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AN
EEE, ECE, CSE,
CIVIL, MEG

Question Paper Code : 41310

B.E./B.Tech. DEGREE EXAMINATION, APRIL/MAY 2018

Third Semester

Civil Engineering

MA 6351 – TRANSFORMS AND PARTIAL DIFFERENTIAL EQUATIONS
(Common to Mechanical Engineering (Sandwich)/Aeronautical Engineering/
Agriculture Engineering/Automobile Engineering/Biomedical Engineering/
Computer Science and Engineering/Computer and Communication Engineering/
Electrical and Electronics Engineering/Electronics and Communication
Engineering/Electronics and Instrumentation Engineering/Geoinformatics
Engineering/Industrial Engineering/Industrial Engineering and Management/
Instrumentation and Control Engineering/Manufacturing Engineering/Marine
Engineering/Materials Science and Engineering/Mechanical Engineering/
Mechanical and Automation Engineering/Mechatronics Engineering/Medical
Electronics/Petrochemical Engineering/Production Engineering/Robotics and
Automation Engineering/Bio Technology/Chemical Engineering/Chemical
and Electrochemical Engineering/Food Technology/Information Technology/
Petrochemical Technology/Petroleum Engineering/Plastic Technology/
Polymer Technology)
(Regulations 2013)

Time : Three Hours

Maximum : 100 Marks

Answer ALL questions.

PART – A

(10×2=20 Marks)

1. Find the complete integral of the PDE : $z = px + qy + \sqrt{pq}$
2. Solve : $(D^3 - 3DD'^2 + 2D'^3)z = 0$
3. Find b_n in the expansion of $f(x) = x^2$ as a Fourier series in $(-\pi, \pi)$.
4. Define Root mean square value of a function.
5. Classify the partial differential equation $u_{xy} = u_x u_y + xy$.
6. State possible solutions of the one dimensional heat equation.
7. Find the Fourier transform of $f(x) = \begin{cases} 1 & \text{in } |x| < a \\ 0 & \text{in } |x| > a \end{cases}$



8. State the convolution theorem for Fourier transforms.
9. Find the Z-transform of $\{n\}$.
10. Prove that $Z\{nf(n)\} = -z \frac{d}{dz} F(z)$, where $Z\{f(n)\} = F(z)$.

PART - B

(5×16=80 Marks)

11. a) i) Find the singular solution of the equation $z = px + qy + p^2 + pq + q^2$. (8)
- ii) Solve : $x(y - z)p + y(z - x)q = z(x - y)$. (8)
- (OR)
- b) i) Solve : $(D^2 + 4DD' - 5D'^2)z = \sin(x - 2y) + e^{2x - y}$. (8)
- ii) Solve : $(D^2 + DD' - 6D'^2)z = y \cos x$. (8)
12. a) i) Find the Fourier series for $f(x) = x^2$ in $-\pi < x < \pi$. (8)
- ii) Find the half range cosine series for $f(x) = x(\pi - x)$ in $(0, \pi)$. (8)
- (OR)
- b) Find the Fourier series expansion upto the first three harmonics for the function defined in the following table (16)

| | | | | | | | |
|---|---|-----------------|------------------|-------|------------------|------------------|--------|
| x | 0 | $\frac{\pi}{3}$ | $\frac{2\pi}{3}$ | π | $\frac{4\pi}{3}$ | $\frac{5\pi}{3}$ | 2π |
| y | 1 | 1.4 | 1.9 | 1.7 | 1.5 | 1.2 | 1.0 |

13. a) A string is stretched and fastened to two points $x = 0$ and $x = l$ apart. Motion is started by displacing the string into the form $y = k(lx - x^2)$ from which it is released at time $t = 0$. Find the displacement of any point on the string at a distance of x from one end at time t . (16)
- (OR)
- b) A bar, 10 cm long with insulated sides, has its ends A and B kept at 20°C and 40°C respectively until steady state conditions prevail. The temperature at A is then suddenly raised to 50°C and at the same instant that at B is lowered to 10°C . Find the subsequent temperature at any point of the bar at any time. (16)

14. a) Find the Fourier transform of the function $f(x)$ defined by $f(x) = \begin{cases} 1-x^2 & \text{in } |x| \leq 1 \\ 0 & \text{in } |x| > 1 \end{cases}$.

Hence prove that $\int_0^\infty \frac{\sin s - s \cos s}{s^3} \cos\left(\frac{s}{2}\right) ds = \frac{3\pi}{16}$. Also show that

$$\int_0^\infty \frac{(x \cos x - \sin x)^2}{x^6} dx = \frac{\pi}{15}. \quad (16)$$

(OR)

- b) i) Show that the Fourier transform of $f(x) = e^{-\frac{x^2}{2}}$ is $e^{-\frac{s^2}{2}}$. (8)
- ii) Find the Fourier cosine transform of $e^{-a^2 x^2}$ and hence find the Fourier sine transform of $x e^{-a^2 x^2}$. (8)

15. a) i) Find the inverse Z-transform of $\frac{8z^2}{(2z-1)(4z+1)}$ using convolution theorem for Z-transforms. (8)
- ii) Find the inverse Z-transform of $\frac{z^2 - 3z}{(z-5)(z+2)}$ using residue theorem. (8)
- (OR)
- b) i) Solve : $y_{n+2} - 4y_{n+1} + 4y_n = 0$, $y_0 = 1$, $y_1 = 0$, using Z-transform. (10)
- ii) Find the Z-transform of $\{n\}$ and $\left\{\frac{1}{n+1}\right\}$. (6)