UTHM
Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESION 2013/2014

COURSE NAME	:	MECHANICS OF MACHINES
COURSE CODE	:	BDA 20303
PROGRAMME	:	2 BDD
DATE	:	JUNE 2014
DURATION	:	3 HOURS
INSTRUCTIONS	:	ANSWER **FOUR (4)** FROM **FIVE (5)** QUESTIONS

THIS QUESTION PAPER CONSIST OF **SIX (6)** PAGES

Q1 **(a)** Explain the following terms;

(i) gear system,
(ii) gear trains, and

(4 marks)

(b) Figure **Q1** shows a motor accelerating a hoist with diameter 0.9 m, through two sets of gear reducing system. The number of teeth on gear 1, gear 2, gear 3 and gear 4 are 100, 350, 100 and 450 respectively. Moment of inertia for the motor shaft is 5 kgm^2, middle shaft is 20 kgm^2 and hoist shaft is 100 kgm^2. The rope that is encircled on the hoist must capable to accelerate up a load of M kg that is sliding on a 1 in 50 slope at acceleration of 3 m/s^2. Friction on the slope is 1000 N and the total torque at motor required to raise the load is 1500 Nm. Gear efficiency of gear set 1-2 is 90% and gear efficiency for gear set 3-4 is 95% gear. The friction torque effect at the middle shaft is $T_X = 150$ Nm and at the hoist shaft is $T_y = 800$ Nm. Find

i) gear ratio of the system

(3 marks)

ii) equivalent moment inertia for a gear system, and

(3 marks)

iii) the total mass if the motor able to accelerate the load at acceleration of 3.0 m/s^2.

(15 marks)

Q2 **(a)** V-belt drive have its advantages and disadvantages over flat belt drive. Write down **five (5)** of V-belt drive advantages and their disadvantages over flat belt.

(5 marks)

(b) A V belt drive transmit power from an electric motor to a compressor. A compressor required 90 kW of power to run at 250 rpm. The electric motor run at 750 rpm. The diameter of the pulley on the compressor shaft should not be greater than 1 m, while the centre distance between the pulleys is limited to 1.75 m. The belt speed should not exceed 1600 m/min. If the belt density, ρ is 1000 kg/m^3 and its allowable tensile stress, σ is 2.5 MPa, the groove angle of the pulley is 35° and the coefficient of friction between the belt and the pulley, μ is 0.25. Calculate:

(i) Diameter of driving pulley, d_l

(2 marks)

(ii) The centrifugal tension, T_c

(4 marks)

(iii)   Angle of lap, θ on the smaller pulley.

(3 marks)

(iv)   Power transmitted per belt.

(7 marks)

(v)   The number of V-belts required to transmit the power if each belt has a cross-sectional area of 375 mm^2.

(2 marks)

(vi)   The length required for each belt.

(2 marks)

Q3   (a)   Explain **three (3)** reason why balancing is important to be conducted in a system

(6 marks)

(b)   An industrial stirrer tank, as shown in Figure **3(a)**, were installed with 4 unit of solid rod welded at the main rotating shaft. At the edge of rod were fixed with square blades A, B, C and D. The blades masses are 2 kg, 3 kg, 4 kg and 2 kg respectively and their radius of rotations are 800 mm, 700 mm, 600 mm and 800 mm. From top view, the angular position of masses B, C and D are 45°, 115° and 235° anticlockwise from the mass A. Due to installation error and poor workmanship, an abnormal vibration had occurred due to unbalance situation. As a countermeasure, balancing masses are to be placed in P and Q planes. The distances between planes are shown in Figure **3(b)**. By neglecting the solid rod and rotating shaft masses;

(i)   Find both new square blades P and Q position to be installed to balance the systems using mathematical or graphical method.

(15 marks)

(ii)   If the radius is 400 mm, what would be the balance masses for P and Q square blades?

(2 marks)

(iii)   What is the Centrifugal force F_C for square blade P, if the motor is running at 25 rpm.

