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UNIVERSITI TUN HUSSEIN ONN MALAYSIA

**FINAL EXAMINATION
SEMESTER I
SESSION 2021/2022**

COURSE NAME : ACOUSTICS AND LIGHTING
COURSE CODE : BFB 41103
PROGRAMME CODE : BFF
EXAMINATION DATE : JANUARY / FEBRUARY 2021
DURATION : 3 HOURS
INSTRUCTION : 1. ANSWER **ALL** QUESTIONS.
2. THIS FINAL EXAMINATION IS AN **ONLINE ASSESSMENT AND CONDUCTED VIA CLOSE BOOK.**

THIS QUESTION PAPER CONSISTS OF **SEVEN (7) PAGES**

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ANSWER ALL QUESTIONS

- Q1** (a) (i) Lighting equipment provide illuminances for practical or aesthetic effects for a space. Select and justify **TWO (2)** types of lighting that is suitable for a restaurant and justify your answer. (8 marks)
- (ii) Light wave carries energy through matter or space in which the energy is in the form of dynamic motion. Describe the light phenomena based on **FIGURE Q1 (a)**, and also describe what happens if there are ripples of waves in the water? (4 marks)
- (b) (i) Daylight is a combination of all direct and indirect sunlight radiation. With the aid of sketches, illustrate the differences between diffuse radiation, direct radiation and reflected radiation of daylight into a building. (9 marks)
- (ii) In order to maximize the utilization of daylight for building illumination, three important aspects need to be considered at the planning stage which is building location, orientation and design. With the aid of sketches, discuss **ONE (1)** of building orientation effect on building illumination. (4 marks)
- Q2** (a) A lecture hall with the dimension of 16 m (length) x 8 m (width) and 4 m (height) having concrete wall and floor ($\alpha = 0.02$), plasterboard ceiling ($\alpha = 0.09$) and a wood door sized 0.6 m (width) x 1.2 m (height) with absorption coefficient value $\alpha = 0.20$. Analyse the followings:
- (i) The frequencies for oblique room modes up to 100 Hz of frequency with maximum of 2 nodes levels. Use the sound speed value of 340 m/s in your analysis. (3 marks)
- (ii) The reverberation time of the hall if 2 numbers of (4 m x 3 m) acoustic board with an average absorption coefficient of 0.80 are installed to each of the longest wall. (5 marks)
- (b) You have been assigned to set up the audio system for a conference room. A parallel seminars will be conducted at seminar room A and B. Both rooms are having sized of 15 m (length) x 6 m (width) x 4 m (height) and both rooms are located side by side as **FIGURE Q2 (b)**. The room constant for the hall is 300



m^2 , and the front row is about 3 meters away, while the last row is located 10 meters away from the speaker position.

- (i) If 65 dB of sound pressure level is required at the 1st sitting row and maximum of 60 dB of sound pressure level is required at the last sitting row, recommend the most suitable position of the speaker if the speaker produced an average of 75 dB of sound power level.

(9 marks)

- (ii) The partition wall consists of a concrete wall with sound reduction index of 50 dB and a wooden door (1.0 m x 2.0 m) with sound reduction index of 36 dB. Estimate the average sound reduction index (SRI) of the partition wall and the average sound level in the adjacent seminar room if the average sound pressure level in the seminar room is 63 dB and absorption area is 15 m^2 .

(8 marks)

- Q3** (a) A school located near busy roads as **FIGURE Q3 (a)** is exposed to noise pollution that certainly disrupt school activities such as study, discussion and teaching sessions. Discuss in detail **TWO (2)** specific effects of noise pollution from the nearby roads on the school community.

(10 marks)

- (b) Underground and above ground rail tracks are among the main source of noise encountered by nearby residents. Most transportation noise is produced due to vibration emission with interfering frequencies between 25 Hz to 100 Hz. With the aid of sketches, discuss how transportation noises are being transmitted and propose the effective ways to control and reduce the impact from those noises on human.

(15 marks)

- Q4** (a) You have been given a project to design a modern indoor and outdoor lighting system for the new lecture building complex in UTHM. Propose **TWO (2)** types of light to be used for the lighting system based on location with meeting the required quality and efficiency of the building.

(10 marks)

- (b) A new multi-purpose hall has dimensions of 35 m (length) x 10 m (width) and 5 m floor to ceiling height. The ceiling and walls are yet to be painted. The working plane of the hall is between 0.8 m to 1.2 m above the floor level. Bare fluorescent tube light fitting with 5,200 lighting design lumens providing 400 lux has a spacing-to-height ratio of 1.5 and energy consumption 140 W are to be used to illuminate the space. Assuming the maintenance factor is 85 %, refer to **TABLE 1** and **TABLE 2** to determine the following:

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- (i) Estimated total power consumption and electrical loading per square meter of floor area for the hall. (10 marks)

- (ii) Propose the layout of lighting design for the hall. (5 marks)

-END OF QUESTIONS-

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FIGURE Q1 (a): Light phenomena

