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**NATIONAL OPEN UNIVERSITY OF NIGERIA**

**14-16 AHMADU BELLO WAY, VICTORIA ISLAND LAGOS**

**SCHOOL OF SCIENCE AND TECHNOLOGY**

**MAY/JUNE 2012 EXAMINATION**

MTH 315 ANALYTICAL DYNAMICS

TIME ALLOWED: 3 HOURS

TOTAL: 70 MARKS

INSTRUCTION: ANSWER ANY 5 QUESTIONS

1.(a) (i) Define degrees of freedom and give two examples -4 marks

(ii) Find the number of degrees of freedom in each for a rigid body which can move freely in three dimensional -4marks

(b) A system of particles consists of a 3 gram mass located at (1,0,-1),a 5 gram mass at (-2,1,3) and 2 gram mass at (3,-1,1).

Find the coordinates of the center of mass -6 marks

2.(a) (i) Differentiate between holonomic and non-holonomic constraints -4 marks

(ii) In each of the following cases state whether the constraint is holonomic or non-holononic :

a bead moving on a circular a wire,a particle sliding down an inclined plane under the influence of gravity

and a particle sliding down a sphere from a point near the top under the influence of gravity – 3marks

(b) Prove that the total momentum of a system of particles can be found by multiplying the total mass M of the system by

the velocity of the center of mass -7 marks

3.(a) Two particles having masses *m*1 and *m*2 are located on a frictionless double inclined curves and connected by an

inextensible mass less string passing over a smooth pulley. Use the principle of virtual work to show that for

equilibrium we must have ,where and are the angles of the incline. -6 marks

(b) Use D Alembert’s principle to describe the motion of the masses in (a) -8 marks

4. (a) State the laws of motion given by Sir Isaac Newton which are considered the axioms of mechanics -6 marks

(b) Due to a force field, a particle of mass 5 units moves along a space curve whose position vector is given as a function

of time t by. Find (a ) the velocity, (b) the momentum (c) the acceleration and

(d) the force field at any time t. -8 marks

5.(a) Explain the following terms (i) Work (ii) Power (iii) Energy -6 marks

(b) (i) A particle of constant mass m moves in space under the influence of a force field F. Assuming that at times  and

the velocity is and  respectively, prove that the work done is the change in kinetic energy,ie

- 4 marks

(ii) Show that the force field F defined byis a conservative

force field. -4 marks

6.(a) Explain the following terms (i) uniform force field (ii) uniformly accelerated motion (iii) freely falling bodies-6 marks

(b) A particle of mass *m*  moves along a straight line under the influence of a constant force of magnitude F. If its initial

speed is  find (i) thespeed, (ii) the velocity and (iii) the distance travelled after time t.-8 marks

7. (a) Exaplain the following terms (i) moment of a force (ii)Moment of a Couple ( iii) Equilibrium of a Particle -6 marks

(b) (i)A uniform beam is 24m long and has a mass 100kg and masses of 60kg and 80 kg are suspended from its ends; at

what point must the beam be supported so that it may rest horizontally? -6 marks

(ii) particle moves along the x axis in a force field having potential . Determine the point of

equilibrium. -2 marks