Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2019/2020

COURSE NAME	:	MECHANICS OF MACHINE
COURSE CODE	:	DAM 21703 / DAM 31703
PROGRAMME CODE	:	DAM
EXAMINATION DATE	:	DECEMBER 2019 / JANUARY 2020
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWERS **FIVE (5)** QUESTIONS ONLY

THIS QUESTION PAPER CONSISTS OF **NINE (9)** PAGES

Q1 (a) State **two (2)** advantages and disadvantages of driving gear.

(4 marks)

(b) A gearbox has an input speed of 2000 rpm clockwise and an output speed of 500 rpm anticlockwise. The input power is 50 kW and the efficiency is 60%. Determine the:

(i) gear ratio.
(ii) input torque.
(iii) output power.
(iv) output torque.
(v) holding torque.

(10 marks)

(c) The gearing of machine tool is shown in **Figure Q1(c)**. The motor shaft is connected to gear A while the final gear F is fixed on the output shaft.

(i) Calculate the gear ratio for the compound chain.
(ii) If the input gear rotates clockwise, in which direction does the output rotates.

(6 marks)

Q2 (a) List **three (3)** concern for initial tension in the belt.

(3 marks)

(b) An engine running at 200 rpm drives a line shaft with the help of a belt as in **Figure Q2(b)**. The diameter of the pulley on the engine is 80 cm and the diameter of the pulley on the line shaft is 40 cm. A 100 cm diameter pulley on the line shaft drives a 20 cm diameter pulley keyed to a dynamo shaft. Determine the speed of the dynamo shaft when:

(i) there is no slip.

(10 marks)

(ii) there is a slip of 2.5% at each drive.

(7 marks)

Q3 (a) Explain the relation between of statics balance and the centrifugal force. (4 marks)

(b) A shaft is rotating with constant speed carries four masses at plane A, B, C and D with of each masses from shaft axes is 1.2 kg, 3.5 kg, 4.0 kg and 2.0 kg. Each mass is arranged with distance 60 cm apart as shown in **Figure Q3(b)**. Given the radius of mass B and C is 5 cm and 3.5 cm respectively. If the rotating shaft system need to be completely balance:

(i) determine the radius of mass at plane A and D. (12 marks)

(ii) determine the angular setting relative to plane A and D. (2 marks)

(iii) sketch the final angular position of all masses on the shaft. (2 marks)

Q4 (a) Define the limiting angle of friction. (4 marks)

(b) An electric motor supplying 2 kW power to rotate a screw in an internal thread hole of metal block. The rotating screw need to raise a load 35 kN. The screw type is a single Vee thread with 12 mm pitch and a mean diameter 40 mm. Given the angle of Vee thread β is 20° and the coefficient of friction between the nut and the screw is 0.15, calculate:

(i) the force required to raise the load. (7 marks)

(ii) the percentage of efficiency. (4 marks)

(iii) the torque required on the screw to raise the load. (2 marks)

(iv) the motor speed in RPM to rotate the screw. (3 marks)

Q5 (a) Describe **four (4)** types of inversion in slider crank mechanism and example for each inversion. (4 marks)

(b) The four bar chain in **Figure Q5(b)** comprises of link OA = 0.5 m, link AB = 0.9 m and link BP = 0.7 m. Crank OA is rotating clockwise with an angular velocity of 2.6 rad/s which is decreasing at 4.5 rad/s^2.

(i) Redraw the **Figure Q5(b)** using scale of 1 cm : 0.2 m. (3 marks)

(ii) Draw the velocity diagram of the bar chain using scale of 1 cm : 0.2 m/s. (6 marks)

(iii) Draw the acceleration diagram of the bar chain using scale of 1 cm : 1 m/s^2. (7 marks)

Q6 (a) Give **two (2)** examples for desirable vibration and undesirable vibration.

