NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY

FACULTY OF INDUSTRIAL TECHNOLOGY

DEPARTMENT OF INDUSTRIAL AND MANUFACTURING ENGINEERING

DYNAMICS I

TIE 2106

First Semester Supplementary Examination Paper

August 2015

This examination paper consists of four (4) printed pages

Time Allowed: 3 hours

Total Marks: 100

Examiner's Name: Mr. W. Tumbudzuku

<u>INSTRUCTIONS AND INFORMATION TO CANDIDATE:</u>

1. Answer all five(5) questions.
2. Each question carries 20 marks.
3. Use of calculators is permissible.

Question 1

The topics kinematics of particles, kinematics of rigid bodies, kinetics of particles and kinetics of rigid bodies are covered in the dynamics course.
With reference to the course outline explain why engineers should study dynamics. [20]

Question 2

Under space curvilinear motion write short notes on:

a) Rectangular and cylindrical coordinates. [6]

b) A particle following a space curvilinear motion has a velocity given by: $\boldsymbol{v(t) = 34t^3 i + 21t^2 j + \sin\alpha t k \ ms^{-1}}$. If at time $\boldsymbol{t=0}$ the particle has the position $\boldsymbol{x(o)=5j+3k \ m}$, find:

   i. The acceleration of the particle ***a(t).*** [7]

   ii. The position of the particle **r(t).** [7]

Question 3

The firing mechanism of Figure Q3 shows a pinball machine consisting of a plunger *P* having a mass of 0.3 kg and a spring of stiffness k = 350 N/m. When s = 0, the spring is compressed 30 mm. If the arm is pulled back such that s = 60 mm and released, determine the speed of the 0.25 kg pinball B just before the plunger strikes the stop, that is, s = 0. Assume all surfaces of contact to be smooth. The ball moves in the horizontal plane. Note that the ball slides without rolling. [20]

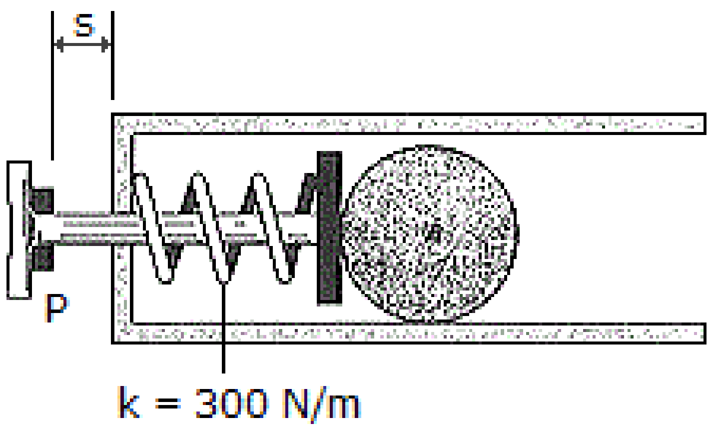

Figure Q3 Pinball machine

Question 4

Give a detailed comparison of the angular and linear motion. [20]

Question 5

A car having a mass of 1800 kg strikes a rigid sign post with an initial speed of 30 km/h as shown in Figure Q5. The front end horizontally deforms by 0.5m. If the car is free to roll during collision, determine the average horizontal collision force causing the deformation. [20]

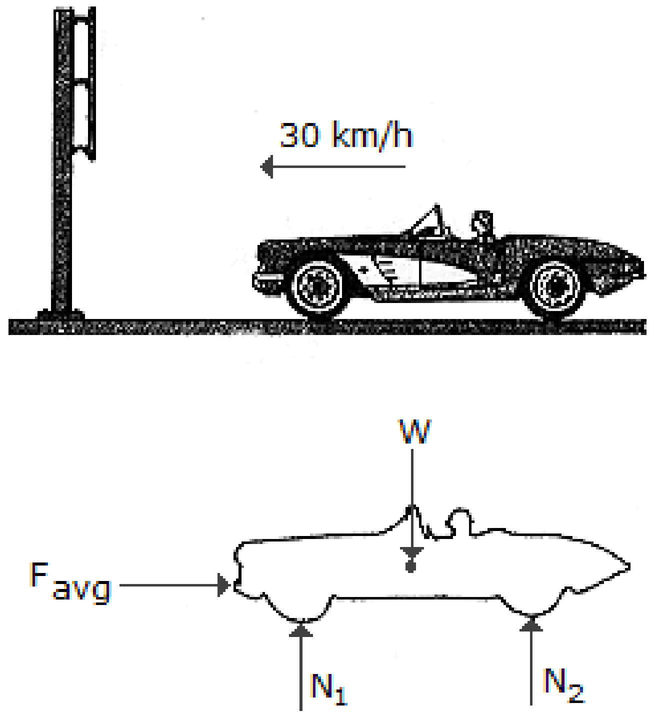

Figure Q5 Collision of bodies

Question 6

The bars shown in figure Q6 are sliding freely on a horizontal rod, for the conditions specified in table Q6, determine:

(a) The final velocity of both beads. [8]
(b) The percentage of the initial kinetic energy lost as a result of the collision of the two bars. [6]
(c) The average interaction force between the beads if the duration of impact is 0.001s. [6]

Table Q6 Collision conditions

mA	vA	mB	vB	e
9kg	**3m/s**	**2kg**	**Om/s**	**0.3**

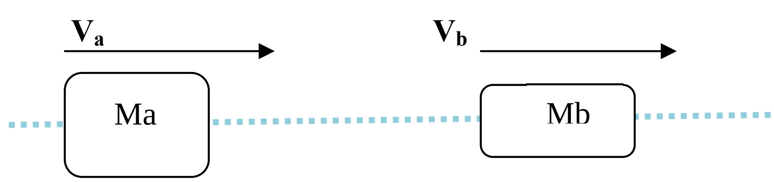

Figure Q6 Sliding bars

Question 7

(a) Mention the applications of friction, where there is need to minimize it and some where these effects are essential. [6]

(b) With the aid of a diagram distinguish between the coefficient of static friction and the coefficient of kinetic friction. [6]

© A uniform pole has a weight of 2kN and a length of 15m. Determine the maximum distance *d* it can be placed from the smooth wall and not slip if the inclination with the ground is 45^o. The coefficient of static friction between the floor and the pole is u_s = o.32. [8]

End of examination !!!