UTHM
Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2022/2023

COURSE NAME	:	BUILDING SCIENCE AND SUSTAINABILITY
COURSE CODE	:	BNB 31503
PROGRAMME CODE	:	BNB
EXAMINATION DATE	:	JULY/ AUGUST 2023
DURATION	:	3 HOURS
INSTRUCTIONS	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 **SIX (6)** PAGES

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Q1 (a) List **EIGHT (8)** practically of healthy building.

(4 marks)

(b) Sketch **SIX (6)** internal elements of the built environment.

(6 marks)

(c) Building science is the application of physics to the built environment. Analyse the interrelated building science categories towards building services system.

(15 marks)

Q2 A Classroom of 25 m x 15 m x 3.5 m height has a dark grey wall and light brown coloured ceiling. The working plane is 0.9 m above the floor and the value of illuminance 400 lux. New CFL lamp luminaries are to be used with Lighting Design Lumens (LDL) emit 3100 lumens measured at 2000 hours of use. By using **Table Q2 (i)** and **Q2 (ii)**:

(a) Calculate the room index.

(5 marks)

(b) Calculate numbers of fittings.

(5 marks)

(c) Calculate total power consumption per square meter if each luminaire is to use 30 watts.

(3 marks)

(d) Calculate minimum numbers of luminaries row and column.

(4 marks)

(e) Calculate the distance between the wall and luminaires.

(4marks)

(f) Calculate the distance between luminaires.

(4 marks)

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Q3 (a) Differentiate between absorption and reflection of sound wave.

(4 marks)

(b) Investigate **THREE (3)** types of Indoor Air Quality (IAQ) contaminants commonly occurring in domestic buildings and recommend improvements towards sustainability.

(9 marks)

(c) A badminton court of dimensions 22 m x 10 m x 5 m is to be mechanically ventilated. The maximum occupancy will be 120 people. The supply air for each person is to comprise 20 l/s of fresh air and 15 l/s of recirculated air. Allowing 12% natural exfiltration, calculate:

(i) The flow rate of supply duct, natural exfiltration and extract air.

(ii) The room air change in ACH.

(iii) The area of supply duct if the limiting air velocity is 10 m/s.

(12 marks)

Q4 (a) Mechanical ventilation is a combination of mechanical and electrical system that can exhaust and supply the air. As an Energy Manager, you are required to study integration between energy conservation and energy efficiency that can be implemented towards mechanical ventilation while improving indoor air quality (IAQ) for occupants in factory.

(6 marks)

(b) An office building needs to upgrade its Green Building Index (GBI) classification besides reducing building impact on human health and the environment during the lifecycle of the building. As a Building Manager:

(i) Classify **THREE (3)** GBI criteria. State **ONE (1)** application and **ONE (1)** innovation for each criterion.

(9 marks)

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(ii)   Propose and recommend your plan for upgrading the office building from Silver to Platinum Classification towards sustainable and low carbon cities.

(10 marks)

-END OF QUESTIONS-

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Table Q2 (i) Utilization Factors

Luminance Factors		Room Index								
Ceiling	Wall	0.75	1.00	1.25	1.5	2.00	2.50	3.00	4.00	5.00
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

Table Q2 (ii) Luminance factors for painted surfaces

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

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Formula:

1. $Room\ index = \dfrac{L \times W}{H\,(L+W)}$

2. $Number\ of\ fitting = \dfrac{LUX \times working\ plane\ area}{LDL \times UF \times MF}$

3. $Minimum\ numbers\ of\ row = \sqrt{\dfrac{N \times L}{W}}$

4. $Minimum\ numbers\ of\ collomn = \sqrt{\dfrac{N \times W}{L}}$

5. Distance between wall and luminaires:

   a) $2x = \dfrac{L}{(number\ of\ luminarie\ in\ row)}$

   b) $2x = \dfrac{W}{(number\ of\ luminarie\ in\ collomn)}$

6. Distance between luminaires:

   a) $\dfrac{L}{number\ of\ luminaires\ in\ row}$

   b) $\dfrac{W}{number\ of\ luminaires\ in\ collomn}$

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