



NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY

FACULTY OF THE BUILT ENVIRONMENT

DEPARTMENT OF ARCHITECTURE

ENVIRONMENTAL DESIGN I

AAR 2104

Examination Paper

December 2016

This examination paper consists of 4 pages

Time Allowed: 3 hours

Total Marks: 100

Special Requirements: Utilization Factor Table

Examiner's Name: Mr. B. NCUBE

INSTRUCTIONS

1. Answer *any four* questions

MARK ALLOCATION

QUESTION	MARKS
1.	25
2.	25
3.	25
4.	25
5.	25
TOTAL	100

QUESTION 1

- a) Explain the term thermal transmittance (U-value). (2)
- b) The cavity wall of an existing house has outer and inner brickwork leaves each 105mm with a 50mm air gap between them, finished with a 16mm layer of plaster inside. The relevant values of thermal conductivity, in W/m K are: brickwork 0.73, plaster 0.46. The standard thermal resistances, in $\text{m}^2 \text{K/W}$ are: outside surfaces 0.055, inside surface 0.123 air gap 0.18. Calculate the Thermal transmittance (U-value) of this wall. (5)
- c) Outline and describe two categories under which a building gains heat energy. (18)

QUESTION 2

- a) Outline and explain the factors to be considered in lighting design. (15)
- b) An area measuring 18m by 8m is to have a service illuminance of 300lx. The tubular fluorescent lamps each have a luminous flux output of 2820 lm and the luminaires give a utilisation factor of 0.4. The light loss factor assumed is 0.8. Calculate the number of lamps required and suggest a layout for them using the attached tables. (10)

QUESTION 3

- a) Outline and describe the properties of any three types of sound absorbers. (6)
- b) Explain the difference between the following sound control techniques; "Absorption" and "Insulation" (6)
- c) Describe four general insulation principles that could be used in construction of the interiors of an auditorium. (13)

QUESTION 4

- a) Compare and contrast the following Outdoor spaces in 'Hot-Dry Climates and Warm-Humid Climates' (15)
- b) Using sketches describe a typical building to be located in either of the Climatic conditions to achieve comfort. (10)

QUESTION 5

- a) Describe four methods by which an Architect can reduce solar heat gain through windows (16)
- b) Outline and describe building materials to be used in the erection of buildings within the following three climatic conditions.
 - i) Hot, dry climate
 - ii) Warm humid climates
 - iii) Cold snowfall climates (9)

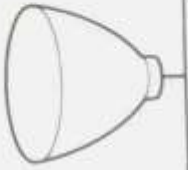
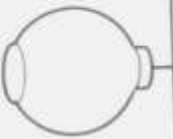

Description of fitting	Typical outline LOR	Basic downward LOR %	Ceiling		Reflectances							
			Walls	Room index	0.7	0.5	0.3	0.1	0.5	0.3	0.1	
Aluminium industrial reflector, Aluminium or enamel high-bay reflector		70	0.6	0.39	0.36	0.33	0.39	0.36	0.33	0.39	0.35	0.33
			0.8	0.48	0.43	0.40	0.46	0.43	0.40	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