UTHM
Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2016/2017

COURSE NAME	:	MECHANICS OF MACHINE
COURSE CODE	:	DAJ 32103
PROGRAMME CODE	:	DAJ
EXAMINATION DATE	:	JUNE 2017
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWER **FIVE (5)** QUESTIONS ONLY

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

BAHASA MELAYU

S1 (a) Senaraikan **empat (4)** kegunaan gear beserta contoh.

(4 markah)

(b) Sebuah motor memecut beban 550kg dengan pecutan 2 m/s^2 melalui sistem gear seperti dalam **Rajah S1(b)**. Beban diikat pada tali dan dililit pada gegendang yang mempunyai garis pusat 1.5 m. Gear bagi syaf gegendang mempunyai 200 bilangan gigi dan gear bagi syaf motor mempunyai 20 bilangan gigi serta gear A mempunyai 40 gigi dan gear B mempunyai 80 gigi. Gear A dan B berada pada satu shaft. Kecekapan sentuhan gear adalah 90%. Jisim dan jejari kisar masing-masing adalah seperti berikut:

	Jisim(kg)	Jejari kisar (mm)
Syaf motor	250	100
Syaf gegendang	1100	500
Syaf gear A-B	250	150

Tentukan daya kilas yang diperlukan untuk menaikkan beban dengan pecutan 2 m/s^2. Geseran diabaikan.

(16 markah)

S2 (a) Senaraikan **tiga (3)** kelebihan tali sawat –V dan tali sawat segerak.

(6 markah)

(b) Satu sistem pacuan terbuka tali sawat rata digunakan dalam sistem pemacu pam air yang menghubungkan dua takal pada jarak 1100 mm. Takal pada syaf motor elektrik berdiameter 100mm berputar pada kelajuan 25 putaran per saat. Diameter takal pada syaf pam air adalah 50mm. Pekali geseran antara tali sawat dan permukaan takal adalah 0.3. Ketegangan maksima yang dibenarkan ialah 550N.

(i) Dapatkan nisbah halaju takal
(ii) Kirakan sudut sentuhan tali sawat
(iii) Kirakan kuasa yang dihantar oleh tali sawat
(iv) Tentukan ketegangan awal tali sawat
(v) Tentukan nisbah halaju takal jika gelinciran tali sawat adalah 5%

(14 markah)

S3 (a) Terangkan tentang keseimbangan statik dan keseimbangan dinamik dan berikan **dua (2)** contoh bagi setiap satu jenis keseimbangan tersebut.

(6 markah)

(b) Sebuah aci yang berputar ditunjukkan dalam **Rajah S3 (b)** mempunyai jisim A, B, C, dan D dengan jejari masing-masing adalah 125 mm, 150mm, 250 mm dan 80 mm. Jarak antara satah-satah bagi jisim yang berputar dan sudut antara jisim B dan C adalah seperti dalam rajah. Jisim bagi B dan C adalah masing-masing 200 g dan 450g. Tentukan nilai jisim A, jisim D dan sudut bagi jisim A dan D untuk sistem berada dalam keseimbangan sempurna.

(14 markah)

S4 (a) Senaraikan **dua (2)** contoh bagi geseran statik dan geseran dinamik.

(4 markah)

(b) Sebuah jek skru benang persegi digunakan untuk menaikkan beban seberat 350kg. Jarak antara benang skru adalah 5mm dan diameter min adalah 12.5mm. Pekali geseran adalah 0.4;

(i) Kirakan kecekapan skru jek apabila beban dinaikkan
(ii) Kirakan daya kilas yang diperlukan untuk menaikkan beban
(iii) Tentukan magnitud daya yang diperlukan, jika pemegang digunakan untuk menaikkan beban dengan jejari 350mm dari pusat benang

(16 markah)

S5 (a) Nyatakan aplikasi bagi mekanisma engkol gelangsar untuk setiap penyongsangan pertama, kedua, ketiga dan keempat.

(4 markah)

(b) **Rajah S5 (b)** menunjukkan dalam sebuah mekanisma engkol gelangsar digunakan di dalam enjin wap. Panjang OA engkol dan rod penyambung AB adalah masing-masing 100cm dan 400cm. Engkol 'OA' berpusing pada satu paksi tetap 'O' mengikut arah jam pada kelajuan 200 rpm pada sudut awal 40°. Dengan melukis gambarajah halaju;

(i) Dapatkan halaju linear omboh B
(ii) Kirakan halaju sudut link AB
(iii) Tentukan halaju linear titik P yang terletak pada jarak 80 cm pada rod penyambung dilanjutkan
(iv) Tentukan halaju cengkaman pada pin A jika diameter pin adalah 5 cm

(16 markah)

S6 (a) Terangkan tentang getaran bebas berserta dengan contoh.

