Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESI 2014/2015

COURSE NAME	:	NOISE AND VIBRATION
COURSE CODE	:	BDA 40603/BDC 4013
PROGRAMME	:	3BDD
EXAMINATION DATE	:	JUNE 2015 / JULY 2015
DURATION	:	3 HOURS
INSTRUCTION	:	**ANSWER FIVE (5) FROM SIX (6) QUESTIONS**

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

Q1 (a) Vibration can be classified in **EIGHT (8)** ways; e.g. deterministic and random vibration. Give and explain briefly only **FOUR (4)** form **EIGHT (8)** important classifications.

(8 marks)

(b) Explain **FOUR (4)** steps the procedure using Newton's Second Law of Motion on a free single degree of freedom vibration

(4 marks)

(c)

FIGURE Q1(c) shows the bucket of Fire Bridget truck which is located at the end of the telescoping boom. The cockpit weight is 2 kN along with the Fire Bridget. If $l_1 = l_2 = l_3 = l_4 = 3$ m; cross-section areas $A_1 = 20$ cm^2 , $A_2 = 20$ cm^2, and $A_3 = 5$ cm^2 Calculate;

(i). the stiffness of the telescoping boom in vertical direction;

(5 marks)

(ii). the natural frequency of the bucket one degree of freedom model

(3 marks)

Given;

$$\frac{1}{k_b} = \frac{1}{k_{b1}} + \frac{1}{k_{b2}} + \frac{1}{k_{b3}}$$

$$k_b = \frac{A_i E_i}{l_i}$$

Q2 (a) Define these terms

(i). The number of degrees of freedom

(2 marks)

(ii). The principal coordinates

(2 marks)

(b) The motor-pump system shown in **FIGURE Q2(b)** is modeled as a rigid bar of mass m= 50kg and mass moment of inertia J_0 = 100 kg-m^2. The foundation of the system can be replaced by two springs of stiffness k_1 = 500 N/m and k_2 = 200 N/m. Determine the natural frequencies of the system. Assume the distances between C.G and spring, (k_1 and k_2) as l_1 = 0.4 m and l_2 = 0.6 m

(16 marks)

Q3 (a) The spring-mass system is shown in **FIGURE Q3(a)**.

(i) Derive the equation of motion of the system using Newton's second law of motion.

(5 marks)

(ii) Find the flexibility and the stiffness influence coefficients.

(5 marks)

(iii) Determine the natural frequencies and the corresponding mode shapes of the system

(5 marks)

(b) **FIGURE Q3(b)** shows three degree of freedom spring-mass system. Calculate the fundamental natural frequency of vibration of system by using Rayleigh's Method. Assume that $m_1 = m_2 = m_3 = m$, $k_1 = k_2 = k_3 = k$. Use the mode of the system as;

$$\bar{X} = \begin{Bmatrix} 1 \\ 2 \\ 3 \end{Bmatrix}$$

(5 marks)

Q4 (a) Define what is Hand-Arm Vibration (HAV)

(2 marks)

(b) Define the following terms:

(i) Sound Power

(2 marks)

(ii) Sound Pressure

(2 marks)

(iii) Sound Intensity

(2 marks)

(iv) Infrasound

(2 marks)

(v) Ultrasound

(2 marks)

(c) The sound pressure level of a machine is measured in octave band in the presence of a background noise, which is also measure with the machine turn off. The results of the measurement are shown in **TABLE Q1**. Calculate;

(i) the sound pressure level generated by the machine without background noise;

(3 marks)

(ii) the sound pressure level generated by the machine without background noise in A-weighting;

(2 marks)

(iii) the overall sound pressure level generated by the machine in A-weighting.

(3 marks)

Use **TABLE Q2** for A-weighting

TABLE Q1

OCTAVE BAND Hz	Machine on (dB)	Machine off (dB)
125	92	88
250	88	82
500	85	77
1000	78	66
2000	76	63
4000	75	55
8000	70	53

TABLE Q2

OCTAVE BAND Hz	A-weighting
63	-39.4
125	-26.2
250	-16.1
500	-8.6
1000	0
2000	1.2
4000	1
8000	1.1

Q5 (a) Write down the equation relating the Sound Pressure Level, *SPL* in a room, the Sound Power Level, *SWL*, the directivity factor Q , the distance from the source to the receiver, r and the acoustic properties of the room, *RC*.

