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CONFIDENTIAL

SET A

UNIVERSITI KUALA LUMPUR
Malaysia France Institute

FINAL EXAMINATION
JANUARY 2014 SESSION

SUBJECT CODE	:	FCD 20402
SUBJECT TITLE	:	ACOUSTIC AND VIBRATION
LEVEL	:	DIPLOMA
TIME / DURATION	:	3.30 pm - 5.30 pm (2 HOURS)
DATE	:	0 2 JUN 2014

INSTRUCTIONS TO CANDIDATES

1. Please read the instructions given in the question paper CAREFULLY.
2. This question paper is printed on both sides of the paper.
3. Please write your answers on the answer booklet provided.
4. Answer should be written in blue or black ink except for sketching, graphic and illustration.
5. This question paper consists of TWO (2) sections. Section A and B. Answer all questions in Section A. For Section B, answer two (2) question only.
6. Answer all questions in English.
7. Fomula is appended.

THERE ARE 5 PAGES OF QUESTIONS, EXCLUDING THIS PAGE.

SECTION A (Total: 60 marks)

INSTRUCTION: Answer ALL questions.
Please use the answer booklet provided.

Question 1

a) What is the definition of sound?

(4 marks)

b) State four (4) General characteristic of sound.

(4 marks)

c) What is the definition of:

i. Duct - borne paths

(4 marks)

ii. Air - borne path

(4 marks)

iii. Structure – borne path

(4 marks)

Question 2

a) State five (5) Basic Terminology of Acoustical Terms most frequently encountered For HVAC system design?

(5 marks)

b) From the question 2(a) answer, what is the definition of that terms?

(15 marks)

Question 3

A = 50dB B=49dB C= 48dB

Figure Q3(a): Celling Exposed unit with dB

a) Refer to the figure Q 3(a), Determine the total sound pressure level from the three (3) Unit of Air conditioning by three (3) methods:

i. By Calculation method

(10 marks)

ii. By Rule method

(5 marks)

iii. By using chart method

(5 marks)

SECTION B (Total: 40 marks)

INSTRUCTION: Answer TWO questions.
Please use the answer booklet provided.

Question 4

Calculate the sound pressure level (SPL) radiating from an Air conditioning unit receiver by a worker at the distance of 3m from the air conditioner. The air conditioner is installed at the middle of ceiling of the room 20m x 16.5m x 5.0m. The air conditioner manufacturer specification of the sound power level (SWL) is 80dB. The background noise of the room is 70dB and radius from fan coil reservoir.
The room is constructed by concrete wall, ceiling, and floor absorption coefficient of:
α wall = 0.1
αfloor = 0.2
αcelling = 0.15

Calculate:

a) Total absorption area

(4 marks)

b) Average absorption coefficient

(4 marks)

c) Room constant

(4 marks)

d) Reverberation time

(4 marks)

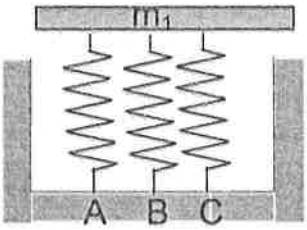
e) Total sound pressure level

(4 marks)

Question 5

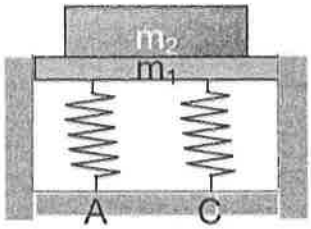
A tray of mass m_1 is attached to 3 springs as shown in figure Q5(a). The natural frequency is 2Hz. After that, a mass m_2=1kg block has been placed in the center of the tray, and spring B of k_B is 10kN/m has been removed and the period of the natural frequency is observed to be 1.5Hz. Determine the mass m_1 of the tray.

