electronics and Instrumentation Engineering/Industrial Engineering/ Industrial Engineering and Management/Instrumentation and Control Engineering/ Manufacturing Engineering/Marine Engineering/Material Science and Engineering/Mechanical Engineering/Mechanical Engineering (Sandwich) Mechanical and Automation Engineering/Mechatronics Engineering/ Production Engineering/Robotics and Automation/Bio Technology/Chemical and Electrochemical Engineering/ Food Technology/Pharmaceutical Technology) (Regulations 2017)

Time : Three Hours

Maximum : 100 Marks

Answer ALL questions.

PART – A

**(10×2=20 Marks)**

1. Obtain the Partial differential equation by eliminating the arbitrary constants a and b from  $z = (x^2 + a)(y^2 + b)$ .
2. Find the complete solution of  $p^2 + q^2 = 1$ .
3. State Dirichlet's Conditions.
4. Write the Complex Fourier series.
5. Write the possible solutions of the steady state two dimensional heat flow equation  $\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} = 0$ .
6. What is meant by steady state ?
7. If the Fourier transform of  $f(x)$  is  $F(s)$ , then find the Fourier transform of  $f(x)\cos ax$ .

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8. Write the Parsevals identity of Fourier transform.
9. Find the Z-transform of  $a^n$ .
10. State Final Value Theorem.

PART – B

(5×16=80 Marks)

11. a) i) Solve the equation  $z = px + qy + \sqrt{1 + p^2 + q^2}$ . (8)

ii) Solve  $z^2(p^2 + q^2) = x + y$ . (8)

(OR)

b) i) Solve  $2(z + xp + yq) = yp^2$ . (8)

ii) Solve  $\frac{\partial^3 z}{\partial x^3} - 2 \frac{\partial^3 z}{\partial x^2 \partial y} = \sin(x + 2y) + 3x^2y$  (8)

(OR)

12. a) i) Find the Fourier series expansions of  $f(x) = x^2 + x$  in  $(-\pi, \pi)$  of Periodicity  $2\pi$ . (8)

ii) Obtain half range Fourier Cosine series expansion of  $f(x) = (x - 1)^2$  in  $0 < x < 1$  and evaluate  $\frac{\pi^2}{6} = 1 + \frac{1}{2^2} + \frac{1}{3^2} + \dots$  (8)

(OR)

b) i) Obtain the Fourier series expansion of  $f(x) = \begin{cases} -x, & -\pi < x \leq 0 \\ x, & 0 < x < \pi \end{cases}$  and evaluate  $\frac{\pi^2}{6} = 1 + \frac{1}{3^2} + \frac{1}{5^2} + \dots$  (8)

ii) Obtain the First three harmonics in the Fourier cosine series of  $y = f(x)$  using the following table : (8)

**x :** 0    1    2    3    4    5

**y :** 4    8    15    7    6    2.

13. a) A tightly stretched string of length  $l$  is fastened at bath end A & C. The string is at rest, with the point B( $x = b$ ) drawn aside through a small distance 'd' and released to execute small transverse vibration. Find the transverse displacement of any point of the string at any subsequent time. (16)

(OR)

b) A uniform bar of length  $l$  through which heat flows is insulated at its sides. The ends are kept at zero temperature. If the initial temperature at the interior points of the bar is given by  $k(lx - x^2)$ , for  $0 < x < l$ , find the temperature distribution in the bar after time  $t$ . (16)

14. a) i) Find the Fourier sine transform of  $f(x) = \frac{e^{-ax}}{x}$ . (8)

ii) Find Fourier transform of  $f(x) = \begin{cases} 1, & |x| < 1 \\ 0, & |x| > 1 \end{cases}$  and hence evaluate  $\int_0^{\infty} \frac{\sin x}{x} dx$ . (8)  
(OR)

b) i) Verify Convolution theorem for Fourier transform, if  $f(x) = g(x) = e^{-x^2}$ . (8)

ii) Find Fourier sine integral of  $f(x) = \begin{cases} 1, & 0 \leq x \leq 1 \\ 0, & x > 0 \end{cases}$  and hence evaluate  $\int_0^{\infty} \frac{1 - \cos(\pi\alpha)}{\alpha} \sin(x\alpha) dx$ . (8)

15. a) i) Find Z-transform of  $2n + 5 \sin \frac{n\pi}{4} - 3a^4$ . (8)

ii) Find the inverse Z-transform of  $\frac{4z^2 - 2z}{z^3 - 5z^2 + 8z - 4}$ . (8)  
(OR)

b) i) Using Convolution Theorem, find the inverse Z-transform of  $\frac{z^2}{(z-2)(z-3)}$ . (8)

ii) Using Z-transformation, solve  $U_{n+2} + 4U_{n+1} + 2U_n = 3^n$  given that  $u_0 = 0, u_1 = 1$ . (8)

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