UNIVERSITI TUN HUSSEIN ONN MALAYSIA

PEPERIKSAAN AKHIR
SEMESTER II
SESI 2008/2009

NAMA MATA PELAJARAN	:	GETARAN DAN KEBISINGAN
KOD MATA PELAJARAN	:	BDC 4013
KURSUS	:	4 BDD
TARIKH PEPERIKSAAN	:	APRIL 2009
JANGKA MASA	:	2 JAM 30 MINIT
ARAHAN	:	JAWAB **SEMUA** SOALAN DARIPADA **BAHAGIAN A** DAN **DUA (2)** SOALAN DARI **TIGA (3)** SOALAN DARIPADA **BAHAGIAN B**

KERTAS SOALAN INI MENGANDUNGI TIGA BELAS (13) MUKA SURAT

BAHAGIAN A – JAWAB SEMUA SOALAN

S1 (a) **Rajah S1 (a)** menunjukkan sebatang rasuk sokongan mudah dikenakan beban pada tiga kawasan berlainan. Diberi

$$keq = \frac{(6 \cdot L \cdot E \cdot I)}{b\ a \cdot (L^2 - a^2 - b^2)}$$

Di mana

keq = kekakuan pegas setara
E = Modulus ketegaran rasuk
I = Momen inersia rasuk
L = Panjang rasuk
a , b = Jarak dari paksi (Sila rujuk **Rajah S1 (b))**

Dengan menggunakan Kaedah Dunkerly, tentukan

(i) Frekuensi tabii individu bagi setiap beban. (10 markah)

(ii) Frekuensi tabii bagi keseluruhan sistem tersebut. (5 markah)

(b) Anggarkan nilai frekuensi tabii asas bagi sistem dua darjah kebebasan di dalam **Rajah S1 (c)** dengan menggunakan Kaedah Rayleigh. Diberi nilai-nilai berikut:

k_1=15N/m k_2=10N/m k_3=12N/m m_1 = 1.5 kg m_2 = 2.4 kg

(10 markah)

S2 (a) Terangkan perkara-perkara berikut yang ada kaitan dengan kebisingan.

(i) Ambang Peralihan Sementara

(ii) Kegagalan Pendengaran Akibat Kebisingan

(iii) *Serapan Bunyi sesuatu bahan*

(iv) *Penebatan Bunyi sesuatu bahan*

(8 markah)

(b) Beri takrifan pemalar bilik, R dan masa penggemaan, RT. Diberi:

$$\text{Pemalar bilik, } R = \frac{S\bar{\alpha}}{1-\bar{\alpha}}$$

$$\text{Masa penggemaan, } RT = \frac{0.16V}{S\bar{\alpha}}$$

Terangkan berkenaan dengan sebutan S, V and $\bar{\alpha}$ yang digunakan dalam persaman di atas.

(5 markah)

(c) Ruang dalam sebuah kilang baru adalah 42 m panjang, 25 m lebar dan 10 m tinggi. Lantainya adalah dari konkrit, sementara dinding-dinding dan bumbungnya dari kepingan logam penggeladak. Dapatkan nilai pemalar bilik, R dan masa penggemaan, RT bagi ruang kilang ini.

Jadual 1(c) menunjukkan julat bagi $\bar{\alpha}$ untuk beberapa ruang akustik.

Jadual 1(c) : Julat bagi $\bar{\alpha}$

Bilik atau ruang sekitaran akustik	Julat bagi $\bar{\alpha}$
Langsung	0.07
Agak langsung	0.15
Sederhana	0.40
Agak Mati	0.50

(12 markah)

BAHAGIAN B – PILIH DAN JAWAB DUA (2) SOALAN SAHAJA

S3 (a) Terangkan secara ringkas apakah paras tekanan bunyi, *SPL* dan paras kuasa bunyi, *SWL*.

(4 markah)

(b) Hubungan di antara paras tekanan bunyi, *SPL* dan paras kuasa bunyi, *SWL* diberi oleh persamaan:

$$SPL = SWL + 10\,Log\,(a+b)\,dB$$

Dengan

$$a = Q / 4\pi r^2$$
$$b = 4 / R_c$$

Terangkan secara ringkas definasi dan makna sebutan *a*, *b* dan R_c. Anda tidak perlu membuat pembuktian.

