UNIVERSITY OF RUHUNA

Faculty of Engineering

End-Semester 8 Examination in Engineering: December 2016

Module Number: EE8202 **Module Name: Electrical Systems in Buildings**

[Three Hours]

[Answer all questions]

[All the lecture notes and the hand written notes are allowed to use during the exam]

[No text books are allowed]

Q1 a) i) Compare the Terra-Terra (TT) system and the Terra-Neutral-Combined-Separate (TN-C-S) system in terms of the earth loop impedance and the earth fault current.

ii) Explain briefly why it is usually necessary to use a Residual Current Device (RCD) to protect against indirect contact in a TT system, but not in a Terra-Neutral (TN) earthing system.

iii) Why does a Miniature Circuit Breaker (MCB) have both a bi-metallic trip element and as well as an electromagnetic trip element?

[3 Marks]

b) An RCD is used as the protective device against the electric shock in a TT system. The Figure 1 shows the TT earthing arrangement. The resistance of the earth electrode of the substation neutral is 10 Ω and the resistance of the earth electrode of the installation is 20 Ω.

i) By considering the worst case, calculate the maximum possible earth fault current within the above installation. Clearly state your assumptions.

ii) Calculate the fault voltage U_f at the installation. Is it safe? Justify your answer.

[4 Marks]

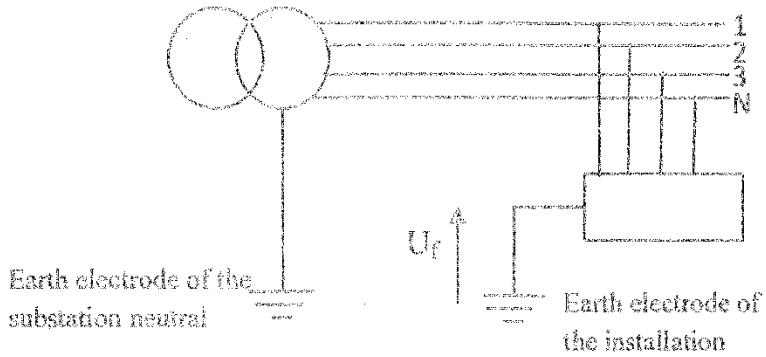


Figure 1

c) It is found that a certain TT installation has following details.

Transformer (Dy11) winding resistance (Ref: to secondary side)	= 0.001 Ω/phase
Phase conductors of main supply (Single core)	= 25 mm^2 Cu/XLPE/PVC
Neutral conductors of main supply (Single core)	= 25 mm^2 Cu/ XLPE/PVC
Phase conductors of within installation (Single core)	= 16 mm^2 Cu/XLPE/PVC
Neutral conductors of within installation (Single core)	= 16 mm^2 Cu/ XLPE/PVC
Source earth electrode resistance	= 2.5 Ω
Installation earth resistance	= 10 Ω
Distance from source to installation MDB	= 40 m
Distance from MDB to 3-phase load	= 20 m
Main cable installation method	= In the air
Cable installation method within installation	= In the conduit

By considering the worst case, calculate the maximum possible earth fault current at the load terminals. Clearly state your assumptions.

[5 Marks]

Q2 a) Give two suitable examples where MCB or fuses are omitted for protection against overload. Explain the reason for this omission.

[2 Marks]

b) Explain the difference between basic protection and fault protection with respect to electric shock protection.

[2 Marks]

c) A hostel building has a 400 V, 50 Hz, 3-phase power requirement and the supply cable to be run in 78 m long, Cu/XLPE/PVC cable in the open air. The supply, with a design load of 62 A at a power factor of 0.95 lagging, is to be protected against overload and short circuit. The maximum ambient temperature is 45°C. Determine the followings, clearly stating the assumptions you made.

i) The correction factor for the temperature.

ii) The minimum cross-sectional area of the live conductor.

iii) Voltage drop in the cable and accordingly, the suitable cable for the hostel building.

iv) Cross-sectional area of circuit protective conductor and, suitable circuit breaker capacity and type.

[6 Marks]

Q3 a) Explain briefly the Color Rendering Index (CRI) of a light source?

