



UTHM

Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION SEMESTER II SESSION 2023/2024

- COURSE NAME : ACOUSTICS AND LIGHTING
- COURSE CODE : BFB 41103
- PROGRAMME CODE : BFF
- EXAMINATION DATE : JULY 2024
- DURATION : 3 HOURS
- INSTRUCTIONS :
1. ANSWER ALL QUESTIONS
 2. THIS FINAL EXAMINATION IS CONDUCTED VIA
 - Open book
 - Closed book
 3. STUDENTS ARE **PROHIBITED** TO CONSULT THEIR OWN MATERIAL OR ANY EXTERNAL RESOURCES DURING THE EXAMINATION CONDUCTED VIA CLOSED BOOK

THIS QUESTION PAPER CONSISTS OF **SIX (6)** PAGES

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Q1 Sound represents energy transmitted through the compression and rarefaction of molecules within a medium, whether it be air, liquid, or solid. The human auditory system demonstrates heightened sensitivity to sound frequencies from 1 kHz to 4 kHz, compared to both extremely low and high frequencies. Different weighting filters are used to represent how human hearing responds to different frequencies at various sound levels.

- (a) Determine the medium which a sound wave has travelled, given that the sound wave has a frequency of 3250 Hz and a wavelength of 0.431 m. Please provide justification or assumption in your answer.

(6 marks)

- (b) The human ear does not perceive sound pressure similarly across different frequencies. This can be offset by using the dB(A), dB(B), or dB(C) filters. Compare the differences between filters dB(A) and dB(C) criteria and provide appropriate illustrations to support your explanation.

(7 marks)

- (c) Reverberation time is the duration of sound to decay in a room. The relationship between it and the geometric volume (V) of the room is proportionate, but it is inversely related to the absorption area (A) of the boundary surfaces. Consider two rooms (room A and room B) that have the same volume of 200 m^3 , but different in their building materials.

- i. Provide an analysis of the reverberation time for both rooms assuming they are constructed with concrete walls, floors, and ceilings, each with an absorption coefficient (α) of 0.02. Additionally, consider that Room B has been equipped with a suspended acoustic ceiling with an absorption coefficient of 0.5.

(6 marks)

- ii. Explain **TWO (2)** reasons that influence the reverberation time of both rooms (room A and room B).

(6 marks)

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Q2 Sound Reduction Index (SRI) is a fundamental parameter in noise isolation control. The value of SRI building elements shows the sound insulation performance of a building.

- (a) Mr. Beh intends to renovate his 2-bedroom apartment in Batu Pahat. Bedrooms A and B are separated by a living room, each with different partition wall constructions as depicted in **Figure Q 2.1**. He intends to use a single layer of gypsum board for Wall A, which separates Bedroom A and the living room. For Wall B, he plans to install a double layer of gypsum board filled with fiberglass insulation. Compare the Sound Reduction Index (SRI) of Wall A and Wall B by considering **FOUR (4)** factors that can influence the sound insulation performance of these walls.

