Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2019/2020

COURSE NAME	:	BUILDING SERVICES 1
COURSE CODE	:	BFB40603
PROGRAMME CODE	:	BFF
EXAMINATION DATE	:	DECEMBER 2019 / JANUARY 2020
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWER **ALL** QUESTIONS

THIS QUESTION PAPER CONSISTS OF **NINE (9)** PAGES

Q1 (a) With the help of a diagram, compare **THREE (3)** different mechanisms of heat transfer in a building

(6 marks)

(b) A new office building design as shown in **Figure Q1 (b)** has been submitted for overall thermal transfer value (OTTV) assessment. Assume that the four elevations of the building are identical with total area of the wall is 675 m^2. Wall is painted with grey paint and solar absorption factor for the paint is 0.54. Total area of windows is 246 m^2 and windows are using 6mm single-glazed glass with shading coefficient of 0.51. U-value of the wall is 2.87 W/m^2K and U-value of the window is 5.7 W/m^2K. Referring to **Table 1,** determine the followings:

(i) OTTV of the office building.

(13 marks)

(ii) Compare the OTTV of the office building in **Q1(b)(i)** with the standard OTTV in Malaysia.

(2 marks)

(iii) Propose **TWO (2)** strategies to improve OTTV of the office building.

(4 marks)

Q2 (a) With the aid of a diagram, demonstrate the basic cooling cycle of an air conditioning system in a building.

(10 marks)

(b) List **FIVE (5)** purposes of air conditioning system in the buildings.

(5 marks)

(c) The weather in Malaysia is hot and humid year round. As an engineer, you are appointed to design an air conditioning system that is suitable for an office building in this climate. Assume that the outside air temperature is 35°C with 70% relative humidity to be conditioned, so that cold and dry air at 25°C and 50% relative humidity can be supplied to the building. By using psychrometric chart given in **Figure Q2(c).** Neatly plot the required air conditioning process and estimate the following values:

(i) Dew point temperature.

(2.5 marks)

(ii) Amount of moisture removed.

(2.5 marks)

(iii) Amount of heat removed.

(2.5 marks)

(iv) Amount of heat added.

(2.5 marks)

Q3 (a) A mixed resistors circuit as shown in **Figure Q3(a)** is made from a combination of parallel and series circuits. The values of the resistances mentioned in the circuit are in Ohm (Ω) and the supply voltage is in Volt (V). Determine the:

(i) Current through the circuit (I).

(4 marks)

(ii) Voltage drop (V) across the circuit.

(5 marks)

(b) Explain **THREE (3)** purposes of lift traffic control.

(6 marks)

(c) A 19-storey commercial office block has a net floor area above ground level of 25,000m². Assume that 19% of the total population are using the lift during 5 min peak time and a population density of one person per 15 m² of net floor area. Refer **Table 2** to **Table 5,** estimate the:

(i) Flow rate.

(2.5 marks)

(ii) Travel distance and speed.

(2.5 marks)

(iii) Minimum capacity and number of lifts and waiting time.

(2.5 marks)

(iv) Evaluate the quality of lift service.

(2.5 marks)

Q4 (a) Explain **TWO (2)** primary objectives of desigining water supply system in the buildings.

(4 marks)

(b) As a consulting engineer, you are required to design suitable rectangular shape water storage tanks, suction tanks, and supply pipe for discharge of 1.30 litres/sec, based on gravity supply for a hostel. The hostel consists of four (4) blocks of building, each building has 90 rooms and each room can accommodate 4 students. Assume head pressure is 8 m and length of pipe is 30 m (allow 20% for bends) with negligible head loss. Assume for 24 hours interruption of supply, and 12 hours disruption of supply, will be covered by 95 litres of cold water per person. Determine the total water requirement and design a suitable rectangular water storage tank system to store the water.

(10 marks)

(c) A client requests to install an indoor rainwater harvesting system into a double storey house located in Subang Jaya using gravity fed with automatic top up system. Based on the following information and information given in **Table 6** and **Table 7**, design a rainwater harvesting system for the house.

