TECHNICAL UNIVERSITY OF MOMBASA

SCHOOL OF APPLIED AND HEALTH SCIENCES

MATHEMATICS AND PHYSICS

UNIVERSITY EXAMINATION FOR:

UNIT: ANALYTICAL MECHANICS

UNIT CODE: AMA 4434

SPECIAL SUPPLEMENTARY EXAMINATION

SERIES: SEPT. 2017

TIME: 2HOURS

Instructions to Candidates

You should have the following for this examination

-Answer Booklet, examination pass and student ID

This paper consists of five questions. Attempt Question one and any other two.

Do not write on the question paper.

Question ONE

(a) A spaceship of mass m is travelling in deep space with velocity V_1=20km/s relative to the sun. It affects a rear stage of mass 0.2m with the relative speed u=5km/s. Determine the velocity of the spaceship. (5mks)

(b) The morse function $V_{(x)}$ approximates the potential energy of a vibrating diatomic molecule as a function of x, the distance of separation of its constituent atoms and is given by

$$V_{(x)} = V_0 [\ 1-e^{-(x-xo)10}]^2 - V_0$$

Where V_0, X_0 and δ are parameters chosen to describe the observed behavior of a particular pair of atoms. The force that each atom exerts on the other is given by derivative of this function with

respect to X. show that X_0 is the separation of the two atoms when the potential energy function is a minimum and that its value for that distance of separation is $V(X_0)=-V_0$

(5mks)

(c) The terminal speed of a baseball in a force full is 30m/s. assuming a linear air drag. Calculate the effects of air resistance on a simple pendulum. (6mks)

(d) A particle in a central field moves in the spiral orbit.

$$R=CO^2$$

Determine the force function. (7mks)

(e)Find the principal moments of inertia of a square plate about a corner (7mks)

Question TWO

(a) Under what central force will a particle describe a circle with the force centre on the circumference of a circle.

(7mks)

(b) Find the change in the values of energy and angular momentum when the problem of a two-body system interacting through gravitational force is reduced to an equivalent ave-body case.

(13mks)

Question THREE

(a) A particle of mass m moves in two dimensions under the following potential energy function

$V(r)= 1/2\ k(X^2 +4y^2)$.

Find the resultant motion, given the initial conditions at t=0, x=a, y=0 x=0 $y=V_0$ (7mks)

b. A moving particle of mass m_1 collides elastically with a particle of mass m_2 at rest

I. If $m_1>$ show that maximum possible a angle by which the incident particle m_1 can be deflected is given by $\theta_1=\sin^{-1}(m2/m1)$

II. If $m_2> m_1$, show that the angle of deflection θ_2 of m_2 is $\theta_2 =\sin^{-1}Vm_2.m_1/2m_2$ if particle m_1 yets deflected by angle $\theta_1=90^0$. Angles are to be measured with respect to the initial direction of incident particle m_1.

(13mks)

Question FOUR

(a) Set up the language for a simple pendulum and hence describe its motion.

(10mks)

(b) A bead is sliding on a uniform of rotating wire in a force free space. Find the resulting motion

(5mks)

(c) The langragian for a certain problem is

$$L=1/2m(r^2+r^2\Omega^2)+u(r)$$

Identify the cyclic co-ordinate and the corresponding conservation law (5mks)

Question FIVE

(a) Determine the moment of inertia of a CO molecule about an axis passing through its CM and perpendicular to its own axis. Given M_c=12amu, M_o=15.985amu and $rc_o=1.13_x10^{-10}$m

Take amu=1.67_x10^{-27}kg. (7mks)

(b) An ice skater spin at 3Π rad/s with her arms extended. If her moment of inertia with arms folded is 75percent of that with arms extended. Find her angular velocity when she folds her arms. Also find the fractional change in kinetics energy.

(c) A ball of mass m falls from rest, from a height h above a horizontal surface and rebounds. Balls continues to bounce up and down till it stops if at each rebound it loses a fraction n of its kinetic energy just before collision, how long will it continue to move before stopping

If h=0.5m, n=0.1, =10m/s^2 calculate the time.

(11mks)