TECHNICAL UNIVERSITY OF MOMBASA

Faculty of Applied & Health Sciences

DEPARTMENT OF MATHEMATICS & PHYSICS

UNIVERSITY EXAMINATION FOR:

BACHELOR OF TECHNOLOGY INFORMATION TECHNOLOGY

SMA 2273: APPLIED MATHEMATICS

END OF SEMESTER EXAMINATION
SERIES: DECEMBER 2013
TIME ALLOWED: 2 HOURS

Instructions to Candidates:
You should have the following for this examination
- *Mathematical tables*
- *Scientific Calculator*

This paper consist of **FOUR** questions
Answer question **ONE (COMPULSORY)** and any other **TWO** questions
Maximum marks for each part of a question are as shown
This paper consists of **THREE** printed pages

Question One (Compulsory)

a) State the THREE Newton's Laws of linear motion **(3 marks)**

b) Find the maximum possible error in the measurement of the force of an object (mass m) travelling at a velocity v in a circle radius r if $m = 4.5kg \pm 0.1kg,\ v = 40m/s \pm 1m/s$ and $r = 12.5m \pm 0.5m$ **(5 marks)**

c) Use dimensional analysis to give the dimensions of the below quantities
- **(i)** Power **(6 marks)**
- **(ii)** Impulse **(3 marks)**

d) A girl of mass 50kg jumps onto the ground from a 4m high wall. Calculate the fore on her when she lands:

(i) If she bends her knees and stops in 0.2 seconds **(4 marks)**

(ii) If she keeps her legs straight and stops in 0.025 **(1 mark)**

e) Define moment of a couple **(2 marks)**

f) The following masses hang on a uniform metre rule as follows:

Mass A 10kg at the 10cm mark of the metre rule

Mass B 15kg at the 35cm mark of the metre rule

Mass C 12kg at the 50cm mark of the metre rule

The metre rule is pivoted at the 60cm mark. A single mass M = 99.5kg balances the three masses A, B and C

(i) Diagrammatically represent the above information **(2 marks)**

(ii) At what mark of the metre rule is mass M **(4 marks)**

Question Two

A ball is fired at a speed of 25.0m/s from ground level at an angle of 30.0° above the horizontal. Using principle of projectiles in two dimensions:

a) What is the minimum speed of the ball while it is in the air. **(4 marks)**

b) How far does the ball travel **(6 marks)**

c) When does the ball's speed equal 22.5m/s **(5 marks)**

d) What is the ball's height when it has travelled 41m **(5 marks)**

e) Broadways produces two types of bread one at a cost of 50 shillings per loaf, the other at a cost of 60

Question Three

a) State the Law of conservation of momentum **(2 marks)**

b) Consider a body A having mass m and let u and v be the velocities of A before and after collision respectively. Consider another body B having mass m' and let u' and v' be the velocities of B before and after collision respectively. Using the above Information, show that:
$mu + m'u' = mv + m'v'$

NOTE: Use diagrams where possible. **(9 marks)**

c) mass A of 12kg moving with a velocity of 10m/s collides with a mass B of 8kg moving in the opposite direction at 6m/s. Calculate:

(i) The final velocity in the case where the two masses stick together on Impact, **(3 marks)**

(ii) Now assume that the masses above do not stick together but mass A moves on with a velocity of 0.5m/s. Calculate the velocity of B. **(3 marks)**

d) A horizontal jet of water leaves a horse pipe and strikes a wall horizontally with a velocity of 20m/s. If the end of the pipe has a diameter of 2cm, calculate the force that will be exerted on the wall. **(3 marks)**

Question Four

a) A force of magnitude 80N acts along the positive x-axis and another 50N force is inclined at 120o to the horizontal surface. Find the resultant force and its direction from the 80N force. **(5 marks)**

b) A uniform ladder of weight 400N and length 4m rests with its foot on a rough horizontal ground with coefficient of friction of 0.4. The top rests on a smooth vertical surface. Find the angle of inclination of the ladder with the horizontal just before it slips **(4 marks**

c) Two masses of 3kg and 2kg are attached to either end of an inextensible string which passes over a frictionless pulley. The system is released so that it moves freely. Calculate:

(i) The acceleration of the system **(3 marks)**

(ii) The tension in the string **(2 marks)**

d) A uniform beam AB of length 4m and mass 10kg is freely hinged to a fixed pivot at A and supported in a horizontal position by a light string of length 5m attached to the beam at B and to a point 3m vertically above A. Find the tension in the string and the reaction at the pivot. **(5 marks)**

Question Five

a) A constant force F acts on a body of mass 40kg and changes its velocity from $V1 = 7\hat{i} - 2\hat{j} + 6\overset{n}{k}$, to $V_2 = 11\hat{i} + 6\hat{j} - 2\hat{k}$ in 20 seconds. Calculate

(i) The magnitude of the force F **(5 marks)**

(ii) The work done on the body in 20 seconds **(5 marks)**

b) A body moves around a circle of radius 20m, if its tangential speed is 40m/s, find:

(i) The angular speed **(2 marks)**

(ii) The angular acceleration **(1 mark)**

(iii) The normal acceleration **(1 mark)**

(iv) The arc covered after a time t = 10 seconds **(3 marks)**

(v) The angle subtended after a time t = 10seconds **(3 marks)**

(vi) The number of revolutions after a time t = 10 seconds **(2 marks)**