(5 markah)

(b) Rod seragam nipis, AB yang ditunjukkan dalam **Rajah S6 (b)** mempunyai jisim 2kg dan membawa jisim tertumpu sebanyak 4.5 kg di B. Rod digantung pada A dan dikekalkan dalam kedudukan melintang oleh dua pegas berketegangan K1=2kN/m dan K2=3.5kN/m pada C. Kirakan frekuensi ayunan. (Abaikan kesan jisim spring).

(15 markah)

- SOALAN TAMAT -

Q1 (a) *List **four (4)** uses of gear and examples:*

(4 marks)

(b) *A load of 550kg accelerated by a motor with the acceleration of 2 m/s^2 through the gear system as shown in **Figure Q1(b)**. Load is tied to a rope and wrapped on a drum with a diameter of 1.5 m. Gear for the drum shaft has 200 number of teeth and gear for motor shaft has 20 teeth and the gear A has 40 teeth and the gear B has 80 teeth. Gear A and B are on one shaft. The gears efficiencies are 90%. The mass and radius of gyration of each are as follows:*

	Jisim(kg)	*Radius of gyration (mm)*
Motor shaft	250	100
Drum shaft	1100	500
A-B gear shaft	250	150

Determine torque required to raise the load with an acceleration of 2 m/s^2. Friction is ignored.

(16 marks)

Q2 (a) *List **three (3)** advantages of V-belt and synchronous belt:*

(6 marks)

(b) *An open belt drive systems uses flat belt in water pump drive system connecting the two pulleys at a distance of 1100 mm. Pulley on the electric motor is 100mm in and rotates at a speed of 25 revolutions per second. Diameter of the pulley on the water pump shaft is 50mm. The coefficient of friction between the belt and pulley surfaces is 0.3. The maximum allowed tension is 550N.*

Determine:

(i) *Find the speed ratio of the pulleys*
(ii) *Calculate the belt angle of contact*
(iii) *Calculate power transmitted by the belt*
(iv) *Determine initial tension of the belt*
(v) *Determine the speed ratio of the pulley if belt slippage is 5%.*

(14 marks)

Q3 (a) *Explain about the static balance and dynamic balance and give **two (2)** examples respectively.*

(6 marks)

(b) *A rotating shaft is shown in **Figure Q3(b)** has a mass of A, B, C, and D with each radius is 125 mm, 150mm, 250mm and 80mm respectively. The distance between planes of the rotating mass and the angle between the mass B and C are shown in the figure. The mass of B and C are 200g and 450g respectively. Determine the mass A, D and angle of the A and D for the system in perfect balance.*

(14 marks)

Q4 (a) *List **two (2)** examples of static friction and dynamic friction.*

(4 marks)

(b) *A square thread screw jacks used to raise a load of 350kg. Distance between the screw thread is 5mm and the mean diameter is 12.5mm. The friction coefficient is 0.4;*

(i) Calculate the efficiency of the screw jack when the load is raise up.
(ii) Calculate the torque required to raise up the load
(iii) Determine the magnitude of the force required, if the handle is used to raise a load with a radius of 350mm from the center line

(16 marks)

Q5 *(a) State the application of slider crank mechanism for each 1st, 2nd, 3rd and 4th inversion.*

(4 marks)

*(b) **Figure Q5 (b)** shows the Slider Crank mechanism used in a steam engine. The length of crank OA and connecting rod AB is 100cm and 400cm respectively. Link OA rotates clockwise about 'O' at 200 rpm with starting angle is 40^{o}. By drawing the velocity diagram;*

(i) Find the linear velocity of piston B
(ii) Calculate the angular velocity of link AB
(iii) Determine the linear velocity of point P that located at distance of 80 cm on the connecting rod extended
(iv) Determine the rubbing velocity at pin A if the pin diameter is 5cm

(16 marks)

Q6 *(a) Explain about free vibration including their example.*

(5 marks)

*(b) A uniform thin rod, AB shown in **Figure Q6 (b)** has a mass of 2 kg and carries a concentrated mass of 4.5 kg at B. The rod is hinged at A and maintained in the horizontal position by two springs of stiffness K1= 2 kN/m and K2= 3.5 kN/m at C. Calculate the frequency of oscillation. (Neglect the effects of the spring mass.*

(15 marks)