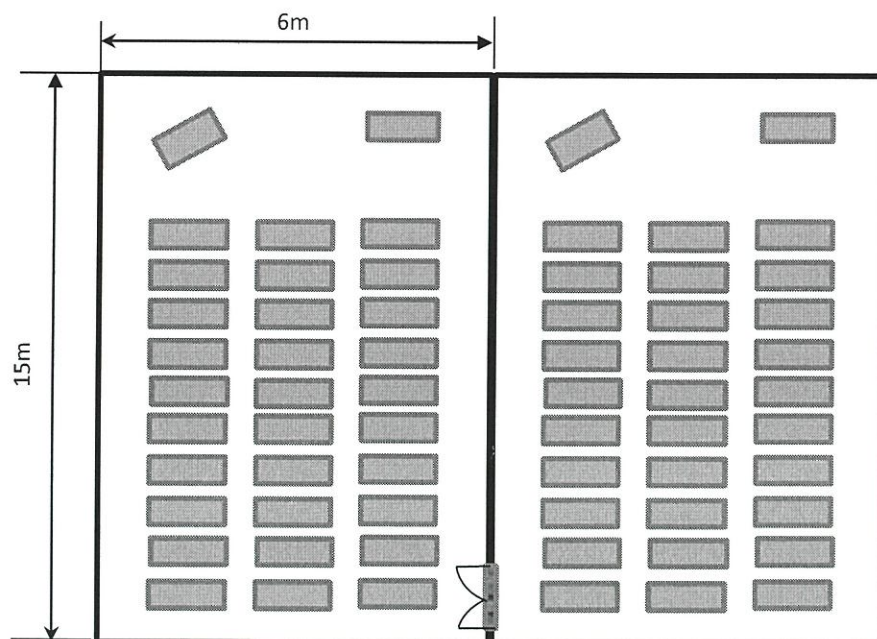


FIGURE Q2 (b): Layout of the seminar halls



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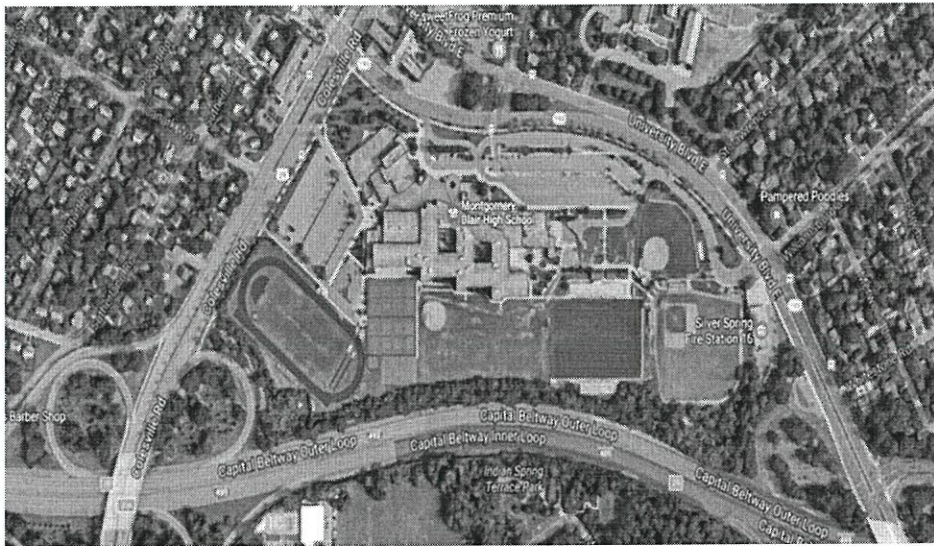


FIGURE Q3 (a): School hemmed in by three roads

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TABLE 1: Luminance factors for painted surfaces

| Surface | Typical colour | Luminance factor range (%) |
|---------|----------------|----------------------------|
| 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 |

TABLE 2: Utilization Factors

| <i>Luminanc</i> | | <i>Room index</i> | | | | | | | | |
|-----------------|--------------|-------------------|----|------|-----|----|-----|----|----|----|
| <i>Ceiling</i> | <i>Walls</i> | 0.75 | 1 | 1.25 | 1.5 | 2 | 2.5 | 3 | 4 | 5 |
| 70 | 50 | 48 | 53 | 59 | 64 | 71 | 75 | 79 | 83 | 86 |
| 70 | 30 | 40 | 46 | 51 | 57 | 64 | 69 | 73 | 78 | 82 |
| 70 | 10 | 35 | 40 | 46 | 51 | 59 | 64 | 68 | 74 | 78 |
| 50 | 50 | 43 | 48 | 52 | 57 | 63 | 67 | 70 | 74 | 76 |
| 50 | 30 | 37 | 41 | 46 | 51 | 57 | 62 | 65 | 70 | 73 |
| 50 | 10 | 33 | 37 | 42 | 46 | 53 | 58 | 61 | 67 | 70 |
| 30 | 50 | 39 | 42 | 46 | 50 | 55 | 59 | 61 | 65 | 67 |
| 30 | 30 | 34 | 37 | 42 | 46 | 51 | 55 | 58 | 62 | 65 |
| 30 | 10 | 30 | 33 | 38 | 42 | 48 | 52 | 55 | 59 | 62 |

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