(5 markah)

(c) (i) Sebuah bilik 10 m x 16 m dengan ketinggian siling 4.5 m mengandungi dua buah mesin yang bising. Dinding, siling dan lantai mempunyai pekali penyerapan seperti di dalam **Jadual 2(a).**

Kira pekali penyerapan purata bunyi, $\bar{\alpha}$ untuk bilik ini.

Jadual 2(a): Pekali penyerapan

Pekali penyerapan	Frekuensi (Hz)				
	125	250	500	1000	2000
Dinding	0.01	0.05	0.06	0.07	0.09
Siling	0.10	0.25	0.70	0.75	0.65
Lantai	0.01	0.01	0.02	0.02	0.02

(6 markah)

(ii) Mesin 1 berada di penjuru bilik dan mesin 2 terletak di bahagian tengah berhampiran dinding 16 m panjang. Paras kuasa bunyi, *SWL* bagi kedua-dua mesin diberi dalam **Jadual 2(b)** dan Faktor Keterarahan, *Q* di beri dalam **Jadual 2(c).**

Tentukan paras tekanan bunyi, SPL pada tengah-tengah bilik ini (atas lantai) apabila kedua-dua mesin ini beroperasi.

Jadual 2(b): Paras Kuasa Bunyi, dB (Linear)

Mesin	Frekuensi (Hz)				
	125	250	500	1000	2000
Mesin 1 (Generating Set)	98	98	97	97	96
Mesin 2 (Compressor)	87	86	89	92	92

Jadual 2(c): Faktor Keterarahan, Q

Kedudukan	Faktor Keterarahan, Q	dB perlu ditambah
Berhampiran dinding dan di bahagian tengah dinding	4	+6
Pada penjuru bilik	8	+9

(6 markah)

(iii) Berikan komen ke atas pendedahan kebisingan pekerja terhadap paras kebisingan di atas (ii), pada tengah-tengah bilik mengikut Perundangan Pendedahan Kebisingan 1989, *Jabatan Keselamatan dan Kesihatan Pekerja.*

(4 markah)

S4 (a) Takrifkan definisi bagi istilah berikut

(i) Nilai Had Pendedahan

(ii) Nilai Tindakan Pendedahan

(iii) Transduser

(iv) Getaran Tidak Teredam

(v) Gandingan Dinamik

(10 markah)

(b) Ahmad merupakan seorang buruh binaan bagi sebuah tapak pembinaan. Setiap hari dia mengendalikan empat jenis peralatan dalam menjalankan tugasan harian seperti di dalam **Jadual 3**:

Jadual 3 : Jadual tugasan harian Ahmad

Jenis Peralatan	Pendedahan
Mesin penghentak	5 m/s^2 selama 30 minit
Mesin penggerudian	3 m/s^2 selama 2 jam
Mesin pengisar	2 m/s^2 selama 1 jam
Mesin pemotong	2.5 m/s^2 selama 1 jam 30 minit

Berdasarkan pernyataan di atas, kirakan

(i) Nilai pendedahan getaran separa, $A_n(8)$ bagi empat jenis tugasan tersebut.

(10 markah)

(i) Nilai pendedahan getaran harian, A(8) yang dialami oleh Ahmad.

(5 markah)

S5 (a) Satu model mekanikal yang ditunjukkan pada **Rajah S5 a(i)** boleh dipermudahkan kepada satu model mudah 1 darjah kebebasan seperti yang ditunjukkan pada **Rajah S5 a(ii)**. Berdasarkan sistem yang dipermudahkan ini, tentukan

(i) kekakuan yang sepadan bagi sistem tersebut

(i) frekuensi tabii (Hz) bagi sistem tersebut.

(10 markah)

(b) Sebuah sistem kebebasan darjah kedua ditunjukkan seperti dalam **Rajah S5 (b).** Berdasarkan sistem tersebut, tentukan

(i) persamaan gerakan yang sepadan

(5 markah)

(ii) frekuensi tabii bagi sistem tersebut dan bentuk mod yang sepadan dengan melukiskan rajah bentuk mod tersebut.

(10 markah)

PART A – ANSWER ALL QUESTIONS

S1 (a) **Rajah S1 (a)** shows a simple supported beam loaded at three different positions. Given that

$$keq = \frac{(6 \cdot L \cdot E \cdot I)}{b\ a \cdot (L^2 - a^2 - b^2)}$$

where

keq = equivalent spring stiffness
E = Modulus Rigidity of beam
I = moment of inertia of beam
L = Length of beam
a , b = Distance from support (Please refer to **Rajah S1 (b)**)

Using the Dunkerly method, determine

(i) Individual natural frequency for each loads.

