MAASAI MARA UNIVERSITY

REGULAR UNIVERSITY EXAMINATIONS 2018/2019 ACADEMIC YEAR SECOND YEAR SECOND SEMESTER

SCHOOL OF SCIENCES
BACHELOR OF SCIENCE AND BACHELOR OF EDUCATION (SCIENCE)

COURSE CODE: PHY 2214
COURSE TITLE: CLASSICAL MECHANICS

DATE: 15TH APRIL 2019   **TIME: 8.30AM -10.30AM**

INSTRUCTIONS TO CANDIDATES

1. Answer Question **ONE** and any other **TWO** questions

2. *Question one carries 30 marks while each of the others carries 20 marks.*
3. *Credit will be awarded for clear explanations and illustrations.*

This paper consists of 2 printed pages. Please turn over.

QUESTION ONE

a) Show that for a single particle with constant mass the equation of motion implies the following differential equation for kinetic energy: $\frac{dT}{dt}=F\cdot v$, while if the mass varies with time the corresponding equation is $\frac{d(mT)}{dt}=F\cdot p$ (5marks)

b) Prove that the magnitude R of the position vector for the center of mass from an arbitrary origin is given by the equation $M^2 R^2 = M\sum_i m_i r_i^2 - \frac{1}{2}\sum_{i,j} m_i m_j r_{ij}^2$
          (5marks)

c) Differentiate giving an example in any case between :
    i. Holonomic constraint and non holonomic constraint
          (3marks)
    ii. Rhenomic and scleronomic constraints
          (3marks)

d) Set up Lagrangian for a simple pendulum and obtain an equation describing its motion.
          (6marks)

e) Prove that the shortest distance between two points in space is a straight line
          (6marks)

f) What are cyclic coordinates
          (2marks)

QUESTION TWO

a) State Hamilton's principle   (3marks)
b) Define a central field   (2marks)
c) Find the equation of motion of a particle in a central field
    (6marks)
d) Show that by the conservation law of energy of a closed system, energy remains constant in time.
          (5marks)
e) Consider a projectile of mass m projected upwards. Find its equation of motion.
    (4marks)

QUESTION THREE

2

a) Differentiate between conservative forces and non-conservative forces

   (2marks)

b) State advantages of variation principles formulation

   (3marks)

c) Find the minimum surface of revolution for a curve passing between two fixed points and revolving about the y-axis.

   (7marks)

d) Find the equation of motion of a solid cylinder that rolls down an incline plane.

   (8marks)

QUESTION FOUR

a) State D'Alembert's principle

   (3marks)

b) Prove that the transformation Q=p and P=-q is canonical

   (3marks)

c) Consider a uniform thin disk that rolls without on a horizontal plane. A horizontal force is applied to the centre of the disk and in a direction parallel to the plane of the disk. Derive Lagrange's equations and find the generalized force.

   (7marks)

d) Find the motion of two bodies interacting via a central force

   (7marks)

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