SULIT

POLITEKNIK MALAYSIA

BAHAGIAN PEPERIKSAAN DAN PENILAIAN
JABATAN PENDIDIKAN POLITEKNIK
KEMENTERIAN PENDIDIKAN TINGGI

JABATAN KEJURUTERAAN MEKANIKAL

PEPERIKSAAN AKHIR

SESI JUN 2017

DJJ5113 : MECHANICS OF MACHINES

TARIKH : 30 OKTOBER 2017
MASA : 11.15 PAGI - 1.15 PETANG (2 JAM)

Kertas ini mengandungi **SEMBILAN (9)** halaman bercetak.

Struktur (4 soalan)

Dokumen sokongan yang disertakan : Formula

JANGAN BUKA KERTAS SOALAN INI SEHINGGA DIARAHKAN

(CLO yang tertera hanya sebagai rujukan)

INSTRUCTION:
This paper consists of **FOUR (4)** structured questions. Answer **ALL** questions.

ARAHAN:
*Kertas ini mengandungi **EMPAT (4)** soalan struktur. Jawab **SEMUA** soalan.*

QUESTION 1

SOALAN 1

A steel drum of a lifting machine has a mass of 26 kg, 2.5 m in diameter and 0.21 m radius of gyration. A mass of 80 kg is tied to one end of the rope and the other end is tied with a weight of 30 kg.
Sebuah gelendung mesin angkat berjisim 26 kg, berdiameter 2.5 m dan berjejari kisar 0.21m. Satu jisim seberat 80 kg diikat pada satu hujung tali dan hujung satu lagi diikat dengan pemberat seberat 30 kg.

CLO1
C1

i. Draw the free body diagram of the hoisting system
Lukis gambarajah jasad bebas bagi sistem mesin angkat

[6 marks]
[6 markah]

CLO1
C3

ii. Calculate the driver torque to lift up the mass of 80 kg with the acceleration of 2.5 m/s^2
Kirakan tork pemacu untuk menaikkan jisim 80 kg dengan pecutan 2.5 m/s^2

[9 marks]
[9 markah]

CLO1
C3

iii. Calculate the linear velocity when the mass is lifted if power output of the system is 1.8kW
Kirakan halaju linear ketika jisim dinaikkan jika kuasa keluaran sistem ialah 1.8 kW.

[3 marks]
[3 markah]

CLO1
C4

iv. If the drum is freely released, determine the acceleration of the system
Jika gelendung itu bergerak bebas, tentukan pecutan sistem tersebut

[7 marks]
[7 markah]

QUESTION 2

SOALAN 2

CLO1 C2

(a) A body that is vibrating in Simple Harmonic Motion (SHM) has amplitude of 15 cm and a frequency of 4 Hz. Determine the maximum values of the linear velocity and the linear acceleration of the body.

Satu jasad yang sedang bergetar dengan Gerakan Harmonic Mudah (GHM) mempunyai amplitude 15 cm dan frekuensi 4 Hz. Hitungkan nilai maksimum halaju linear dan pecutan linear jasad tersebut.

[7 marks]
[7 markah]

(b) A body that is moving in Simple Harmonic Motion has a periodic time of 0.4s. A mass of 14 kg is suspended vertically from one end of a spring which is attached to a rigid support. The body produces a static deflection of 25mm. Then, it was pulled down by 23 mm and then released.

Satu jasad yang sedang bergerak dengan gerakan harmonic mudah mempunyai masa berkala 0.4s. Sebuah jisim 14kg digantung dengan tegak daripada satu hujung spring yang dipasang pada suatu sokong tegar. Jasad itu menghasilkan pesongan statik 25 mm. Kemudian ia ditarik ke bawah sejauh 23 mm dan kemudiannya dilepaskan.

CLO1 C3

i. Calculate the acceleration of the body

Kirakan pecutan jasad

[3 marks]
[3 markah]

CLO1 C3

ii. Calculate the velocity of the body when it is at 12 mm from equilibrium position

Kirakan halaju jasad itu bila ia berada pada 12 mm dari kedudukan keseimbangan

[2 marks]
[2 markah]

(c) Figure S3 show a piston, connecting rod and a crank mechanism. The crank rotates counter clockwise direction at a constant velocity of 300 rad/s.

Rajah S3 menunjukkan satu piston, rod penyambung dan mekanisma engkol. Engkol berputar pada arah lawan jam dengan halaju seragam 300 rad/saat .