(10 marks)

(ii) Fundamental natural frequency for the system..

(5 marks)

(b) Calculates the fundamental natural frequency for 2nd degree-of-freedom, shown in **Rajah S1 (c)** by using Rayleigh's Method. Given that

k_1=15N/m k_2=10N/m k_3=12N/m m_1 = 1.5 kg m_2 = 2.4 kg

(10 marks)

S2 (a) Explain the following that related to noise:

(i) Temporary Threshold Shift (TTS)

(ii) Noise Induced Hearing Loss (NIHL)

(iii) The sound absorption of a material.

(iv) The sound insulation of a material.

(8 marks)

(b) Define the room constant, R and the reverberation time, RT. Given that:

$$\text{Room constant, } R = \frac{S\bar{\alpha}}{1-\bar{\alpha}}$$

$$\text{Reverberation time, } RT = \frac{0.16V}{S\bar{\alpha}}$$

Explain the term S, V and $\bar{\alpha}$ use in above equations.

(5 marks)

(c) A new factory space was measured as 42 m length, 25 m width and 10 m high. Floor surfaces are concrete, while walls and roof are of sheet metal decking. Estimate the room constant, R and reverberation time, RT of this factory space.

Jadual 1(c) shows the typical range of $\bar{\alpha}$ for several room acoustic environments.

Jadual 1(c) : Typical range of $\bar{\alpha}$

Room or Space Acoustic Environment	Typical Range of $\bar{\alpha}$
Live	0.07
Fairly Live	0.15
Average	0.40
Fairly Dead	0.50

(12 marks)

PART B – CHOOSE AND ANSWER TWO (2) QUESTIONS ONLY

S3 (a) Explain briefly what are the Sound Pressure Level (SPL) and Sound Power Level (SWL).

(4 marks)

(b) The relationship between sound pressure level, *SPL* and sound power level, *SWL* is given by the expression:

$$SPL = SWL + 10\,Log\,(a+b)\;dB$$

Where

$$a = Q / 4\pi r^2$$
$$b = 4 / R_c$$

Briefly explain the definition and meaning of each of the above terms, (in particular *"a", "b" and "R_c").* You are not required to prove the equation.

(5 marks)

(c) (i) A large room contains two noisy machines. The room is 10m x 16m with a 4.5m high ceiling. The walls, ceiling and floor have absorption coefficients as given in **Jadual 2(a)**.

Compute the average sound absorption coefficient, $\bar{\alpha}$ for this room.

Jadual 2(a): *Absorption coefficient*

Absorption Coefficient	Frequency (Hz)				
	125	250	500	1000	2000
Wall	0.01	0.05	0.06	0.07	0.09
Ceiling	0.10	0.25	0.70	0.75	0.65
Floor	0.01	0.01	0.02	0.02	0.02

(6 marks)

(ii) Machine 1 is located at the corner of the room, and machine 2 located against the 16m length wall at the middle position of the wall. The sound power levels, SWL of both machines are as given in **Jadual 2(b)** and the Directivity factors, Q is given in **Jadual 2(c).**

Determine the sound pressure level (in the overall dB (A) level) at the centre mid position of the room (at the same level of the machines) when the above two machines operating.

Jadual 2(b): Sound Power Levels, dB (Linear)

Machine	Frequency (Hz)				
	125	250	500	1000	2000
Machine 1 (Generating Set)	98	98	97	97	96
Machine 2 (Compressor)	87	86	89	92	92

Jadual 2(c): *Directivity Factors*, Q

Position	Directivity Factor, Q	dB to be added
At the edge in the middle between two edges	4	+6
At the corner of the room	8	+9

(6 marks)

(iii) Comment also on a worker's noise exposure to the above noise level in mid position of the room in accordance to the *Jabatan Keselamatan dan Kesihatan Pekerja* Noise Exposure Regulations 1989.

(4 marks)

S4 (a) Give the definition for the following terminologies.

