SOUTH EASTERN KENYA UNIVERSITY

UNIVERSITY EXAMINATIONS 2016/2017

FIRST SEMESTER EXAMINATION FOR THE DEGREE OF BACHELOR OF SCIENCE (PHYSICS) AND BACHELOR OF EDUCATION (SCIENCE)

SPH 305: CLASSICAL MECHANICS

5TH DECEMBER, 2016 **TIME: 4.00-6.00 P.M**

INSTRUCTIONS:

1. Attempt question **ONE** and any other **TWO** questions.
2. Question one carries **30 marks** while the rest carry **20 marks each**

QUESTION ONE (THIRTY MARKS)

(a) (i) What are constraints? (2Marks)

(ii) Classify them (3Marks)

(iii) In solving mechanical problems, constraints introduce two difficults. Name them (3Marks)

(iv) What are degrees of freedom of a system of N particles. (2Marks)

(b) Find the langrange's equation of motion for an electrical network comprising of inductance L and capacitor C. The condenser is charged to q coulombs and the current flowing in the circuit is i amperes. (5Marks)

(c) What are generalized coordinates? (2Marks)

Deduce the following:

(i) Generalized displacement (4Marks)

(ii) Generalized velocity (4Marks)

(d) For a linear harmonic oscillator $V = \frac{1}{2}kx^2$, use Halmitonian principle to obtain its Equation of motion. (5Marks)

QUESTION TWO (TWENTY MARKS)

(a) (i) State the Halmilton's variation principle (2Marks)

(ii) What is a cyclic coordinate? (2Marks)

(iii) Show that the generalized momentum conjugate to a cyclic coordinate is Conserved. (6Marks)

(b) Express angular momentum of a system as the sum of center of mass and angular momentum of the motion about the center of mass. (10Marks)

QUESTION THREE (TWENTY MARKS)

(a) Write the transformation equations for the set of variables (r_i) to (q_j) set. (8Marks)

(b) Two particles of masses M_1 and M_2 are located on a frictionless double incline and connected by in extensible mass less string passing over a smooth peg. Use the principle of virtual work to show that for equilibrium, we must have

$$\frac{sin\alpha_1}{sin\alpha_2} = \frac{M_1}{M_2}$$ (12Marks)

QUESTION FOUR (TWENTY MARKS)

(a) Derive D'Alembert's principle of virtual work (12Marks)

(b) Two masses m are connected by springs having equal spring constant C, so that the masses are freee to slide on a frictionless table. The ends of the springs are attached with fixed walls. Using Lagranian equation, set up the differential equation of the vibrating mass. (8Marks)

QUESTION FIVE (TWENTY MARKS)

(a) Derive the Halmilton's equations of motion (10Marks)

(b) Using the above equations, find the equation of motion for a simple pendulum (10Marks)