APRIL, 2021
PHY 301SW
CLASSICAL MECHANICS
(THEORY)
2 HOURS

CANDIDATE'S INDEX NUMBER:
IE/MAT/A
SIGNATURE:

UNIVERSITY OF CAPE COAST
COLLEGE OF EDUCATION STUDIES
SCHOOL OF EDUCATIONAL DEVELOPMENT AND OUTREACH
INSTITUTE OF EDUCATION

FIVE-SEMESTER BACHELOR OF EDUCATION (SANDWICH) PROGRAMME
SECOND YEAR, END-OF-FIRST SEMESTER EXAMINATION, APRIL, 2021

APRIL 29, 2021 CLASSICAL MECHANICS (THEORY) 9:00 AM - 11:00 AM

[70 MARKS]

Answer question ONE and any other TWO questions from this Section.

1. a. If **A** = 5i – 3j + 2k; and **B** = 3i + j -2k ; **C** = i – 3j + 4k ; delight (i) the scalar triple product **A. (B X C)** (ii) the vector product **(A X B) X C**.

   b. Find the area of the triangle with vertices at P (2, 3, 5), R (3, 6, 5).

   c. A constant force **F** acting on a particle of mass *m* changes the velocity from v_1 to v_2 in time τ. Prove that $F = m(v_2 - v_1)\,\tau$.

   d. A particle is moved by a force **F** = 20i -30j +15k along a straight line from point A to point B with position vectors 2i + 7j - 3k and 5i -8 j -6k. Find the work done.

   e. Express in symbols the principle of conservation of energy from a simple harmonic oscillator.

$V = ut + \frac{1}{2}at$ $\quad V = u + at$

2. A particle travels so that its acceleration is given by **a** = 2^{e-t} **i**+5 cos t**j** – 3 Sin t **k**. If the particle is located at (1,-3,2) at t = 0 and is moving with the velocity given by 4 **i** – 3**j** + 2**k** Find
   i. the velocity ,
   ii. the displacement of the particle at any time t> 0.

$s = ut + \frac{1}{2}at^2$

$v^2 = u^2 - 2as$

3. a. A ball of mass 0.500-kg with speed 15.0 m/s collides with a wall and bounces back with a speed of 10.5 m/s.
      i. If the motion is in a straight line, calculate the initial and final momentum and the pulse.
      ii. If the wall exerted an average force of 1000N on the ball how long did the collision last?

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b. Given that Simple Harmonic Motion (SHM) of a system have K.E $=\frac{p^2}{2m}$ and P.E $=\frac{1}{2}kx^2$

Find the Hamiltonian.

4. a. i. Show by means of substitution $r = \frac{1}{u}$ S

ii. how that the differential equation for the path of the particle in central field is describing the motion of a particle in a central field can be written

as $\frac{d^2u}{d\theta^2} + u = \frac{f(\frac{1}{u})}{mh^2u^2}$

b. Prove that GM = g R^2 where M and R are the respective mass and radius of the earth. Use it to calculate the mass of the earth.

c. Set up the Lagrangian for a simple pendulum and obtain an equation describing its motion.