[1 Mark]

b) Layout drawing of a hostel building is shown in Figure 2. It is needed to be illuminated for required lux level using LED lights of an efficacy of 100 lm/W. Efficiency of the fixture is 85% and, 25% margin is to be allowed for loss due to aging. Considering the ground floor, answer the following questions.

i) 1200 mm LED tube light fitting of rating 1 x 18 W and LED E27 10.5 W lamps are to be used to illuminate the given building. Illumination level of the rooms and the lobby area has to be 400 lux and 200 lux, respectively. How many LED tube lights and LED lamps are needed to obtain the recommended illumination for the ground floor?

ii) Draw a suitable layout arrangement of the distribution of the LED tube lights and LED lamps on the layout.

iii) Calculate the maximum current required for LED tube light and LED lamp fitting. Clearly state the assumptions you made.

iv) Propose a suitable socket outlet layout arrangement for the hostel building.

v) Draw a line diagram considering the light and socket outlet loads you have proposed.

vi) Prepare a rough cost estimate for the above light and socket outlet arrangement.

[10 Marks]

c) A class 1 type lightning protection system needs to be installed for the hostel building given in Figure 2. Propose a suitable design to protect the given building from lightning.

[3 Marks]

Q4 a) Describe the advantages of the IP based Closed Circuit Television (CCTV) system.

[2 Marks]

b) Explain the advantages of installing a Building Management System in a building.

[2 Marks]

c) A 1/3 inch camera is viewing an entrance gate to a factory. The car coming through the gate is the critical view. Distance between the camera and the gate is 100 m. Width of the gate is 12 m and the front dimensions of the car are 5 m x 5 m. Determine,

i) the focal length.

ii) the scene height.

iii) the scene area.

iv) the critical area of view. Is the car within the identification area? Justify your answer.

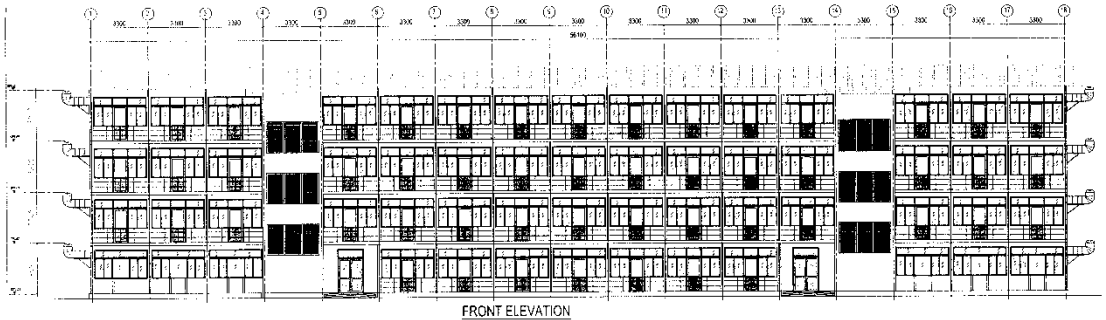
[6 Marks]

c) A layout drawing of a hostel building is shown in Figure 2. It is required to propose a suitable CCTV camera system for the ground floor of the hostel building covering all the critical areas.

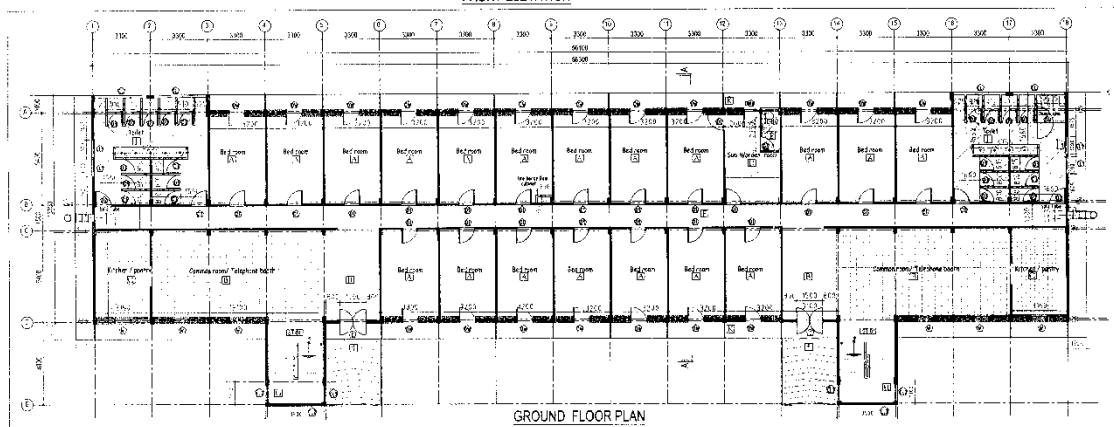
i) Propose suitable cameras including camera type, IP ratings, rough focal length, and view angle for selected locations.

