UNIVERSITY OF SWAZILAND

SUPPLEMENTARY EXAMINATION, JULY 2016

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 five questions in this paper. Answer ANY FOUR QUESTIONS
2. Each question carries 25 marks.
3. Marks for different parts of a question are shown in the right hand margin.

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THIS QUESTION PAPER CONTAINS SIX (6) PAGES INCLUDING THIS PAGE

QUESTION ONE ***(25 marks)***

(a) State Newton's 2nd Law of Motion as it relates to linear momentum and force. *(3 marks)*

(b) What is an impulsive force? *(2 marks)*

(c) A mass of 10 kg is dropped vertically on to a fixed horizontal plane with an impact velocity of 12 m/s. The mass rebounds with a velocity of 7 m/s. If the mass-plane contact time is 35 ms, calculate:

(i) The impulse *(4 marks)*

(ii) The impulsive force *(3 marks)*

(d) A 12000 kg truck moving at a speed of 1.2 m/s on a horizontal track collides with a 18000 kg truck moving at 1.8 m/s towards it. If the cars couple together after the collision, determine:

(i) The speed of the coupled trucks just after the collision, *(6 marks)*

(ii) The average force between them if the coupling takes place in 0.5 s. *(7 marks)*

QUESTION TWO ***(25 marks)***

A pin-jointed truss ABCD is fixed on a vertical wall using freely hinged pin joints at A and D as shown in Fig.Q2. The truss carries a load of 10 kN at B. Determine the internal forces in the truss elements and the reactions of the wall fixtures. Dimensions of the structural elements are deliberately not given because you should not need them. Note that smooth hinges have both normal and tangential reactions, but no restraining moment. *(25 marks)*

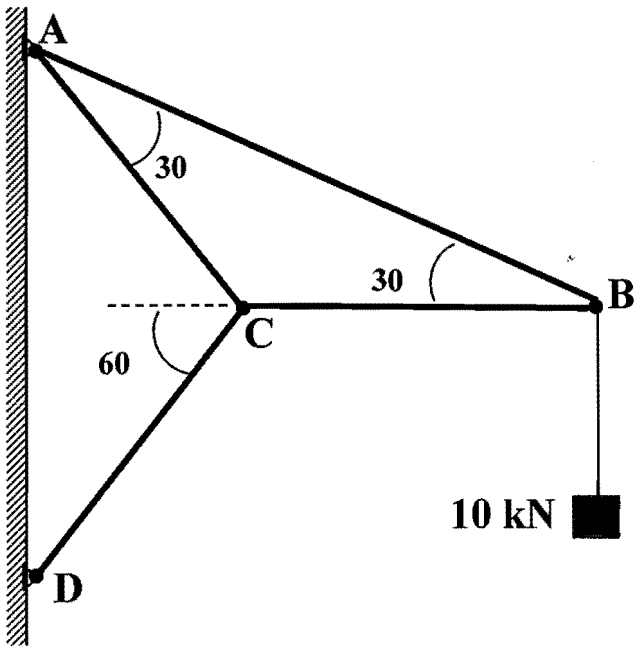

Fig. Q2

QUESTION THREE *(25 marks)*

(a) "In engineering friction is both desirable and undesirable". Briefly explain this statement and state how these two extremes are achieved using appropriate materials.

(6 marks)

(b) A block of mass 50 kg is to be kept in equilibrium on an inclined plane by a string, pulley and mass ***M*** kg arrangement as shown in Fig.Q3. The coefficient of friction between the block and the inclined surface is 0.3 and the pulley is frictionless (resulting in uniform tension on the string). Find the range of values of mass ***M*** which can keep the body in equilibrium on the incline without moving up or down the incline.

