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UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2014/2015

COURSE NAME	:	MECHANIC OF MACHINE
COURSE CODE	:	BDA 20303
PROGRAMME	:	2 BDD
DATE	:	JUNE 2015
DURATION	:	3 HOURS
INSTRUCTIONS	:	ANSWER FIVE(5) QUESTIONS ONLY

THIS QUESTION PAPER CONSISTS OF EIGHT (8) PAGES

Q1 A shop owner has approached your design company to make a mechanical product display that can rotate on a box. **Figure Q1(a)** below shows the intended idea. As the round handle turns the product also rotates. The shop owner has decided that the model should be motorized and he has sketched the drawing as shown in **Figure Q1(b)**.

(i) Using the incomplete Figure Q1(a), sketch a mechanism that would convert the rotary motion of the handle into rotary motion of the product. Explain your gear system construction.

(8 marks)

(ii) If the motor turns in a clockwise direction, which direction will gear 'X' turn?

(2 marks)

(iii) What is the name of the gear arrangement shown in Figure Q1(b)?

(2 marks)

(iv) The motor turns at 180 rpm. How fast will gear 'Y' turn?

(8 marks)

Q2 (a) V-belt drive have its advantages and disadvantages over flat belt drive. Write down fives (5) advantages of V-belt drive compared to flat belt drive.

(5 marks)

(b) A V-belt with groove angle 60° is used to transmit power between two pulleys at 1.5 m apart. The driver pulley that runs at 1200 rpm having radius of 50 mm while the follower pulley radius is 250 mm as shown in **Figure Q2.**

(i) Given the belt has a mass of 0.4 kg/m, the maximum tension is 750 N; coefficient of friction $\mu = 0.4$, find the maximum tension difference of the belt.

(8 marks)

(ii) Given the belt cross section area is 320 mm^2, and Young's Modulus for the material is 300 MN/m^2, find the speed of the driven pulley and the power transmitted to it.

(7 marks)

Q3 (a) In the balancing system, define the following terms.

(i) balancing

(ii) static balance,

(iii) dynamic balance, and

(iv) reference plane.

(4 marks)

(b) Five masses A, B, C, D and E rotate in the same plane at equal radii as shown in **Figure Q3(b)**. The masses A, B and C are 10 kg, 5 kg, and 8 kg respectively. The angular position of masses B, C, D and E measured in the same direction from A are 60°, 135°, 210° and 270° respectively. Find the masses D and E for complete balance.

(16 marks)

Q4 The mechanism as shown in **Figure Q4** are outfit with slider D which only allowed to move on a horizontal path. The crank OA is rotating anti-clockwise at 180 rpm. The links dimensions are as follows:

OA = 180 mm, CB = 240 mm, AB = 360 mm and BD = 540 mm.

(i) Find the velocity at point A, υ_{AO}.

(1 marks)

(ii) Draw the space and velocity diagram at that instant as in **Figure Q4**

(8 marks)

(iii) Determine the angular velocity of links AB, CB and BD.

(3 marks)

(iv) Determine the rubbing velocity on the pin A and D, given pins diameter are 30 mm.

(4 marks)

(v) Calculate the required torque at crank OA, to overcome 2 kN force at D.

(4 marks)

Q5 (a) Explain briefly the meaning of static friction.

(3 marks)

(b) Discuss briefly the law of dry friction.

(3 marks)

(c) An electric motor driven power screw moves a nut in a horizontal plane against a force of 75 kN at a speed of 300 mm / min. The screw has a single square thread of 6 mm pitch on a major diameter of 40 mm. The coefficient of friction at screw threads is μ=0.1. Calculate;

(i) Torque required to rotate the screw

(10 marks)

(ii) Power required by the motor.

(4 marks)

Q6 **Figure Q6** shows a space diagram of mechanism in a steam engine. The dimensions of links are AB = 12 cm, BC = 48 cm, CD = 18 cm, DE = 36 cm, EF = 12 cm and FP = 36 cm, find

(i) Velocities of piston at point C, P and E if crank AB rotates clockwise at 200 rpm.

(15 marks)

(ii) Acceleration of slider C

(5 marks)

END OF QUESTION

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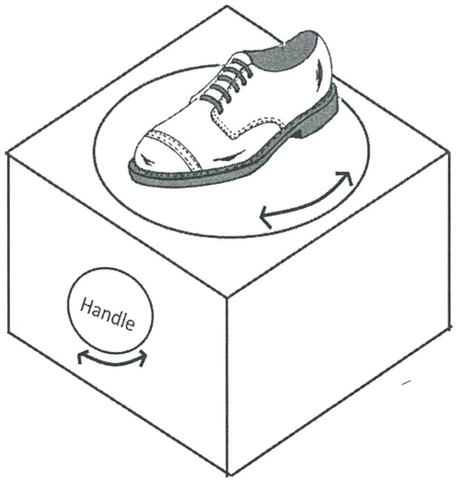

