Menofia University Faculty of Engineering Shebin El-kom Academic Year: 2019-2020 Department : Basic Eng. Sci.	Subject: Engineering Mathematics Code: BES 712 Time Allowed : 3 hours Date : 13/ 8 / 2020

Allowed Tables and Charts : None

Answer all the following questions: [100 Marks]

Q.1 **A) For the following statements, state true or false and why?** [20]

1. A differential equation involving derivatives with respect to a multiple independent variable 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:

1. Boundary conditions (give an example)
2. Initial conditions (give an example)
3. Quasi-linear Partial differential equation (give an example)
4. Initial value problem (give an example)
5. Boundary value problem (give an example)

Q.2 **(A)** For the total differential equation in three variables, [30]

Solve the following equation $yz\,dx + \left(x\,z - y\,z^3\right)dy - 2xy\,dz = 0$

(B) For the total differential equation in three variables,

Solve the following equation $yz\,dx - z^2 dy - xy\,dz = 0$,

using the method of substitution and also by the integrating factor.

Q.3 **(A)** Solve the wave equation in an infinite domain (using Fourier Transform) [30]

$$\frac{\partial^2 u}{\partial t^2} = C^2 \frac{\partial^2 u}{\partial x^2}, \qquad -\infty < x < \infty, \qquad t > 0$$

With the boundary conditions:

$$u(x, t) \to 0 \qquad as \qquad x \to \pm\infty$$

And initial conditions:

$$u(x, 0) = f(x), \qquad \frac{\partial u(x, 0)}{\partial t} = 0, \quad -\infty < x < \infty$$

(B) If $y_1 \, and \, y_2$ are two solutions of the equation $ty'' + 2y' + te^t y = 0$ and $w(y_1, y_2)(1) = 2$ Find $w(y_1, y_2)(5)$

(C) Find the particular solution of the following partial differential equation

$$\frac{\partial^2 u}{\partial x^2} - \frac{\partial u}{\partial y}\frac{\partial u}{\partial x} - 2\frac{\partial^2 u}{\partial y^2} = e^x (y - 1)$$

Q.4 **(A)** Find the complete general solution and the singular solution of the following non-linear partial differential equation [20]

$$\frac{\partial u}{\partial x}\frac{\partial u}{\partial y} = 2xy$$

(B) For the following partial differential equation

$$x^2 \frac{\partial z}{\partial x} + y^2 \frac{\partial z}{\partial y} + z^2 = 0$$

Find: **(i)** The general solution of the PDE.

(ii) The particular solution which passes through the curve $xy = x + y, \; z = 1$

(iii) The equation of the required integral surface.

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

With our best wishes ***Dr. Osama N. salih***