



UTHM

Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

**FINAL EXAMINATION
SEMESTER II
SESSION 2022/2023**

COURSE NAME : ACOUSTIC & NOISE CONTROL
COURSE CODE : BDC 40803
PROGRAMME CODE : BDD
EXAMINATION DATE : JULY / AUGUST 2023
DURATION : 3 HOURS
INSTRUCTION : 1. ANSWER ALL QUESTIONS
2. THIS EXAMINATION IS CONDUCTED VIA **CLOSED BOOK**.
3. STUDENT ARE **PROHIBITED TO CONSULT THEIR OWN MATERIAL OR ANY EXTERNAL RESOURCES DURING THE EXAMINATION CONDUCTED VIA CLOSED BOOK**

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

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- Q1** (a) Choose either A or B, whichever is the correct answer.
- i. SPL means the level, in decibels, calculated as _____ times the common logarithm of the ratio of a sound pressure to the sound pressure of 20 micro-Pascals.
 - A. ten
 - B. twenty

 - ii. Noise mapping is used to identify _____.
 - A. noisy machinery, processes, and areas
 - B. sound emitted by noise sources

 - iii. Based on the degree of fluctuation, noise can be classified as _____.
 - A. continuous or intermittent
 - B. steady, fluctuating, and impulsive

 - iv. The estimate of employees' exposure should be representative of the work that they do, considering:
 - I. the work they do or are likely to do
 - II. the ways in which they do the work
 - III. How it might vary from one day to the next
 - A. I & II
 - B. I, II & III

 - v. The noise exposure limit (NEL) as stipulated under the Occupational Safety and Health (Noise Exposure) Regulations 2019.
 - I. Daily noise exposure limit exceeding 82 dBA
 - II. Daily personal noise dose exceeding 100%
 - III. Peak SPL exceeding 140 dBC
 - A. II & III
 - B. I, II & III

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(5 marks)

- (b) Identify four (4) objectives of a noise risk assessment that is conducted by a noise risk assessor (NRA) who is registered with the Director General.

(4 marks)

- (c) Distinguish between noise zoning and noise contouring with an example of a sketch of a work area with two (2) machines laid out that generate noise at 90 dBA and 88 dBA, respectively.

(5 marks)

- (d) Determine the procedure to measure employees' exposure monitoring using a noise dosimeter as a requirement in personal exposure monitoring.

(6 marks)

Q2 (a) Choose the correct answer for the items below, either A or B:

- i. Employers purchasing new plants shall obtain noise level information from _____.

- A. Manufacturer or Supplier
- B. Designer or Contractor

- ii. Principles of noise engineering control based on the NIOSH standard are:

- I. Absorption
- II. Acoustic
- III. Damping

- A. I & III
- B. I, II & III

- iii. A dissipative type of silencer or muffler can be defined as _____.

A. Governed primarily by its internal configuration and the reduction of flow velocity caused by abrupt changes in shape and the resonance of added branches or cavities to a pipe or duct.

B. Governed primarily by the presence of sound-absorbing material that dissipates acoustic energy.

- iv. The daily exposure duration limit for employee exposed to a noise level of 91 dBA is _____
- A. 2 hours
B. 2 hours 31 minutes
- v. Areas where persons may be permanently exposed to noise levels exceeding the noise exposure limit (NEL) shall be sign-posted as _____.
- A. NOISY AREA
B. HEARING PROTECTION ZONES

(5 marks)

- (b) You have been appointed by top management as a hearing conservation administrator to manage noise exposure at the workplace. Demonstrate four (4) noise control procedures that follow the recommended method of approach according to the order outlined by NIOSH and DOSH, Malaysia.

(4 marks)

- (c) Solve the following questions by using the noise control formula:
- i. The noise level is 90 dB (SPL₁) at 1 meter (r₁). Calculate the noise level (SPL₂) at a distance of 2 meters (r₂).
- ii. A worker exposed to the daily noise exposure level $L_{EX,8H} = 93$ dB(A) is given an ear plug with the NRR = 29 dB(A). Calculate the NRR_{ACTUAL} and the new estimated noise exposure after wearing the PHP.

(5 marks)

- (d) A chiller pump motor had been used for transmitting the cold chill water as a part of the Heating, Ventilation, and Air Conditioning (HVAC) system, which produces up to 93 dBA noise level. As a mechanical engineer, you are required to propose noise engineering control measures at the sound source generation. Support your recommendation with a rule of thumb noise engineering control procedure.

(6 marks)

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Q3 (a) Determine whether the following statement is true or false.

