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M.E./M.Tech. I Semester

Examination, December 2017

Advance Mathematics and Numerical Analysis

Time : Three Hours

Maximum Marks : 70

Note: i) Attempt any five questions out of eight.

ii) All questions carry equal marks.

1. Find the solution of the parabolic equation $u_{xx} = 2ut$, when $u(0,t) = u(4,t) = 0$ and $u(x,0) = x(4-x)$, taking $h = 1$ Find the values upto $t = 5$.

2. Evaluate the pirotal values of the equation $u_{tt} = 16u_{xx}$ taking $Dx = 1$ upto $t = 1.25$. The boundary conditions are $u(0,t) = u(5,t) = 0$, $u_t(x,0) = 0$ and $u(x,0) = x^2(5-x)$.

3. a) Find the Hankel transform of $\frac{e^{-ax}}{x}$ taking $x\,J_0(px)$ as the Kernel of the transform.

   b) Find Mellin transform of sin$x$.

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4. a) Find Fourier sine transform of $f(n) = \frac{1}{x}$.

   b) Find Fourier cosine transform of $f(x) = e^{-x}$.

5. a) Show that the function $y = xe^x$ is a solution of the volterra integral equation

   $$y(x) = \sin x + 2\int_0^x \cos(x-t)\,y(t)\,dt$$

   b) Form an integral equation corresponding to the differential equation $y'' + xy' + y = 0$ with the initial condition $y(0) = 1;\ y'(0) = 1$.

6. Test for the extremum of the functional

   $$I[y(x)] = \int_0^{\pi/2} (y'^2 - y^2)\,dx\ ;\ y(0) = 0\ ;\ y(\pi/2) = 1$$

7. Solve the boundary value problem

   $y'' - y + x = 0,\ (0 \le x \le 1),\ y(0) = 0,\ y(1) = 0$ by Rayleigh-Ritz method.

8. Write a short note on the followings:
   a) Green's function
   b) Integro differential equation
   c) Finite element method
   d) Functional

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