Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2016/2017

COURSE NAME:	ACOUSTIC AND NOISE CONTROL
COURSE CODE:	BDC 40803
PROGRAMME:	BDD
EXAMINATION DATE:	JUNE 2017
DURATION:	3 HOURS
INSTRUCTIONS:	ANSWERS **FIVE (5)** OUT OF **SIX (6)** QUESTIONS

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

Q1 (a) Three omnidirectional, uncorrelated acoustic sources A, B and C are to be placed at three corners of a square with 10 m sides. Independent calibration tests on these sources showed that they produced the following amounts of acoustic power.

Source A = 10 watts
Source B = 20 watts
Source C = 15 watts

i. Calculate the sound pressure level at the remaining corner (opposite B) of the 10 meter square (i.e position D), assuming that D is the far field A,B and C.

(6 marks)

ii. Explain physically the meaning of sound intensity and show why more than one microphone is necessary for its measurement except in the far field of a source where the acoustic pressure and particle velocity are in phase.

(4 marks)

iii. What is the advantage of sound intensity measurement over sound pressure measurements for the determination of the sound power of noisy equipment

(2 marks)

(b) The sound pressure levels from five noise sources are measured individually at a point in a workshop and their (logarithmic) average value is 80 dB(A). What is your expected when all five source are operation if four of the level were 72 dB(A), 74 dB(A), 76 dB(A) and 80 dB(A),

i. Determine the level produced by the fifth source.

(4 marks)

ii. Give your evaluation on the different of sound pressure level between four sources and five sources.

(4 marks)

Q2 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) Describe the sources of error that could affect noise level measurements made with a sound level meter and describe how you could minimize the effects of wind noise on an outdoor sound measurement taken with a Sound Level Meter.

(8 marks)

(b) If noise measurements are being taken in support of a legal case, why would you use a sound level meter on site, rather than a tape recording which you could analyze at your leisure?

(8 marks)

(c) Why is L_{Aeq} the quantity generally used to describe the level of a time varying noise. Compute the L_{Aeq} of a noise which is 80dB(A) for 15 minutes, 70dB(A) for 2 hours, 90dB(A) for 2 hours, 99dB(A) for 5 minutes and 75dB(A) for 4 hours.

(4 marks)

Q3 (a) Your task is to refine the acoustic properties in a room by changing wall materials. Since the room has a problem at frequency range,

i. justify the correct type of material that you are going to be used.

(3 marks)

ii. Explain and sketch the important characteristic of the chosen material.

(3 marks)

(b) A 2m X 2m X 2m enclosure is constructed around a small compressor. The enclosure is made of a lightweight metal with a transmission loss of 26 dB at 500 Hz. The average absorption coefficient in the enclosure is 0.3 in the 500 Hz octave frequency band.

The compressor generates a sound power level of 101.8 dB(A) in the 500 Hz octave band.

i. Calculate the A-weighted sound power level radiated by the exterior of the enclosure. Assume the interior of the enclosure is diffuse.
Use: $Lw = L_p + 10 \log S - TL$

(7 marks)

ii. Calculate the maximum available open area for ventilation in the enclosure that will results in a sound pressure level of 55 dB(A) for the 500 Hz octave band at a distance 25 meters. Assume hemispherical radiation and ignore ground effects.
Use: $L_p = L_w - 10 \log (S\pi r^2)$; $TL = 10 \log A$;
$A = 20/[10^{TL/10} (20 - S_{open}) + S_{open}]$

(7 marks)

Q4 A machine in a factory of dimensions 50 m x 50 m x 5 m emits a sound power level of 130 dB in the 500 Hz octave band. The machine is located in the centre of the factory mid-way between the floor and ceiling.

(a) Calculate the direct and reverberant sound pressure levels 5 m from the acoustic centre of the machine. Assume the machine radiates uniformly in all directions, the room has a specular reflecting floor and ceiling and no other machines or reflecting surfaces are in the room. Assume that the pressure reflection coefficient (absorption coefficient) amplitude is 0.7 for both the floor and ceiling.

