Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2022/2023

COURSE NAME	:	ACOUSTICS AND LIGHTING
COURSE CODE	:	BFB 41103
PROGRAMME CODE	:	BFF
EXAMINATION DATE	:	JULY/ AUGUST 2023
DURATION	:	3 HOURS
INSTRUCTION	:	1. ANSWER ALL QUESTIONS. 2.THIS FINAL EXAMINATION IS CONDUCTED VIA **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 **SEVEN** (7) PAGES

Q1 (a) Describe the term noise.

(2 marks)

(b) Identify **TWO (2)** characteristics that can cause sound to become noise.

(4 marks)

(c) A lecture hall with a volume of 400 m^3 has a reverberation time of 1.5 seconds, causing a distraction to students during the lecture session. This hall was constructed with plastered brick walls, concrete floors, and a concrete ceiling. The hall is located next to the noisy laboratory.

(i) Explain the acoustic sound field of this lecture hall.

(3 marks)

(ii) Determine **THREE (3)** economical methods that can be used to improve the acoustic quality of this lecture hall to meet its purpose.

(6 marks)

(iii) One side of the 50 m^2 plastered brick wall faces the noisy laboratory. Based on information provided in **Table Q1(c)**, estimate the average sound reduction index of this wall.

(6 marks)

(iv) Explain **TWO (2)** possible ways to increase the sound reduction index of the brick wall.

(4 marks)

Q2 (a) A field test of noise level assessment has been carried out outside public secondary school which located next to a heavy traffic road. The average noise level captured during the day is 78 dB(A).

(i) Based on the given scenario, predict the noise condition of the school.

(2 marks)

(ii) Recommend **THREE (3)** strategies in the noise control systems to insulate this school from the noisy outdoor environment. You may sketch out the layout to illustrate your points.

(9 marks)

(b) When significant vibrations affect a building, the damages appear similar with other structural issues which may affect a building. Briefly describe **THREE (3)** common impacts of building vibration with appropriate example respectively.

(6 marks)

(c) Vibration is a frequent problem in buildings. As a building engineer, propose with appropriate justifications **FOUR (4)** approaches that can be adopted to mitigate the vibration caused by nearby ground transportation and earthquake. You may sketch out the layout to illustrate your points.

(8 marks)

Q3 (a) Light wave carries energy through matter or space in which the energy is in the form of dynamic motion. Critique with appropriate justification the light wave propagation phenomena shown in **Figure Q3(a)**.

(9 marks)

(b) Daylight is a sustained source of light derived from the sun. Components of daylight include direct sunlight, diffuse skylight, and reflected light. A window is one of the building elements that can be used for space illumination during the daytime. By using suitable illustrations, explain the comparison of daylight factor contours between two rooms installed with different opening designs.

(8 marks)

(c) Malaysia is a tropical country situated near the Equator, where daylight is available almost every day from 8 a.m. to 6 p.m. The availability of daylight makes daylight harvesting an option for building illumination. Discuss **FOUR (4)** arguments against incorporating a large curtain wall into the facade design of a single-story Malaysian bungalow.

(8 marks)

Q4 (a) Describe the following light sources:

(i) Point source.

(2 marks)

(ii) Linear source.

(2 marks)

(iii) Area source.

(2 marks)

(b) The lighting in office workspace directly affects the mood, energy level, and productivity of staff. Recommend **TWO (2)** artificial lighting systems that suit best for an office building. Justify your answers.

(6 marks)

(c) A factory with a floor area of 120 metres in length and 80 metres in width is illuminated by artificial light for 12 hours daily. All lighting fixtures are turned off during the weekend (Friday and Saturday) to save energy.

(i) Based on information in **Table Q4(c)**, calculate the electricity cost per year of this factory with two different types of lamps if the overall illumination of the factory is to be maintained over the floor area at 250 lux.

(11 marks)

(ii) Based on the answer in **Q4 (c)(i)**, make a recommendation which type of lamp is preferable and justify your answer.

(2 marks)

-END OF QUESTIONS-

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Table Q1(c): Sound reduction index of the materials.

Materials	Quantity	Area/ unit (m^2)	Sound reduction index/ unit
Plastered brick walls	1	36	50 dB
Timber door	2	2.5	43 dB
Glazed window	6	1.5	35 dB

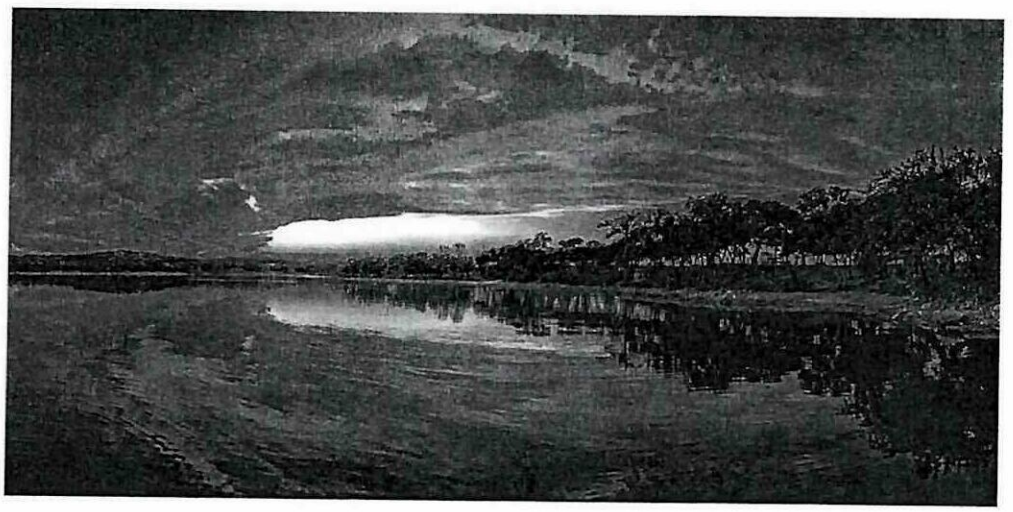

Figure Q3(a): Effects of light in two different mediums

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Table Q4(c): Lighting information for factory

150W tungsten-halogen lamps		
Total lighting	:	48 weeks/ year
Electricity cost	:	RM 0.60 / kWh
Light loss factor	:	70 %
Efficacy of lamp	:	25 lumen/watt
Lamp life cycle	:	2,000 hours
Cost of lamp	:	RM15.50 per unit
80W tubular fluorescent warm white lamps		
Total lighting hour	:	48 weeks/ year
Electricity cost	:	RM 0.60 / kWh
Light loss factor	:	68 %
Type of lamps	:	80W tubular fluorescent warm white lamps
Efficacy of lamp	:	90 lumen/watt
Lamp life cycle	:	10,000 hours
Cost of lamp	:	RM25.00 per unit

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The following information may be useful. The symbols have their usual meaning.

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

$$\mathrm{SRI_{average}} = -10\log\left(\frac{S_1\left(10^{\frac{-SRI_1}{10}}\right) + S_2\left(10^{\frac{-SRI_2}{10}}\right) + S_3\left(10^{\frac{-SRI_3}{10}}\right)}{S_1 + S_2 + S_3}\right)$$

$$Installed\ lumens = \frac{Lux \times Floor\ area}{Light\ loss\ factor}$$

$$Input\ power = \frac{Installed\ lumen}{Efficacy}$$