[ESS07]

UNIVERSITY OF BOLTON

SCHOOL OF ENGINEERING

HNC CONSTRUCTION AND SURVEYING

SEMESTER TWO EXAMINATION 2018/2019

CONSTRUCTION SCIENCE AND MATERIALS

MODULE NO: CAS4010

Date: Tuesday 21st May 2019 **Time: 14:00 – 15:30**

INSTRUCTIONS TO CANDIDATES: **There are FOUR questions.**

Answer ANY THREE out of four

All questions carry equal marks. Marks for parts of questions shown in brackets

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Background Scenario relates to the Four questions

A Housing Association is proposing to construct a six storey apartment block in the centre of Manchester. The ground floor of the block will incorporate a convenience store and a community hub for the local resident Rock Choir. It is proposed to build using 140mm open panel timber frame cladded with brick slips. In your capacity as a consultant Building Engineer, you have been called in to advise the Housing Association on technical aspects of the new build programme, in relation to the performance of the building fabric and internal environment.

Question 1

(a) Explain what is meant by the term 'overall thermal transmittance' coefficient. Within your answer identify all of the mechanisms that transfer heat through a cavity wall.

(5 marks)

(b) Calculate the U value of the proposed timber frame wall from the data table below assuming internal surface resistance to be 0.123m^2K/W and external surface resistance to be 0.055 m^2K/W, cavity air space resistance 0.18 m^2K/W.

(15 marks)

Layer	Thickness	Thermal Conductivity
Plaster dry lining	15mm	0.16
Wool Quilt Insulation	140mm	0.040
Exterior Grade Plywood	18mm	0.14
Air space	20mm	
Brick slip facing	20mm	0.84

(c) Briefly discuss which documents you would need to consult to ensure that the U value above complies with the current Building Regulations.

(5 marks)

Total 25 marks

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Question 2

(a) Explain where surface condensation may occur within the apartment blocks and suggest remedial actions to control the problem. **(5 marks)**

(b) The risk of interstitial condensation is a problem in any new build. This may occur in the timber frame wall. Explain with the aid of sketches how interstitial condensation can be prevented from occurring in the wall and what precautions should be taken to prevent the wood from rotting.

(15 marks)

(c) Once the building is in operation, explain how the Relative Humidity (RH) could be controlled and monitored to ensure the RH level remains within acceptable levels for human comfort. Use the psychometric chart as an aid to your explanation. **(5 marks)**

Total 25 marks

Question 3

(a) Explain the reasons why you would require different illuminance levels for different parts of the apartment, citing the correct illuminance levels for given situation as follows:
hallway;
kitchen;
living room;
bedroom;
bathroom.

(5 marks)

(b) The convenience store has the following dimensions length 10 width 5m with floor to ceiling height of 2.5m. The lights that are intended to be used for the store are ceiling mounted. The 100 W tubular flourescent lamps chosen have a luminous efficacy of 80 lm/W. The luminaires have a DLOR of 50 %. Room reflectance ceiling 0.5 walls 0.3. Assume main factor is 0.85.

Calculate the number of lamps required to provide a service illuminance 500 lx one metre above the floor level on the serving counter. **(15 marks)**

(c) Work out the maximum spacing require for the lamps and suggest a suitable layout providing a diagram showing the position of the lamps in the luminaires. **(5 marks)**

Total 25 marks

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Question 4

(a) Explain with the aid of annotated section drawing how you would sound insulate the separating floor between the convenience store and community hub and the first floor apartment to ensure adequate sound reduction.

(5 marks)

(b) The community hub room, used by the rock choir has dimensions length 10 width 5m floor to ceiling height 2.5m. Determine the ideal reverberation time for the room.

(5 marks)

(c) The community hub room has a two windows 2.5m wide by 2.5m high with a door 2.0m wide by 2.1m high. The room has the following surfaces finishes.

Surface finishes	Absorption coefficient
Wall plasterboard and skim	1.0
Ceiling plasterboard on battens	1.0
Floors, plastic tiles	0.05
Door	0.1
Windows	0.1

Calculate the actual reverberation time of the proposed room and compare this with the ideal reverberation time suggesting any amendments to the surface finishes to meet the ideal time if required.