Typical features of a double storey house in Subang Jaya:

- Dual flush toilet
- Assumed water usage 4.8 l/flush, 5 flushes per occupant per day and 4 occupants in the house
- Metal roof with total of 100 m^2 roof size and less than 40° roof pitch
- Rainfal intensity is assumed to be 150 mm/h
- Rectangular gutter with 1:600 gradient with no bending
- 1.0 mm of rainfall is used as first flush depth

(11 marks)

– END OF QUESTIONS –

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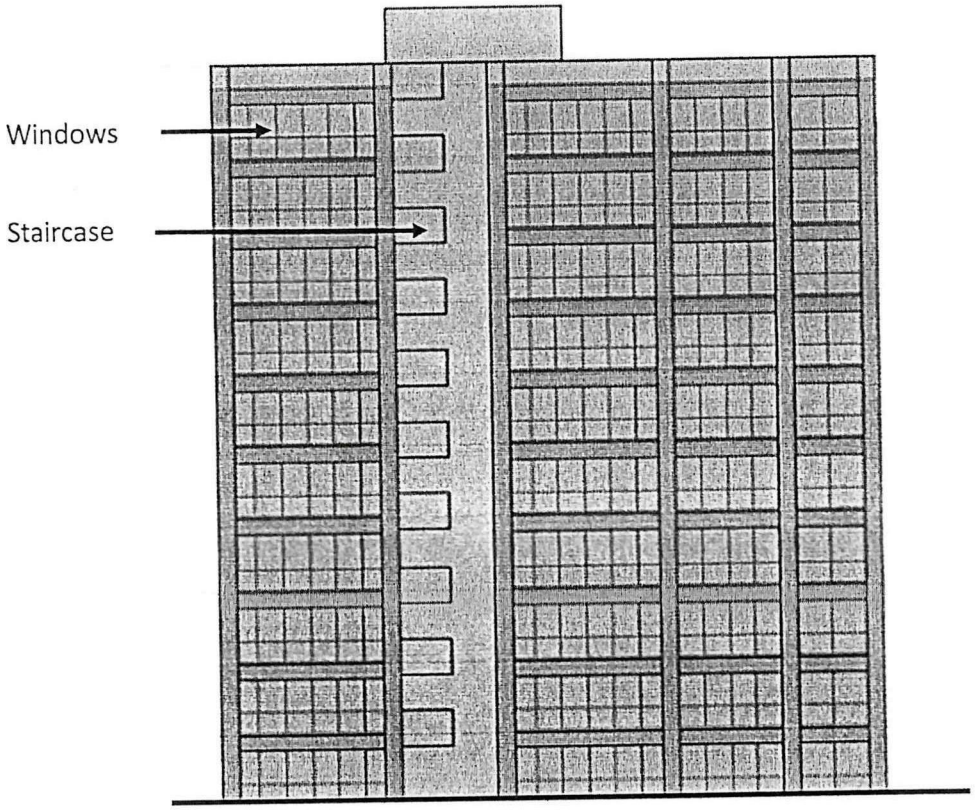

FIGURE Q1(b)

TABLE 1

Solar Correction Factors

Orientation	CF
North	0.90
North-East	1.09
East	1.23
South-East	1.13
South	0.92
South-West	0.90
West	0.94
North-West	0.90