(2 marks)

Q4 (a) Suggest 3 modification can be done to increase the power transmitting capabilities for friction clutch

(6 marks)

(b) A friction clutch is to transmit 10 kW at 3000 rpm. It is to be of single plate type with both sides of the plate effective, the axial pressure being limited to 0.09 N/mm². If the external diameter of the friction lining is 1.4 times the internal diameter and the coefficient of friction may be taken as 0.3, find the required dimensions of the friction lining. Assume the system in uniform wear conditions.

(19 marks)

Q5 (a) Explained briefly about mechanism. With the help of diagram, list types of inversion.

(5 marks)

(b) Figure **Q4** shows a space diagram of mechanism in a steam engine. With dimensions of the links are $AB = 12$ cm, $BC = 48$ cm, $CD = 18$ cm, $DE = 36$ cm, $EF = 12$ cm and $FP = 36$ cm,

(i) Find the velocities of C and P if crank AB rotates clockwise at 300 rpm

(12 marks)

(ii) Rubbing velocity at F if the pin diameter is 12 mm

(3 marks)

(iii) Torque produced at A if force 500 N is applied at slider P and system efficiency is 100%.

(5 marks)

END OF QUESTION

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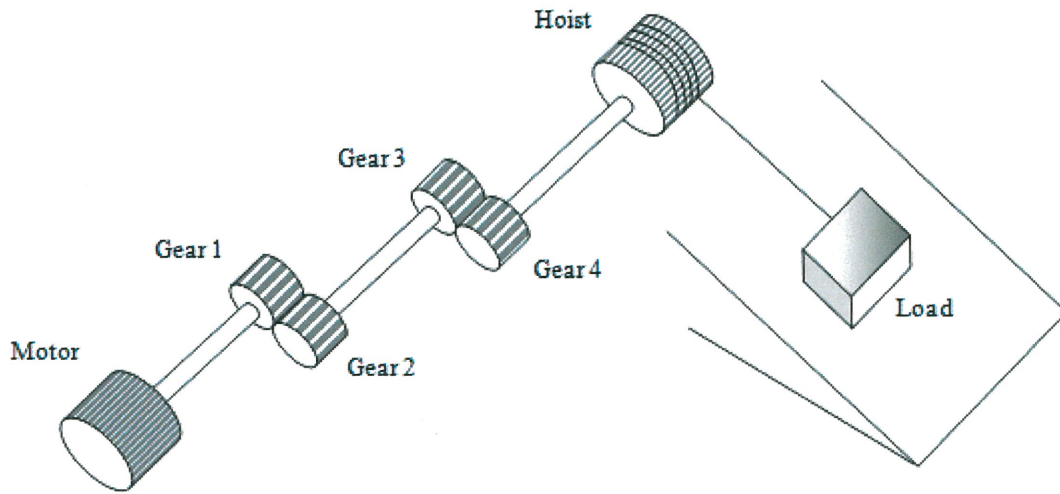

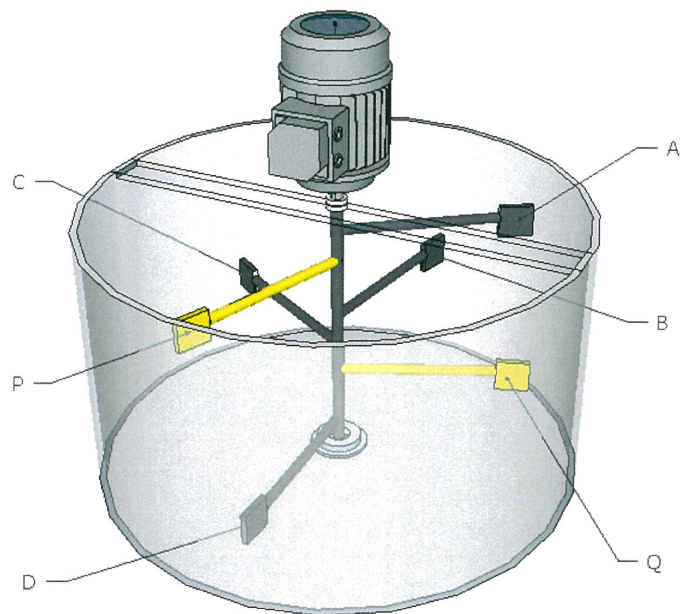**FIGURE Q1**

FIGURE Q3(a)

