



## UNIVERSITY OF RUHUNA

### Faculty of Engineering

End-Semester 7 Examination in Engineering: March 2022

Module Number: EE7207

Module Name: Electrical Installations I

[Three Hours]

[Answer all questions]

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- Q1 a) i) In the definition of "Low Voltage", what is the upper limit?  
ii) Refer to *Reg 411.3.3: Additional requirements for socket-outlets and for the supply of mobile equipment for use outdoors* of IET Wiring regulations. State the respective part number, chapter number, section and sub section of the regulation 411.3.3. [3.0 Marks]
- b) i) State four types of abnormal situations that can occur in a low voltage system.  
ii) A three-phase 400 V, 15 kW, 0.85 PF induction motor is fed by a 0.1  $\Omega$  per phase, 400 V three-phase transformer. The induction motor and the transformer are connected through a 10 m long cable having resistance of 0.01  $\Omega$ /m per phase. The induction motor's starting current is 5 times as its rated current. Select a suitable three pole MCB for this application. Neglect the cable voltage drop. (Circuit Breaker's rated current can be selected from 6A, 10A, 16A, 20A, 25A, 32A, 40A, 60A, 80A, 100A, 125A, 160A, 200A, 250A, 300A, 400A, 500A, 600A, 800A, 1000A, 1200A, 1500A) [5.0 Marks]
- Q2 a) Explain with diagram(s) the possible dangerous situation in an IT type distribution system. [2.0 Marks]
- b) In a certain site it was found that the soil resistivity is 100  $\Omega$ m. There are rod type earth electrodes in the market with 1.2 m length and 20 mm diameter. If we want to achieve less than 25  $\Omega$  earth electrode resistance, then what should be the required total length of the rod type earth electrode? [3.0 Marks]
- c) i) What are the two methods that are used to select suitable protective conductor sizes for Low voltage Electrical installations as per IET wiring regulations?  
ii) If the protective conductor is of the same material as that of the line conductor, how do you calculate the protective cable size? Explain how the protective conductor cross sectional area changes with the cross sectional area of the line conductor.

iii) State the suitable protective conductor sizes for the cables given below.

- I. 4 core 150 mm<sup>2</sup> Cu/XLPE/PVC
- II. 4 core 25 mm<sup>2</sup> Cu/XLPE/PVC
- III. 2 core 6 mm<sup>2</sup> Cu/PVC/PVC

[5.0 Marks]

- Q3 a) i) Name five different types of cables that are manufactured according to their applications.
- ii) State three correction factors that are used to evaluate cable sizes.
- iii) What is the permissible voltage drop for low voltage Electrical installations as per IET regulations?

[3.0 Marks]

b) A workshop is equipped with two three-phase, 400V, 50 Hz, 0.9 PF, 10 kW lathe machines as shown in Figure Q3. The ambient temperature is 40°C. Two cables should be laid from consumer unit to Lathe-1 and Lathe-2 separately. Find the followings.

- i) Correction factors assuming four core 70°C thermoplastic insulated cables.
- ii) Capacities of the protection device and the minimum cross sectional area of the cables.
- iii) Voltage drop for of the cables.
- iv) Cross sectional area of the circuit protective conductor. State any assumptions you make.

[7.0 Marks]

- Q4 a) i) Explain diversity and utilization factors of the electrical installations?
- ii) What is the difference between Ring and Radial circuit topology? Explain with suitable diagrams.

[3.0 Marks]

b) Small business premises have the following equipment.

- 3 number of 4 kW three-phase cookers.
- 2 number of 1 kW three-phase water heaters (instantaneous type).
- 1 number of 2 kW three-phase motors (0.8 PF).
- 6 number of 13 A socket outlets (assume utilization factor as 0.5).

Find the power requirement of the premises.

[5.0 Marks]



- Q5 a) i) What is the contract document and what are the key components in a contract document?
- ii) What are the advantages of a BOQ?
- iii) Using the demand values calculated, draw a single line diagram for the business premises mentioned in Q4. b). No need to calculate or indicate the cable sizes.

[5.0 Marks]

- b) A building layout drawing is shown in Figure Q5. It is needed to be illuminated for the required lux level using lights of an efficacy of 95 lm/W. The utilization factor is 0.85 and the maintenance factor is 0.8. You may assume the lux levels and the floor area of different blocks in the building layout.

Following lights/lamp fittings are available

- LED tube, 1x18 W ,1200 mm lamp fitting
- LED tube, 2x18 W ,1200 mm lamp fitting
- LED tube, 1x10 W ,600 mm lamp fitting
- LED panel light, 12 W, 300 mm x300 mm
- LED panel light, 18 W, 300 mm x300 mm
- LED panel light, 40 W, 600 mm x600 mm
- LED indoor wall light, 7 W
- LED outdoor wall light, 7 W, IP65

Stating assumptions you made answer the following questions.

