UNIVERSITY OF SWAZILAND

MAIN EXAMINATION, NOVEMBER/DECEMBER 2014

FACULTY OF SCIENCE

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

TITLE OF PAPER:	ENGINEERING MECHANICS AND MATERIALS SCIENCE
COURSE CODE:	EE201
TIME ALLOWED:	THREE HOURS

INSTRUCTIONS:

1. **There are seven questions in this paper. Answer Question 1 and any other four questions, making a total of five questions**
2. **Each question carries 20 marks.**
3. **Marks for different parts of a question are shown in the right hand margin.**

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THIS PAPER CONTAINS EIGHT (8) PAGES INCLUDING THIS PAGE

QUESTION ONE (COMPULSORY) ***(20 marks)***

(a) What are the commonly used methods to anchor bodies with force members on vertical or horizontal surfaces? How do the reactions at the anchor points differ?

(6 marks)

(b) Distinguish between the following mechanical properties of a material

(i) Ductility and brittleness

(ii) Elasticity and plasticity

(iii) Fatigue and creep

(iv) Strength and hardness

(8 marks)

(c) Discuss the stress-strain curves of the following materials and highlight any differences between them.

(i) Brittle ceramics

(ii) Ductile metals

(iii) Ductile polymers *(6 marks)*

QUESTION TWO ***(20 marks)***

A block M of weight 100 N lies on a horizontal surface. Another block P weighing 120 N lies on an inclined surface. The two blocks are attached to each other by a string passing over a smooth pulley A. The block M is kept at rest by a weight W attached to another string passing over a smooth pulley B anchored as shown in Fig. Q2. Take the coefficient of friction between the blocks and the surfaces as 0.3.

Find the value of W required to keep the block P from just starting to move down the incline.

(20 marks)

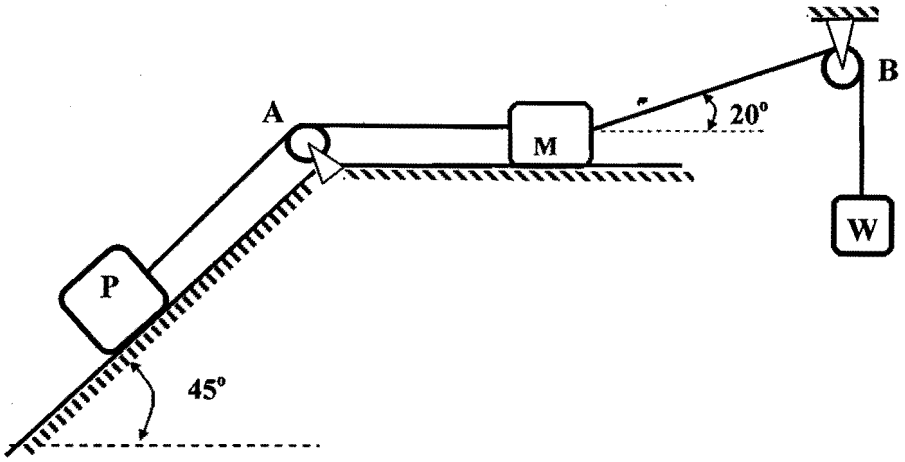

Fig. Q2

QUESTION THREE (20 marks)

(a) A ball of mass 60 g is moving with a velocity of 6 m/s when it strikes a stationary ball of mass 30 g. The velocity of the 60 g ball after impact is 3 m/s in the same direction as before impact. Determine the velocity of the 30 g ball after impact. *(5 marks)*

(b) A vehicle accelerates uniformly from 16 m/s to 25 m/s over a distance of 200 m. The contact surfaces of the tyres of the vehicle have a radius of 270 mm. Calculate:

(i) the time the vehicle took to cover that distance (mean velocity may be used)

(ii) the initial angular velocity of each wheel of the vehicle

(iii) the angular acceleration of the each wheel

(iv) the tangential acceleration of a point on the contact surface of the tyre.

(10 marks)

(c) Calculate the kinetic energy of a solid flat disc of diameter 50 cm and of uniform thickness of 8cm rotating about its centre at 100 rpm. Take the density of the disc material as 7860 kg/m3. For a solid flat disc of mass m and radius R, $I = \frac{mR^2}{2}$.

(5 marks)

QUESTION FOUR ***(20 marks)***

Briefly discuss the properties common to each of the following broad categories of materials:

(a) Metals *(5 marks)*

(b) Elastomers *(5 marks)*

(c) Glasses *(5 marks)*

(d) Polymers *(5 marks)*

QUESTION FIVE *(20marks)*

Two blocks of masses 10 kg and 30 kg are connected by an inextensible cord and pulleys as shown in Fig. Q5 . If the mass of the cord and the pulleys assumed negligible, determine the velocity of each block 3 seconds after the blocks are released from rest.

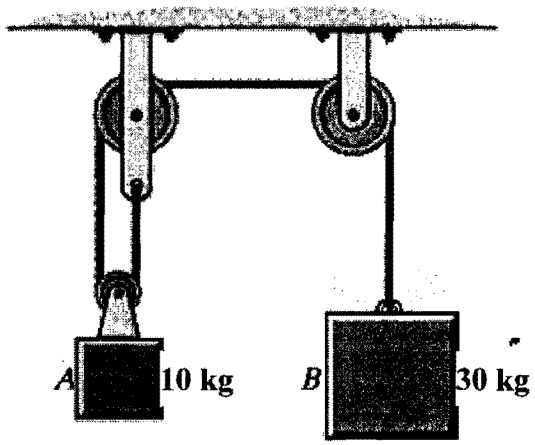

Fig. Q5

QUESTION SEVEN ***(20 marks)***

A light inextensible string ABCD is tied to two points A and D on a horizontal ceilng. Two weghts of 30 N and 40 N are tied to the points B and C as shown in the following diagram. If AB and BC make inclinations of 50° and 40° respectively to the horizontal:

(a) Find the tension in parts AB and BC of the string

(b) Find also the tension in part CD of the string and the inclination which CD makes with the vertical.