(4 marks)

(b) A uniform platform of 4 m long of mass 50 kg carries a small central load of 15 kg and is hinged at point O as in **Figure Q6(b)**. It is supported in the horizontal position by two springs symmetrically places at point A and B, whose stifness are 16 000 N/m and 4000 N/m respectively. If the moment of inertia of the platform through its center is given by $\frac{1}{12}ml^2$ where m and l are the mass and length of the platform respectively:

(i) determine the moment of inertia of the system about point O.

(5 marks)

(ii) find the natural frequency of the platform about its hinge.

(11 marks)

- END OF QUESTIONS -

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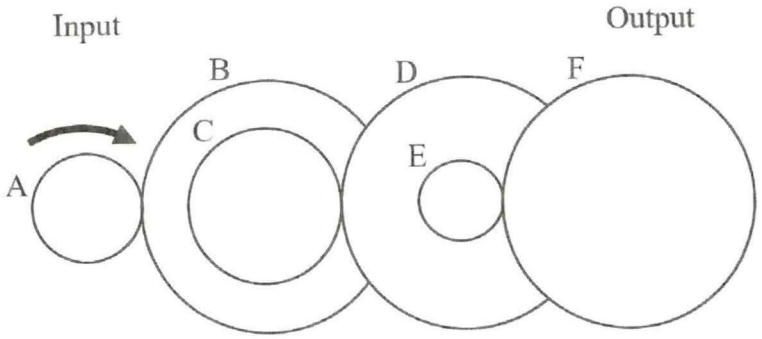

Gear	A	B	C	D	E	F
Teeth	20	100	40	100	10	100

Figure Q1(c)

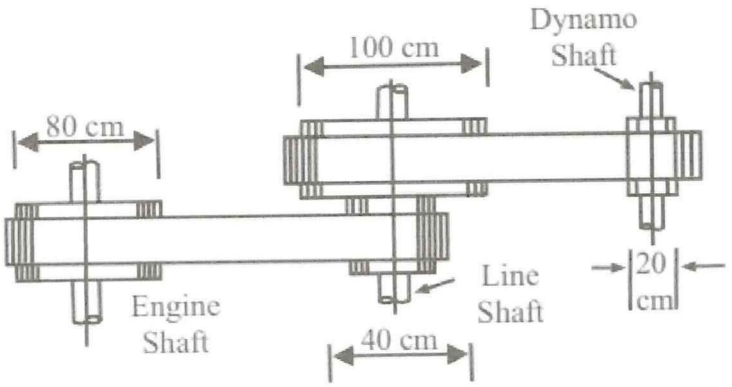

Figure Q2(b)

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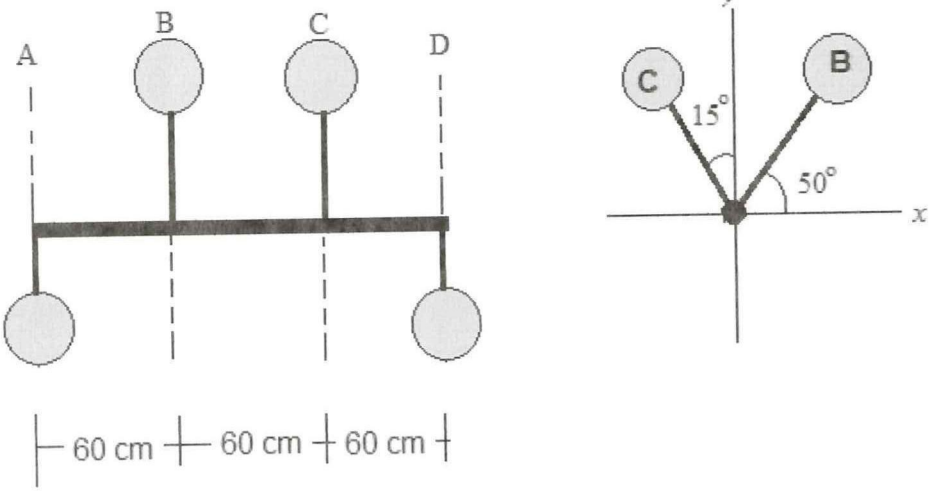

