Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2013/2014

COURSE NAME	:	MECHANICS OF MACHINES
COURSE CODE	:	BNJ 20303
PROGRAMME	:	2 BNH/BNK/BNL
EXAMINATION DATE	:	JUNE 2014
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWER **FIVE (5)** QUESTIONS ONLY

THIS QUESTION PAPER CONSISTS OF **SEVEN (7)** PAGES

Q1 (a) Describe **THREE (3)** advantages of power transmission belt compare to other form of power transmission AND sketch **FOUR (4)** types of belt drive shapes.

(5 marks)

(b) **Figure Q1** shows an open belt drive system that is used to connect two parallel shafts 4 meter apart. The diameter of bigger pulley is 1.5 meter and the smaller pulley is 0.5 meter. The mass of the belt is 1 kg/m length. The maximum tension is not exceeds 1500 N and used only for flat belt type. The coefficient of friction, $\mu = 0.25$. The bigger pulley, which is the driver, run at 250 rpm. Due to slip, the speed of the driven pulley is 725 rpm.

Calculate :-

(i) The power transmitted.
(ii) The power lost due to friction.
(iii) Efficiency of the drive system.

(15 marks)

Q2 (a) Gear system is used in power transmission system for most of the mechanical system nowadays. Gear can be classified according to the relative position of the axes of the mating gears. Describe AND give **ONE (1)** example, the types of axes of the mating gears.

(5 marks)

(b) A vehicle has a mass of 1000 kg carries a load of mass *M* kg, moves directed at an angle 15° using the first gear. The wheels run at 400 rpm when the engine speeds at 2000 rpm. The moment of inertia of the wheel is 20 kgm^2 and the engine part is 2 kgm^2. The wheel has a radius of 0.5m and the engine can produce maximum torque of 600 Nm.

Determine :-

(i) Gear ratio for the first gear.
(ii) The maximum value of *M* if the vehicle climbs up with 0.5m/s^2 acceleration. Assuming wind friction is 250 N and gear efficiency is 90%.

(15 marks)

Q3 An effort of 3 kN is required just to move a certain body up an inclined plane of angle 20 degree. The effort of 1 kN is also required just to move the same body down the same plane. Both forces act parallel to the plane.

(a) Draw free body diagrams for both conditions.

(5 marks)

(b) Determine the weight of the body and the coefficient of friction.

(7 marks)

(c) What would the coefficient of friction value if the same body is made just to move on the same plane with zero degree of inclination? Please explain and verify your answer with calculation.

(9 marks)

Q4 (a) Describe briefly about balancing technique for machine or rotating mechanical part AND explain how it is said to be perfectly balanced.

(3 marks)

(b) A shaft carries four rotating masses A, B, C and D in this order, along its axis as shown in **Figure Q4(a) and Figure Q4(b)**. The mass A is assumed to be concentrated at a radius of 18 cm, B at 24 cm, C at 12 cm and D at 15 cm. The masses of B, C and D are 30kg, 50 kg and 40 kg respectively. The planes containing B and C are 30 cm apart. The angular spacing of the planes containing C and D are 90° and 210°, respectively relative to B measured in the same sense. If the shaft and masses are to be in complete dynamic balance.

Calculate :-

(i) The magnitude of mass A
(ii) The angular position of mass A from *B*.
(iii) The position of the planes A and D from *B*.

(17 marks)

Q5 A mass-pulley-spring system is shown in **Figure Q5**. Springs in series and parallel arrangement are attached to Pulley 1 and Pulley 2 respectively. The friction and the masses of the pulley are neglected.

(a) Draw an equivalent mass-pulley-spring arrangement for the system.
(5 marks)

(b) Draw the free body diagram for the equivalent system.
(5 marks)

(c) Derive the equation of motion of the system.
(5 marks)

(d) Calculate the natural frequency of the system if k = 100 N/m and m = 5 kg.
(5 marks)

Q6 **Figure Q6** shows a rigid rod *ABD* with uniform cross section in which the centre of gravity is located at *B*. Mass of the rod is 2.5 kg with radius of gyration 0.5 m about *B*. The rod carries 10 kg mass and is attached with a spring (k = 5 kN/m) at end *D*. The rod also carries 5 kg mass at end *A*. A damper *C* is attached to the rod 75 cm from *B*. When the rod *ABD* was given a small initial displacement, it was found that the vibration amplitude reduced to half after three complete oscillations.

(a) Calculate the damping ratio, ζ of the damper *C*.
(4 marks)

(b) Determine the damped natural frequency of the system.
(10 marks)

(c) Determine the damping constant of the damper *C*.
(6 marks)

- END OF QUESTION –

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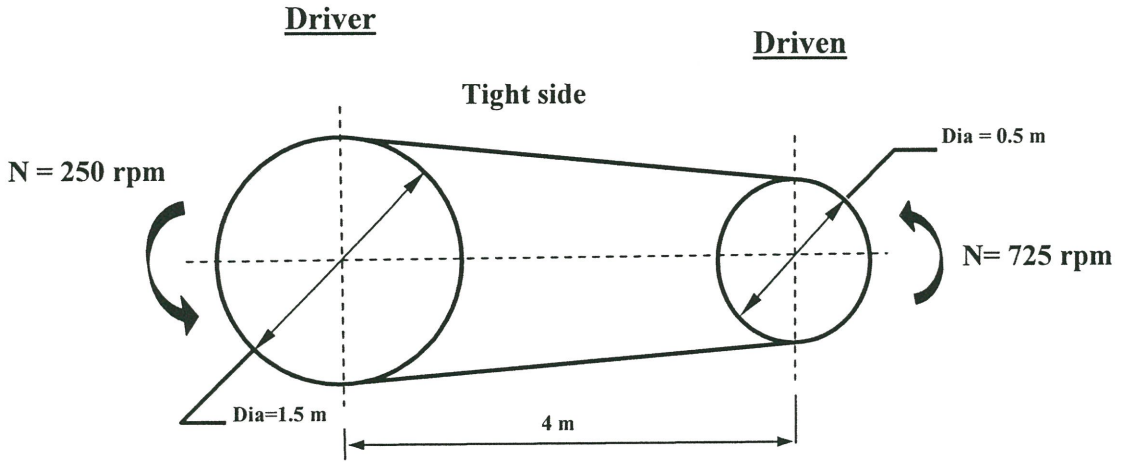

