UNIVERSITI TUN HUSSEIN ONN MALAYSIA

PEPERIKSAAN AKHIR
SEMESTER 2
SESI 2008/2009

NAMA MATA PELAJARAN	:	MEKANIK MESIN
KOD MATA PELAJARAN	:	BDA 2033
KURSUS	:	2 BDD
TARIKH PEPERIKSAAN	:	APRIL 2009
JANGKA MASA	:	2 ½ JAM
ARAHAN	:	JAWAB **EMPAT (4)** SOALAN DALAM BAHAGIAN A DAN JAWAB **SATU (1)** SOALAN SAHAJA DALAM BAHAGIAN B

KERTAS SOALAN INI MENGANDUNGI 10 MUKA SURAT

BAHAGIAN A

S1 (a) Nyatakan maksud terma-terma berikut:

(i) Addendum

(ii) Dedendum

(iii) Pic diameter, P_d (6 markah)

(b) Satu rangkaian gear majmuk ditunjukkan dalam **Rajah S1** seperti di bawah. Ciri-ciri bagi setiap gear adalah seperti berikut:

Gear 2: $N_2 = 12$ gigi dan $P_d = 12$, Gear 3: $D_3 = 2.5$ in,

Gear 4: $N_4 = 15$ gigi, Gear 5: $D_5 = 3.0$ in. dan $P_d = 10$

Gear 6: $D_6 = 1.5$ in. dan $P_d = 8$ Gear 7: $N_7 = 32$ gigi

Tentukan:

(i) Kelajuan bagi gear 7 (dalam psm) apabila gear 2 berputar pada kelajuan 1800 psm, melawan arah jam.

(ii) Jarak di antara syaf yang membawa gear 2 dan gear 7

(14 markah)

S2 (a) Nyatakan kelebihan menggunakan talisawat jenis V berbanding talisawat rata. (4 markah)

(b) Dalam sebuah sistem talisawat bersilang seperti dalam **Rajah S2**, sebuah syaf berputar pada kelajuan 150 psm dan memutarkan sebuah lagi syaf pada kelajuan 250 psm dengan menghantar kuasa sebanyak 10 kW. Jarak di antara kedua-dua syaf adalah 230 cm dan diameter bagi takal yang lebih besar (pemacu) adalah 150 cm. Tali sawat rata yang digunakan mempunyai lebar 12 cm dan ketebalan 1.5 cm. Diberi pekali geseran, $\mu = 0.35$.

Kirakan:

(i) Sudut lekapan talisawat, dalam radian,

(ii) Tegangan di bahagian tegang, i.e. tegangan maksimum T_1. Abaikan tegangan empar.

(iii) Tegasan dalam talisawat (kN/m^2) (16 Markah)

S3 (a) Senarai dan lukiskan empat jenis-jenis ubahsuaian mekanisma '*slider-crank*'. (6 Markah)

(b) Penyambung **Rajah S3** mempunyai dimensi OA = 20.3 mm, AB = 49 mm dan AC 33.8 mm. Kedudukan sudut aci engkol adalah 34.4° dan sudut BAC = 38.6°. Penyambung 2 berputar dengan kelajuan $\omega 2 = 15$ rad/s mengikut arah lawan jam. Kirakan $\omega 3$ dan halaju di titik A, B dan C dengan menggunakan kaedah:

(i) Lukisan rajah halaju. (7 Markah)

(ii) Analisis. (7 Markah)

S4 (a) Dengan menggunakan plat cekam tunggal, buktikan persamaan $T = \frac{2}{3}\mu W\left[\frac{r_1^3 - r_2^3}{r_1^2 - r_2^2}\right]$. Gunakan andaian tekanan seragam di seluruh permukaan sentuhan. (10 Markah)

(b) Sebuah cekam plat berbilang mempunyai 5 cakera di syaf pemacu dan 3 cakera di syaf penurut. Diameter luar bagi permukaan sentuhan adalah 260 mm dan diameter dalam adalah 130 mm. Dengan andaian tekanan seragam dan mengambilkira nilai $\mu = 0.3$, tentukan:

(i) Bilangan pasangan bagi permukaan sentuhan

(ii) Jumlah daya spring yang diperlukan untuk menolak plat bagi menghantar kuasa sebanyak 25 kW pada kelajuan 1620 psm.

