



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 Lagrangian?
(ii) Express the Lagrange equation in coordinate dimensional oscillator (3 mks)
- e. (i) What is the relationship between the Hamiltonian function and the Lagrangian 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 Lagrangian L in Cartesian coordinates (2 mks)
- c. What is a gauge transformation? (2 mks)
- d. Find the gauge transformation of Lagrangian 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 planetary 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 Lagrangian 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)