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FACULTY OF INDUSTRIAL TECHNOLOGY

DEPARTMENT OF I NDUSTRI AL AND MANUFACTURI NG ENGI NEERI NG

Bachelor of Engineering Honours Degree Industrial \& Manufacturing Engineering
$1^{\text {st }}$ SEMESTER EXAMINATIONS - DECEMBER 2011

DYNAMICS I
COURSE CODE: TIE 2106

EXAMINATION DURATION 3 HOURS

INSTRUCTIONS TO CANDIDATE

Answer any FIVE (5) Questions

## Question One

The position of a particle moving along the x -axis is given as $x(t)=10 t^{3}-20 t+30 \mathrm{~m}$
(a) Determine the velocity of the particle as a function of time.
(b) Determine the acceleration as a function of time.
(c) Evaluate the position, velocity and acceleration of the particle at $\mathrm{t}=10 \mathrm{~s}$.
(d) Determine the total distance travelled by the particle between time $t=6 \mathrm{~s}$ and

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\begin{equation*}
t=9 \mathrm{~s} . \tag{4}
\end{equation*}
$$

(e) Sketch $x(t), v(t)$ and $a(t) ; 0 \leq t \leq 9 \mathrm{~s}$.

## Question Two

A 20 kg crate slides down a ramp and falls as shown if Figure Q2. The initial speed of the crate is $10 \mathrm{~m} / \mathrm{s}$ 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.
(b) Gravitational potential energy (Inverse Square Law).
(c) Potential Energy of a Linear Elastic Spring force.
(d) Conservative forces.
(e) Power and efficiency.

## Question Four

A 20 kg 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 $t=8 \mathrm{~s}$.
(b) The velocity of the box at $\mathrm{t}=12 \mathrm{~s}$.
(c) The time at which the box stops sliding.


## Figure Q4

## Question Five

The speed of a toboggan sliding down a hill increases from 0 to $20 \mathrm{~m} / \mathrm{s}$ in 10 s . The combined mass of the toboggan and riders is 200 kg , and the slope of the hill is $20^{\circ}$. Determine:
(a) The average friction force between the toboggan and the snow.
(b) The corresponding coefficient of friction.

## Question Six

The mass of three particles weighing $3 \mathrm{~kg}, 5 \mathrm{~kg}$ and 1 kg is located at $(8 i+3 j+3 \mathrm{k}) \mathrm{m}$ and has a velocity given by $v=(5 i-12 \mathrm{k}) \mathrm{m} / \mathrm{s}$. The position of the 3 kg particle is $5 i$ and it's velocity is $(3 i+8 k) \mathrm{m} / \mathrm{s}$ and the position of the 1 kg particle is $(8 j+3 \mathrm{k}) \mathrm{m}$ and it's velocity is ( $3 i-3 j$ ) $\mathrm{m} / \mathrm{s}$.
Determine the position and velocity of the 5 kg particle at this instant.

## End of examination !!!

