UNIVERSITY OF RUHUNA

Faculty of Engineering

End-Semester 8 Examination in Engineering: December 2025

Module Number: EE8206 **Module Name: Electrical Installations II (C-18)**

[Three Hours]

[Answer **all questions**, each question carries 10 marks]

Q1 A newly constructed five-storied academic and administrative building is to be commissioned for a Faculty of Engineering. The building consists of:

- 40 academic staff offices, 10 lecture halls, 5 computer laboratories, 1 central administration office, 1 security control room, 1 main server/equipment room (Ground Floor)

The faculty management requires the implementation of the following low-voltage communication systems: Structured Cabling System, CCTV Surveillance System, PABX-based Voice Communication System, Video Intercom System.

a) Propose a structured cabling design for the building based on TIA/EIA-568 standards. Identify the horizontal cabling, backbone cabling, and work area components.

[2 Marks]

b) Select suitable cable types (Cat 6, Cat 6A, fiber, etc.) for, horizontal runs, Backbone between floors, Server room interconnections. Justify your choices.

[2 Marks]

c) Draw and explain a logical structured cabling hierarchy diagram for the building, including: Equipment Room (ER), Telecommunication Rooms (TR), Work Areas (WA).

[2 Marks]

d) Compare analog CCTV and IP-based CCTV systems and justify which is more suitable for this building.

[1 Mark]

e) Explain how the CCTV system can be integrated with the existing LAN infrastructure.

[1 Mark]

f) Compare **Traditional PABX** and **IP-PBX** systems.

[1 Mark]

g) Explain the role of the protocols SIP and RTP used in VoIP.

[1 Mark]

Q2 a) i) What are the sources of damage from Lightning as per the IEC 62305?

ii) What are the types of damage from Lightning as per the IEC 62305?

[2 Marks]

b) The plan and elevation of a roof slab arrangement of a building are shown in Figure Q2. All dimensions are given in millimeters. The building is required to be protected using a Class I Lightning Protection System (LPS) in accordance with IEC 62305.

i) Considering Class I protection, determine the following to comply with IEC 62305.

- Radius of the rolling sphere
- Maximum size of the copper air-termination mesh
- Maximum permissible distance between down conductors

ii) Using the parameters determined in Q2(b)(i), draw a neat sketch, showing

Air termination system on the roof

Mesh arrangement

Down conductor locations.

Clearly label all major components.

[8 Marks]

Q3 a) i) Draw a freehand sketch of a central air-conditioning system showing all main components. Indicate the locations where power supply is to be provided.

ii) Calculate the total cooling load for a split-type air conditioner using the rule-of-thumb method for an office space of 20 ft (L) × 15 ft (W) × 10 ft (H) with four occupants. If the split-type air conditioner requires a power input of 2.0 kW, calculate the Energy Efficiency Ratio (EER).

[4.0 Marks]

b) i) Briefly explain why fire safety and early detection of fire in buildings are of paramount importance.

ii) Briefly explain what initiation devices and notification devices are in a fire detection system.

[3.0 Marks]

c) i) List the main components of a wet riser fire hydrant system. Briefly explain the role of a breeching inlet in wet riser fire hydrant system.

ii) Classify three types of fires, giving a suitable example for each and the appropriate fire extinguisher.

[3.0 Marks]

Q4 a) i) Define vertical transportation systems in buildings and explain the need for lifts and escalators in modern high-rise and commercial buildings, referring to comfort, safety, regulations, and efficiency.

ii) Describe the main components of a traction lift system, highlighting their individual functions.

iii) Explain the advantages of selecting a Machine Room-Less (MRL) lift system for a building compared to a conventional machine-room lift.

iv) Briefly explain the role of overspeed governor for the safety feature used in lift systems.

[5.0 Marks]

b) A commercial building requires a backup power supply during grid failures. The loads listed in Table Q4 are to be supplied.

Table Q4.

Load	**Power (kW)**
Lighting	25
Air-conditioning	30
Elevators	15
IT equipment	10
Miscellaneous	5
Total Connected Load	85 kW

Additional data:
Generator operates only during utility failure

- Expected operation < 200 h/year
- Power factor = 0.8
- Future load allowance = 20%

i) Identify the appropriate generator classification according to ISO 8528 for this application and justify your selection.

ii) Determine the minimum generator rating (kVA) required.