(19 marks)

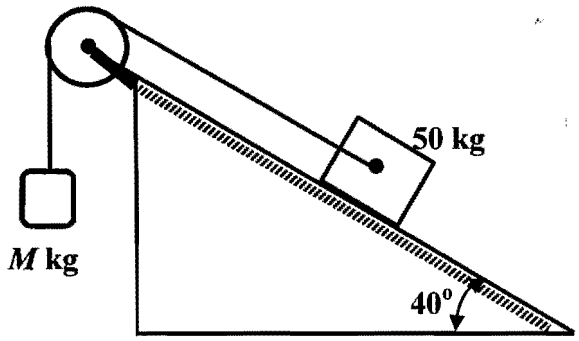

Fig. Q3

QUESTION FOUR *(25 marks)*

(a) Distinguish between the following terms as used in engineering materials

(i) Ductility and brittleness. *(3 marks)*

(ii) Elasticity and plasticity *(3 marks)*

(iii) Fatigue and creep. *(3 marks)*

(iv) Hardness and strength. *(3 marks)*

(b) Two blocks A and B of masses 10 kg and 12 kg respectively are connected by an inextensible cord over two fixed pulleys and one movable pulley as shown in Fig.Q4. If the mass of the cord and the pulleys are assumed negligible, and the pulleys are smooth and frictionless, determine the velocity of each block 3 seconds after the blocks are released from rest. *(13 marks)*

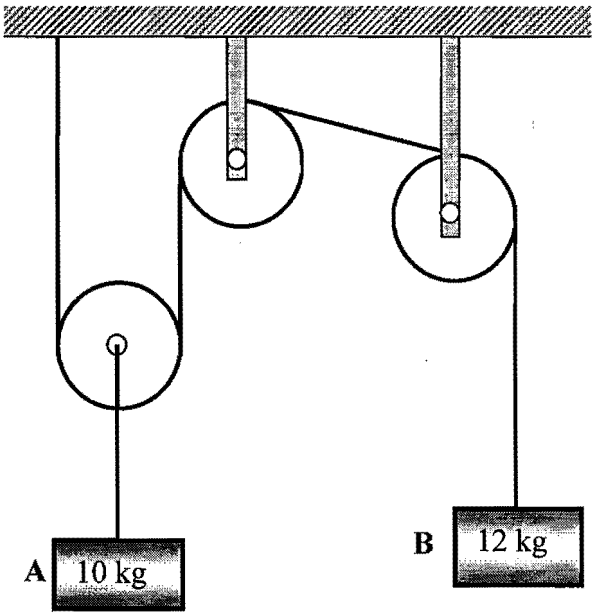

Fig. Q4

QUESTION FIVE *(25 marks)*

(a) A motor rotates at 1500 revolutions per minute with a power of 20 kW.

(i) Calculate the torque it develops. *(3 marks)*

(ii) If the angular acceleration of the motor is 5.0 rad/s^2, calculate the moment of inertia of the motor. *(2 marks)*

(b) A block rests at a distance of 1.5 m from the centre of a rotating disc platform as shown in Fig. Q.5b. The coefficient of static friction between the block and platform is 0.3. If the angular motion of the disc is slowly increased, determine the maximum angular speed in revolutions per minute (r.p.m) which the disc can attain before the block begins to slip. *(12 marks)*

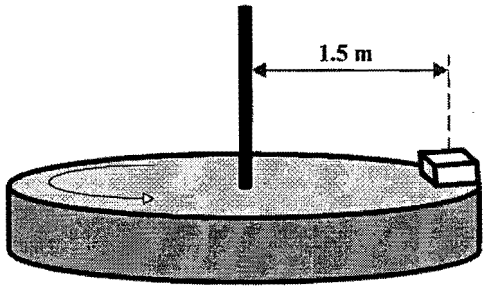

Fig. Q.5b

(c) A metal bar made from a material with $E = 200\times10^9$ N/m^2 is subjected to an axial tensile load of 100 kN. Assume that the bar is of solid circular cross-section.

(i) If the stress in the bar is to be limited to 150×10^6 N/m^2, calculate the required minimum diameter of the bar. *(5 marks)*

(ii) If the bar is 500 mm long, what will be maximum elongation of the bar under the condition given in (i). *(3 marks)*