



**UTHM**  
Universiti Tun Hussein Onn Malaysia

**UNIVERSITI TUN HUSSEIN ONN MALAYSIA**

**FINAL EXAMINATION  
SEMESTER II  
SESSION 2013/2014**

COURSE NAME : NOISE AND VIBRATION  
COURSE CODE : BDA40603  
PROGRAMME : 4BDD  
EXAMINATION DATE : JUNE 2014  
DURATION : 3 HOURS  
INSTRUCTIONS : ANSWERS **TWO (2)** QUESTIONS FROM **PART A** AND **TWO (2)** QUESTIONS FROM **PART B**

**THIS PAPER CONTAINS OF NINE (9) PAGES**

**PART A : ANSWER ALL QUESTIONS**

- Q1 (a) **FIGURE Q1(a)** illustrates a two degree of freedom pendulum systems
- (i) Derive the motion equations of motion of the system (5 marks)
- (ii) Obtain the frequency equation if  $\theta(t) = \Theta \sin(\omega t + \theta)$  (5 marks)
- (iii) Calculate the natural frequency if  $a = 1 \text{ m}$ ,  $m = 1 \text{ kg}$  and  $k = 1 \text{ kN/m}$  (3 marks)
- (b) Free body diagrams of the body of the vehicle and the seat drawn at arbitrary instant are shown in **FIGURE Q1(b)**. Use Lagrange's equation to derive the motion equation of the system. (12 marks)
- Q2 (a) Explain briefly on the two types of hearing impairment. (4 marks)
- (b) Describe the noise control at the receiver. You should also include the attenuation graph of hearing protectors and Noise Reduction Rating. (5 marks)
- (c) The sound pressure level (SPL) at a receiver position,  $r$  is governed by the equation,
- $$\text{SPL} = \text{SWL} + 10 \log \left( \frac{Q}{4\pi r^2} + \frac{4}{R_C} \right)$$
- Where, SWL is the sound power level. If the directivity factor,  $Q = 8$ , the mean absorption coefficient of the room,  $\alpha_{\text{mean}} = 0.10$  and the room total surface area,  $S = 2560 \text{ m}^2$ . Determine;
- (i) the room constant,  $R_C$  (4 marks)
- (ii) the direct sound loss factor if the receiver's position is 4 m from the source. (4 marks)
- (iii) the reverberant sound loss factor. (4 marks)
- (iv) the room radius,  $r$ . (4 marks)





Q5 (a) An employee works 1 hour where the sound level is 90 dBA. The worker inspects gauges and other items for 2 hours where the sound level is 92 dBA. A total of 3 hours is spent in an area around a compressor where the sound level is 94 dBA. The remaining 2 hours are spent in a relatively quiet office area where the sound level is 60 dBA. Is this employee's noise exposure in violation of the OSHA regulations?

(10 marks)

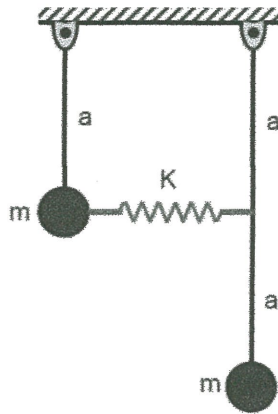
(b) An air vent located outdoors produces the noise spectrum shown in **TABLE Q5(a)**. The vent noise is broadband, and the sound is not impulsive. The vent operates about 30 times each hour, 1 minute duration, during the daytime and the evening, but not during the nighttime. The vent operates year-round. The vent is located in an area with light industry. Determine the environmental noise rating and the anticipated community reaction to the vent noise as given by **TABLE Q5(b)** and **TABLE Q5(c)**.

