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: $\frac{d\mathbf{T}}{dt} = \mathbf{F}.\mathbf{v}$, while if the mass varies with time the corresponding equation is $\frac{d(m\mathbf{T})}{dt} = \mathbf{F}.\mathbf{p}$ (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 $M^2R^2 = M\sum_i m_i r_i^2 - \frac{1}{2}\sum_{i,j} m_i m_j r_{ij}^2$ (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

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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