UNIVERSITY OF RUHUNA

Faculty of Engineering

End-Semester 8 Examination in Engineering: November 2017

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) Briefly explain the importance of lightning protection systems for electrical systems.

[2 Marks]

b) A roof layout of a building is shown in Figure Q1. Design a suitable lightning protection system considering Class 1 protection level and indicate it in Figure Q1. Use copper as the conducting material. Clearly mention the dimensions, sizes and any assumptions you made.

[5 Marks]

c) Briefly explain with suitable examples why it is usually necessary to use isolated type lightning protection systems.

[3 Marks]

Q2 a) Why earthing or grounding is important in an electrical system of a building? Support your answer with suitable examples.

[2 Marks]

b) Compare the followings.

i) Earth Fault Relay (EFR) vs Earth Leakage Relay (ELR)

ii) Incandescent lamp vs Light Emitting Diode (LED) lamp

[2 Marks]

c) A building has a 400 V, 50 Hz, 3-phase power requirement and the supply cable to be run in 200 m long, multi core Cu/XLPE/PVC cable on perforated cable tray in close proximity to two other circuits. The supply, with a design load of 120 A at a power factor of 0.95 lagging is to be protected against overload and short circuit. The maximum ambient temperature is 35°C. Determine the followings, clearly stating the assumptions you made.

i) Grouping and temperature correction factors.

ii) By considering the above correction factors, the minimum cross-sectional area of the live conductor.

iii) Voltage drop in the cable according to the minimum cross sectional area calculated in ii). Accordingly, decide the suitable cable for the building.

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

[6 Marks]

Q3 a) What do you mean by the color temperature of a light source?

[1 Mark]

b) A building layout drawing is shown in Figure Q3. It is needed to be illuminated for required lux level using 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.

i) 10 W, 600 mm LED tube light fittings, 6 W LED panel lights and IP 54, 9 W outdoor type LED lamps are to be used to illuminate the given building. How many LED tube lights, LED panel lights and outdoor type LED lamps are needed to obtain the recommended illumination for the building?

ii) Draw a suitable layout arrangement of the distribution of the LED tube lights, LED panel lights and outdoor type LED lamps on the layout drawing.

[4 Marks]

c) Considering the layout drawing in Figure Q3, propose a suitable power socket outlet arrangement for the building. Assume that all the air conditioners are of split type.

[3 Marks]

d) Considering 400 V, 50 Hz, 3-phase power supply, draw a suitable 3-phase line diagram considering lights and power socket outlet loads. All the phases should approximately be balanced.

[3 Marks]

e) Assuming that you are the electrical design engineer for the building, prepare a Bill of Quantity (BOQ) for the light and socket outlet arrangement.

[3 Marks]

f) Considering the layout drawings, proposed a suitable fire detection system for the building. (Use separate symbols for heat and smoke detectors, call points, alarms etc.)

[3 Marks]

g) Propose three energy savings tips for the building.

[3 Marks]

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

[1 Mark]

b) Explain the advantages of having a Building Management System (BMS) in a building.

[2 Marks]

c) A 1/4 inch camera is viewing an entrance gate to a hospital. The lorry 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 lorry are 4 m x 4 m. Determine,

i) the focal length.

ii) the scene height.

iii) the scene area.

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

[4 Marks]

d) A layout drawing of an office building is shown in Figure Q4. It is required to propose a suitable CCTV camera system for the ground floor of the building covering all the critical areas.

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

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

[3 Marks]