- i) Suitably select the light/lamp fittings and calculate the number of light/lamp fittings to achieve the required lux level.
- ii) Design the lighting layout for the distribution of the lamps on the ceiling. Use Figure Q5 in the question paper to draw the lighting layout.
- iii) Draw a suitable power socket and ceiling/exhaust fans layout on the same Figure Q5.

[9.0 Marks]

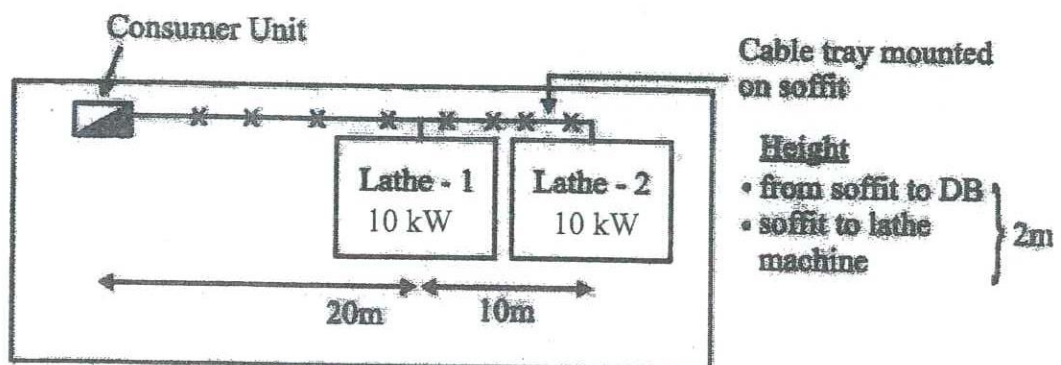
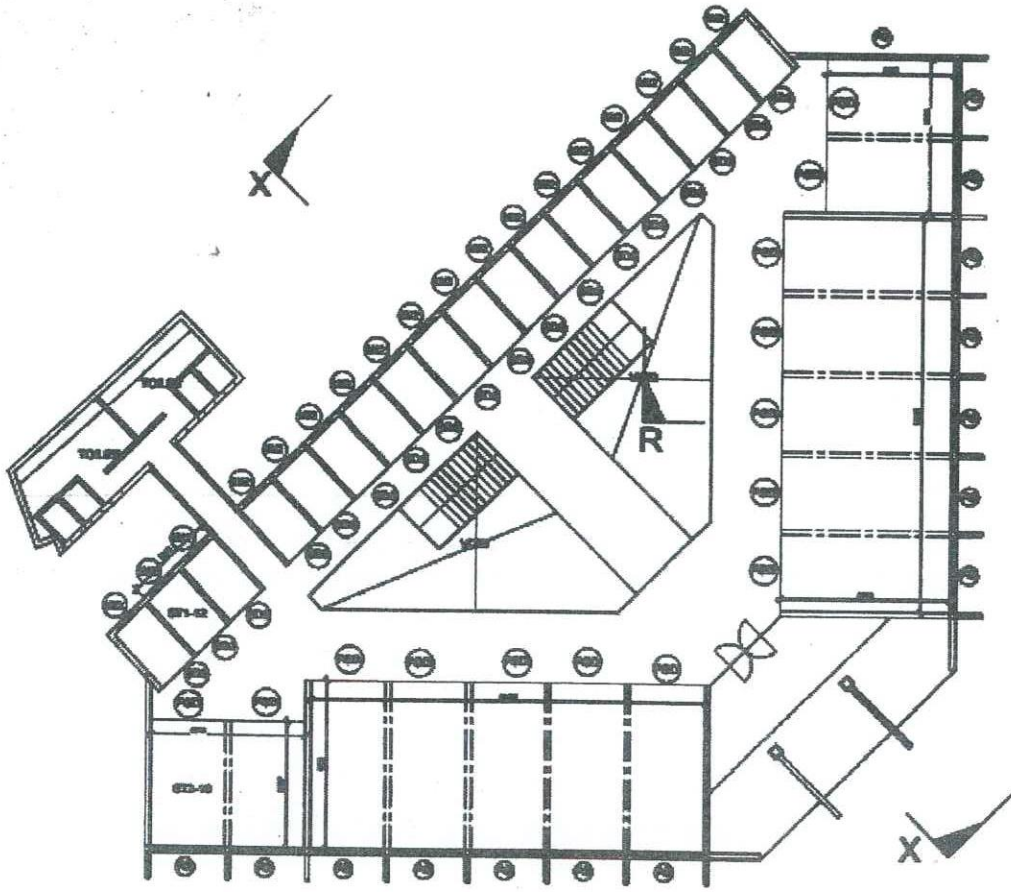


Figure Q3: Workshop Layout

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**UPPER FLOOR**

Figure Q5: Building layout drawing

Detach this page and attach with your answer script.