(10 Markah)

BAHAGIAN B

S5 (a) Nyatakan sistem yang seimbang secara statik dan sistem yang seimbang secara dinamik.

(4 Markah)

(b) **Rajah S5** menunjukan satu sistem bersama dua pemberat yang berputar pada suatu rod. W1 = 66.7 N dengan sudut 0° berjejari 152.4 mm dan W2 = 98.0 N dengan sudut 270° berjejari 127 mm. Jika pemberat imbangan terletak di satah 3 dengan jejari 27 mm dan di satah 4 dengan jejari 203.2 mm. Dapatkan magnitud dan sudut pemberat imbangan yang diperlukan supaya sistem berada dalam imbangan dinamik.

(16 Markah)

S6 (a) Nyatakan perbezaan diantara frekuensi tabii, ω_n dan frekuensi tabii teredam, ω_d. Terangkan secara ringkas perbezaannya.

(6 Markah)

(b) Sebuah rod seragam AB seperti yang ditujukkan dalam **Rajah S6** mempunyai jisim 1kg dan mempunyai jisim 2.5kg di *B*. Rod tersebut digantung di A dan ia kekal dalam keadaan kedudukan mendatar disebabkan oleh sebuah pegas 1.8 kN/m di *C*. Cari frekuasi ayunan sistem tersebut. Abaikan kesan berat pegas.

(14 Markah)

PART A

Q1 (a) Explain the following terms:

(i) Addendum,

(ii) Dedendum ,

(iii) Diametral pitch, P_d. (6 marks)

(b) A compound gear train is shown in **Rajah S1**. The gears have following properties:

Gear 2: $N_2 = 12$ teeth and $P_d = 12$, Gear 3: $D_3 = 2.5$ in

Gear 4: $N_4 = 15$ teeth, Gear 5: $D_5 = 3.0$ in. and $P_d = 10$

Gear 6: $D_6 = 1.5$ in. and $P_d = 8$, Gear 7: $N_7 = 32$ teeth

Determine:

(i) The speed of gear 7 (in rpm) as gear 2 drives at 1800 rpm counterclockwise.

(ii) The distance between the shafts that carry gears 2 and 7.

(14 marks)

Q2 (a) State the advantages of using V-belt drive over flat belt drive.

(4 marks)

(b) A shaft running at 150 rpm is to drive another shaft at 250 rpm and transmit 10 kW in a cross belt drive **Rajah S2**. The distance between the shafts is 230 cm and the diameter of the bigger pulley (driver) is 150 cm. The flat belt employed is 12 cm wide and 1.5 cm thick. Take coefficient of friction $\mu = 0.35$.

Calculate:

(i) angle of contact, in radian,

(ii) tension in the tight side, i.e. maximum tension, T_1. Neglect centrifugal tension.

(iii) stress in the belt (kN/m^2)

(16 marks)

Q3 (a) List and draw four types of inversion in slider crank mechanism.

(6 marks)

(b) The linkage in **Rajah S3** has the dimensions OA = 20.3 mm, AB = 49 mm and AC= 33.8 mm. The crank angle in the position shows is 34.4° and the angle of BAC is 38.6°. Link 2 rotate at $\omega 2$ = 15 rad/sec in the anticlockwise direction. Find $\omega 3$ and velocity at point A, B and C.

(i) Use the velocity difference graphical method. (7 marks)

(ii) Use an analytical method. (7 marks)

Q4 (a) Derive using single plate clutch, using assumptions of uniform pressure over the contact area, equation $T = \frac{2}{3}\mu W\left[\frac{r_1^3 - r_2^3}{r_1^2 - r_2^2}\right]$. (10 marks)

(b) A multi-disc clutch has 5 discs on the driving shaft and 3 discs on the driven shaft. The outside diameter of the contact surface is 260 mm and 130 mm internal diameter. Assuming uniform pressure and take coefficient of friction, μ = 0.3, find:

(i) The number of pairs of contact surfaces

(ii) The total spring load pressing the plates together to transmit power of 25 kW at speed of 1620 rpm.

