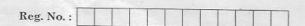
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Question Paper Code: 80214

B.E./B.Tech. DEGREE EXAMINATIONS, APRIL/MAY 2019.

Third Semester

MA 8353 - TRANSFORMS AND PARTIAL DIFFERENTIAL EQUATIONS

(Common to Aeronautical Engineering/Agriculture Engineering/Automobile Engineering/Civil 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/Sandwich)/Mechanical and Automation Engineering/Mechatronics Engineering/Production Engineering/Robotics and Automation Engineering/Biotechnology/Chemical and Electrochemical Engineering/Food Technology/Pharmaceutical Technology)

(Regulation 2017)

Time: Three hours

Maximum: 100 marks

Answer ALL questions.

PART A — 
$$(10 \times 2 = 20 \text{ marks})$$

- 1. Form the partial differential equation from the equation  $2z = \frac{x^2}{a^2} \frac{y^2}{b^2}$
- 2. If  $u = x^2 + t^2$  is a solution of  $c^2 \frac{\partial^2 u}{\partial x^2} = \frac{\partial^2 u}{\partial t^2}$ , then find the value of c?
- 3. State giving reasons whether the function  $f(x) = x \sin\left(\frac{1}{x}\right)$  can be expanded in Fourier series in the interval of  $(0, 2\pi)$ .
- 4. Sketch the graph of one even and one odd extension of  $f(x) = x^3$  in [0, 1].
- 5. Classify the PDE  $3\frac{\partial^2 z}{\partial x^2} 4\frac{\partial^2 z}{\partial x \partial y} + \frac{\partial^2 z}{\partial y^2} = 0$ .
- 6. Write all three possible solutions of one dimensional heat equations.
- 7. State convolution theorem for Fourier transform.

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 State the condition for the existence of Fourier cosine and sine transforms of derivatives.

 The integers 0, 1, 1, 2, 3, 5, 8, ... are said to form a Fibonacci sequence. Model the Fibonacci difference equation (no need to solve)

10. Find Z-transform of unit impulse sequence  $\delta(n) = \begin{cases} 1, & n = 0 \\ 0, & n \neq 0 \end{cases}$ 

PART B —  $(5 \times 16 = 80 \text{ marks})$ 

11. (a) (i) Solve  $\frac{\partial^3 z}{\partial x^3} - 2 \frac{\partial^3 z}{\partial x^2 \partial y} = 2e^{2x} + 3x^2y$ .

(ii) Solve  $x^2(y-z)p + y^2(z-x)q = z^2(x-y)$ , where  $p = \frac{\partial z}{\partial x}$ ,  $q = \frac{\partial z}{\partial y}$ . (8 + 8)

(b) (i) Solve  $\frac{\partial^2 z}{\partial x^2} + \frac{\partial^2 z}{\partial x dy} - 6 \frac{\partial^2 z}{\partial y^2} = y \cos x$ .

(ii) Solve  $(x^2 - yz)p + (y^2 - zx)q = z^2 - xy$  where  $p = \frac{\partial z}{\partial x}$ ,  $q = \frac{\partial z}{\partial y}$ . (8 + 8)

12. (a) Find the Fourier series expansion of  $f(x) = \sqrt{1 - \cos x}$ ,  $0 \le x \le 2\pi$  and hence evaluate the value of the series  $\frac{1}{1.3} + \frac{1}{3.5} + \frac{1}{5.7} - \dots$ 

Or

(b) The displacement y(x) of a part of a mechanism is tabulated with corresponding angular movement  $x^{\circ}$  of the crank. Express y(x) as a Fourier series neglecting the harmonics above the third.

x°:	0	30	60	90	120	150	180	210	240	270	300	330
y(x):	1.8	1.1	0.3	0.16	0.5	1.3	2.16	1.25	1.3	1.52	1.76	2

13. (a) (i) Using the method of separation of variables, solve  $\frac{\partial u}{\partial x} = 2\frac{\partial u}{\partial t} + u$  where  $u(x, 0) = 6e^{-3x}$ .

(ii) Solve the equation  $\frac{\partial u}{\partial t} = \frac{\partial^2 u}{\partial x^2}$  with boundary conditions  $u(x, 0) = 3\sin \pi x$ , u(0, t) = 0 and u(1, t) = 0 where 0 < x < 1, t > 0.

Or

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- (b) (i) Solve using by the method of separation of variables  $\frac{\partial^2 z}{\partial x^2} 2\frac{\partial z}{\partial x} + \frac{\partial z}{\partial y} = 0 \, .$ 
  - (ii) A tightly stretched flexible string has its ends fixed at x=0 and x=L. At time t=0, the string is given a shape defined by  $y=\mu\,x(L-x)$ , where  $\mu$  is a constant, and then released. Find the displacement of any point x of the string at any time t>0. (8+8)
- 14. (a) Find the Fourier transform of  $e^{-a^2x^2}$ , a > 0. By using the properties, find the Fourier transform of  $e^{-2(x-3)^2}$ . (10+6)

Or

(b) Using Parseval's identities, prove that

(i) 
$$\int_{0}^{\infty} \frac{dt}{(\alpha^{2} + t^{2})(b^{2} + t^{2})} = \frac{\pi}{2ab(\alpha + b)} \text{ (ii) } \int_{0}^{\infty} \frac{t^{2}dt}{(t^{2} + 1)^{2}} = \frac{\pi}{4}. \tag{8+8}$$

15. (a) Find the inverse Z-transform of

(i) 
$$\frac{2z^2 + 3z}{(z+2)(z-4)}$$
 (ii)  $\frac{2(z^2 - 5z + 6.5)}{(z-2)(z-3)^2}$  for  $2 < |z| < 3$ . (6 + 10)

Or

(b) Using the Z-transform, solve

(i)  $u_{n+2} + 4u_{n+1} + 3u_n = 3^n$  with  $u_0 = 0$ ,  $u_1 = 1$ 

(ii) 
$$u_{n+2} - 2u_{n+1} + u_n = 3n + 5$$
. (8 + 8)

30

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