NATIONAL OPEN UNIVERSITY OF NIGERIA
PLOT 91, CADASTRAL ZONE, NNAMDI AZIKIWE EXPRESSWAY, JABI - ABUJA
FACULTY OF SCIENCES
DEPARTMENT OF PURE AND APPLIED SCIENCES
SEPTEMBER, 2020_1 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. Distinguish between degrees of freedom and constraints (**4 mks**)
b. What is virtual displacement? (**4 mks**)
c. Briefly explain the term conservative systems (**3 mks**)
d. (i) What is classical Langrangian?
(ii) Express the Langrange equation in coordinate dimensional oscillator (**3 mks**)
e. (i) What is the relationship between the Hamiltonian function and the Langrangian function?
(ii) State the Hamilton's equation of motion (**4 mks**)
f. Briefly explain the concept of effective potential (**4 mks**)

Question 2

a. What is a rigid body? (**3 mks**)
b. State the number of degrees of freedom in an Atwood machine and point particle sliding elliptical wire. (Give reason) (**3 mks**)
c. Briefly explain Holonomic constraints **(3 mks)**
d. State 3 kinds of non Holonomic constraints. **(3 mks)**

Question 3

a. When is a classical system said to be conservative? (**3 mks**)
b. Express the Langrangian L in Cartesian coordinates (**2 mks**)
c. What is a gauge transformation? (**2 mks**)
d. Find the gauge transformation of Langrangian of harmonic oscillator (**5 mks**)

Question 4

a. State D'Alembert's principle (**2 mks**)
b. Derive D'Alembert's principle from Newton's second law of motion (**5 mks**)
c. Use D'Alembert's principle to relate generalized forces to the rate of change of momentum (**5mks**)

Question 5

a. State Kepler's laws of planetry motion (**12mks**)
b. Use the 2nd Kepler's law and the expression for the angular momentum to prove Kepler's 3rd law.

Question 6

a. Use momentum conservation to reduce a two body problem to the problem of one body motion in a central force field **(8mks)**
b. Show that lagragian equation of motion for a simple pendulum is given by $ml^2\ddot{\theta} = -mgl\sin\theta$ where l is the length of a light rigid rod, θ the angle the rod makes with the vertical and m is the mass of the bob. **(4mks)**