(15 marks)

Total 25 marks

END OF QUESTIONS

Formula sheets over the page….

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FORMULA SHEET

Thermal Resistance $R = d / k$

Thermal Transmittance Coefficient (U Value) $U = 1 / R$

Room Index $RI = L \times W / H_m (L + W)$

Number of Lamps $N = E \times A / F \times UF \times MF$

Maximum space of lamps $Smax = 1.5 \times H_m$

Stephen and Bate formula $RT = r (0.0118 \sqrt[3]{V} + 0.107)$

Actual Reverberation time $= 0.16 V / A$

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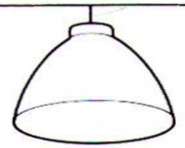
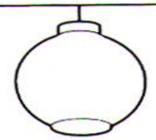
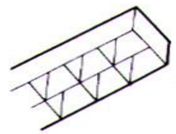
Description of fitting	Typical outline LOR	Basic downward LOR %	Ceiling	Reflectances 0.7			0.5			0.3		
			Walls	0.5	0.3	0.1	0.5	0.3	0.1	0.5	0.3	0.1
			Room index									
Aluminium industrial reflector, Aluminium or enamel high-bay reflector		70	0.6	0.39	0.36	0.33	0.39	0.36	0.33	0.39	0.35	0.33
			0.8	0.48	0.43	0.40	0.46	0.43	0.40	0.46	0.43	0.40
			1.0	0.52	0.49	0.45	0.52	0.48	0.45	0.52	0.48	0.45
			1.25	0.56	0.53	0.50	0.56	0.53	0.49	0.56	0.52	0.42
			1.5	0.60	0.57	0.54	0.59	0.57	0.53	0.59	0.55	0.53
			2.0	0.65	0.62	0.59	0.63	0.60	0.58	0.63	0.59	0.57
			2.5	0.67	0.64	0.62	0.65	0.62	0.61	0.65	0.62	0.60
			3.0	0.69	0.66	0.64	0.67	0.64	0.63	0.67	0.64	0.62
			4.0	0.71	0.68	0.67	0.69	0.67	0.65	0.69	0.66	0.64
			5.0	0.72	0.70	0.69	0.71	0.69	0.67	0.71	0.67	0.66
Near-spherical diffuser, open beneath		50	0.6	0.28	0.22	0.18	0.25	0.20	0.17	0.22	0.18	0.16
			0.8	0.39	0.30	0.26	0.33	0.28	0.23	0.27	0.25	0.22
			1.0	0.43	0.36	0.32	0.38	0.34	0.29	0.31	0.29	0.26
			1.25	0.48	0.41	0.37	0.42	0.38	0.33	0.34	0.32	0.29
			1.5	0.52	0.46	0.41	0.46	0.41	0.37	0.37	0.35	0.32
			2.0	0.58	0.52	0.47	0.50	0.48	0.43	0.42	0.39	0.36
			2.5	0.62	0.56	0.52	0.54	0.50	0.47	0.45	0.42	0.40
			3.0	0.65	0.60	0.56	0.57	0.53	0.50	0.48	0.45	0.43
			4.0	0.68	0.64	0.61	0.60	0.56	0.54	0.51	0.48	0.46
			5.0	0.71	0.60	0.65	0.62	0.59	0.57	0.53	0.50	0.48
Recessed louvre trough with optically designed reflecting surfaces		50	0.6	0.28	0.25	0.23	0.28	0.25	0.23	0.28	0.25	0.23
			0.8	0.34	0.31	0.28	0.33	0.30	0.28	0.33	0.30	0.28
			1.0	0.37	0.36	0.32	0.37	0.34	0.32	0.37	0.34	0.32
			1.25	0.40	0.38	0.35	0.40	0.37	0.35	0.40	0.37	0.35
			1.5	0.43	0.41	0.38	0.42	0.40	0.38	0.42	0.39	0.38
			2.0	0.46	0.44	0.42	0.45	0.43	0.41	0.44	0.42	0.41
			2.5	0.48	0.46	0.44	0.47	0.45	0.43	0.46	0.44	0.43
			3.0	0.49	0.47	0.46	0.48	0.46	0.45	0.47	0.45	0.44
			4.0	0.50	0.49	0.48	0.49	0.48	0.47	0.48	0.47	0.46
			5.0	0.51	0.50	0.49	0.50	0.49	0.48	0.49	0.48	0.47

