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**NATIONAL OPEN UNIVERSITY OF NIGERIA**

**PLOT 91, CADASTRAL ZONE, NNAMDI AZIKIWE EXPRESSWAY, JABI - ABUJA**

**FACULTY OF SCIENCES**

**DEPARTMENT OF PURE AND APPLIED SCIENCE**

 **JULY 2018 EXAMINATIONS**

**COURSE CODE: PHY301**

**COURSE TITLE: CLASSICAL MECHANICS II**

**CREDIT UNIT 3**

**TIME ALLOWED (21/2 HRS)**

**INSTRUCTION: *Answer question one (1) and any other four (4) questions***

**QUESTION 1**

1. (a) State the constraint equation in the Atwood’s machine and state the

 condition that could make the constraint equation rheonomic. **(2 marks)**

 (b) Explain briefly what is meant by the number of degrees of freedom. . **(2 marks)**

 (c) Distinguish between holonomic and non-holonomic constraints. . **(2 marks)**
 (d) Give examples of holonomic and non-holonomic constraints. . **(2 marks)**
 (e) State the three kinds of non-holonomic constraints. . **(2 marks)**
 (f) What are the expressions for: (a) the first reference frame known as the
 fixed frame (b) the second reference frame known as the rotating frame? . **(2 marks)**

 (g) State the D’Alembert’s Principle. **(2 marks)**

 (h) State the expression for pure gravitational acceleration in the rotating
 frame of the Earth. . **(2 marks)**

 (i) State the expressions for:

 (a) the Lagrangian for a particle of mass *m* moving in a non-inertial

 rotating frame in the presence of the potential *U(r)* . **(1 mark)**(b) the Euler Lagrange equation. **(1 mark)**

 (j) Express Lagrange’s equation in generalized coordinates **(2 marks)**

 (k) What is the implication of the expression?

 $\frac{d}{dt}\frac{∂L}{∂∅}=\frac{d}{dt}mR^{2}\dot{∅}=mR^{2}\ddot{∅}=0$ **(2 marks)**

**QUESTION 2**

 a. (i) What do you understand by constraints? **(3 marks)**
 (ii) State the constraint equation of the elliptical wire and state if it is

 scleronomic or rheonomic. **(3 marks)**
b. Show that velocity dependent constraints are non integrable constraints. **(6 marks)**

**QUESTION 3**

 3. a. Explain the following :(i) Virtual displacement **(3 marks)**

 (ii) Virtual work **(3 marks)**

 b. Find the gauge transformation of Lagrangian of electromagnetic fields. **(6 marks)**

**QUESTION 4**

4. a. Explain generalized forces. **(4marks)**

 b. Derive generalized force from the expression of virtual work and
 virtual displacement. **(8 marks)**

**QUESTION 5**

5. a. State Kepler’s second law. **(3 marks)**

 b. Use θ-component of Lagrangian equation to prove Kepler’s second law. **(9 marks)**

**QUESTION 6**

6. a. What do you understand by a non- inertial frame? **(3 marks)**

 b. Derive the time derivative of vector A in the fixed and rotating reference
 frame. **(9 marks)**