(i) Exposure Limit Value (ELV)

(ii) Exposure Action Value (EAV)

(iii) Transducer

(iv) Undamped Vibration

(v) Dynamic Coupling

(10 marks)

(b) Ahmad works as a labour for a construction company. Everyday, he operates four different tools for daily work routine as in **Jadual 3**:

Jadual 3 : Ahmad's daily work routine

Type of tools	Exposure
Impact machine	5 m/s^2 for 30 minutes
Drilling machine	3 m/s^2 for 2 hours
Blending machine	2 m/s^2 for 1 hour
Cutting machine	2.5 m/s^2 for 1 hour 30 minutes

Based on the above statements, determine

(i) The partial vibration exposures $A_n(8)$ for the four tasks (10 marks)

(i) The daily vibration exposure value A(8) received by Ahmad. (5 marks)

S5 (a) A mechanical model shown in **Rajah S5 a(i)** can be simplified into a simple 1- degree of freedom model as shown in **Rajah S5 a(ii)**. Based on this simplified system, determine

(i) the stiffness equivalent of the system

(i) the natural frequency (Hz) of the system

(10 marks)

(b) A second DOF system is shown as in **Rajah S5 (b).** Based on the system, determine

(i) The equivalent equation of motion for the system (5 marks)

(ii) the natural frequencies of the system and the corresponding mode shapes by drawing the diagram of the mode shapes. (10 marks)

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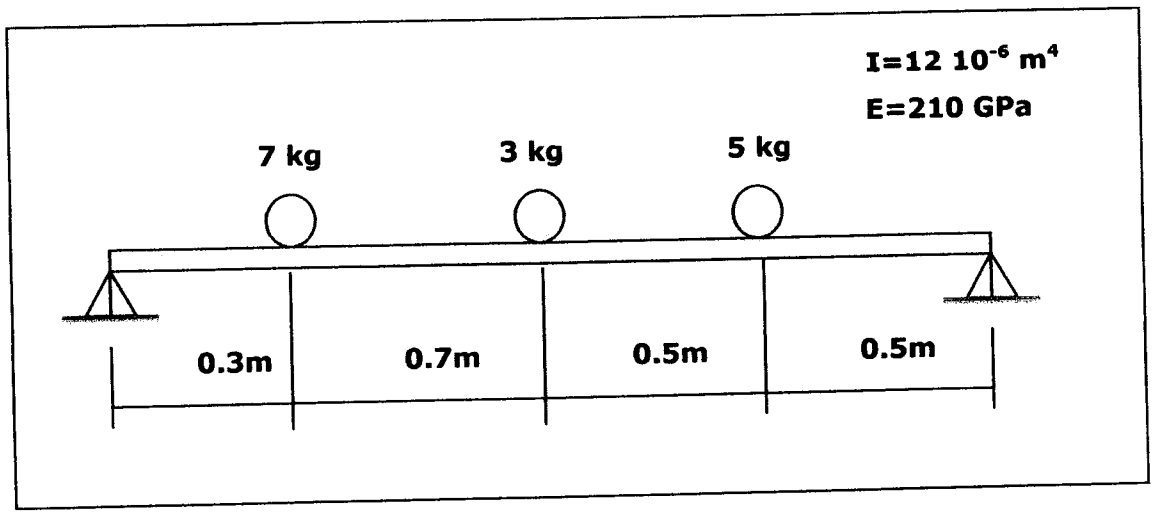
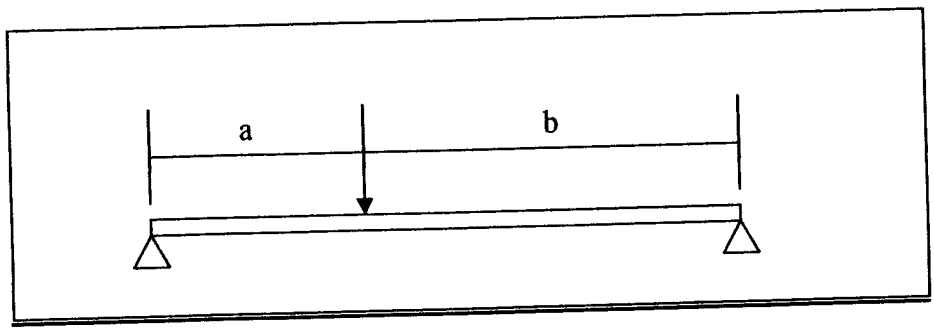
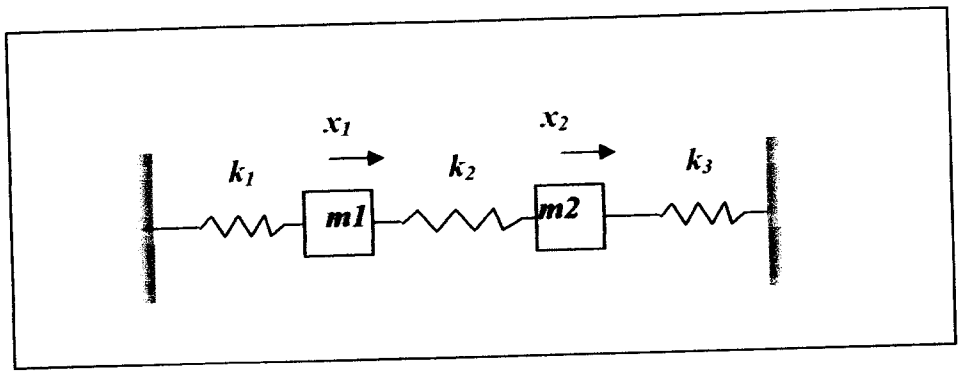