(20 marks)



(a)

Figure Q5(a): Complete system with all Spring A and B installed



(b)

Figure Q5(b): After spring B is remove And additional M_2

Question 6

Refer Figure Q6 and appendix

AHU Fan motor c/w spec: 240V-1 Ø - 50Hz, 4Poles, η_{motor}=90%.

and its weight:

weight of Fan	= 25 kg
weight of motor	= 45 kg
weight of frame (plinth)	= 15 kg.

a) Calculate the mass at point A

(10 marks)

b) Calculate the natural frequency at point A

(10 marks)

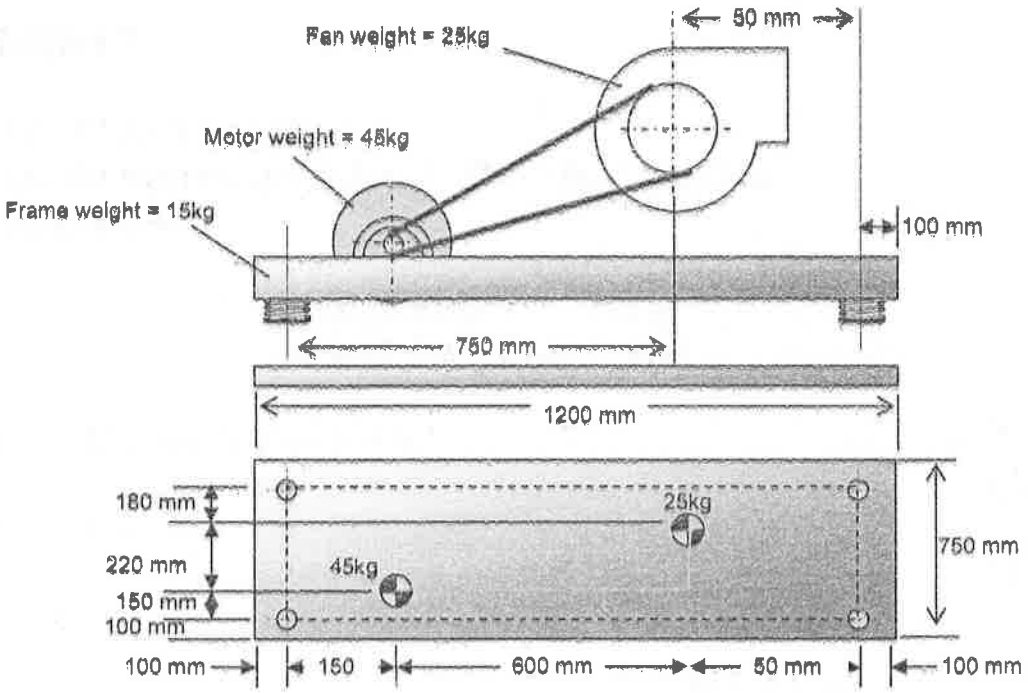
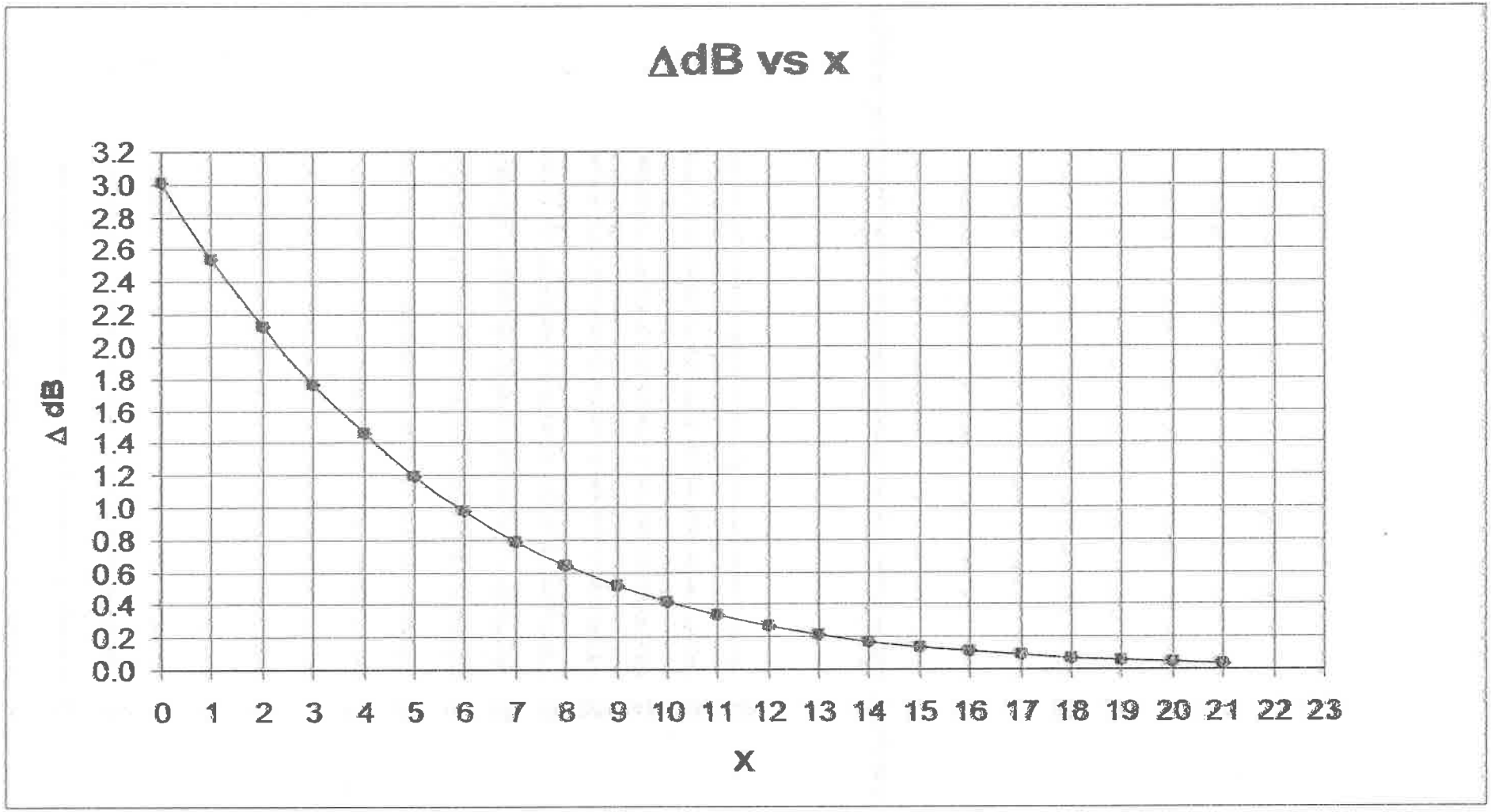


