Monoufya University *Faculty of Engineering* *Department of Basic Eng. Sciences* *Second Semester Exam 2020* *Date of Exam: 19/08/2020*		*Field: Basic Eng. sciences.* *Code: BES 615* *Subject: Eng. Mathematics.* *Time allowed: 3 hrs.* *Total marks: 100 marks*

Answer all the following questions: **[100 marks]**

1.1 Deduce a first order, first degree, homogeneous partial differential equation which has the general solution $u(x, y) = x^2 f(x - y)$.

1.2 Classify, solve, and check the equation $u_{xx} + u_x = 2(2x^3 - y^2)$. **[20 marks]**

2.1 Deduce the general solution of the equation $(mz - ny)z_x + (nx - lz)z_y = ly - mx$

2.2 Classify, solve, and check the equation $e^y z_x - e^x z_y = 0$ **[20 marks]**

3.1 Classify, solve, and check the equation $z_{xx} - 2z_{xy} + z_{yy} = 12xy$.

3.2 Solve and check the equation $(D_x - D_y - 1)(D_x - D_y - 2)z = e^{2x-y}$ **[20 marks]**

4.1 A flexible string is fixed at two end points π apart and is stretched. The motion of the string takes place by displacing the string in the form $y=\sin x$ from which is released at time t=0. If the initial transverse velocity of any point of the string is $y_t(x,0)=0$, determine the unsteady displacement of any point at a distance x from one end at time t.

4.2 A force $\boldsymbol{F}=f_r \boldsymbol{u}_r+f_\theta \boldsymbol{u}_\theta+f_z \boldsymbol{u}_z$ is applied to translate a rigid body of mass m on a cylindrical surface. Deduce Lagrange's equations of motion of the body where: f_r, f_θ, f_z are the force components in r, θ, and z directions. Letting $q_1=r$, $q_2=\theta$, $q_3=z$ be the generalized coordinates and $Q_1=f_r$, $Q_2=rf_\theta$, $Q_1=f_z$ be the generalized forces. Lagrange's function is $L = 0.5m(\dot{r}^2 + r^2\dot{\theta}^2 + \dot{z}^2) - mgz$. Discuss the derived equation of motion. **[20 marks]**

5.1 Solve the steady state heat equation $\nabla^2 u = -4$ in the annular region 1<r<2 with the boundary conditions: $u(1,\theta)=0$, $u(2,\theta)=1$. Calculate the heat flux from the outer boundary.

5.2 Determine the surface passing through the two lines: L_1:{$x=0, z=0$}, and {$x-y=0, z-1=0$} satisfying the differential equation $z_{xx} - 4z_{xy} + 4z_{yy} = 0$. Classify the equation and its solution, then check your solution. **[20 marks]**

This exam contributes " by measuring in achieving Program Academic Standards according to NARS			
Question Number	**Q1, Q2, Q3**	**Q1, Q2, Q3,Q5.2**	**Q3, Q4, Q5.1**
	Knowledge & Understanding Skills	**Intellectual Skills**	**Professional Skills**

With my best wishes
Dr. Bilal Maher