



TECHNICAL UNIVERSITY OF MOMBASA

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF ARCHITECTURE AND QUANTITY SURVEYING

UNIVERSITY EXAMINATION FOR:

BACHELOR OF ARCHITECTURE

EAR 4304: BUILDING SERVICES II (ELECTRICAL)

END OF SEMESTER EXAMINATION

SERIES: DECEMBER 2024

TIME: 2 HOURS

DATE: Pick Date Select Month Pick Year

Instructions to Candidates

You should have the following for this examination

-Answer Booklet, examination pass, and student ID

This paper consists of **five** Questions; Each question carries 20 marks. Attempt any **THREE** Questions.

Do not write on the question paper.

Question ONE

a) Explain any:

- i. FOUR advantages of grid connected power system for a building.
- ii. SIX advantages of solar energy sources in a building.

(10 Marks)

b) 3 resistors rated 84Ω , 80Ω and 20Ω are connected in parallel across 220V supply.

Sketch the circuit and find:

- i. branch currents and total current.
- ii. power dissipated by each resistor and total power.
- iii. energy utilized by circuit for 1 day in kWhrs.

(10 Marks)

- c) A 25m highrise building has 5, 10,000 litre tanks which can fill in 3 hours. A pump is used to raise the water. The efficiency of the pump, the motor and the pipes are 80%, 90% and 75% respectively. Calculate:
- power input to the motor.
 - energy used if the pump operates 3 hours a day.
 - the energy cost at the rate of Sh 19 per unit for 1 month

(10 Marks)

Question TWO

- a)
- Explain any FOUR characteristics of a good cable.
 - Explain the factors considered in terminating a cable.
- (8 Marks)**
- b) Single-phase, special purpose appliance rated 3kW and 6k, all operating at unity power factor are supplied independently from 230V through grouped cables directly clipped. Take grouping factor(C_g), thermal insulation factor(C_i), fuse factor(C_f), and ambient temperature to correction factor(C_a) to be 0.68, 0.93, 0.84, 0.77. Determine;
- The rated currents of each appliance.
 - Design current of each appliance.
 - The recommended size of each cable.
 - The recommended maximum length of each cable.

(12 Marks)

Question THREE

- a)
- State any FOUR factors to consider when choosing a wiring system.
 - List any FOUR accessories associated with conduit wiring system.
- (10 Marks)**
- b) The following cables are installed in a bulding. Select suitable conduit sizes.
- 3, four core 16mm² cables.
 - 12, single core 10mm² cables.
 - 24, single core 6mm² cables.
 - 30, single core 4mm² cables.
 - 90 single core 2.5mm² cables.

(10Marks)

Question FOUR

- a) State any
- FOUR advantages of 3-phase lighting design for a Hall.
 - FOUR common problems associated with electric lamps.
- (8 Marks)**
- b) A room measuring 15m by 9m by 2.5 m high is to be illuminated to 400lux using 85W fluorescent lamps installed to flush with the ceiling. The working plane is 0.85m above the floor. Give that the luminous efficiency of the lamps is 94lm/W: Take ceiling, wall and floor reflectances as 70%, 50%, and 20%. Also take maintenance factor of 0.8 and:
- Calculate the mounting height and the room index.
 - From the attached table find Coefficient of Utilization(U_f).
 - Estimate the number of lamps required.
 - Sketch the plan for lamps on horizontal plane.
- (12 Marks)**

Question FIVE

- a) State any:
- FOUR benefits of installing HVAC units as opposed to ceiling fans.
 - FOUR ways of implementing natural cooling in buildings.
- (8 Marks)**
- b) A premises measures 7m by 4m 2.8 m high. It used by 20 people having light physical activity each taking $45\text{m}^3/\text{Hr}$. Take air density as $1.2\text{kg}/\text{m}^3$, heat capacity of air (C_p) = $1.005\text{KJ}/\text{kgK}$; moisture content of exhaust(D_v) = $46\text{kg}/\text{m}^3$; moisture content of intake(D_u) = $26\text{kg}/\text{m}^3$, density(ρ) = $250\text{kg}/\text{m}^3/\text{hr}$; exhaust air temperature(t_v) = 95°C ; intake air temperature (t_u) = 25°C ; and the heat loss is 6kW. Calculate the:
- Air exchange due to number of occupants.
 - Air exchange rate with vapor emission take.
 - Air exchange rate to remove the heat.
 - The total air exchange rate and rating of the fan operating at 1 atmospheric pressure.
- (12 Marks)**

Table 4.6 - Current ratings and volt drops for unsheathed single core p.v.c. insulated cables

Cross sectional area	In conduit in thermal insulation	In conduit in thermal insulation	In conduit on wall	In conduit on wall	Clipped direct	Clipped direct	Volt drop	Volt drop
(mm ²)	(A)	(A)	(A)	(A)	(A)	(A)	(mV/A/m)	(mV/A/m)
-	2 cables	3 or 4 cables	2 cables	3 or 4 cables	2 cables	3 or 4 cables	2 cables	3 or 4 cables
1.0	11.0	10.5	13.5	12.0	15.5	14.0	44.0	38.0
1.5	14.5	13.5	17.5	15.5	20.0	18.0	29.0	25.0
2.5	19.5	18.0	24.0	21.0	27.0	25.0	18.0	15.0
4.0	26.0	24.0	32.0	28.0	37.0	33.0	11.0	9.5
6.0	34.0	31.0	41.0	36.0	47.0	43.0	7.3	6.4
10.0	46.0	42.0	57.0	50.0	65.0	59.0	4.4	3.8
16.0	61.0	56.0	76.0	68.0	87.0	79.0	2.8	2.4

Type of conductor	Conductor cross-sectional area (mm ²)	Cable factor
Solid	1	22
	1.5	27
	2.5	39
Stranded	1.5	31
	2.5	43
	4	58
	6	88
	10	146
	16	202
	25	385
Conduit diameter (mm)	Conduit factor	
16	290	
20	460	
25	800	
32	1400	
38	1900	
50	3500	
63	5600	

Utilization Factors			LOR = 57% DLOR = 57.8% ULOR = 0.0%									
Room Reflection			Room Index (RI)									
C	W	F	0.75	1	1.25	1.5	2	2.5	3	4	5	
0.7	0.5	0.2	0.32	0.38	0.43	0.46	0.50	0.53	0.55	0.58	0.59	
	0.3		0.28	0.34	0.38	0.41	0.46	0.50	0.52	0.55	0.57	
	0.1		0.24	0.30	0.35	0.38	0.43	0.47	0.49	0.53	0.55	
0.5	0.5	0.2	0.31	0.37	0.41	0.44	0.48	0.51	0.53	0.55	0.57	
	0.3		0.27	0.33	0.37	0.41	0.45	0.48	0.50	0.53	0.55	
	0.1		0.24	0.30	0.34	0.38	0.42	0.46	0.48	0.51	0.54	
0.3	0.5	0.2	0.31	0.36	0.40	0.43	0.46	0.49	0.51	0.53	0.55	
	0.3		0.27	0.32	0.37	0.40	0.44	0.47	0.49	0.52	0.53	
	0.1		0.24	0.30	0.34	0.37	0.42	0.45	0.47	0.50	0.52	
0.0	0	0.0	0.23	0.28	0.32	0.35	0.40	0.42	0.45	0.47	0.49	
			SHR NOM = 1.25									