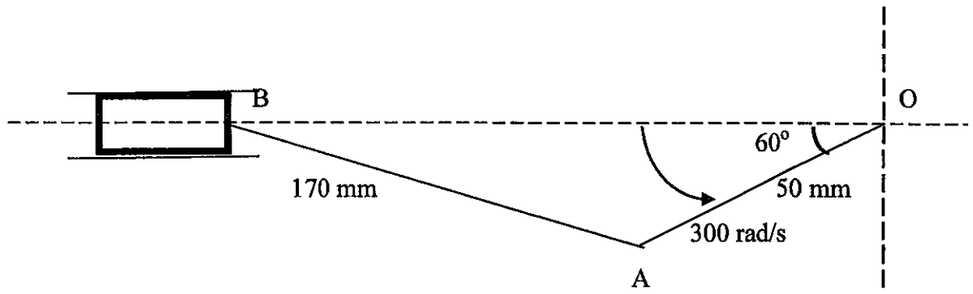

Figure S3

CLO1 C3

i. Draw the space diagram with the scale of 1 cm : 10 mm

Lukis gambarajah ruang dengan skala 1 cm : 10 mm

[3 marks]
[3 markah]

CLO1 C3

ii. Calculate the velocity of the crank OA

Kirakan halaju engkol OA

[3 marks]
[3 markah]

CLO1 C4

iii. Determine the velocity of the piston by drawing the velocity diagram with the scale of 1 cm : 2 m/s

Tentukan halaju piston dengan melukiskan gambarajah halaju dengan skala 1cm : 2m/s

[7 marks]
[7 markah]

QUESTION 3
SOALAN 3

(a) A block of mass 60 kg was pulled on horizontal plane by a P.force of 15° to the plane. The coefficient of friction between the block and the surface is 0.4.
Satu bungkah berjisism 60 kg ditarik oleh satu daya P yang bersudut 15° kepada satah. Pekali geseran diantara bungkah dengan lantai ialah 0.4.

CLO1 C2

i. Draw the friction diagram
Lukis gambarajah geseran

[3 marks]
[3 markah]

CLO1 C2

ii. Calculate the force required to pull the body with acceleration 2.7m / s².
Kira daya yang diperlukan untuk menarik jasad dengan pecutan 2.7m/s².

[4 marks]
[4 markah]

CLO1 C3

(b) A rotating shaft as shown in Figure Q3 (b) carries three masses P = 15 kg, Q = 29 kg and R = 8 kg which has a radius of rotation of 270 mm, 200 mm and 280 mm from the axis of the shaft. To balance the system, two balancing masses S and T with the same radius of rotation 400 mm, mounted at the midpoint between P and Q and Q and R.
Sebatang aci berputar seperti ditunjukkan dalam Gambarajah S3 (b) membawa tiga jisim P=15 kg, Q= 29 kg dan R= 8 kg yang mempunyai jejari putaran 270 mm, 200 mm dan 280 mm dari paksi aci. Untuk keseimbangan sistem, dua jisim imbang S dan T dengan jejari putaran yang sama 400 mm, dipasang pada titik tengah diantara P dan Q serta Q dan R.

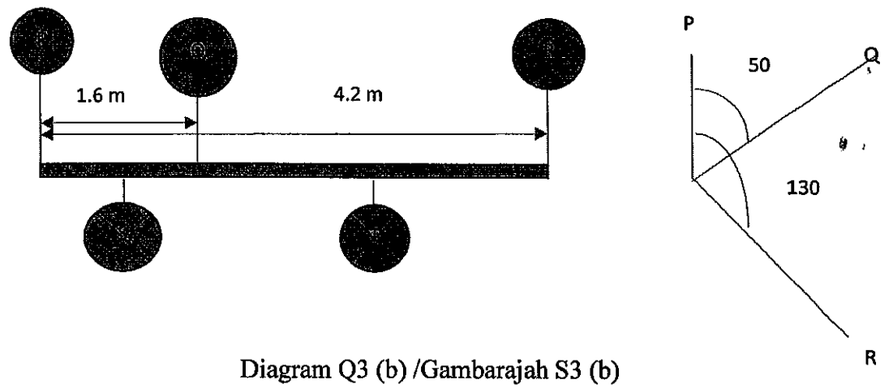

Diagram Q3 (b) /Gambarajah S3 (b)

CLO1 C3

i. Draw and complete the MR and MRL table
Bina dan lengkapkan jadual MR dan MRL

[5 marks]
[5 markah]

CLO1 C3

ii. Determine the magnitude and angle of mass T relative to P by using MRL polygon with the scale of 1cm:1kgm2.
Tentukan magnitud dan sudut jisim T berbanding kepada P dengan menggunakan poligon MRL dengan skala 1cm:1kgm2

[6 marks]
[6 markah]

CLO1
C4

iii. Draw MR polygon and find the magnitude and angle of mass S relative to P by using the scale of 1cm:1kgm

Lukis poligon MRL dan dapatkan magnitud dan sudut jisim T berbanding kepada P dengan menggunakan skala 1cm:1kgm

[7 marks]
[7 markah]

QUESTION 4

SOALAN 4

CLO1
C2

(a) Explain **THREE (3)** disadvantages of belt drives compared to gear.