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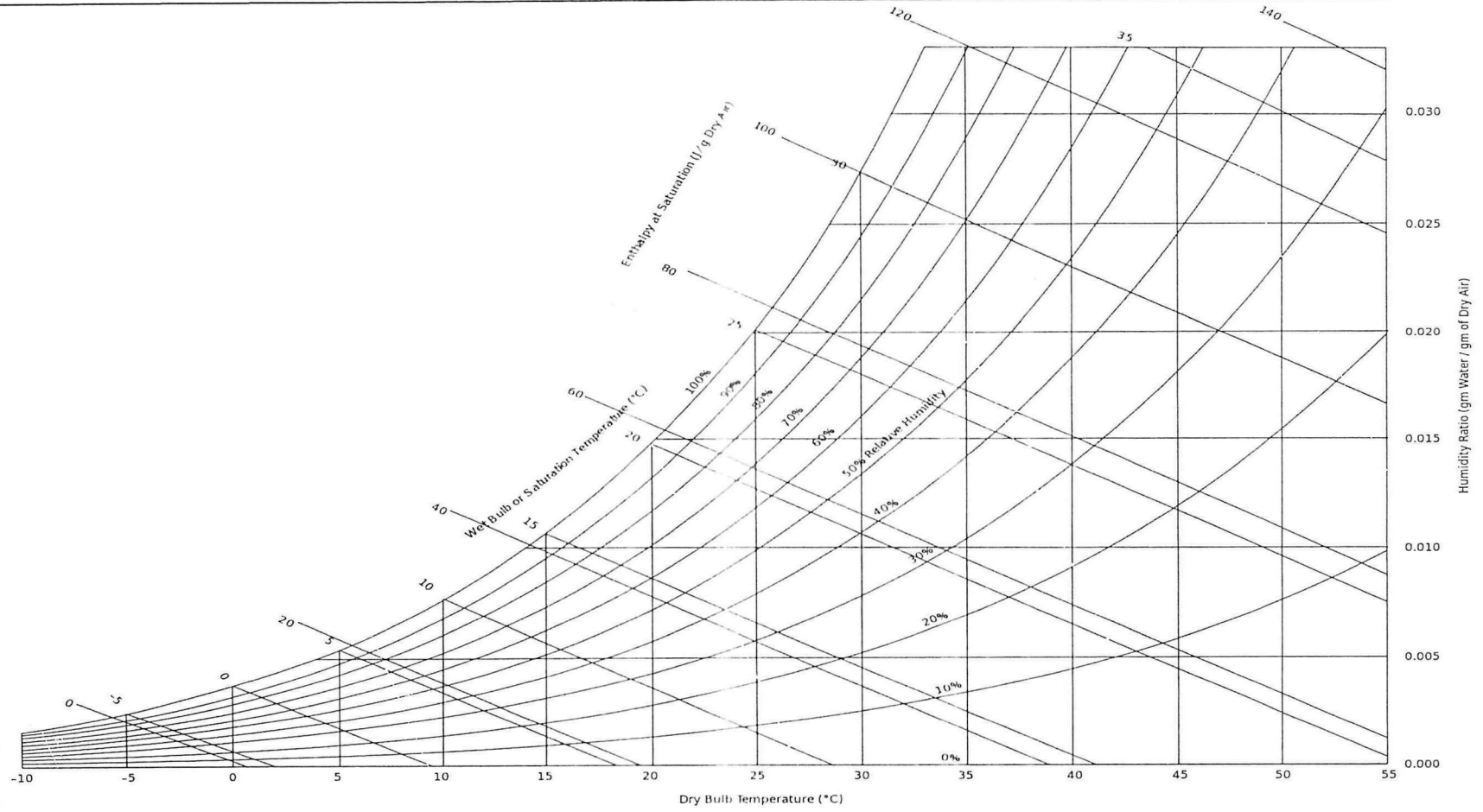

FIGURE Q2 (c)