(10 marks)

PART B

Q5 (a) State a system in static balance and a system in dynamic balance.

(4 Marks)

(b) **Rajah S5** shows a system with two weights on a rotating shaft. W1 = 66.7 N with 0° at a 152.4 mm radius and W2 = 98.0 N with 270° at a 127 mm radius. If the balance weight in plane 3 is placed at radius of 127 mm and in plane 4 of 203.2 mm. Determines the magnitudes and angles of the balance weights needed to dynamically balance the system.

(16 Marks)

Q6 (a) State the difference between natural frequency ω_n and damped natural frequency ω_d. Briefly explain about the differences.

(6 Marks)

(b) A uniform thin rod, AB shown in **Rajah S6** has a mass of 1kg and carries a concentrated mass of 2.5kg at B. The rod is hinged at A and remains horizontal by a having a stiffness 1.8 kN/m at point C. Find frequency of oscillation by neglecting the effects of spring mass.

(14 Marks)

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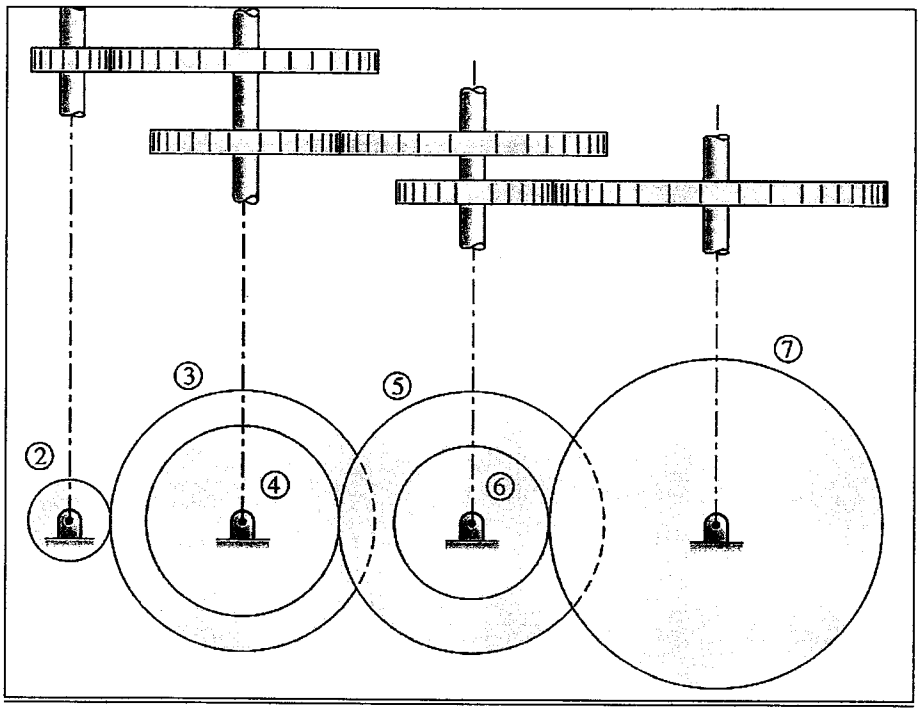
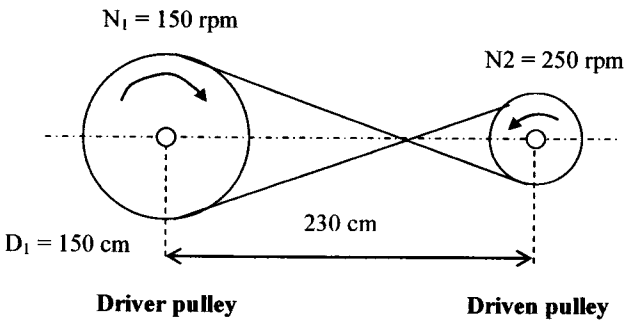
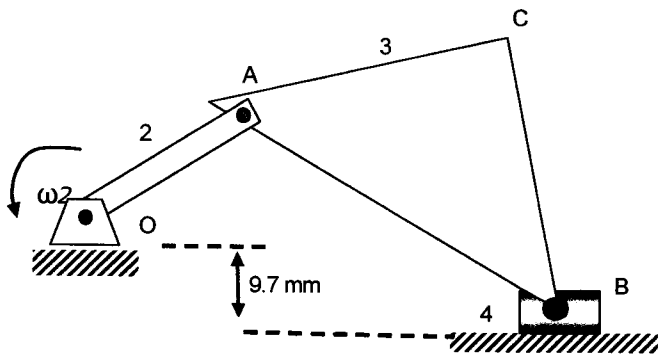
MATAPELAJARAN : MEKANIK MESIN **KOD M/P : BDA 2033**



