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Exam.Code:0906
Sub. Code: 6206

2063
B.E., Second Semester
MATHS-201: Differential Equations and Transforms
(Common to all streams)

Time allowed: 3 Hours **Max. Marks: 50**

NOTE: ***Attempt <u>five</u> questions in all, including Question No. I which is compulsory and selecting two questions from each Part.***

x-x-x

Question I (a) Check for exactness and hence solve the differential equation $(4y+x^3)\,dx + x\,dy = 0$.

(b) Define degree and order of a differential equation.

(c) State the convolution theorem for Laplace transforms.

(d) Derive using definition the Laplace transform of unit step function.

(e) Eliminate the constants a and b from the equation $2z = (ax+y)^2 + b$.

$(2 \times 5 = 10)$

Part A

Question II (a) Find the complete solution of the differential equation

$$(D^3 + 3D^2 + 3D + 1)y = e^{-x} + x + 1$$

(b) Find a power series solution in powers of x of the differential equation $y'' - 3y' + 2y = 0$

(5+5=10)

Question III (a) Solve using method of variation of parameters the differential equation $y'' + 3y' + 2y = 2\,e^{x}$.

(b) Find inverse Laplace transforms of the following functions:
(i) $\frac{9}{s^2}\left(\frac{s+1}{s^2+9}\right)$ (ii) $\frac{3(1-e^{-\pi s})}{s^2+9}$ (iii) $\ln\left(1+\frac{\omega^2}{s^2}\right)$

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(5+5=10)

Question IV (a) Find the Laplace transform of the functions:
(i) $f(t) = \begin{cases} \sin\omega t & 0 < t < \pi/\omega \\ 0 & \text{otherwise} \end{cases}$ (ii) $f(t) = t^2\,u(t-1)$

(b) Solve the initial value problem $y''+3y'+2y = \begin{cases} 4t, & 0 < t < 1 \\ 8 & \text{otherwise,} \end{cases}$ $y(0) = 0,\ y'(0) = 0.$

(5+5=10)

P.T.O.

Part B

Question V (a) Find the Fourier Cosine and Sine series of the function

$$f(x) = \pi - x, \quad 0 < x < \pi.$$

(b) Show that the given integral represents the indicated function:

$$\int_0^\infty \frac{\sin w \cos xw}{w} dw = \begin{cases} \pi/2 & \text{if } 0 \leq x < 1 \\ \pi/4 & \text{if } x = 1 \\ 0 & \text{if } x > 1 \end{cases}$$

(5+5=10)

Question VI (a) Find the Fourier transform of e^{-ax^2}, $a > 0$. It may be assumed that $\int_{-\infty}^{\infty} e^{-v^2} dv = \sqrt{\pi}$

(b) Find the general integrals of the linear partial differential equation $px(z - 2y^2) = (z - qy)(z - y^2 - 2x^3)$

(5+5=10)

Question VII (a) Find the solution $u(x, y)$ of the equation $u_x - u_y = 0$ by the method of separation of variables.

(b) Find D'Alembert's solution of the wave equation; initial deflection is $f(x)$ and initial velocity is 0.

(5+5=10)