(10 marks)

(b) Define the directivity and assign values to it for a source located

(i) near the center of a room

(ii) near the center of a wall

(iii) at the center of edge formed by two adjacent surfaces and

(iv) at the center formed by three adjacent surfaces

(5 marks)

(c) Use the equation in Q5 (a) to study the decay of sound in a hard-walled room, and in a soft-walled room with little reflection.

Take SWL of source = 95 dB, source directivity, $Q = 2$, $\alpha = 0.3$ hard, and $\alpha = 0.9$ soft, total surface area of the room, $S = 500$ m2, let $r = 1.5$ m and $r = 8$ m. Use **Figure Q5(c).**

(5 marks)

Q6 As a new mechanical engineer working in an international company, you are requested to conduct a noise assessment at one area in a mechanical workshop since machine operators keep complaining the new generator is too noisy so that operators cannot concentrate in doing the expected tasks.

(a) Propose the list of equipment to do the noise assessment, and draw the illustration of the instruments setup.

(6 marks)

(b) Explain how you will conduct the noise assessment (method, location, duration).

(10 marks)

(c) What kind of information that you want to present, and what are you going to do with the obtained data.

(4 marks)

-END OF QUESTIONS-

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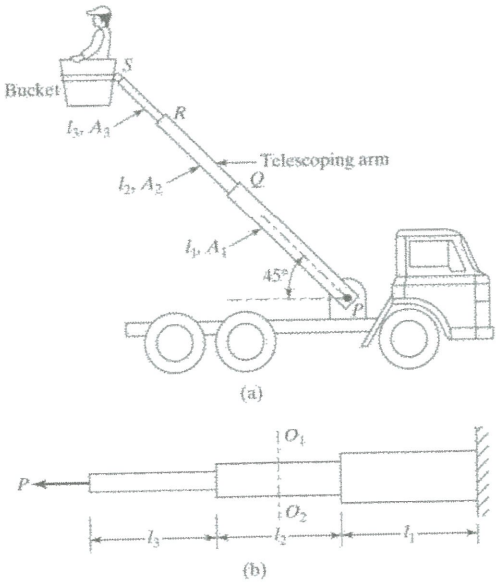

FIGURE Q1(c)

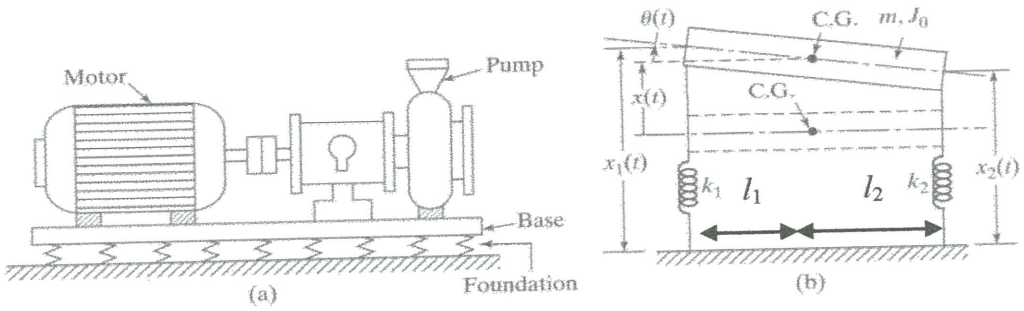

FIGURE Q2(b)

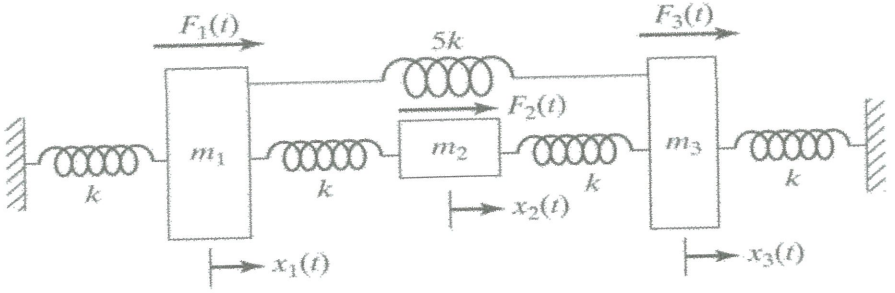

FIGURE Q3(a)