Figure Q3(b)

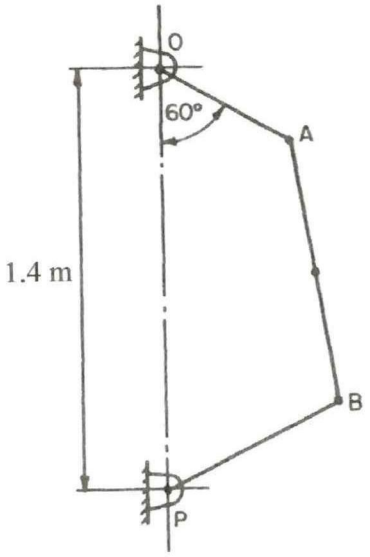

Figure Q5(b)

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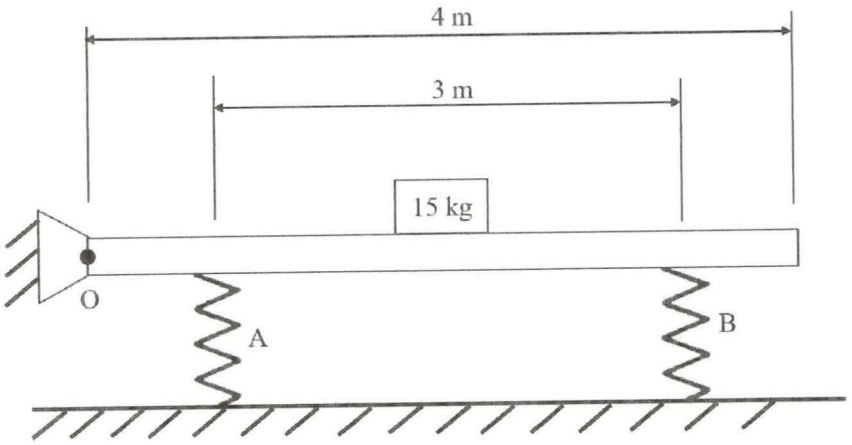

Figure Q6(b)

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List of Formula

1. Linear velocity at the contact surface of gear, $\pi D_1 N_1 = \pi D_2 N_2$
2. Equivalent Moment of Inertia, $I_{equiv} = \left(I_A + \frac{I_B n^2}{\eta_G} \right)$
3. Velocity Ratio for belt drives, $n = \frac{N_2}{N_1} = \frac{d_1}{d_2}$
4. Belt tension ratio for flat belt, $\frac{T_1}{T_2} = e^{\mu\theta}$
5. Belt tension ratio for V-Belt, $\frac{T_1}{T_2} = e^{\left(\frac{\mu\theta}{\sin\beta}\right)} = e^{(\mu\theta)(\operatorname{cosec}\beta)}$
6. V-Belt type force balance, $R_N = \frac{R}{2\sin\beta}$
7. Maximum Power for Belt Drives, $P = (T_1 - T_2)v$
8. Centrifugal force term, $\rho A v^2 = T_C$
9. Limiting Angle of Friction, $\tan\phi = \frac{F}{R_N} = \mu$
10. Inclination of Square Threaded Screw, $\tan\alpha = \frac{p}{\pi d}$
11. Efficiency for Square Threaded Screw, $\eta = \frac{p}{\pi D \tan(\beta + \alpha)}$
12. Radial component of acceleration, $f_{BA}^r = \omega^2 (BA) = \frac{(V_{BA})^2}{BA}$

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13. Tangential component of acceleration, $f_{BA}^{t} = \alpha(BA)$

14. Newton's Second Law of Motion, $\sum M_O = I_O\ddot{\theta}$

15. Principle of conversion of energy, $\frac{d}{dt}[T.K + T.U]$