[5.0 Marks]

Q5 a) i) Define a Building Management System (BMS) and explain its role in achieving energy efficiency, occupant comfort, and sustainability in modern buildings.

[2.0 Marks]

ii) Explain the working principle of any two sensors commonly used in BMS applications (e.g., RTD temperature sensor, CO_2 sensor, differential pressure sensor). Include signal type and typical application.

[2.0 Marks]

b) i) Describe the three-level BMS architecture with the aid of a neat sketch, clearly stating the function of each level.

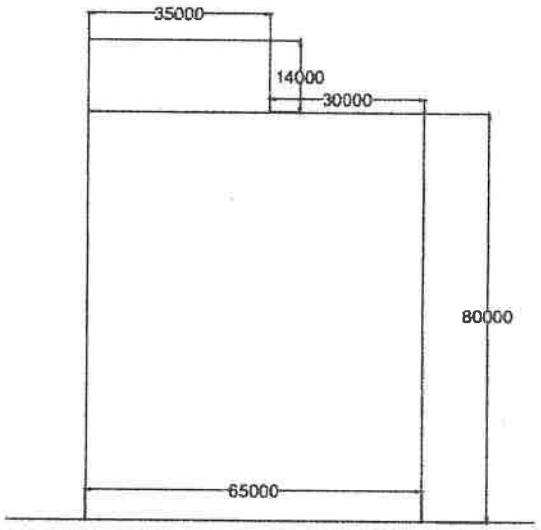
[3.0 Marks]

ii) A commercial office building is served by AHUs with VAV boxes, chilled water pumps with VSDs, and is fully integrated with a centralized BMS. The maintenance manager reports the following issues:

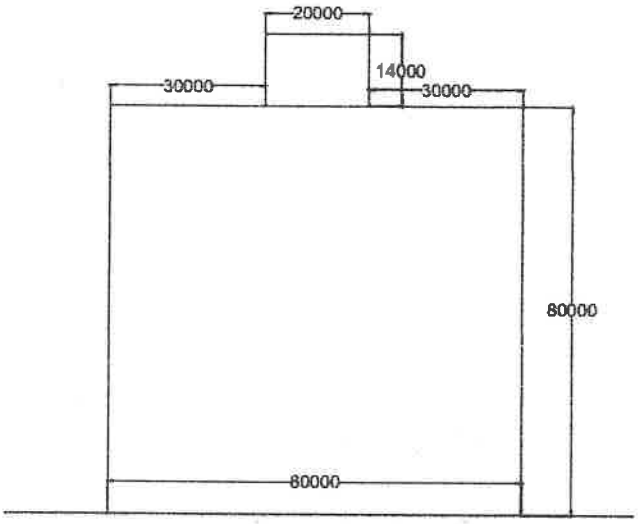
- High energy consumption during partial occupancy hours
- Indoor CO_2 levels exceeding 1000 ppm in meeting rooms
- Inconsistent room temperature control in VAV zones

Identify and justify four BMS field devices (sensors/actuators) that should be monitored or controlled to address the above issues.

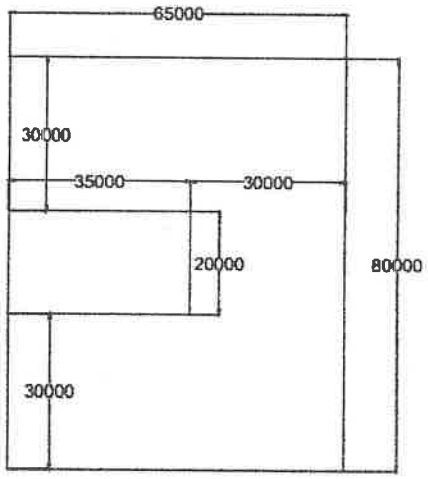
[3.0 Marks]



FRONT ELEVATION



SIDE ELEVATION



PLAN (ROOF LEVEL)

Figure Q2.