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CONFIDENTIAL

SET A

UNIVERSITI KUALA LUMPUR
Malaysia France Institute

FINAL EXAMINATION
JANUARY 2011 SESSION

SUBJECT CODE	:	FCD 20402
SUBJECT TITLE	:	ACOUSTIC AND VIBRATION
LEVEL	:	DIPLOMA
TIME / DURATION	:	9.00am – 11.00am (2 HOURS)
DATE	:	14 MAY 2011

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 7 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 unit of sound?

.....

(2 marks)

(b) What is the definition of sound?

(4 marks)

(c) State four (4) general characteristic of sound?

(8 marks)

(d) What is the definition of frequency?

(3 marks)

(e) What is the definition of octave bands?

(3 marks)

Question 2

(a) What is the definition of Sound Pressure Level (SPL)?

(2.5 marks)

(b) What is the definition of Sound Power Level (SWL)?

(2.5 marks)

(c) What is the Power in Watt for an Air-Conditioner unit that produces Sound Power Level (SPL) of 45dB?

(5 marks)

(d) Referring to figure Q2(d), given that, sound pressure level (SPL_1) is 45 dB, Sound pressure level (SPL_2) is 30 dB and radius (r_1) at 2m calculate :

i. Radius r_2.

ii. Sound power level (SWL) produce by source.

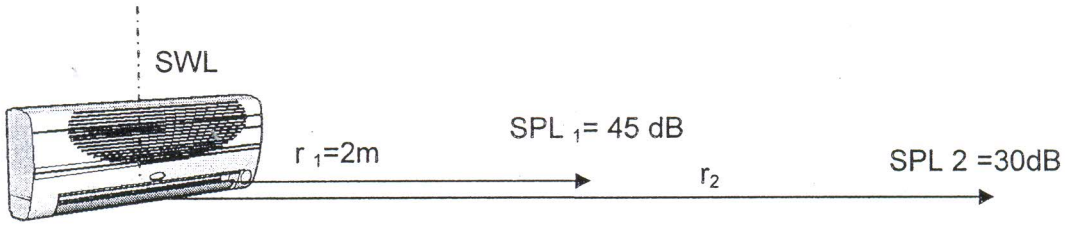


Figure Q2 (d): Sound pressure distance

(10 marks)

Question 3

Referring figure Q3, for directivity (Q) at free field condition, calculate the Sound pressure level (SPL) for each points B,C,D,E when the sound pressure level (SPL_A) is 90dB and radius (r_A)is 2m..

(20 marks)

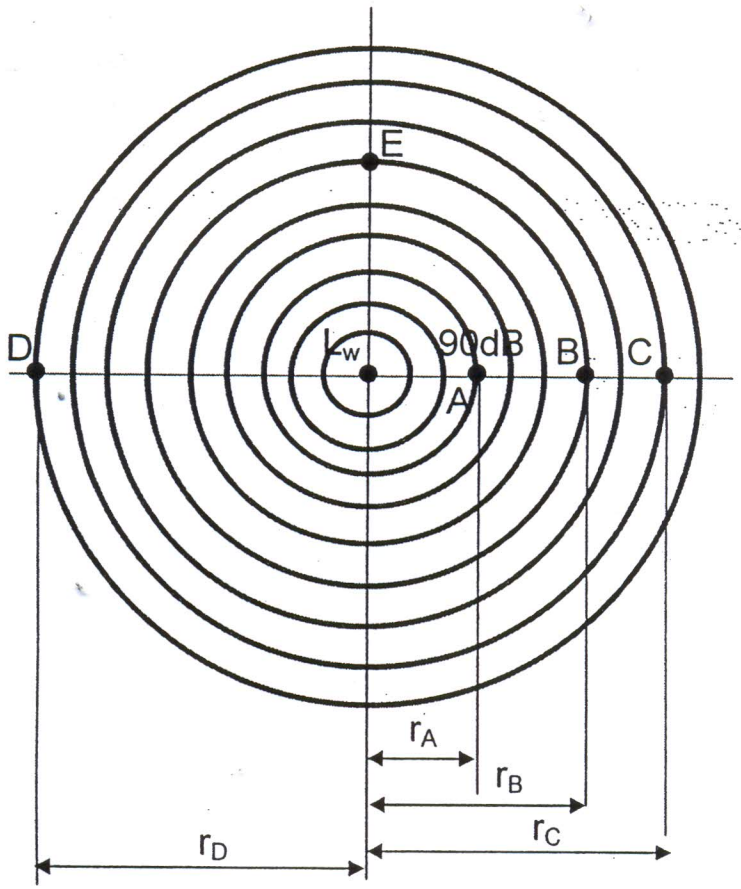


Figure Q3: Sound Pressure Level

SECTION B (Total: 40 marks)

