KENYATTA UNIVERSITY

UNIVERSITY EXAMINATIONS 2010/2011

INSTITUTE OF OPEN, DISTANCE AND E-LEARNING

SECOND SEMESTER EXAMINATION FOR THE DEGREE OF BACHELOR OF SCIENCE

SPH 200: MECHANICS II

DATE: Monday 4th July, 2011 **TIME:** 11.00 a.m. – 1.00 p.m.

INSTRUCTIONS
Answer Question **ONE** and any other **TWO** Questions.

QUESTION ONE

A]. Describe in details, the followings terms as applied to mechanics of bodies;
Moment of inertia of a body [5]
Radius of gyration of a body [5]

B]. Name any two major factors influencing the moment of inertia of a body and briefly explain how they do so. [6]

C]. Identify and prove the type of motion undergone by a body of mass **m** described by equation $y = A \sin \omega t$. [4]

D]. Prove that the rotational kinetic energy of a rigid body is given by

$$T = \frac{1}{2} I\omega^2$$

The terms have their usual meaning. [5]

E]. Calculate the period of oscillation of a uniform solid sphere of radius r and mass m, if it be suspended vertically downward from a point on its surface, (Moment of inertia of the solid sphere about its diameter is $\frac{2}{5}mr^2$). [5]

QUESTION TWO

A]. State the law of conservation of angular momentum and express it in equation form. [5]

B]. Show that during a simple harmonic motion,
i). the speed is minimum at the end points and maximum at the centre point.
ii). the acceleration is maximum at the end points and minimum at equilibrium position. [10]

C]. Calculate the length of a pendulum executing a simple harmonic motion with a time period of 3 seconds. (Given gravitational acceleration to be 9.81 m / s^2.) [5]

QUESTION THREE

A]. i. Using examples, show the difference between conservative and non-conservative forces in mechanics. **[6]**

ii. Calculate the angle (θ) between two vectors **m** and **n** given that;
m = 3k – 2i and **n = 3i - 4j**. **[4]**

B]. Identify and give reasons for the type of motion undergone by a body of mass **m** if the motion is described by an equation $y = A \sin \omega t$.
The symbols representing their usual values. **[5]**

C]. Define the resonant frequency in a forced oscillation. If there is no dumping, what would be the relationship between the resonant frequency and the natural frequency? [5]

QUESTION FOUR

A]. With the help of illustrations, outline a practical application of moment of inertia in the centrifuge technology. **[5]**

B]. State and prove the parallel axis theorem for the moment of inertia **[9]**

C]. In 10 seconds, a car accelerates from rest to attain a speed where its wheels rotate at 10 revs / sec.

i). What is the angular acceleration of the wheel? **[3]**

ii). What is the linear acceleration of the car if the rotating wheels have a radius of 25 cm? **[3]**

QUESTION FIVE

A]. Sketch a diagram of a damped harmonic oscillator. **[3]**
The oscillator has a mass of 500 g, a damper of 25 g/s and a spring constant of 75 N/m.

i). Calculate the period of the oscillator **[3]**

ii). After how long is the amplitude of oscillation half its original value? **[4]**

iii). After how long is the mechanical energy of the oscillator half its original value? **[5]**

B]. A circular cylinder of mass **m** and radius **r** is suspended vertically from a point. The cylinder is given an angular twist Φ and the resulting torque τ is found to be proportional to the twist, such that $\tau = - \lambda\Phi$. Find the expression for the period (T) of oscillation, if the cylinder undergoes simple harmonic motion. **[5]**

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