Figure Q6: AHU System

END OF QUESTION

Appendix 1


ΔdB vs x
Δ dB
3.2
3.0
2.8
2.6
2.4
2.2
2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23
X

Appendix 2: Formula

- $Log\ (ab) = log\ a + log\ b$
- $Log\ (a/b) = log\ a - log\ b$
- $Log\ a^b = b\ log\ a$
- $Log_a\ a = 1$
- $Log_a\ 1 = 0$
- $Log_a\ b = \frac{log_e\ b}{log_e\ a}$

ACOUSTICS:

- $\lambda = \frac{v}{f}$ where λ= wavelength, v= speed (m/s); f=frequency (Hz)
- $v = \sqrt{\gamma RT}$

  Where $R = \frac{\overline{R}}{M}$, M= Molar Mass; $\overline{R}$ = Universal Gas constant (8.314 kJ/kmol.K)

- For Air : $v = \sqrt{\gamma RT} \approx 20.04\sqrt{T}$ where T in Kelvin
- T(K) = 273 + $^\circ$C
- $L_w = 10\log\left(\frac{W}{W_{ref}}\right)$ where $W_{ref} = 10^{-12}$ watt
- $L_p = 20\log\left(\frac{P}{P_{ref}}\right)$ where $P_{ref} = 20\ \mu Pa$
- $L_I = 10\log\left(\frac{I}{I_{ref}}\right)$ where $I_{ref} = 10^{-12}$ watt/m^2
- $L_{TOTAL} = 10\log\left[\sum_{i=1}^{n} 10^{\frac{L_i}{10}}\right]$
- $L_{P1} - L_{P2} = 20\,Log\left(\frac{r_2}{r_1}\right)$
- Free Field : $L_p = L_w + 10\log\left(\frac{Q}{4\pi r^2}\right)$ where Q=Directivity (1,2,4,8)
- Closed Room : $L_p = L_w + 10\log\left(\frac{Q}{4\pi r^2} + \frac{4}{R}\right)$

where R =Room constant; $R = \frac{S\bar{\alpha}}{(1 - S\bar{\alpha})}$; absorption coeff. $\alpha_{abs} = \frac{I_{abs}}{I_{inc}}$;

- S= $S_1+S_2+S_3+\ldots+S_n$, $\bar{\alpha} = \frac{S_1\alpha_1 + S_2\alpha_2 + \ldots\ldots + S_n\alpha_n}{S}$
- Reverberation time in sec $T_{60} = \frac{0.16V}{A}$, where V= Room volume,

  Total absoption area (TSA) $A = \sum S_i\bar{\alpha}_i$