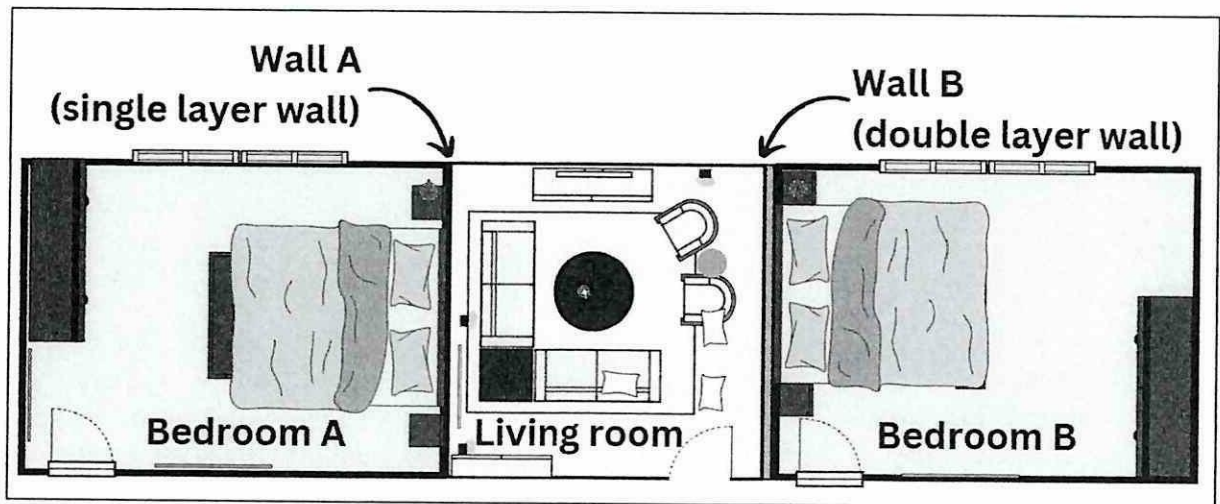


Figure Q 2.1 Layout of Bedroom A and Bedroom B.

(8 marks)

- (b) A new high-rise building is planned to be built in the busy town of Kuala Lumpur. This building consists of commercial units at the lower floors, including retail shops, restaurants, and office units, while the upper floors of the building are residential units. This building is located next to busy commercial district, traffic roads, public transportation hubs including bus and rapid train stations.

(i) Examine **TWO (2)** possible challenges faced by the occupants in this building.

(5 marks)

(ii) Recommend **THREE (3)** strategies that can be integrated into this building for ensuring occupant comfort, satisfaction, and safety in this building.

(12 marks)

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Q3 Lighting is crucial in buildings for several purposes such as improving visibility, ensuring safety, enhancing functionality, adding aesthetic appeal, promoting comfort and well-being. Various types of lighting, such as ambient, task, accent, and natural lighting, are utilised in buildings based on their specific uses and the intended purpose of a given space. Excessive lighting could lead to glare that make the occupants to feels discomfort, distracting, or even impair vision.

(a) Illumination in an art gallery serves multiple crucial functions, each of which enhances the ambiance and exhibition of the artwork. Describe **THREE (3)** primary function of illumination in an art exhibition.

(9 marks)

(b) Consider a spacious office design including windows that extend from the floor to the ceiling, allowing sufficient natural light to fill the space. Nevertheless, the windows do not have sufficient shading or diffusing systems, which results in direct sunlight entering the workspace. In addition, the office is equipped with glossy or polished surfaces such as glass barriers, whiteboards, and polished floors. These surfaces can reflect and causing glare.

(i) Based on above situation, identify **TWO (2)** effects of glare to the occupants.

(4 marks)

(ii) Propose **FOUR (4)** ways to mitigate the effects of glare in this area.

(12 marks)

Q4 You have been assigned to consult architect on the lighting system for a mid-rise office building. The building owner requested to consider sustainability, energy efficiency, and occupant comfort aspects in the building design.

(a) Identify **FOUR (4)** daylight harvesting techniques can be applied to this building in maximizing the usage of natural daylight and enhance sustainability.

(8 marks)

(b) Although the design of this mid-rise building has considered daylight harvesting, the owner requests your team to include appropriate supplementary illumination artificial lamps in the lighting system design. Proposed and justify **ONE (1)** type of lamp and its location for this building. You may provide suitable sketches to illustrate your answer.

(5 marks)

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- (c) An office unit in this mid-rise building has floor plan of 40m x 50m which rely on the artificial lighting system is expected to be illuminated for 14 hours every day in year 2025. The whole office unit is to maintain at 400 lux. There are two options of lamps which 36W Compact Fluorescent Cool White Lamp and 9W LED that to be used. Based on data given in **Table Q 4.1**, compare the electricity cost of both lamps for year 2025. Assume that the electricity cost is 58 sen/kWh.

(12 marks)

Table Q 4.1 Information of artificial lighting system.

Type of lamp	36W Compact Fluorescent Cool White Lamp	9W LED Warm White
Lumen output	1350 lumens	800 lumens
Average rated life	15,000 hours	50,000 hours
Light loss factor	70%	80%

- END OF QUESTIONS -

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APPENDIX

$$T = \frac{0.161V}{A}$$

$$L_2 = L_1 - SRI + 10 \log S_p - 10 \log A$$

$$\text{Room Index} = \frac{lW}{H(l+W)}$$

$$\text{Number of fitting} = \frac{\text{lux} \times \text{working plane area}}{LDL \times UF \times MF}$$

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