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Question Paper Code: 52764

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2017
Fifth Semester

Civil Engineering

MA 2211 – TRANSFORMS AND PARTIAL DIFFERENTIAL EQUATIONS (Common to all Branches)

(Regulations 2008)

Time: Three Hours

Maximum: 100 Marks

Answer ALL questions.

PART - A

 $(10\times2=20 \text{ Marks})$

- 1. If f(x) is discontinuous at a point x = a, then what does its Fourier series represent at that point.
- 2. Write the complex form of Fourier series for a function f(x) defined in -l < x < l.
- 3. State the Fourier integral theorem.
- 4. If F[f(x)] = F(s), then find F[f(x-a)].
- 5. Find the partial differential equation by eliminating the arbitrary constants 'a' and 'b' from the relation z = a(x + y) + b.
- 6. Find the complete integral of $z = px + qy + \sqrt{pq}$.
- 7. If the ends of the string of length *l* are fixed and the midpoint of the string is displaced by a distance 'h' transversely and the string is released from rest, then write the initial conditions.
- 8. Write all possible solutions of two dimensional heat flow equation in steady state.
- 9. Find the Z-transform of the function f(n) = n.
- 10. Form the difference equation by eliminating arbitrary constant 'a' from $y_n = a.2^{n+1}$.



(2)

PART - B

(5×16=80 Marks)

- 11. a) i) Find the Fourier series for a function $f(x) = x + x^2$ in $(-\pi, \pi)$ and hence deduce the value of $\frac{1}{1^2} + \frac{1}{2^2} + \frac{1}{3^2} + \dots$
 - ii) Find the Fourier series of y = f(x) up to second harmonic which is defined by the following data in $(0, 2\pi)$.

| x | 0 | π/3 | 2π/3 | π | 4π/3 | 5π/3 | 2π |
|------|---|-----|------|-----|------|------|----|
| f(x) | 1 | 1.4 | 1.9 | 1.7 | 1.5 | 1.2 | 1 |

(OR)

- b) i) Find the half range cosine series for $f(x) = x(\pi x)$ in $(0, \pi)$. Hence deduce the value of $\frac{1}{1^4} + \frac{1}{2^4} + \frac{1}{3^4} + \dots$ (8)
 - ii) Find the Fourier series for a function $f(x) = \begin{cases} l x, & 0 < x \le l \\ 0, & l < x \le 2l \end{cases}$ in (0, 2l). (8)
- 12. a) i) If $F_S(s)$ and $F_C(s)$ denote Fourier sine and cosine transform of a function $f(x) \text{ respectively, then show that } F_C\left\{f(x)\sin ax\right\} = \frac{1}{2}\left\{F_S(s+a) F_S(s-a)\right\}. \tag{4}$
 - ii) Find the Fourier transform of a function $f(x) =\begin{cases} 1 |x| & |x| < 1 \\ 0 & |x| > 1 \end{cases}$ and hence

find the value of
$$\int_{0}^{\infty} \frac{\sin^{4} t}{t^{4}} dt$$
 by Parseval's identity. (12)

(OR)

- b) i) State the convolution theorem for Fourier transform.
 - ii) Find the Fourier sine and cosine transforms of a function $f(x) = e^{-x}$. Using Parseval's identity, evaluate:

1)
$$\int_{0}^{\infty} \frac{dx}{(x^2+1)^2}$$
 and 2) $\int_{0}^{\infty} \frac{x^2 dx}{(x^2+1)^2}$ (14)

- 13. a) i) Find the singular integral of $z = px + qy + p^2 q^2$. (8)
 - ii) Find the general integral of $x(y^2 + z) p + y(x^2 + z) q = z (x^2 y^2)$. (8)
 - b) Solve the following equations:

i)
$$(D^2 - DD' - 20D'^2) z = \sin(4x - y)$$
. (8)

ii)
$$(D^2 - D'^2 - 3D + 3D') z = xy$$
. (8)

- 14. a) A tightly stretched string of length l has its end fastened at x = 0, x = l. At t = 0, the string is in the form f(x) = kx(l-x) and then released. Find the displacement at any point of the string at a distance x from one end and at any time t > 0. (16)
 - b) A rod of length l cm has its ends A and B kept at 0° C and 100° C respectively, until steady state conditions prevail. If the temperature at B is suddenly reduced to 0° C and maintained at 0° C, find the temperature distribution u(x, t) at a distance x from A at any time t. (16)
- 15. a) i) If Z[f(n)] = F(z), then show that

1)
$$f(0) = \lim_{z \to \infty} F(z)$$
 and (8)

2)
$$\lim_{n\to\infty} f(n) = \lim_{z\to 1} [(z-1) F(z)]$$

ii) Find
$$Z^{-1} \left[\frac{8z^2}{(2z-1)(4z+1)} \right]$$
 by using convolution theorem. (8)

- b) i) Find the inverse Z-transform of $\frac{z}{(z-1)^2(z+1)}$ by method of partial fraction. (6)
 - ii) Solve the difference equation $y(n + 2) + 4y(n + 1) + 3y(n) = 3^n$, given that y(0) = 0 and y(1) = 1, by using Z-transform. (10)