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

Question 4

Refer to figure Q4,
Calculate the Sound pressure level (SPL) radiating from an Air conditioning unit received by a worker at the distance of 4m from the Air conditioner. The Air conditioner is installed at the middle of a wall of the room of 17.5m x 12.5m x 4.0m. The Air conditioner manufacture specify the Sound power level (SWL) is 90 dB. The background noise of the room is 80dB and radius from fan coil to the receiver.
<Note>
The room is of concrete construction with the following data :

Door : 1.0m x 2.5 m
Window: 2.5m x 1.5m

$\alpha_{wall} = 0.1$
$\alpha_{floor} = 0.2$
$\alpha_{ceiling} = 0.15$
$\alpha_{window} = 0.25$
$\alpha_{Door} = 0.1$

Calculate:

a) Total Absorption Surface Area ,(ΣTSA) in m^2 (4 marks)

b) Average absorption coefficient , α_{bar} (4 marks)

c) Room constant , R in m^2 (4 marks)

d) Reverberation time, T_R in Sec (4 marks)

e) Total Sound pressure level (Lp) in dB (4 marks)

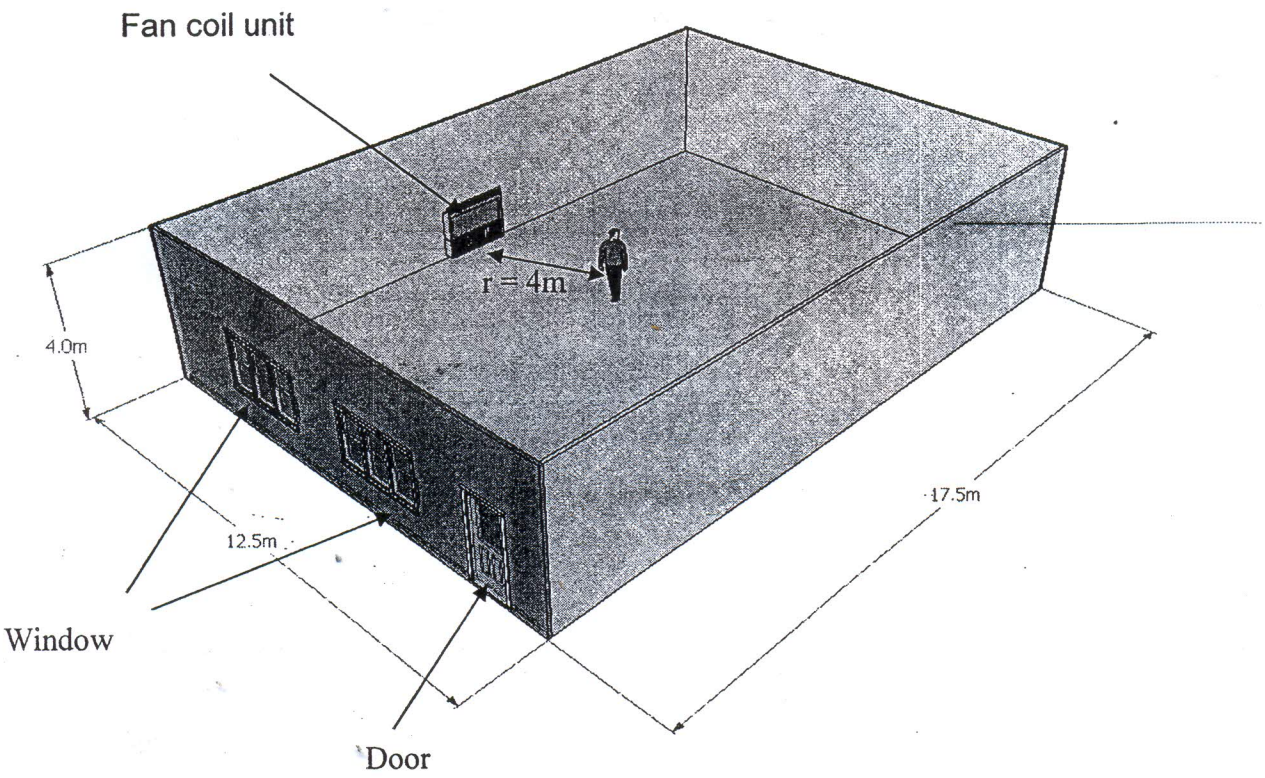


Figure Q4: Indoor unit location

Question 5

A tray of mass m_1=50kg is attached to 3 springs as shown in figure Q5(a). The natural frequency is 3.18Hz. After that, another m_1 block has been placed on top of the first m_1 and spring B is removed, as in figure Q5(b) now the natural frequency is observed to be 1.6Hz. Determine the spring stiffness of k_A and k_B.