*Note*Please attach FIGURE Q2 (c) together with your answer script*

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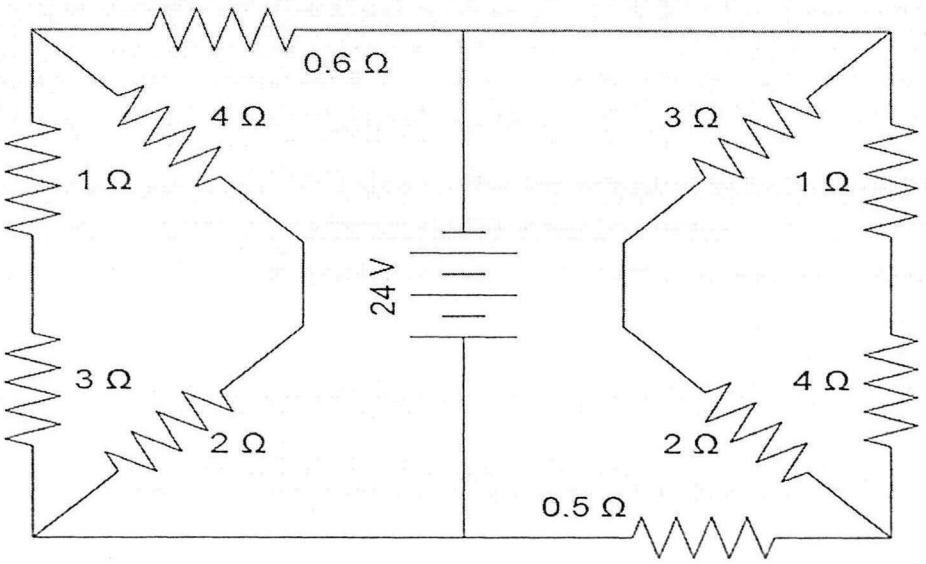

FIGURE Q3(a)

TABLE 2

Passenger lift performance (based on 3.3 m floor to floor heights) and lifts serving all of 15 floors		Interval (s)				Handling capacity (persons)
Number of cars	Speed (m/s)	12 Passengers	16 Passengers	20 Passengers	24 Passengers	
		29	32	37	41	
4	2.50	103	112	127	137	
			31	36	40	
4	3.50		116	132	142	
			25	29	32	
5	3.50		146	165	178	
				24	27	
6	3.50			198	213	

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TABLE 3

Speed (m/s)	Lift travel in metres			
	Municipal flats	Luxury flats	Offices	Bed lifts
0.25—0.375	—	—	—	5
0.50	30	15	10	10
0.75	45	20	15	—
1.00	55	25	20	20
1.50	—	—	30	45
2.50	—	—	45	100
3.50	—	—	60	—
5.00	—	—	125	—

TABLE 4

Interval (s)	Quality of service
25—35	Excellent
35—45	Acceptable for offices
60	Acceptable for hotels
90	Acceptable for flats

TABLE 5

Minimum number of lifts for offices

Installation	Quality of service
One lift for every three floors	Excellent
One lift for every four floors	Average
One lift for every five floors	Below average

Note: A lower standard than the above would be acceptable for hotels and blocks of flats. Where large numbers of people have to be moved, cars smaller than twelve-person capacity are not satisfactory.

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TABLE 6

Roof Area (m^2)	Roof Runoff Rate (L/s)	Rectangular/ Eave Gutters (mm)				Rectangular Downpipe * (mm)			
		Cal. Size		Ava. Size		Cal. Size		Ava. Size	
		width	depth	width	depth	width	depth	width	depth
50	1.98	115	57.5	190	150	75.9	38	100	50
60	2.38	120	60	190	150	79.2	40	100	50
70	2.77	130	65	190	150	85.8	43	100	50
80	3.17	135	67.5	190	150	89.1	45	100	50
100	3.96	150	75	190	150	99	50	100	50
120	4.75	160	80	190	150	105.6	53	120	80
150	5.94	175	87.5	190	150	115.5	58	120	80
200	7.92	195	97.5	250	178	128.7	64	150	75

**Downpipe size is 66% of gutter width*

TABLE 7

Demand (liter/day)	Optimum Rainwater Storage Tank Cistern Capacity (m^3) Roof Catchment Area (m^2)					
	50	100	200	300	400	500
50	0.5	0.5	0.5	0.5	0.5	0.5
100	0.5	0.5	0.5	0.5	0.5	0.5
200	1.8	1.0	0.8	0.8	0.8	0.7
300	-	1.9	1.3	1.3	1.3	1.3
400	-	3.6	2.0	1.6	1.6	1.6
500	-	7.4	2.7	2.1	2.1	2.1