(15 marks)

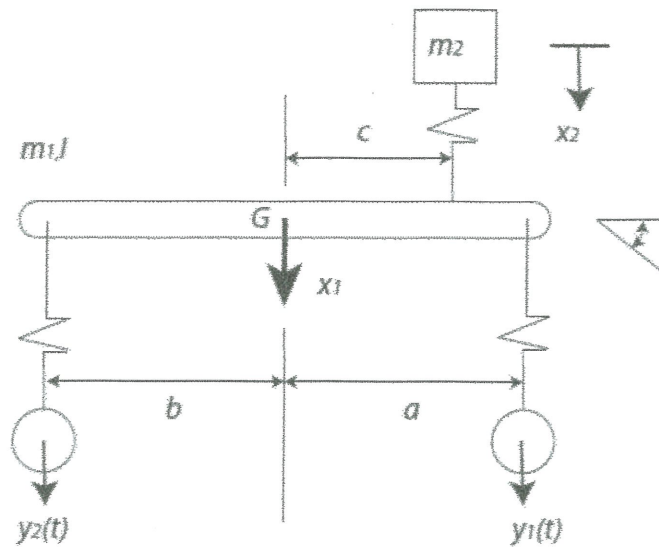
-END OF QUESTION-

**FINAL EXAMINATION**

**SEMESTER/SESSION :** SEMESTER 1 /2013/14      **PROGRAMME :** 4BDD  
**COURSE :** NOISE AND VIBRATION      **COURSE CODE:** BDA40603



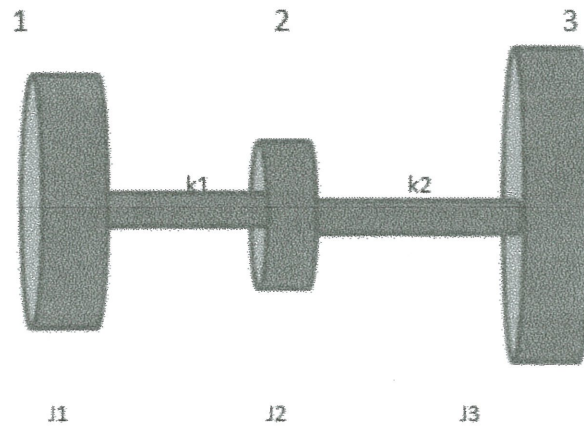
**FIGURE Q1(a)**



**FIGURE Q1(b)**

**FINAL EXAMINATION**

**SEMESTER/SESSION :** SEMESTER 2 /2013/14      **PROGRAMME :** 4BDD  
**COURSE :** NOISE AND VIBRATION      **COURSE CODE:** BDA40603



**FIGURE Q3**

**TABLE Q5(a): The noise spectrum of an air vent located outdoors**

	Octave band center frequency, Hz							
	63	125	250	500	1,000	2,000	4,000	8,000
$L_p$ (OB), dB	43	50	55	61	66	69	71	69
$N_o$ , dB	—	33	46	58	66	71	75 <sup>a</sup>	74
$L_{CNR-65}$	86	78	72	68	65	63	60	59
Reduction, dB	—	—	—	—	1	6	11	10

<sup>a</sup>Largest value.

### FINAL EXAMINATION

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**TABLE Q5(b): Correction Factors (CF) for Various Influencing Factors for Community Noise Reaction**

Influencing factor	Possible condition	CF, dB
Noise spectrum	Noise with pure-tone components	+5
	Broadband noise	0
Repetitiveness	Continuous to 1/minute	0
	10-60 times/hour	-5
	1-10 times/hour	-10
	4-24 times/hour	-15
	1-4 times/day	-20
	1 time/day	-25
Time of day	Daytime only (7:00 a.m. to 6:00 p.m.)	-10
	Evening (6:00 p.m. to 10:00 p.m.)	-5
	Nighttime (10:00 p.m. to 7:00 a.m.)	0
Season of the year	Winter only	-5
	Summer (and winter)	0
Type of area	Rural	+10
	Suburban	+5
	Urban residential	0
	Residential with some business	-5
	Area with light industry	-10
	Area with heavy industry	-15
Peak factor	Impulsive sounds	+5
	Non-impulsive sounds	0



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**TABLE Q5(c): Average Community Reaction to Noise Based on the Composite Noise Rating  $L_{CNR}$**

Corrected composite noise rating, $L_{CNR}$ , dB	Community response	Percent of population complaining
39 dB or less	No reaction	
40-45 dB	Mild annoyance	1
46-50 dB	Sporadic complaints	2
51-55 dB	Widespread complaints	7
56-69 dB	Threats of legal action	12
70 dB or greater	Vigorous legal action	22