ii) Draw a schematic CCTV diagram with Digital Video Recorder (DVR) and cameras.

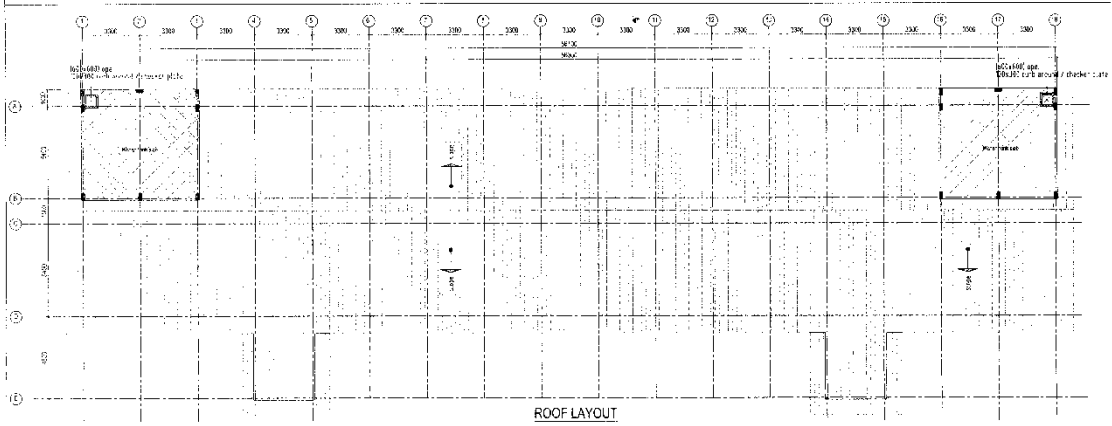
[4 Marks]



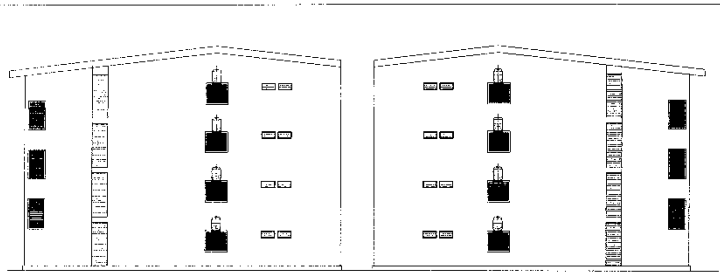
FRONT ELEVATION



GROUND FLOOR PLAN



ROOF LAYOUT



SIDE ELEVATION

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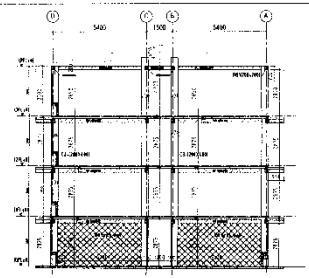

SEC. A-A

PROJECT TITLE :
PROPOSED UNIVERSITY HOSTEL BUILDING

DRAWING TITLE : FLOOR PLANS,FRONT SIDE ELEVATIONS,SECTIONS, FOUNDATION DETAILS & SCHEDULE OF DOOR & WINDOWS

SCALE : DRAWING NO : REV NO#

SCHEDULE OF DOOR AND WINDOWS

Figure 2