Figure Q1(a)

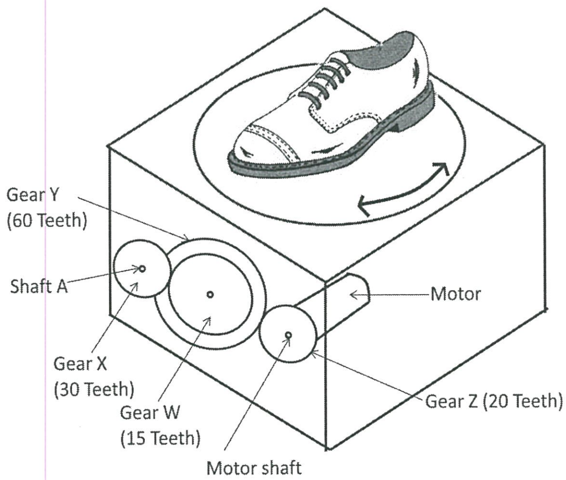

Figure Q1(b)

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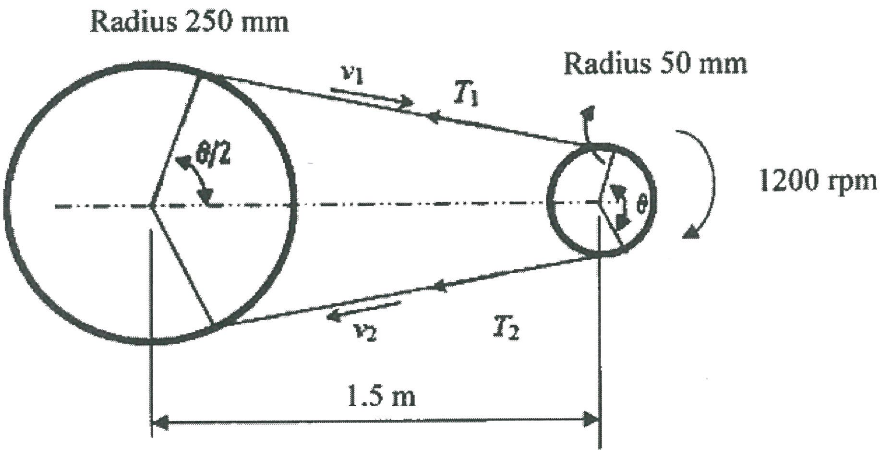

Figure Q2

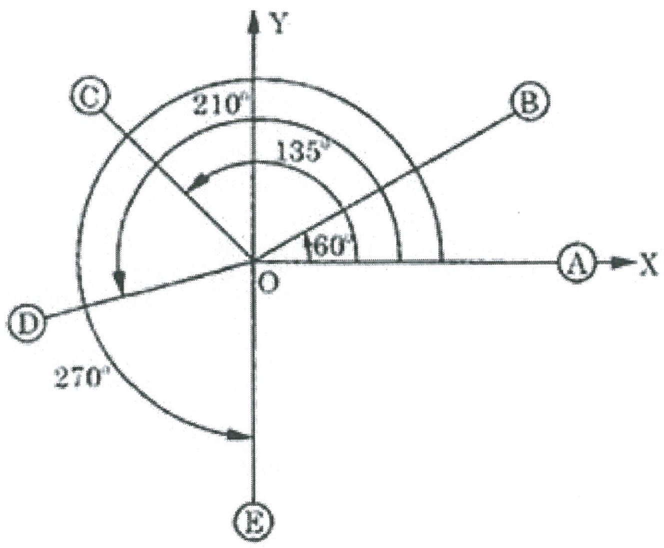

Figure Q3(b)

