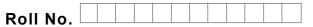


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M.Sc Mathematics (2018 Batch) (Sem.–1) MATHEMATICAL METHODS Subject Code : MSM-105-18 Paper ID : [75133]

Time : 3 Hrs.

Max. Marks : 70

INSTRUCTION TO CANDIDATES :

- 1. SECTION-A is COMPULSORY consisting of FIVE questions carrying TWO marks each.
- 2. SECTION B & C. have THREE questions each.
- 3. Attempt any FOUR questions from SECTION B & C carrying FIFTEEN marks each.
- 4. Select atleast TWO questions from SECTION B & C each.

SECTION-A

1. (a) Find Laplace Transformation of F(t), where

$$F(t) = \begin{cases} 4, & 0 < t < 1 \\ 3, & t > 1. \end{cases}$$

- (b) Write a short note on Volterra integral equations.
- (c) Apply change of scale property to find Laplace Transformation of sin (*at*).
- (d) Find Fourier Transformation of f(x), where

$$f(x) = \begin{cases} \frac{\sqrt{2\pi}}{2\epsilon} & |x| \le \epsilon \\ 0, & |x| > \epsilon \end{cases}$$

(e) Write a short note on various applications of Laplace Transforms.



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SECTION-B

2. Solve with the help of Laplace Transformation $\frac{\partial y}{\partial t} = 3 \frac{\partial^2 y}{\partial x^2}$,

where
$$y\left(\frac{\pi}{2}, t\right) = 0, \left(\frac{\partial y}{\partial x}\right)_{x=0} = 0$$
 and $y(x, 0) = 30 \cos(5x)$.

3. Show that
$$L^{-1}\left(\frac{8}{(p^2+1)^3}\right) = (3-t^2)\sin t - 3t\cos t$$
,

where L^{-1} stands for inverse Laplace Transformation.

4. Find Fourier cosine transform of $f(x) = \frac{1}{1 + x^2}$, and hence find Fourier sine transform of

$$F(x) = \frac{x}{1+x^2}$$

SECTION-COM

5. Reduce the initial value problem

$$\phi''(x) - 3\phi'(x) + 2\phi(x) = 4\sin x$$

with conditions $\phi(0) = 1$, $\phi'(0) = -2$ to a non-homogeneous Volterra's integral equation of second kind. Conversely, derive the original differential equation with initial conditions from the integral equation obtained.

6. Solve the following integral equation :

$$\phi(x) = 1 + \lambda \int_0^\pi \sin(x+\xi) \,\phi(\xi) \,d\xi.$$

7. Determine the eigen values and eigen function for the following homogeneous integral equations with degenerate kernels:

$$\phi(x) = \lambda \int_{-1}^{1} (5x\xi^3 + 4x^2\xi + 3x\xi) \,\phi(\xi) \,d\xi.$$

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