- END OF QUESTIONS -

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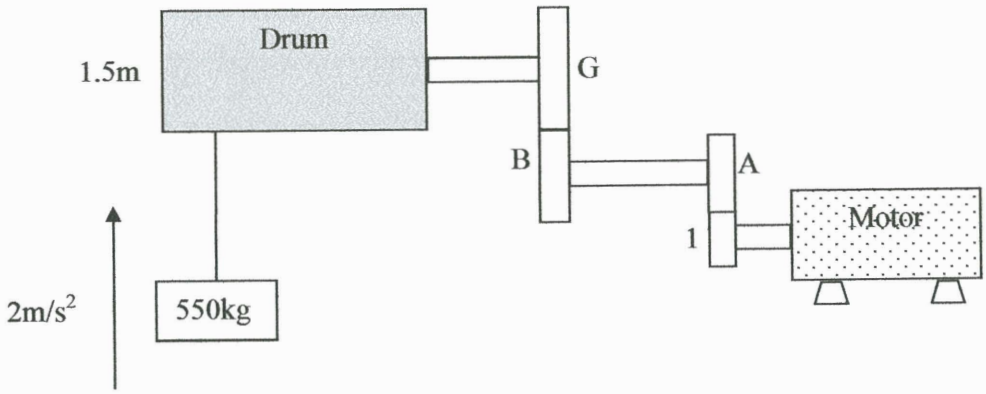
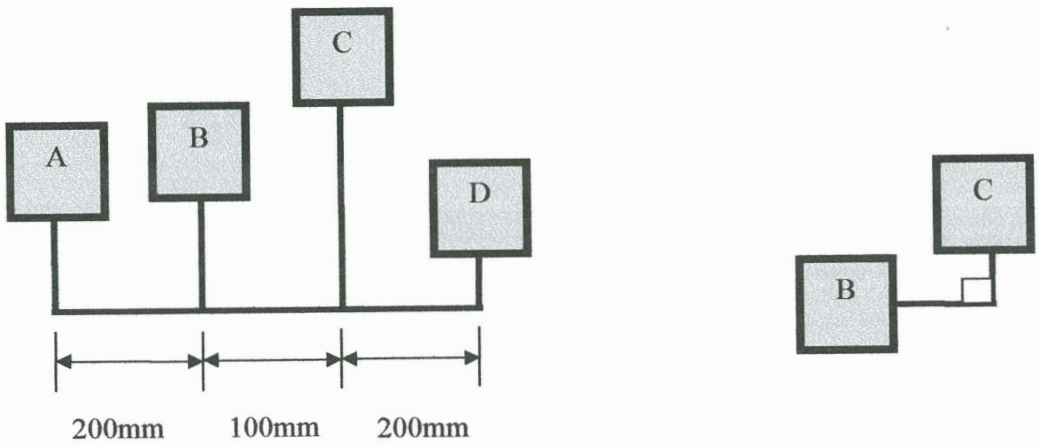


Rajah S1 (b) / *Figure* Q1 (b)



Rajah S3 (b) / *Figure Q3 (b)*

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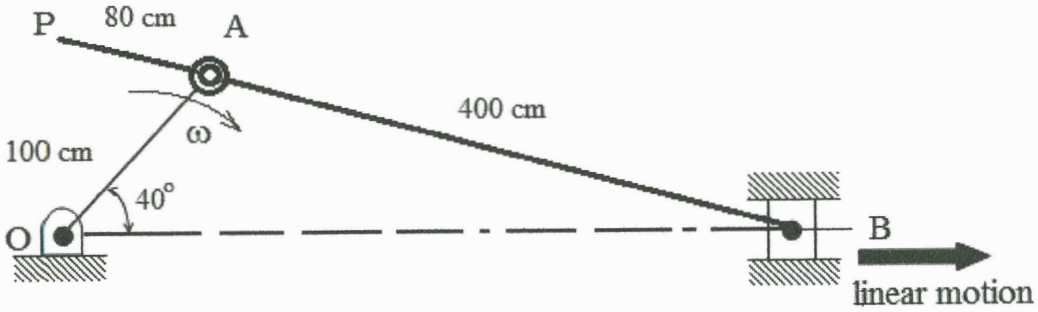
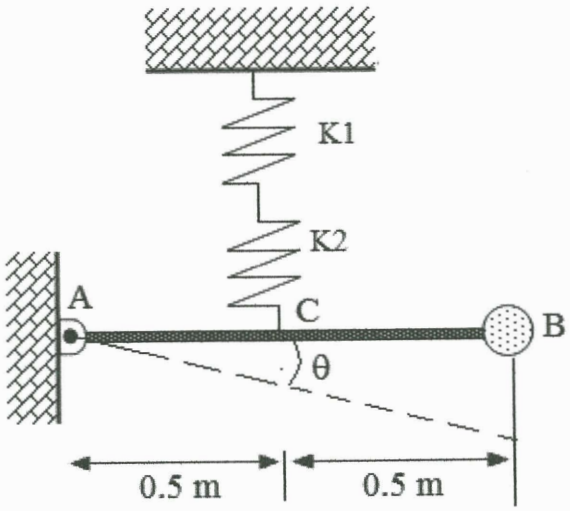


Rajah S5 (b) / *Figure Q5 (b)*



Rajah S6 (b) / *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, $n = \frac{N_2}{N_1} = \frac{d_1}{d_2} = \frac{t_1}{t_2}$
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. Power for Belt Drives, $P = (T_1 - T_2)v$
8. Centrifugal force term, $T_c = \rho A v^2$
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. Force to moving up or lowering down , $P = W\tan(\phi \pm \alpha)$
12. Efficiency for Square Threaded Screw jack , $\eta = \frac{p}{\pi D \tan(\phi + \alpha)}$

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13. Radial component of acceleration, $a_{BA}^{n} = \omega^2 (BA) = \frac{(V_{BA})^2}{BA}$

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

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

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