(20 marks)

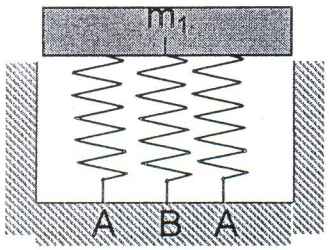


Figure Q5(a): Complete system with all Spring A and B installed

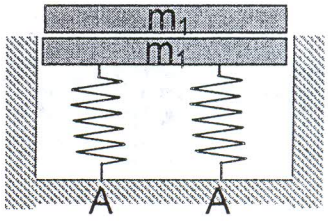


Figure Q5(b): After spring B is remove And additional M_1

Question 6

Refer to Figure Q6:

An AHU Fan motor has the following specifications

: 240V – 1phase – 50Hz

: η_{motor} = 90%

: Compressor poles = 4 poles

: Weight of Fan = 20kg

: Weight of Motor = 40kg

: Weight of Frame = 15kg

: Safety Factor = 20% (for the final weight)

Calculate δ_{st} of the spring A (refer to Appendix 1)and select the closest suitable spring for corner A.

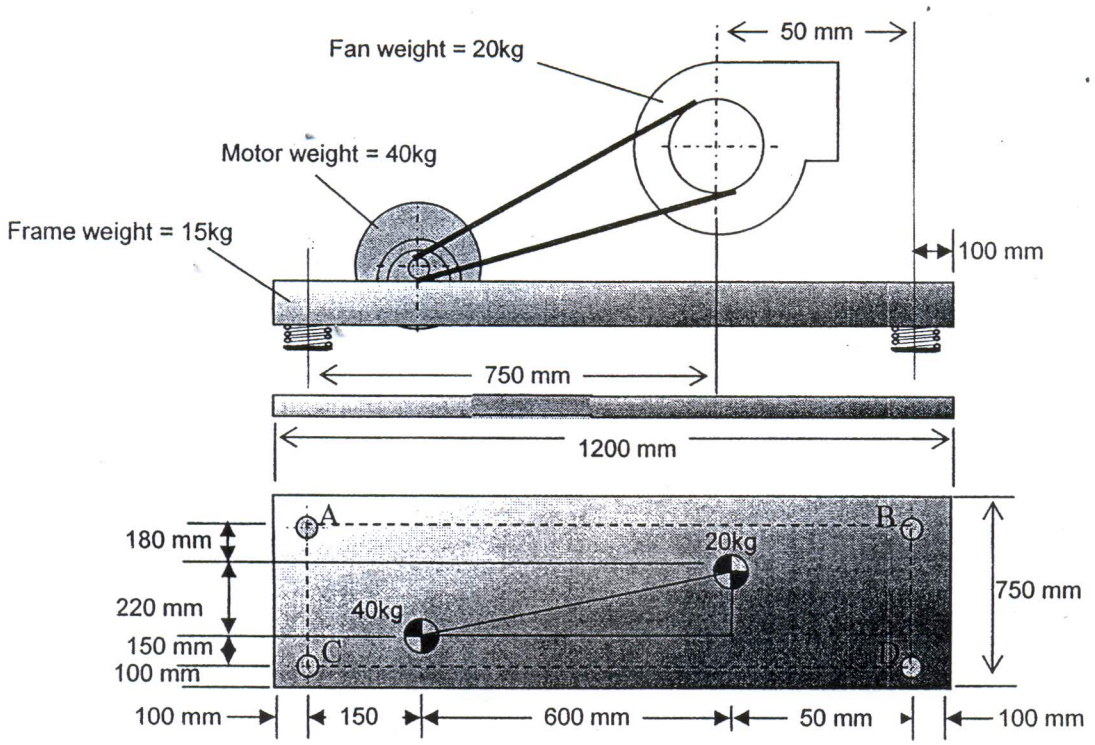
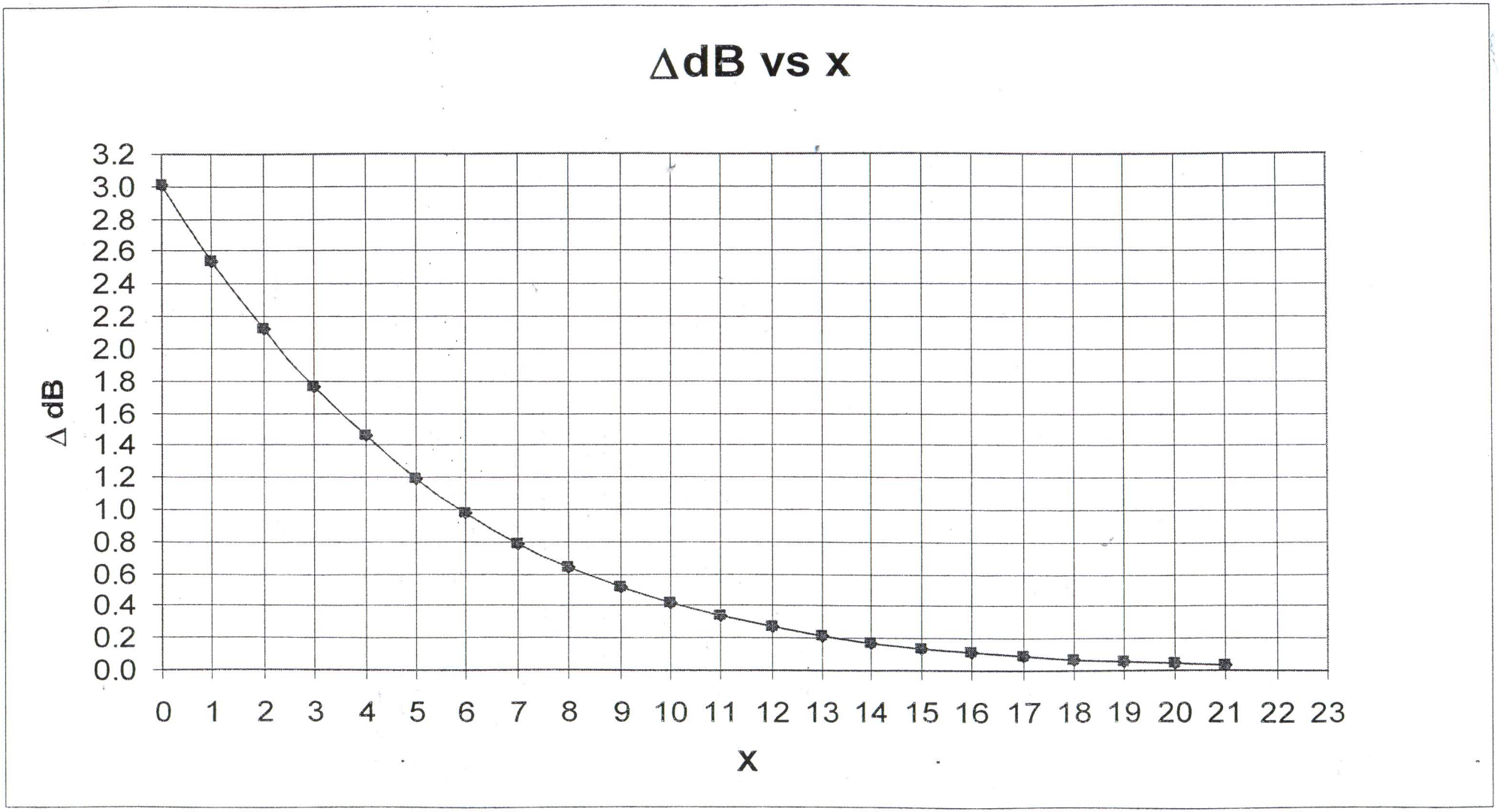


Figure Q6: Location of Fan at AHU unit.

END OF QUESTION

Appendix Technical Document



Appendix of Spring Selection

Formulae:

- *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 = $\frac{log_c\, b}{log_c a}$*

ACOUSTICS:

- $\lambda = \frac{v}{f}$ where □= 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 + □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 □Pa
- $L_I = 10\log\left(\frac{I}{I_{ref}}\right)$ where I_{ref} = 10^{-12} watt/m^2
- $L_{TOTAL} = 10\log\left[\sum_{i=1}^{n} 10^{\frac{L_i}{10}}\right]$
- $L_{P1} - L_{p2} = 20Log\left(\frac{r_2}{r_1}\right)$
- 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= $S_1+S_2+S_3+....+S_n$, $\bar{\alpha} = \frac{S_1\alpha_1 + S_2\alpha_2 + ... + S_n\alpha_n}{S}$
- Reverberation time in sec $T_{60} = \frac{0.16V}{A}$, where V= Room volume,

  Total absoption area (TSA) $A = \sum S_i\alpha_i$