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Total No. of Questions : 09] [Total No. of Pages : 02

B.Tech. (Sem. - 3rd)

APPLIED MATHEMATICS - III

SUBJECT CODE : AM - 201

Paper ID : [A0303]

[Note : Please fill subject code and paper ID on OMR]

Time : 03 Hours **Maximum Marks : 60**

Instruction to Candidates:

1) Section - A is **Compulsory**.
2) Attempt any **Four** questions from Section - B.
3) Attempt any **Two** questions from Section - C.

Section - A

Q1) *(10 x 2 = 20)*

a) Determine $L^{-1}\dfrac{4s-5}{s^2-s-2}$.

b) Give Dirichlet's conditions for the Fourier series expansion of any function $f(x)$.

c) Write Legendre and Bessel's differential equation.

d) Show function $f_n(x) = \sin nx$, $n = 1, 2, \ldots\ldots$ are orthogonal on $[-\pi, \pi]$.

e) Using definition of Laplace transform, find $L\{\cos at\}$.

f) For a periodic function of period 2π, prove that $\int_a^b f\,dx = \int_{a+2\pi}^{b+2\pi} f\,dx$.

g) Find the residue of $\dfrac{z^2}{z^2+a^2}$ at $z = ia$.

h) What are order, degree and form of equation

$$x^2\frac{\partial^2 z}{\partial x^2} + y^2\frac{\partial^2 z}{\partial y^2} = x\frac{\partial z}{\partial x} - y\frac{\partial z}{\partial y}?$$

i) Write Cauchy's integral formula for complex integration.

j) Form a partial differential equation from $z = f\left(\dfrac{y}{x}\right)$.

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Section - B

(4 x 5 = 20)

Q2) Obtain the Fourier series in the interval $[-l, l]$ of the function $f(x) = \left|\cos\left(\frac{\pi x}{l}\right)\right|$.

Q3) Find the value of $L\left[\int_0^t e^t \frac{\sin t}{t} dt\right]$.

Q4) Is the function $u(x, y) = 2xy + 3xy^2 - 2y^3$, a harmonic function?

Q5) Prove the recurrence formula $\frac{d}{dx}(J_n(x)) = -\frac{n}{x} J_n(x) + J_{n-1}(x)$, from Bessel's functions.

Q6) Solve the equation $\frac{\partial^2 z}{\partial x^2} - 2\frac{\partial z}{\partial x} + \frac{\partial z}{\partial y} = 0$ by the method of separation of variables.

Section - C

(2 x 10 = 20)

Q7) (a) Solve the following pair of simultaneous differential equations $\frac{d^2x}{dt^2} - x = y$, $\frac{d^2y}{dt^2} + y = -x$, given that at $t = 0$; $x = 2$, $y = -1$, $\frac{dx}{dt} = 0$ and $\frac{dy}{dt} = 0$.

(b) Find Fourier sine series for $f(x) = x - x^2$, $x \in [-\pi, \pi]$.

Q8) (a) Show that real integral $\int_0^{2\pi} \frac{d\theta}{2 + \cos\theta} = \frac{2\pi}{\sqrt{3}}$, by using contour integration.

(b) Expand $\sin z$ in a Taylor series about $z = 0$ and determine the region of convergence.

Q9) (a) Expand $erf(x)$ in ascending powers of x and find the value of $erf(0)$.

(b) Solve $(D_x^4 - D_x^3 D_y + 2D_x^2 D_y^2 - 5D_x D_y^3 + 3D_y^4)\, z = 0$.

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