Table 6.3 Utilisation factors for some luminaires

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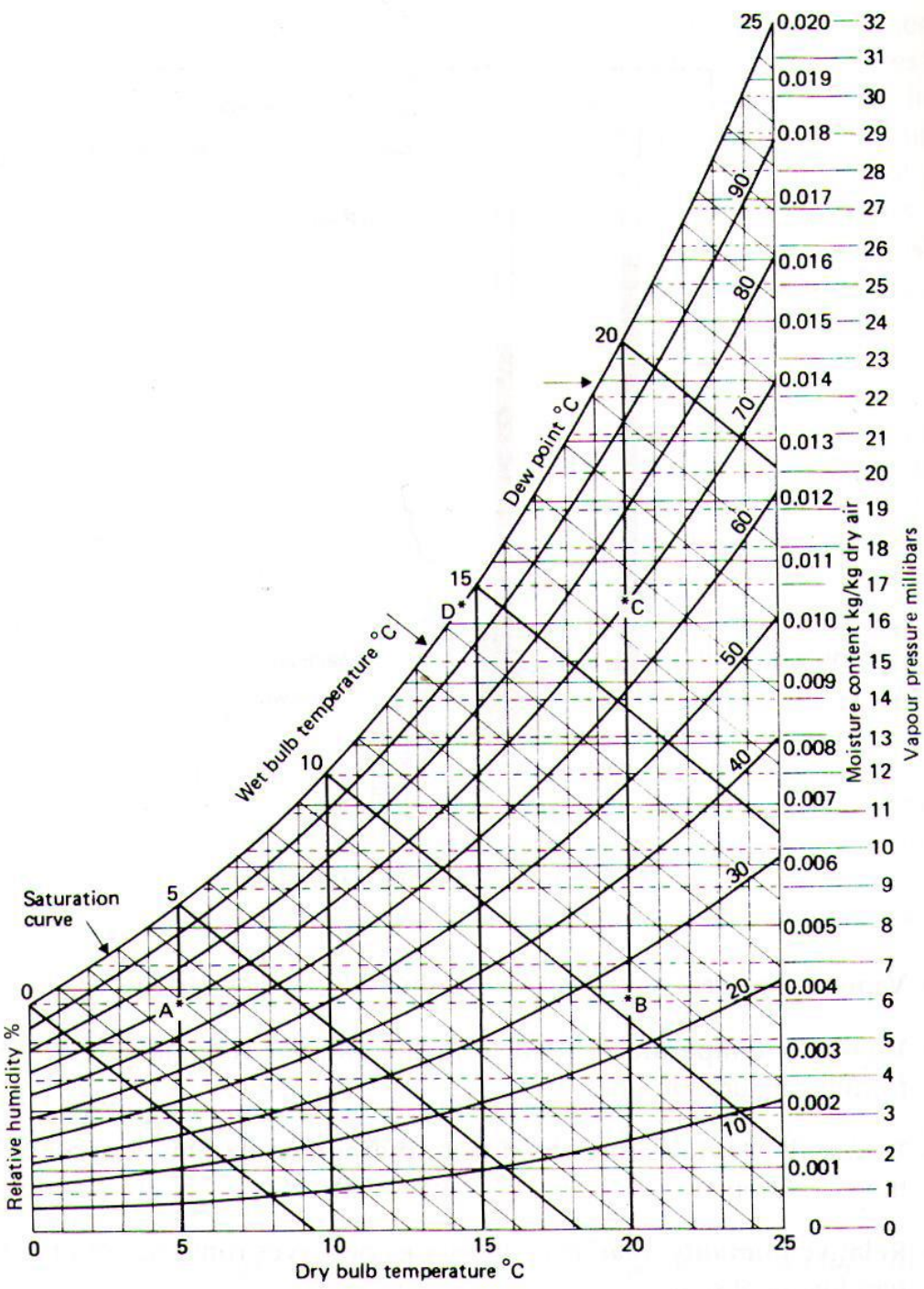

Figure 4.3 Psychrometric chart of moisture and temperature

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