Rajah S1



Rajah S2



Rajah S3

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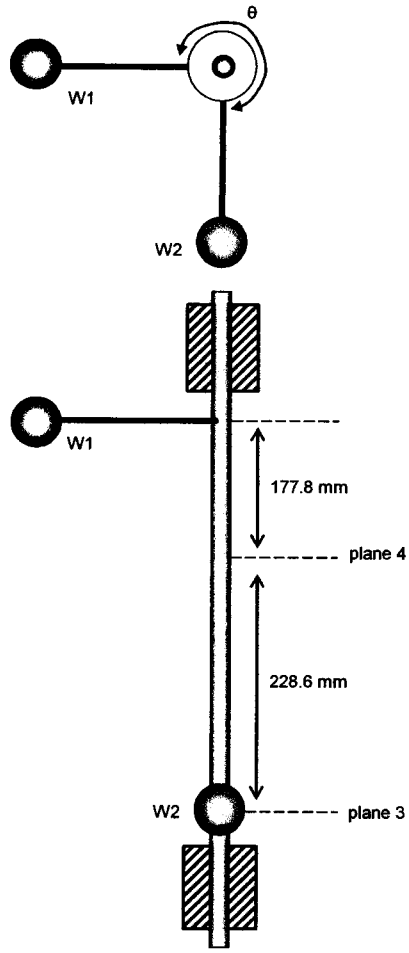
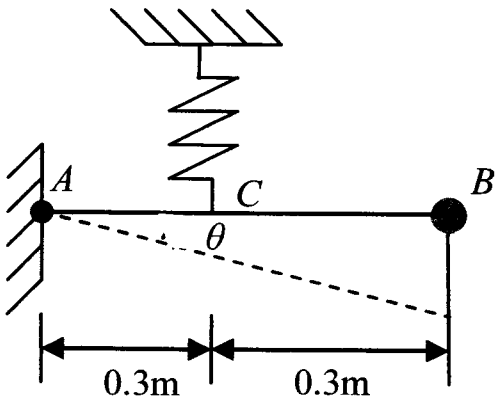
MATAPELAJARAN : MEKANIK MESIN **KOD M/P : BDA 2033**



Rajah S5



Rajah S6

PEPERIKSAAN AKHIR

LAMPIRAN 1

SEMESTER/SESI : 2/2008/2009 **KURSUS : 2 BDA**

MATAPELAJARAN : MEKANIK MESIN **KOD M/P : BDA 2033**

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. V-Belt type force balance, $R_N = \frac{R}{2\sin\beta}$
5. Maximum Power for Belt Drives, $P = (T_1 - T_2)v$
6. Centrifugal force term, $\rho A v^2 = T_C$
7. Limiting Angle of Friction, $\tan\phi = \frac{F}{R_N} = \mu$
8. Inclination of Square Threaded Screw, $\tan\alpha = \frac{p'}{\pi d}$
9. Motion Up the Plane, $P = W\frac{\tan\alpha + \tan\phi}{1 - \tan\alpha\tan\phi}$
10. Efficiency of screw thread for motion up the plane, $\eta = \frac{W \times p'}{P \times \pi d}$
11. Clutch under Uniform Pressure condition, $\frac{T}{W} = \frac{2}{3}n\mu\left[\frac{r_1^3 - r_2^3}{r_1^2 - r_2^2}\right]$
12. Clutch under Uniform Wear condition, $T = \frac{n\mu W}{2} \times (r_1 + r_2)$
13. Acceleration in Harmonic Motion, $\ddot{x} = -Aw^2 \sin\omega t = -\omega^2 x$
14. Damped natural frequency, $\omega_d = \omega_n\left(\sqrt{1-\xi^2}\right)$