NATIONALUNIVERSITY OF SCIENCE AND TECHNOLOGY

FACULTY OF INDUSTRIAL TECHNOLOGY

DEPARTMENT OF INDUSTRIAL AND MANUFACTURING ENGINEERING

B-Eng Hons Industrial and Manufacturing Engineering

<u>Main Examination</u>

COURSE   :   **DYNAMICS I**

CODE   :   **TIE 2106**

DATE   :   **JANUARY 2013**

DURATION   :   **3 HOURS**

INSTRUCTIONS AND INFORMATION TO CANDIDATE

1. Answer any Five (**5**) questions.

2. This paper contains Seven (**7**) questions.

3. There are Four (**4**) printed pages.

QUESTION I

(a) Define displacement, velocity, speed and acceleration. [4]

(b) Explain the difference between instantaneous and average values of speed, velocity and acceleration. [2]

(c) Outline the conditions under which the equations of uniformly accelerated motion may be applied. [10]

(d) A body accelerates uniformly from rest. After 20 minutes it has travelled 100m.
   (i) Calculate the average acceleration. [2]
   (ii) Calculate also the instantaneous speed. [2]

QUESTION 2

(a) The motion of a particle is described by the following relationship :

   $x(t) = (6cos6t+10 sin7t+ 17t)m/s$. Compute the velocity and acceleration of the particle at t=10secs. [10]

(b) An air plane, flying horizontally at 800km/h drops a bomb from a height of 3km downward. Determine the horizontal distance d travelled by the bomb before it hits the target. [10]

QUESTION 3

The total linear momentum of a system of four particles at time $t = 5s$ is given by $G_{2.2} = 10i - 8j + 5k$ kg.m/s. At time $t = 10s$, the linear momentum has changed to $G_{2.4} = 5i - .5j + 6k$ kg.m/s. Calculate the magnitude **F** of the time average of the resultant of the external forces acting on the system during the interval. [20]

QUESTION 4

Write short notes on the following five types of rigid body motion
(a) Translation [4]
(b) Rotation about a fixed axis [4]
(c) General plane motion [4]
(d) Rotation about a fixed point [4]
(e) General [4]

Question 5

With reference to the following headings, explain why engineers should study dynamics:
(a)	Kinematics of particles	[4]
(b)	Kinematics of rigid bodies	[4]
(c)	Kinetics of particles using:	
	(i) Newton's second law	[4]
	(ii) Work and energy methods	[4]
	(iii) Impulse and momentum	[4]

Question 6

(a)   With the aid of diagrams differentiate between direct central impact and oblique central impact   [8]

(b)   Two bodies A and B are moving to the right as shown in Figure Q5 Determine the final velocity of both bodies after collision if they stick together.   [12]
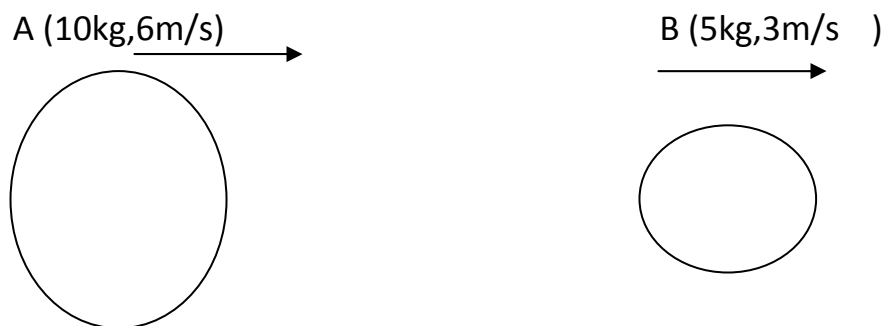
A (10kg,6m/s)   B (5kg,3m/s   )

Figure Q5 Collision of elastic bodies

Question 7

A 50kg crate slides down a ramp and falls as shown if figure Q6. The initial speed of the crate is 20m/s and the coefficient of friction between the crate and the floor is 0.3, determine:

(a)   The distance d from the end of the ramp to where the package hits the floor.
[12]
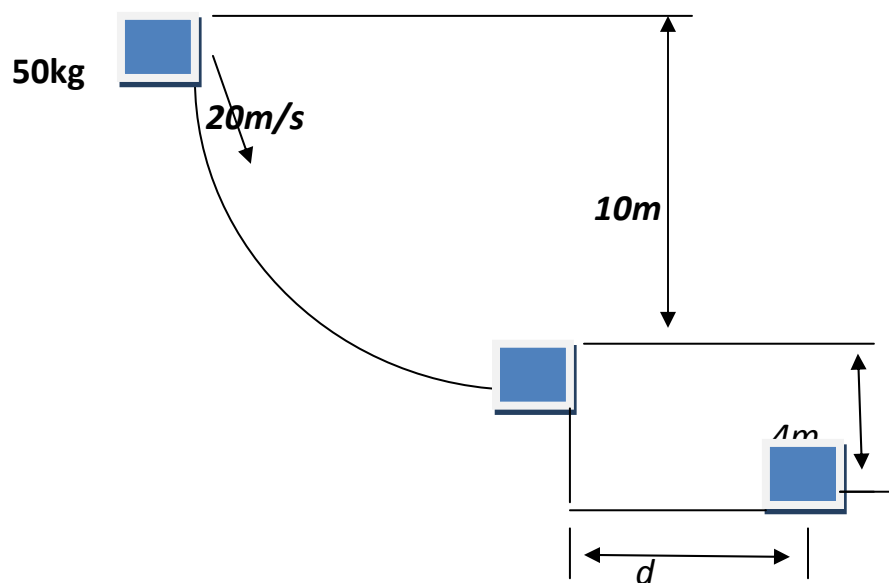
(b)   The speed of the crate when it hits the floor.
[8]

50kg

20m/s

10m

4m

d

Figure Q6 Body sliding down a ramp

End of examination!!!