



**NATIONAL OPEN UNIVERSITY OF NIGERIA**  
**14/16 AHMADU BELLO WAY, VICTORIA ISLAND, LAGOS**  
**SCHOOL OF SCIENCE AND TECHNOLOGY**  
**JUNE/JULY EXAMINATION**

**COURSE CODE: MTH315**

**COURSE TITLE: ANALYTICAL DYNAMICS(3 units)**

**TIME ALLOWED:3 HOURS**

**INSTRUCTION: ANSWER ANY 4 QUESTIONS**

1.(a)) Define degrees of freedom and give two examples **-7½ marks**

(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 **-10 marks**

2. 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

$$\frac{\sin \alpha_1}{\sin \alpha_2} = \frac{m_2}{m_1}$$

equilibrium we must have ,where  $\alpha_1$  and  $\alpha_2$  are the angles of the incline.

**-17½ marks**

3. (a) State the laws of motion given by **Sir Isaac Newton** which are considered the axioms of mechanics **-8 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

$r = (2t^3 + t)i + (3t^4 - t^2 + 8)j - 12t^2k$  . Find (i) the velocity, (ii) the acceleration **-9 ½ marks**

4.(a) Explain the following terms (i) Work (ii) Power (iii) Energy **-9 marks**

(b) (i) A particle of constant mass m moves in space under the influence of a force field F. Assuming that at times  $t_1$  and  $t_2$  the velocity is  $v_1$  and  $v_2$  respectively, prove that the work done is the change in kinetic energy, ie

$$\int_{t_1}^{t_2} F \cdot dr = \frac{1}{2}mv_2^2 - \frac{1}{2}mv_1^2$$

**-8½ marks**

5.(a) Explain the following terms (i) uniform force field (ii) uniformly accelerated motion

**-9 marks**

(b) A particle of mass  $m$  moves along a straight line under the influence of a constant force of magnitude  $\mathbf{F}$ . If its initial speed is  $v_0$  find (i) the speed (ii) the distance travelled after time  $t$ .

**-8½ marks**

6. (a) Explain the following terms (i) moment of a force (ii) Equilibrium of a Particle **-9 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? **-8½ marks**