*Terangkan **TIGA(3)** kekurangan tali sawat berbanding gear.*

[3 marks]
[3 markah]

(b) An open belt drive connects two pulleys with diameter of 900 mm and 400 mm on a parallel shaft with 2.75 m apart. The belt has a coefficient of friction of 0.3. The driver pulley is the smaller pulley which runs at 450 rpm:

Sebuah sistem tali sawat terbuka menyambungkan dua takal berdiameter 900 mm dan 400 mm pada aci yang selari berjarak 2.75 m. Tali sawat yang digunakan mempunyai geseran 0.3. Takal yang berdiameter lebih kecil adalah pemacu yang berputar pada 450 rpm.

CLO1
C2

i. Determine the angle of lap for each pulley , θ

Tentukan sudut untuk setiap takal, θ.

[4 marks]
[4 markah]

CLO1
C3

ii. Calculate the length of belt required for the system, L.

Kirakan panjang tali sawat yang diperlukan untuk system, L.

[3 marks]
[3 markah]

CLO1
C4

iii. If the maximum tension of the belt does not exceed 2000 N, determine the power transmitted in the belt drive system.

Jika tegangan maksimum talisawat tidak melebihi 2000 N, tentukan kuasa dalam sistem tali sawat.

[3 marks]
[3 markah]

(c) A close belt drives connects two pulleys, with the diameter of 600 mm and 350 mm. The distance between the two pulleys is 4 m. The larger pulley runs at 220 rev/min. The coefficient friction between the belt and the pulley is 0.3.

Satu tali sawat sambungan tertutup menyambungkan dua takal berdiameter 600 mm dan 350 mm. Jarak di Antara dua takal tersebut adalah 4 m. Takal berdiameter besar berputar pada 220 psm. Pekali geseran di antara tali sawat dan takal adalah 0.3.

CLO1 C3

i. Calculate the angle of contact between the belt and each pulley, θ

Kirakan sudut sentuhan antara tali sawat dan setiap takal, θ.

[4 marks]
[4 markah]

CLO1 C3

ii. Determine the length of the belt required, L

Tentukan panjang tali sawat yang diperlukan, L

[4 marks]
[4 markah]

CLO1 C4

iii. If the maximum tension of the belt does not exceed 1.8 kN, determine the power transmitted in the belt drive system.

Jika tegangan maksimum talisawat tidak melebihi 1.8 kN, tentukan kuasa dalam sistem tali sawat.

[4 marks]
[4 markah]

SOALAN TAMAT

FORMULA DJJ5113

SIMPLE HARMONIC MOTION

$v = \omega\sqrt{A^2 - x^2}$

$a = x\omega^2$

$\Omega = \omega\sqrt{\phi^2 - \theta^2}$

$\alpha = \omega^2\theta$

$T = \frac{2\pi}{\omega}$

$f = \frac{1}{T}$

$a_{maks} = A\omega^2$

$v_{maks} = A\omega$

Mass on spring	Pendulum
$T = 2\pi\sqrt{\frac{d}{g}}$ $T = 2\pi\sqrt{\frac{m}{k}}$	$T = 2\pi\sqrt{\frac{l}{g}}$

VELOCITY AND ACCELERATION DIAGRAM

$v = \omega r$

$a_r = \omega^2 r$

$a_t = \alpha r$

FRICTION

$\mu = \frac{F}{N}$

$\tan\phi = \mu$

$P_{upward} = W\tan(\alpha + \phi)$

$P_{downward} = W\tan(\alpha - \phi)$

$P_{downward} = W\tan(\phi - \alpha)$

$P_{minimum} = mg\sin(\alpha + \phi)$

$\eta_{forward} = \tan\alpha / \tan(\alpha + \phi)$

$\eta_{reverse} = \tan(\alpha - \phi) / \tan\alpha$

$\eta_{reverse} = \tan(\phi - \alpha) / \tan\alpha$

$\eta_{maximum} = (1-\sin\phi)/(1+\sin\phi)$

HOIST

$v = r\omega$

$a = r\alpha$

$I = mk^2$

Power = $T\omega$

BALANCING

$Centrifugal\ Force = (mr)\omega^2$

$Couple = (mrl)\omega^2$

DRIVE BELT

$T_o = \frac{T_1 + T_2}{2}$

$Torque = (T_1 - T_2)r$

$T_c = mv^2$

$T_c = \frac{1}{3}T_1$

Power = $(T_1 - T_2)V$

Flat belt

$\frac{T_1}{T_2} = e^{\mu\theta}$

$\frac{T_1 - T_c}{T_2 - T_c} = e^{\mu\theta}$

Vee belt

$\frac{T_1}{T_2} = e^{\mu\theta/\sin\beta}$

$\frac{T_1 - T_c}{T_2 - T_c} = e^{\mu\theta/\sin\beta}$