Question 1 (30 marks)

A) For the following statements, state true or false and why?

1. A differential equation involving derivatives with respect to a multiple independent variables is called an *ordinary differential equation (ODE)*.

2. A differential equation involving partial derivatives with respect to more than one independent variable is called *partial differential equations (PDE)*.

3. The lowest order derivative involved in a partial differential equation is called the order of the partial differential equation.

4. The degree of a partial differential equation is the degree of the highest derivative which occurs in it.

5. The partial differential equation (PDE) is called quasi linear PDE if the equation is nonlinear in the highest order derivative but non-linear in other term.

B) Explain each of the following: (give an example for each item)

1. Boundary conditions
2. Initial conditions
3. Quasi-linear Partial differential equation
4. Initial value problem
5. Boundary value problem

Question 2 (30 marks)

Find the dependent variable of the heat equation of a thin rod

$$\frac{\partial u}{\partial t} = k \frac{\partial^2 u}{\partial x^2} + x e^{-t}, \qquad 0 < x < L, \qquad t > 0$$

With the boundary conditions: $\quad u(0, t) = 1, \qquad\qquad u(L, t) = 2$

and initial conditions: $\qquad\qquad u(x, 0) = f(x)$

Question 3 (40 marks)

A) For *the Sturm Liouville boundary value problem*, Discuss the properties of Eigen values and Eigen functions

B) Find the dependent variable of the wave equation

$$\frac{\partial^2 u}{\partial t^2} = \alpha^2 \frac{\partial^2 u}{\partial x^2} + x, \qquad 0 < x < L, \qquad t > 0$$

With the boundary conditions:
$$u(0, t) = 0, \qquad u(L, t) = 1$$

And initial conditions:

$$u(x, 0) = f(x), \qquad\qquad \frac{\partial u(x, 0)}{\partial t} = g(x)$$

This exam measures the following ILOs										
Question Number	Q1-a				Q2	Q3-b			Q1-b	Q3-a	
Skills											
	Knowledge &understanding skills				Intellectual Skills				Professional Skills		

With my best wishes

Associate Prof. Dr. Islam M. Eldesoky