National Institute of Technology Hamirpur (H. P.)

M.Tech. (Chemical Engineering) – 1st Semester

Mid Semester Examination 2020-21

CH-613 Mathematical Techniques

Duration: 2 hrs. **Max. Marks: 50**

- This question paper consists of seven questions and one page.
- Attempt all questions. Make suitable assumptions if necessary, by clearly stating them.
- Marks will be deducted for omitting steps.

1	Determine L^*, B^* for $$Lu = \frac{d^2u}{dx^2} - \frac{du}{dx} \quad in\ 0 < x < 1$$ Subject to u(0) =0, u(1) = 2.	5
2	Solve the following ODEs $$\frac{dx}{dt} = x(Ay - 1 + B)$$ $$\frac{dy}{dt} = y(5 - Bx + y)$$	5
3	Divide the following ODE into four well-posed sub-ODEs: $$\frac{d^2u}{dx^2} + \frac{d^2u}{dy^2} = 0\ subject\ to\ x = 0; x = 1; y = 0; and\ y = 1$$	8
4	Solve the following ODE: $$\frac{d^2u}{dx^2} + \lambda y = 0$$ Subject to: $at\ x = 0;\ y = 0\ and\ at\ x = 1; \frac{dy}{dt} + \beta y = 0$	8
5	Solve the following one dimensional transient heat condution problem with constant heat flux condition at the wall: Energy Balance: $\rho C_p \frac{\partial T}{\partial t} = K \frac{\partial^2 u}{\partial x^2}$ Subject to $at\ t = 0;\ T = T_o; at\ x = 0;\ -K\frac{\partial T}{\partial y} = a_0; and\ at\ x = L; T = T_1$	8
6	Solve the gollowing PDE: $$\frac{\partial u}{\partial t} = \frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y} + \frac{\partial^2 u}{\partial z^2}$$ Subject to: $$at\ t = 0;\ u = u_o$$ $$at\ x = 0\ and\ x = 1; u = 0$$ $$at\ y = 0\ and\ y = 1; u = 0$$ $$at\ z = 0\ and\ z = 1; u = 0$$	8
7	Solve the following PDE: $$\frac{\partial u}{\partial t} = \frac{\partial^2 u}{\partial x^2} + f(x,t)$$ Subject to $at\ t = 0; u = h, at\ x = 0; u = p, and\ at\ x = 1;\ \frac{du}{dx} + \beta u = q$	8