JULY 2022
PHY 301SW
CLASSICAL MECHANICS
2 HOURS

Candidate's Index Number
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
LEVEL 350, FIRST SEMESTER RESIT EXAMINATION, JUNE/JULY 2022

JULY 17, 2022 **CLASSICAL MECHANICS** **9:00 AM - 11:00 AM**

Answer question 1 and any TWO others

1. a. If $\mathbf{A} = A_1\mathbf{i} - A_2\mathbf{j} + A_3\mathbf{k}$ and $\mathbf{B} = B_1\mathbf{i} + B_2\mathbf{j} - B_3\mathbf{k}$, find $\mathbf{A} \times \mathbf{B}$.

   b. The position vectors of two particles are given respectively by $\mathbf{r}_1 = t\mathbf{i} - 2t^2\mathbf{j} + (2t + 3)\mathbf{k}$ and $\mathbf{r}_2 = (2t - 3t^3)\mathbf{i} + 4t\mathbf{j} - t^3\mathbf{k}$. Find the relative velocity of the second particle with respect the first at $t = 1$.

   c. A particle of mass 2 units moves along the space curve define by $\mathbf{r} = (4t^2 - t^3)\mathbf{i} - 5t\mathbf{j} + (t^4 - 2)\mathbf{k}$. Find the momentum acting on it at $t = 1$

   d. A particle travels with uniform angular speed ω around a circle of radius b. Prove that its projection on a diameter oscillates with simple harmonic motion of period $2\pi/\omega$ about the center.

   e. A particle moving in a force field **F** has its momentum given at any time t by $\mathbf{p} = 3e^{-t}\mathbf{i} - 2\cos t\,\mathbf{j} - 3\sin t\,\mathbf{k}$. Find **F**.

   (40 marks)

2. An object of mass 20 kg moves with simple harmonic motion on x axis. Initially ($t = 0$) it is located at the distance 4 meters away from the origin $x = 0$, and has velocity 15 m/s and acceleration 100 m/s^2 directed toward $x = 0$. Find (a) the position at any time , (b) the amplitude , period and frequency of the oscillation (c) the force on the object when $t = \pi/10$ s.

   (30 marks)

3. a. Show that the differential equation describing the motion of a particle in a central field can be written as $\frac{mh^2}{2r^4}\left[\left(\frac{dr}{d\theta}\right)^2 + r^2\right] - \int r\,dr = E$

b. Two masses m_1 and m_2 travelling in the same straight line collide. Find the velocities of the particles after collision in terms of the velocities before collision.

c. Derive lagrange's equation for the non-holonomic constraints. **(30 marks)**

4. a. An object of mass is thrown vertically upward from the earth's surface with speed v_0. Find the position at any time.

b. Find the speed of the particle in terms of its distance from origin O. **(30 marks)**

JULY 2022
PHY 301SW
CLASSICAL MECHANICS
30 MINUTES

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FIVE-SEMESTER BACHELOR OF EDUCATION (SANDWICH) PROGRAMME
LEVEL 350, FIRST SEMESTER MAKE-UP QUIZ II, JUNE/JULY 2022

JULY 17, 2022 **CLASSICAL MECHANICS** **8:30 AM - 9:00 AM**

Answer ALL questions

1. Two masses m_1 and m_2 travelling in the same straight line collide. Find the velocities of the particles after collision in terms of the velocities before collision.

2. Show that the differential equation describing the motion of a particle in a central field can be written as $\frac{mh^2}{2r^4}\left[\left(\frac{dr}{d\theta}\right)^2 + r^2\right] - \int r\mathrm{dr} = \mathrm{E}$

3. Derive lagrange's equation for the non-holonomic constraints.