NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY

FACULTY OF INDUSTRIAL TECHNOLOGY

DEPARTMENT OF INDUSTRIAL AND MANUFACTURING ENGINEERING

Bachelor of Engineering Honours Degree Industrial & Manufacturing Engineering

1st SEMESTER EXAMINATIONS – DECEMBER 2011

DYNAMICS I

COURSE CODE: TIE 2106

EXAMINATION DURATION 3 HOURS

INSTRUCTIONS TO CANDIDATE

Answer any <u>FIVE (5)</u> Questions

Question One

The position of a particle moving along the x-axis is given as $x(t)=10t^3-20t+30m$ (a) Determine the velocity of the particle as a function of time. [3] (b) Determine the acceleration as a function of time. [3]

- (c) Evaluate the position, velocity and acceleration of the particle at t=10s. [4]
- (d) Determine the total distance travelled by the particle between time *t*=6s and

$$t=9s.$$
 [4]

[6]

[12]

[8]

(e) Sketch x(t), v(t) and a(t); $0 \le t \le 9$ s.

Question Two

A 20kg crate slides down a ramp and falls as shown if Figure Q2. The initial speed of the crate is 10m/s and the coefficient of friction between the crate and the floor is 0.25, determine

(a) The distance *d* from the end of the ramp to where the package hits the floor.

(b) The speed of the crate when it hits the floor.



Question Three

Write short notes on:

(a) Conservative forces and potential energy.	[4]
(b) Gravitational potential energy (Inverse Square Law).	[4]
(c) Potential Energy of a Linear Elastic Spring force.	[4]
(d)Conservative forces.	[4]
(e) Power and efficiency.	[4]

Question Four

A 20kg box is at rest when a force F is applied. The magnitude of F varies with time as shown in Figure Q4. Take the static and the kinetic coefficients of friction as 0.3 and 0.2 respectively. Determine:

(a) The velocity of the box at t=8s.	[6]
b) The velocity of the box at $t=12s$.	[6]
(c) The time at which the box stops sliding.	[8]



Question Five

The speed of a toboggan sliding down a hill increases from 0 to 20m/s in 10s. The combined mass of the toboggan and riders is 200kg, and the slope of the hill is 20° . Determine:

(a) The average friction force between the toboggan and the snow. [10](b) The corresponding coefficient of friction. [10]

Question Six

The mass of three particles weighing 3kg, 5kg and 1kg is located at (8i+3j+3k)mand has a velocity given by v=(5i-12k)m/s. The position of the 3kg particle is5i and it's velocity is (3i+8k)m/s and the position of the 1kg particle is(8j+3k)m and it's velocity is (3i-3j)m/s.

Determine the position and velocity of the 5kg particle at this instant. [20]

End of examination !!!