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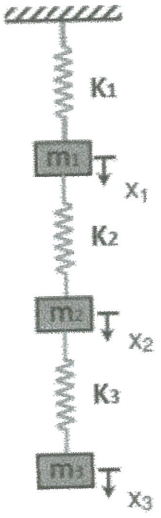

FIGURE Q3(b)

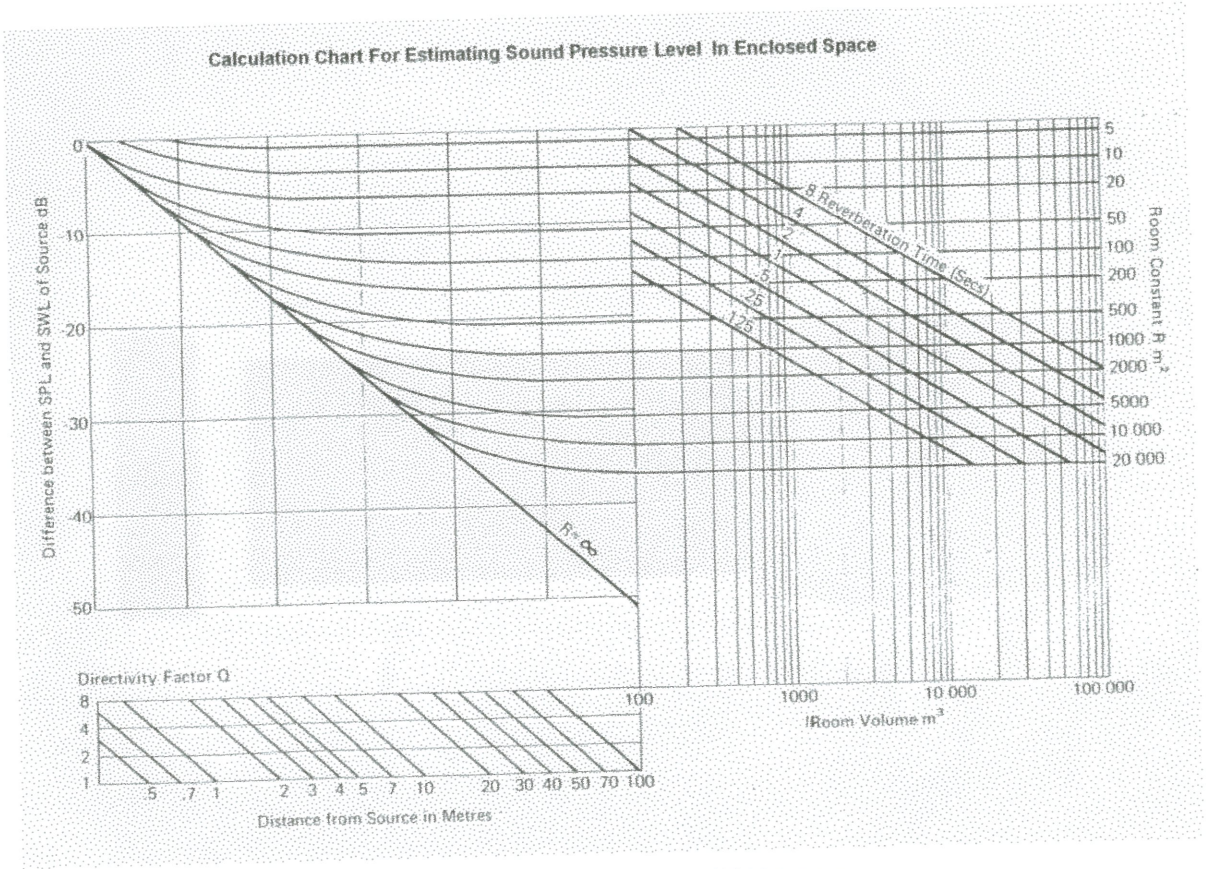

FIGURE Q5(c)