# MAASAI MARA UNIVERSITY

## REGULAR UNIVERSITY EXAMINATIONS
## 2017/2018 ACADEMIC YEAR
## SECOND YEAR SECOND SEMESTER

## SCHOOL OF SCIENCE & INFORMATION SCIENCE
## DEPARTMENT OF MATHEMATICS AND PHYSICAL SCIENCES
## DEGREE IN BACHELOR OF SCIENCE AND BACHELOR OF EDUCATION (SCIENCE)

## COURSE CODE: PHY 2214
## COURSE TITLE: CLASSICAL MECHANICS

**DATE: 3RD MAY 2018** **TIME: 1430 – 1630 HRS**

**INTRUCTIONS TO CANDIDATES**

Answer question **ONE** and **ANY** other **TWO** questions

## Part A: Total Possible Marks 30

1. (a). Explain the difference between kinematics and dynamics as used in classical mechanics. (2 marks)

   (b). (i) Define linear momentum and give its mathematical expression. (2 marks)

   (ii) Starting from linear, show that Newton's 2nd law can be expressed as $F = m\ddot{r}$, where $F$ is external force, m is mass of the body and $\ddot{r}$ is acceleration of the body. (5 marks)

   (c).(i) State the energy conservation theory of a particle (2 marks)

   (ii) Show that the work done by an external force in moving a particle from position one to position two can be expressed as $W_{12} = T_2 - T_2$ and $W_{12} = V_1 - V_2$ and then show that $T_1 + V_1 = T_2 + V_2 = E$ (T is kinetic energy, V is potential energy and E is energy). (11 marks)

   (d) Derive an expression for the virtual work and state the principle (Hint: D'Alemberts Principle) (8 marks)

## Part B: Total Possible Marks 40(Answer 2 questions)

2. (a). Define a conservative force field and give the condition that can be used to determine if a force is conservative. (2 marks)

   (b).Show whether the force, $\vec{F} = (2xy + z^2)\hat{i} + x^2\hat{j} + 2xz\hat{k}$, is conservative or not. Thereafter, determine the potential energy associated with the force, (10 marks)

   (c). Show that the total force acting on a system of particles is $F^{ext}$ ($F^{ext}$ is external force acting on the system of particles). (8 marks)

3. (a). What is a rigid body? (2 marks)

(b).Given a rigid body, containing an infinite number of particles of masses $m_1$, $m_2$, $m_3 \ldots m_n$, and that the masses are $r_1$, $r_2$, $r_3 \ldots r_n$ away from the axis of rotation. Find the rotational kinetic energy of such a body. (5 marks)

(c). Explain what you understand by the following terms (3 marks)

i. Constraints

ii. Non-holonomic constrains

iii. Holonomic constraints

(d). Consider a system of two masses $m_1$ and $m_2$ where $m_2 > m_1$ connected by a light inextensible string of length L. The masses hang over a pulley and can only move vertically. Find the Lagrangian and the equation of motion of the system. (11 marks)

4. (a) If a body with one fixed point rotates with angular velocity $\omega$ and has an angular momentum $\Omega$, prove that the kinetic energy can be given by $T = \frac{1}{2}\omega.\Omega$. (4 marks)

(b) Derive the Hamiltonian and the Hamilton's equation for a simple pendulum. (16 marks)

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