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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**

 **2018\_2 SEMESTER EXAMINATION**

**COURSE CODE: PHY 301**

**COURSE TITLE: CLASSICAL MECHANICS II**

**CREDIT UNIT 3**

**TIME ALLOWED (2½ HRS)**

**INSTRUCTION: *Answer question 1 and any other four questions***

**QUESTION 1**

a) Define the following terms: (i) number of degrees of freedom (2 marks)

 (ii) constraints (2 marks)

 (iii) virtual work (2 marks)

b) Mention two categories of constraints and give examples of each. (4 marks)

c) Derive generalized force from the expressions of virtual work and virtual

 displacement. (4 marks)

d) Give the expression for the Hamiltonian of a system in general coordinates

 and the Hamilton’s equation of motion. (8 marks)

**QUESTION 2**

a) Defined classical Lagrangian and give the Lagrange’s equations in Cartesian

 coordinates. (5 marks)

b) From the generalized equation of motion prove the Euler-Lagrangian equation

 (7 marks)

**QUESTION 3**

 a) Consider two weights of mass $m\_{1}$ and $m\_{2}$ suspended from a frictionless, inertialess pulley of radius a by a rope of fixed length. If the heights are respectively $x$ and $-x$ from the chosen origin such that there is only one degree of freedom for this system. Generate the Lagrange’s equation of motion.

 (5 marks)

b) Use the Kepler’s first law in polar coordinates to describe the shape for$ p>1$, $p=0$ and $p<1$. (7 marks)

**QUESTION 4**

a) Give the difference between Hamiltonian method and the Lagrangian method (5 marks)

b) Use the second Kepler’s law and the expression for the angular momentum to prove Kepler’s third law. (7 marks)

**QUESTION 5**

 a) Define (i) Legendre transform (3 marks)

 (ii) classical Hamiltonian (3 marks)

b) Generate the Hamilton’s equation of motion using the classical Hamiltonian

 (6 marks)

**QUESTION 6**

 a) Use the Lagrangian to construct the Hamiltonian for the system. (5 marks)

b) Find the Hamiltonian corresponding to the Coriolis Lagrangian

 $L=\frac{1}{2}R^{2}\left[\dot{θ}^{2}+cos^{2}θ\left(ω+\dot{∅}\right)^{2}\right]-U\left(θ,∅\right)$

 (7 marks)