- (i) Noise control is not a safety issue. [True / False]

- (ii) Effective noise control must be based on an accurate diagnosis and on assumptions. [True / False]

- (iii) Unless the dominant source is treated first, the overall noise reduction will be very disappointing. [True / False]

- (iv) Noise generation is classified into two major components: aerodynamic and mechatronic. [True / False]

- (v) Enclosure defines building a box around noise sources such as lagging. [True / False]

(5 marks)

(b) Distinguish four (4) fundamentals of noise control best practices to attenuate the noise level.

(4 marks)

(c) Assess the source ranking techniques used as part of the noise control diagnosis procedure.

(6 marks)

(d) As a noise risk assessor (NRA), you are required to perform a noise audit checklist using a semi-quantitative noise risk assessment form. Support your assessment by filling out the form with an example of cutting activity with similar group exposure.

(5 marks)

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Q4 (a) Each acoustic field coefficient has its own mathematical equation. Identify the correct match for the items in the two columns below:

1. Sound absorption coefficient, α	a. $\frac{(\alpha_{200} + \alpha_{500} + \alpha_{1000} + \alpha_{2000})}{4}$
2. Reverberation time, T	b. $10 \log\left(\frac{1}{t}\right) \text{ dB}$
3. Noise reduction coefficient, NRC	c. $\frac{(E_i - E_r)}{E_i}$
4. Room constant, R_c	d. $S\alpha_{mean} / (1 - \alpha_{mean})$
5. Sound reduction index, R	e. $\frac{0.16V}{A}$

(5 marks)

(b) The absorption technique was among the most effective noise control measures, despite the insulation technique. Illustrate and explain the types of absorbers with an absorption coefficient versus frequency diagram.

(4 marks)

(c) A workshop of 8 m long, 6 m wide, and 4 m high with hard sound-reflecting surfaces is to be renovated as a room for meetings. The reverberation time is measured and found to be 3.0 seconds in a particular octave band.

- i. Estimate how much extra sound absorption must be introduced into the room to reduce the reverberation time to 0.8 seconds, suitable for speech.
- ii. If this is to be achieved, use carpet on the floor with an α value of 0.2 in the same band and cover areas of the wall and ceiling with sound-absorbing panels having a sound absorption coefficient, α value of 0.4. Decide on the area of these panels that must be used. (Use Sabine's formula)

(5 marks)

(d) A partition between two rooms with dimensions of 6 m by 3 m consists of a door with a dimension 2 m by 1 m and two windows, each with a dimension of 1.5 m by 1 m. The wall has a room constant R value of 45 dB in a specific octave band, the door has an R value of 35 dB, and the window has an R value of 20 dB.

- i. Value the effective or average room constant, R value, of the partition.
- ii. Estimate the statement in (d) but allow for a 2 mm air gap around the door.

(6 marks)

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- Q5** (a) Determine whether the following statement is true or false.
- (i) Enclosures are sound-insulating structures for the total containment or exclusion of a sound field. [True / False]
 - (ii) TL defines the transfer loss of enclosure. [True / False]
 - (iii) Barriers or screens placed in the path of free-field sound source radiation will create a relatively quiet zone in the acoustic shadow. [True / False]
 - (iv) Because of the surface reflection of the barrier wall, it primarily affects direct and reverberant sound. [True / False]
 - (v) Claddings are sound insulation layers applied on the external surfaces of pipes and ducts. [True / False]
- (5 marks)
- (b) The use of an enclosure made of a good sound-insulating material to reduce the noise from a machine is an obvious and attractive solution to a noise problem. Evaluate the four (4) principles of acoustic enclosures.
- (4 marks)
- (c) The effectiveness of a barrier in reducing sound transmission between source and receiver is limited by the diffraction of sound over the top and around the sides of the barrier, which is determined by the size of the barrier compared with the wavelength of the sound. However, there are some limitations to the performance of barriers. Support the limitation statement with justification.
- (6 marks)
- (d) Damping can be important in reducing the level of vibration and, therefore, radiated noise from thin sheet panels.
- i. Defend this statement by evaluating two (2) cases in which the amount of damping in the panel material will affect the level of vibration and noise.

- ii. Evaluate three (3) possibilities for how the condition of damping in a thin sheet panel can effectively attenuate noise magnitude.

(5 marks)

-END OF QUESTIONS-

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USEFUL FORMULAS:Transmission coefficient, t :

$$t = 10^{-\frac{R}{10}}$$

Transmission coefficient average, t_{avg} :

$$t_{avg} = (t_1 S_1 + t_2 S_2 + \dots + t_N S_N) / S_{Total}$$

Average sound reduction index, R_{avg} :

$$R_{avg} = 10 \log \left(\frac{1}{t_{avg}} \right)$$

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