(7 marks)

(b) If the factory dimension s were 10 m x 10 m x 5 m and the pressure reflection coefficient amplitude for all surfaces was 0.7, what would be the total sound pressure level 5 m from the acoustic centre of the machine.

(5 marks)

(c) For the case in part (b), at what distance form the machine would the direct and reverberant fields be equal.

(3 marks)

(d) What would be the reverberation time in the room of part (b)

(2 marks)

(e) If the factory walls had a Transmission Loss of 25 dB in the 500 Hz octave band, what would be the sound level at a distance of 50 m from outside of the wall across an asphalt car park

(3 marks)

Q5 (a) Diagnosis has shown that in factory XYZ has a particular case sound from the source reaches the receiver via three paths equally which the level at the receiver is 70 dB. Three separate noise control treatments are available to reduce sound transmission via each of three paths by 20 dB.

i. Estimate the noise at the receiver be reduced if first just one, the two and finally all three treatments are used.

(6 marks)

ii. If instead of treating the three paths there is an alternative treatment which will reduce the source level by 20 dB, evaluate the level at the receiver

(3 marks)

iii. Explain the general conclusion can you draw from this question about the noise control process.

(6 marks)

(b) Air enters a room through single grille situated in one of the top corners of the room. A target level of NR 35 has to be achieved by the ventilation system which consists of a fan connected to main duct of length 5 m. The airflow then split into two equal parts, one of the branches of length 3 m serving the room in question via the single grille. There are one bend in the main duct prior to the division of the airflow, and one bend in each of the branches.

Calculate the extra attenuation required in the 250 Hz octave band to meet the NC 35 target at point in the room 4 m from the grille, given the following information, all of which refers to the 250 Hz octave band:

sound power level of fan	85 dB
attenuation of main duct	0.3 dB/m
attenuation of branch duct	0.5 dB/m
attenuation of bend in main duct	6 dB
attenuation of bend in branch duct	3 dB
room constant	50 m2
end refelction at grille	4 dB

Use NR curve in Appendix B

(5 marks)

Q6 (a) Suria Sdn Bhd found that their production line generate excessive noise level. From the previous data they found most of the workers have experience hearing problem due to expose excessive noise level. As a Safety Office, judge the possible Standard Operating Procedure (SOP) could be taken in order to conduct the noise monitoring using Malaysia Regulation.

(10 marks)

(b) The estimated noise levels at the boundary of a proposed new factory are given below (**Table 6(b)**) for each octave band shown.

Table 6(b)

Octave band centre frequency (Hz)	63	125	250	500	1k	2k	4k	8k
L_p (dB re 20μPa)	60	55	55	50	55	55	50	45

(i) Calculate A weighted sound level and NR rating

(3 marks)

(ii) If the surrounding neighborhood is described as "residences bordering an industrial area" and the noise is characterized by just detectable tones what public reaction may be expected throughout day, evening and night? (use A-weighted criteria)

(3 marks)

(iii) Should the factory be built? If so should its hours of operation be restricted? Give your conclusion if the noise only occurred 25%.

(4 marks)

Use **Appendix A and B**

-END OF QUESTION-

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Appendix A

Frequency (Hz)	A weighting Correction	Frequency (Hz)	A weighting Correction	Frequency (Hz)	A weighting Correction
10	-70.4	160	-13.4	2500	1.3
12.5	-63.4	200	-10.9	3150	1.2
16	-56.7	250	-8.6	4000	1.0
20	-50.5	315	-6.6	5000	0.5
25	-44.7	400	-4.2	6300	-0.1
31.5	-39.4	500	-3.2	8000	-1.1
40	-34.6	630	-1.9	10000	- 2.5
50	-30.2	800	-0.8	12000	- 4.3
63	-26.2	1000	0.0	16000	- 6.6
80	-22.5	1250	0.6	20000	- 9.3
100	-19.1	1600	1.0		
125	-16.1	2000	1.2		

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Appendix B