UTHM
Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2023/2024

COURSE NAME	:	ACOUSTICS AND LIGHTING
COURSE CODE	:	BFB 41103
PROGRAMME CODE	:	BFF
EXAMINATION DATE	:	JANUARY/ FEBRUARY 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

TERBUKA

Q1   Sound is an acoustic wave that propagates through a medium, such as air, liquid, or solid.

(a)   With the aid of sketch, describe the following fundamental properties of sound:

(i)   Frequency

(3 marks)

(ii)   Amplitude

(3 marks)

(b)   Calculate the wavelengths of sound with frequency of 350Hz and travel in the air with speed of 343 m/s and 443 m/s.

(4 marks)

(c)   A classroom with the dimension of 4m x 5m x 3.5m obtained reverberation time of 2 seconds. Sound absorption panels with $10m^2$ of the total sound absorption were placed on walls of the classroom to increase the speech intelligibility of the room. Predict the new sound decay of the classroom after the installation of sound absorption.

(6 marks)

(d)   Reverberation time tests were conducted in two rooms (room A and room B) and the results was shown in **Figure Q1.1**. Answer the following questions:
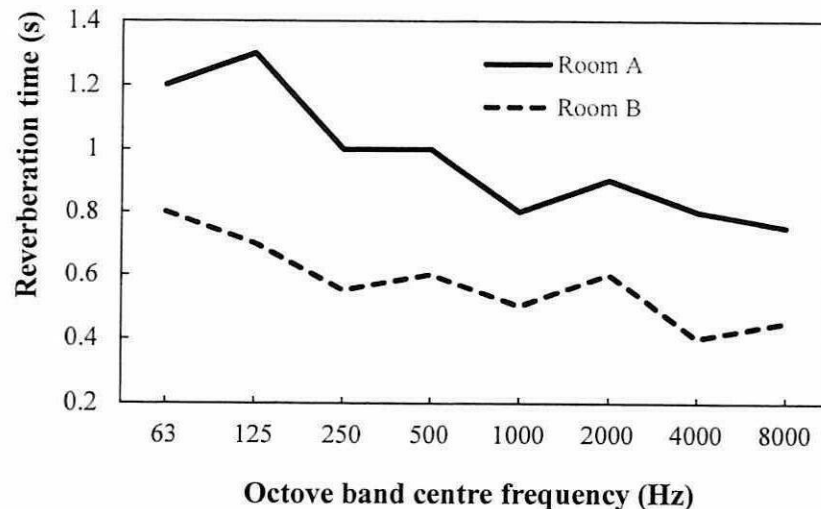

Figure Q 1.1 Reverberation times for tested rooms.

(i)   Choose a room (room A or room B) that suitable to be used as a teaching and learning space. Justify your answer.

(3 marks)

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(ii)   If both rooms are to be considered as teaching and learning spaces, propose **TWO (2)** possible ways to improve the reverberation time of one of the unsatisfied rooms so that it can be use as teaching and learning space too.

(6 marks)

Q2   Malaysian Philharmonic Orchestra is the concert hall that is used for classical music performance. Thus, careful design of the hall is essential to make sure audiences can enjoy the live music from the musicians.

(a)   Explain the potential strategies that designers can employ to mitigate the challenges associated with the sound transmission from the shopping mall and underground rapid train system into the concert hall. You may sketch out the layout to illustrate your points.

(6 marks)

(b)   A big square shaped multipurpose hall is located at the Johor Bahru. In order to attract more visitors to this city, the government proposed to transform this multipurpose hall into a classical music performance hall. The walls of the hall are made of concrete wall and the floor is furnished with tiles. There are several porous absorption panels are placed on the side walls of the hall.

(i)   Critique **FOUR (4)** significant acoustic challenges in the provided concert hall design that hinder its suitability for classical music performances. You may sketch out the layout illustration to clarify your arguments.

(4 marks)

(ii)   Based on the answer from Q2 (b) (i), propose **FOUR (4)** solutions to overcome the challenges. You may sketch out the layout to illustrate your points.

(10 marks)

(c)   The square-shaped multipurpose hall has dimensions of 45 m (length) x 45 m (width) x 10 m (height). A dressing room is situated adjacent to the hall with shares a partition wall of 6 m x 4 m (height). The sound pressure level within the multipurpose hall during the performance event in the hall was measured at 98 dB. Estimate the sound pressure level near the wall of the dressing room if the sound transmission index of the wall is 60dB and the total absorption of the dressing room is 35 m^2.

(5 marks)

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Q3   Optimizing daylight in building design not only enhances the quality of indoor spaces but also an essential aspect of modern architectural design and green building practices.

(a)   Explain **FOUR (4)** benefits of a good lighting quality in a building.

(8 marks)

(b)   Although daylighting in buildings offers various advantages, it may also cause certain conflicts or challenges that require careful management in the design and operation of a building. Justify **THREE (3)** potential challenges or conflicts associated with controlling and optimising natural lighting, along with **THREE (3)** strategies to mitigate the potential drawbacks.

(12 marks)

(c)   Daylighting factor is a term used in the context of building design and energy efficiency to measure and evaluate the effectiveness of a daylighting system in utilizing natural light to reduce the need for artificial lighting. Explain **TWO (2)** components of daylight factor that may influence the effectiveness daylighting system of a five-stories office building that situated next to a nine-stories residential building.

(5 marks)

Q4   Miss Alice is a well-known artist in Batu Pahat. She intends to establish a drawing studio and gallery to exhibit the artworks.

(a)   Choose **THREE (3)** functions of lighting system that may applied to this drawing studio and gallery. You may provide illustrations to support your answer.

(6 marks)

(b)   Based on your answer in **Q4 (a)**, select suitable types of artificial light that can be used in the drawing studio and gallery. Justify your answers.

(6 marks)

(c)   Miss Alice is seeking economical methods for providing sufficient illuminance in the drawing studio using 20W of artificial light with 5000 lighting design lumens. She has two options for room colour combinations. The first option of colour combination is to have a white ceiling and floor, along with dark gray walls. The second colour combination option is from a light brown ceiling, white floor, and light stone-colored walls. The dimensions of the drawing studio are 15m (length) X 8m (width) X 3.5m (height). The drawing table is positioned 1.2m above the floor level, and it requires an illuminance of 600 lux. Assume that the maintenance factor of the lamp is 90%. Referring to the **Table Q 4.1**, answer the following questions.

Table Q 4.1 Luminance factors for a painted surface.

Surfaces	Typical Colour	Luminance Factors
Ceiling	White, Cream	70-80
Ceiling	Sky Blue	50-60
Ceiling	Light Brown	20-30
Walls	Light Stone	50-60
Walls	Dark Grey	20-30
Walls	Black	10
Floor		10

i.   Compare the Utilization Factor (UF) for both colour combination options.

(7 marks)

ii.   Compare the number of luminaires needed for both colour combination options.

(4 marks)

iii.   Suggest which option of colour combination is more economical.

(2 marks)

- END OF QUESTIONS -

APPENDIX

$$A_1 = \frac{0.161V}{T}$$

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

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

$$No\ of\ fitting = \frac{lux \times working\ plane\ area}{LDL \times UF \times MF}$$