Rajah S1(a)



Rajah S1(b)



Rajah S1(c)

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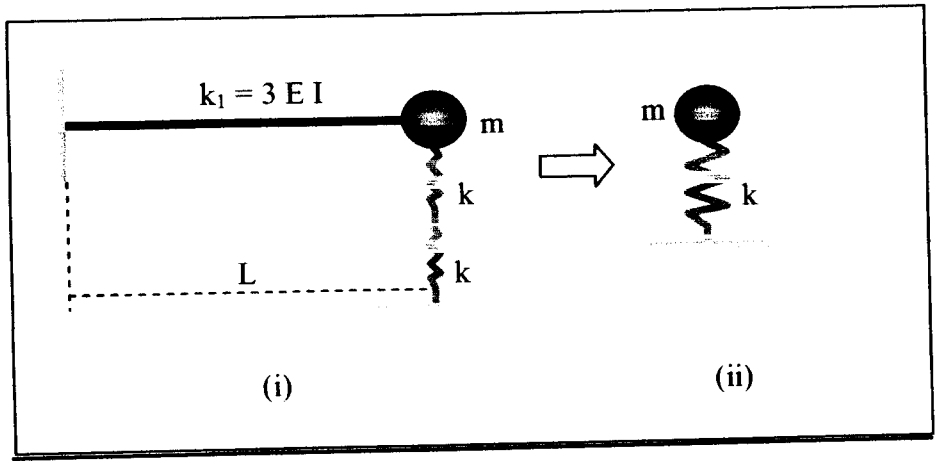
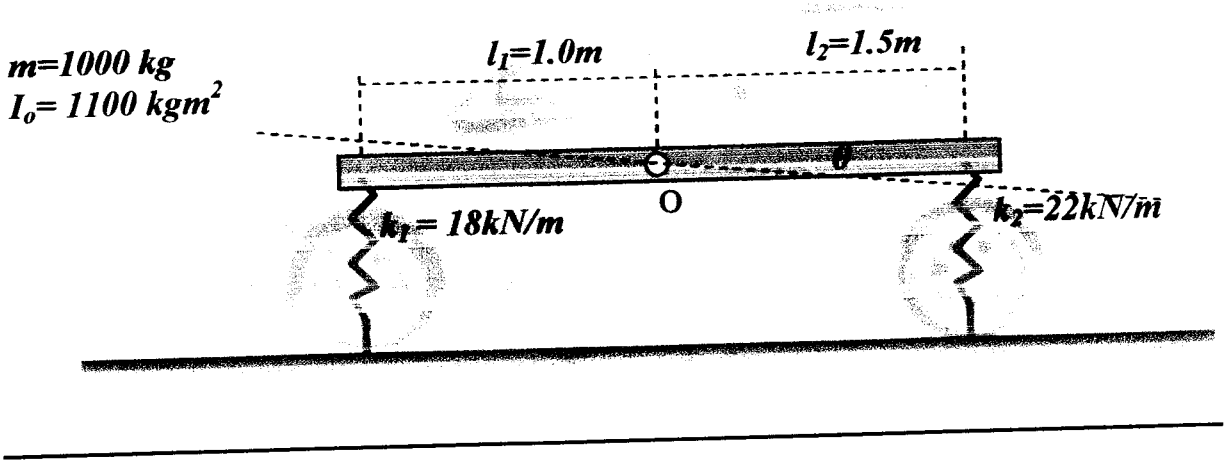


Rajah S5 (a)



Rajah S5 (b)