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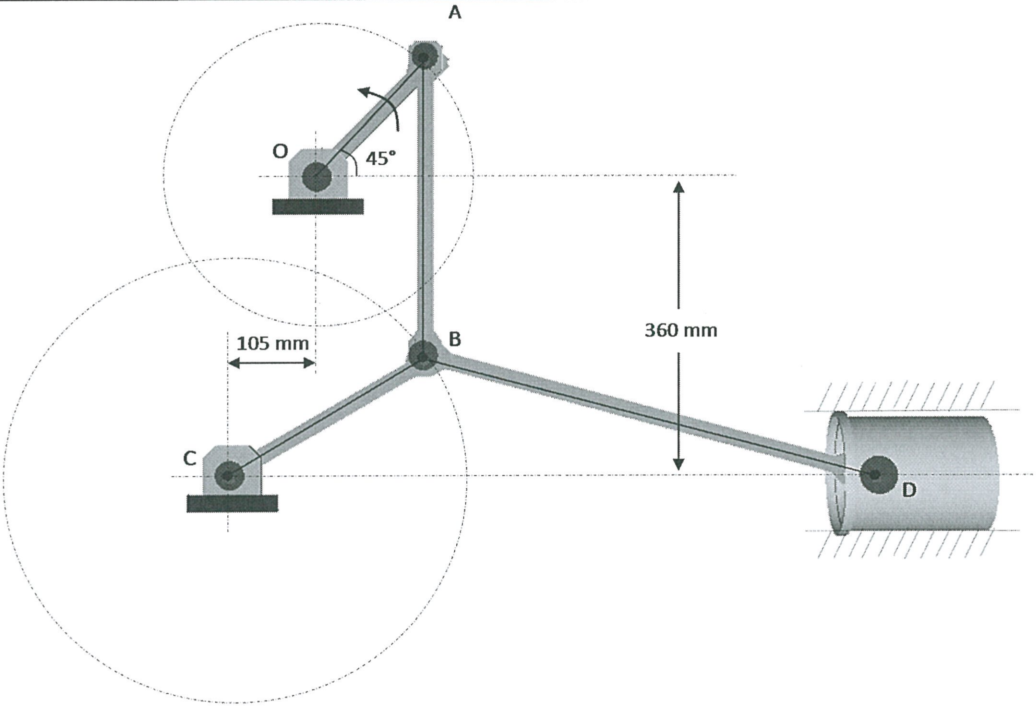

Figure Q4

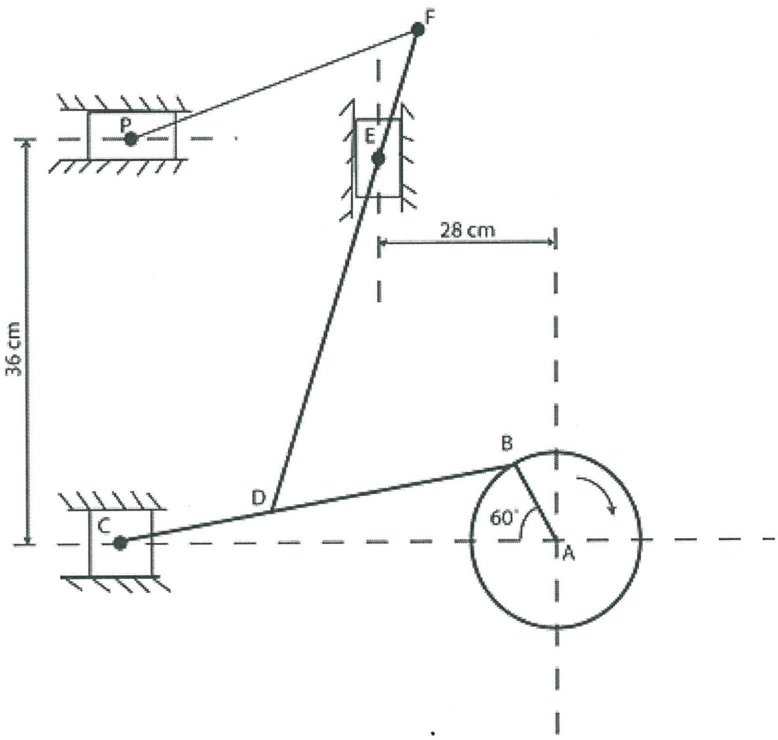

Figure Q6

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LIST OF FORMULA

Gear Ratio , $n = \frac{w_2}{w_1} = \frac{D_1}{D_2} = \frac{N_1}{N_2} = \frac{\alpha_2}{\alpha_1}$

Equivalent moment of inertia, $I_{equiv} = \left(I_A + \frac{I_B n^2}{\eta_G} \right)$

Belt drive velocity ratio, $n = \frac{N_2}{N_1} = \frac{d_1}{d_2}$

Vee Belt ratio, $\frac{T_1}{T_2} = e^{\left(\frac{\mu\theta}{\sin\beta}\right)}$

Power transmission for belt, $P = (T_1 - T_2)v$

Centrifugal force, $\rho A v^2 = T_C$

Creep in belt drive, $\frac{v_1}{v_2} = 1 - \frac{(T_1 - T_2)}{AE}$

Limiting angle of friction, $\tan\phi = \frac{\mu R_N}{R_N}$

Screw thread, $\tan\alpha = \frac{p'}{\pi d}$

Motion up the plane for screw, $P = W \frac{\tan\alpha + \mu}{1 - \mu \tan\alpha}$

Motion down the plane for screw, $P = W \frac{\mu - \tan\alpha}{1 + \mu \tan\alpha}$

Linear velocity, $v = \omega r$

Radial acceleration, $a_R = \frac{v^2}{r} = \omega^2 r$

Tangential acceleration, $a_T = \alpha r$