FIGURE Q1

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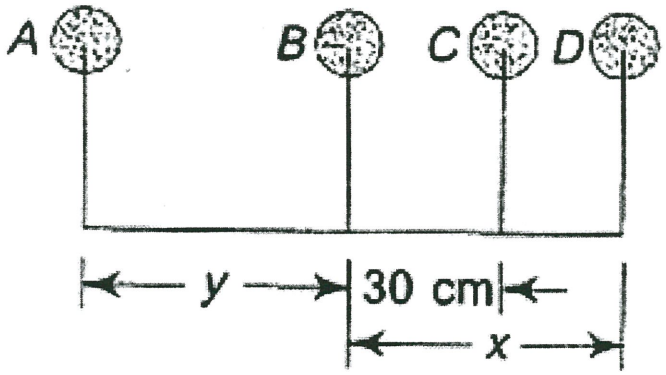

FIGURE Q4(a)

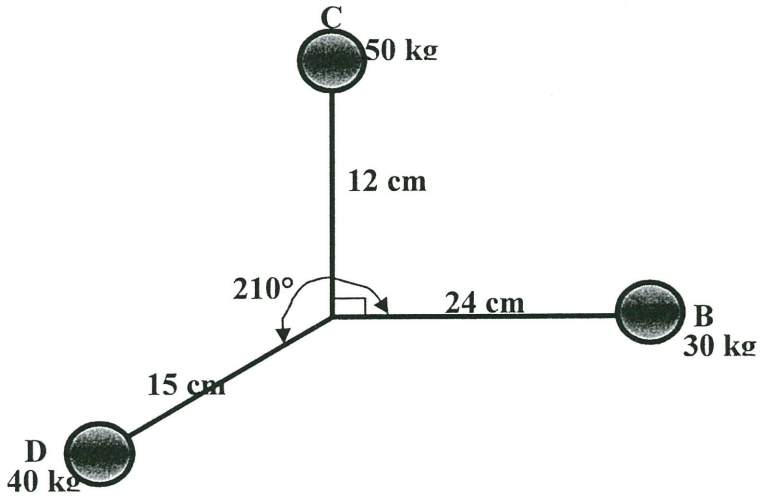

FIGURE Q4(b)

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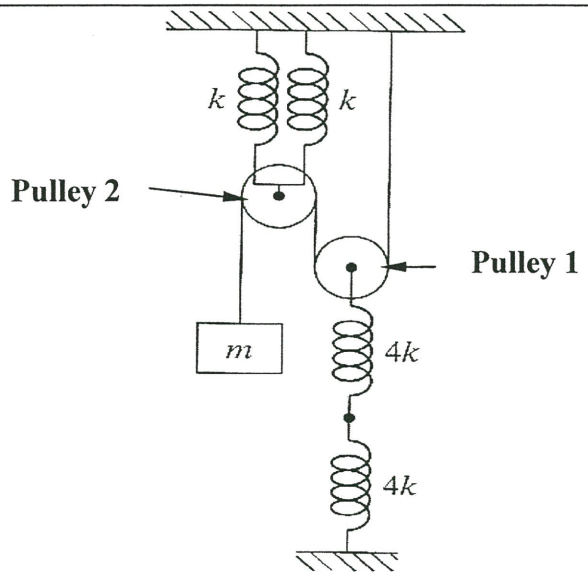

FIGURE Q5

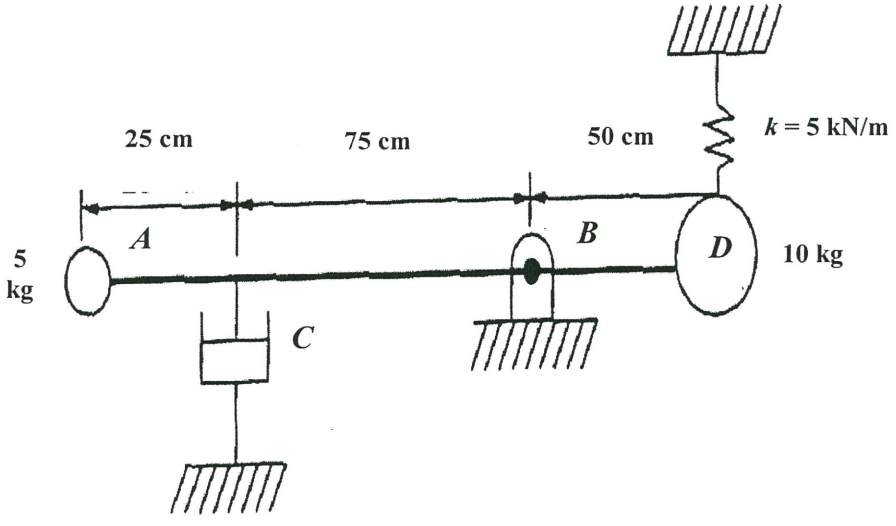

FIGURE Q6