NATIONAL OPEN UNIVERSITY OF NIGERIA
Plot 91, Cadastral Zone, Nnamdi Azikwe Expressway, Jabi, Abuja.

FACULTY OF SCIENCES
April/May Examination 2019

Course Code:	**MTH315**
Course Title:	**Analytical Dynamics**
Credit Unit:	**3**
Time allowed:	**3 HOUR**
Total:	**70 Marks**
Instruction:	**ATTEMPT QUESTION NUMBER ONE (1) AND ANY OTHER (4) QUESTIONS**

1. (a) Define each of the following:
   (i) the degree of freedom of a system. **(3 marks)**
   (ii) the conservation of angular momentum. **(3 marks)**

   (b) Show that $F = x^2 yzi - xyz^2 k$ is non-conservative. **(8 marks)**

   (c) Due to a field, a particle of mass 3 units moves along a space curve whose position vector is given as a function of time t by $\vec{r} = \left(4t^2 + 2t\right)i + \left(t^3 - t^2 + 10\right)j - 6t^3 k$. Find the (i) velocity (ii) momentum (iii) acceleration (iii) force field at any time t. **(8 marks)**

2. (a) State the law for impact of spheres. **(3 marks)**

   (b) A particle is moving with a simple harmonic motion of period 4π about a centre O, it passes through a point distance 4m from O with the velocity 4m/s away from O. Find the time which elapses before it next passes through this point. **(9 marks)**

3. (a) State the Newton's second and third laws of motion. **(3 marks)**

   (b) One end of an elastic string of length 24cm is fixed ended and to the other suspended end, a mass of 4kg is attached, which when in equilibrium stretches the string 4cm. the mass is pulled down at a distance of 3cm below its equilibrium position and then released. Find the period of oscillation and the maximum kinetic energy of the mass.

   (9 marks)

4. (a) State the kinetic energy of a particle. **(3 marks)**

(b) A mass of 10kg rests on a rough horizontal table with coefficient of function $\frac{1}{2}$. It is

attached to one end of light inextensible string which passes through a smooth hole in a
mass of 4kg at its free end. If the mass 4g describes a horizontal circle with velocity of 8m/s
and the mass on the table is on the point of shipping. Find the radius of the circle and the
length of string below the table. **(9 marks)**

5. (a) Three forces of magnitude 15Q, 10Q and 5Q act on a particle in directions which make 120^0
with another. Find their resultant. **(6 marks)**

(b) A ball of mass 10kg moving at 5m/s overtakes another of mass 4kg moving at 2m/s in the

same direction. If $C = \frac{1}{2}$, find the velocities after impact. **(6 marks)**

6. (a)A particle of constant mass m moves in space under the influence of a force field F.
Assuming that at time t_1 and t_2 the velocity is v_1 and v_2. Prove that the work done is the change in

kinetic energy i.e $\int_{t_1}^{t_2} F \cdot dr = \frac{1}{2}mv_2^2 - \frac{1}{2}mv_1^2$. **(6 marks)**

(b) Find the work done in moving an object along a vector $\vec{r} = 6i + 4j - 10k$ if the applied force
is $F = 4i - 2j - 2k$. **(6 marks)**