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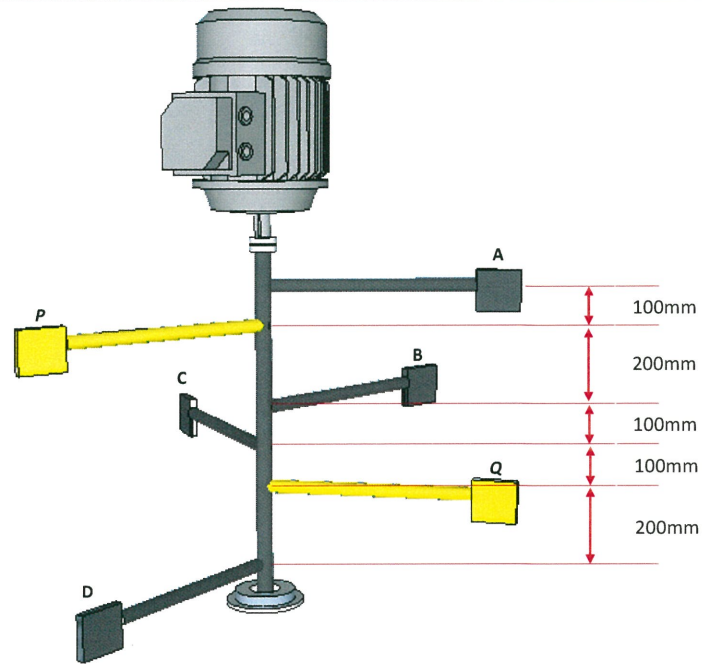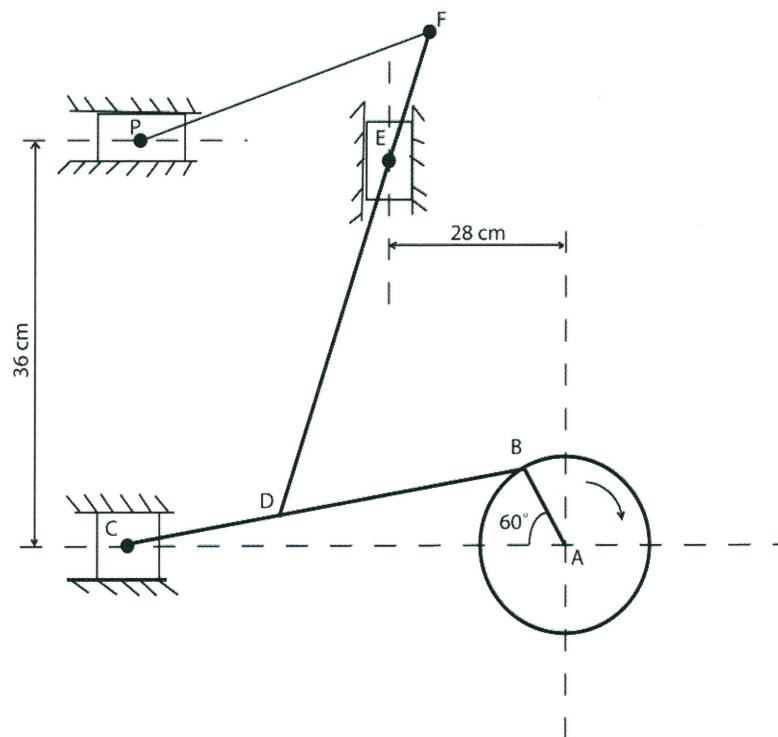COURSE : MECHANICS OF MACHINES   COURSE CODE : BDA 20303

FIGURE Q3(b)

FIGURE Q5