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Roll No. ....

TMA–201

B. TECH. (SECOND SEMESTER)

END SEMESTER EXAMINATION, July/Aug., 2022

ENGINEERING MATHEMATICS–II

Time : Three Hours

Maximum Marks : 100

Note : (i) All questions are compulsory.

(ii) Answer any *two* sub-questions among (a), (b) and (c) in each main question.

(iii) Total marks in each main question are **twenty**.

(iv) Each sub-question carries 10 marks.

1. (a) Solve : (CO1)

$$(D^2+2D+1)y = e^{-x}\cos x + x; D \equiv \frac{d}{dx}.$$

(b) Solve : (CO1)

$$x^2\frac{d^2y}{dx^2} + x\frac{dy}{dx} + y = \sin 2\{\log x\}$$

(c) Solve : (CO1)

$$(D^4 - 3D^2 - 4)y = 5\sin 2x - e^{-2x}; D \equiv \frac{d}{dx}.$$

2. (a) Write down the statement of Convolution theorem and hence to find the inverse Laplace transform of the function : (CO2)

$$f(s) = \left\{\frac{1}{(s^2+a^2)^2}\right\}.$$

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(b) Define the Laplace transform and find the Laplace transform of the function : (CO2)

$$F(t) = te^{2t} \sin t.$$

(c) Evaluate : (CO2)

$$L\left[e^{-4t}\frac{\sin 3t}{t}\right]$$

3. (a) Solve : (CO4)

$$\frac{\partial^2 z}{\partial x^2} - 2\frac{\partial^2 z}{\partial x \partial y} = \sin x \cos 2y$$

(b) Solve : (CO4)

$$4\frac{\partial^2 z}{\partial x^2} - 4\frac{\partial^2 z}{\partial x \partial y} + \frac{\partial^2 z}{\partial y^2} = 16\log(x + 2y)$$

(c) Find a Fourier series expansion for the function $f(x) = x^2$ in the interval $(-\pi, \pi)$. (CO3)

4. (a) Using method of separation of variables to solve $\frac{\partial u}{\partial x} = 2\frac{\partial u}{\partial y} + u(x, y)$; with the condition $u(x, 0) = 6e^{-3x}$. (CO5)

(b) A string is stretched between the fixed points (0, 0) and (1, 0) and then released at rest from the position $u(x, 0) = A\sin \pi x$. Determine the displacement $u(x, t)$. (CO5)

(c) Find the Fourier series for the function $f(x) = |x|$ in $-\pi < x < \pi$, Hence show that :

$$\frac{1}{1^2} + \frac{1}{3^2} + \frac{1}{5^2} + \ldots\ldots = \frac{\pi^2}{8}$$ (CO3)

5. (a) To Prove that : (CO6)

$$(2n+1)xP_n(x) = (n+1)P_{n+1}(x) + nP_{n-1}(x).$$

(b) Prove that : (CO6)

(i) $J_{\frac{1}{2}}(x) = \sqrt{\frac{2}{\pi x}} \sin x$

(ii) $J_{-\frac{1}{2}}(x) = \sqrt{\frac{2}{\pi x}} \cos x$

(c) Find the temperature function $u(x, t)$ of one-dimensional heat equation $\frac{\partial u}{\partial t} = 3\frac{\partial^2 u}{\partial x^2}$ with the boundary condition $u(0, t) = 0 = u(2, t)$ and the initial condition $u(x, 0) = x; 0 < x < 2.$ (CO5)