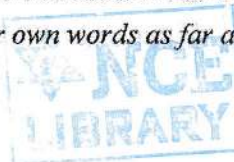


TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2082 Chaitra

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BEL	Pass Marks	32
Year / Part	III / II	Time	3 hrs.

Subject: - Industrial Power Distribution and Illumination (EE 653)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.



1. How is the required capacity (kVA rating) of a transformer determined for an industrial power distribution system? Explain the procedure for selecting an appropriate transformer size by considering factors such as total connected load, maximum demand, diversity factor, load factor, nature of industrial loads, and provision for future expansion. Illustrate your explanation with a suitable example showing the step-by-step calculation used to arrive at the final transformer rating. [8]
2. What are the main objectives of equipment earthing? Explain in brief the various factors affecting the earth resistance. Also, calculate the size and number of earth electrodes required for a rod earthing system if the soil resistivity is 100 Ω m and the desired earth resistance is 5 Ω . [8]
3. Explain the construction of a 3.5 core armoured copper power cable in detail. Draw a neat labeled diagram showing all layers of a typical cable and describe the function of each layer. [6]
4. An 11 kV / 400 V, 800 kVA distribution transformer supplies power to 5 outgoing feeders, as follows: (a) 2 feeders of 200 kVA each and (b) 3 feeders of 100 kVA each. a) Draw the single line diagram (SLD) of the system including the following: HV side isolator and fuse, LV side rating of circuit breaker for each feeder, Earthing of transformer and feeders. Necessary accessories to operate the system safely. [8]
5. Explain the components of an LED lighting system. Define Correlated Color Temperature (CCT) and Color Rendering Index (CRI), and explain their importance in selecting LED lighting for indoor environments. [6]
6. A factory hall having dimensions 40 m $\times$ 20 m $\times$ 4 m is to be illuminated using 600 mm $\times$ 600 mm LED panel lights, each rated at 40 W. An average illumination level of 200 lux is required on the working plane. Determine the number of LED panel lights required to achieve the specified illumination. Draw the lighting and power layout diagram showing the arrangement of lamps, switches, sockets, power and light sub-circuit numbers, and designed the distribution board. The electrical supply available is 400 V, 3-phase, 4-wire system. Assume the following: utilization factor = 0.85, maintenance factor = 0.75, lamp efficacy = 110 lumen/watt. [12]
7. Determine the size and routing of cable of 3.5 core armoured aluminium cable from transformer to MDB where load is 500 kVA and 3.5 core unarmoured copper cable MDB to SDB₁ and SDB₂ required to carry the load of 150 kW and 250 kW respectively. It is given that length of cable from transformer to MDB 200 m and MDB to SDB₁ and SDB₂ are 30 m and 60 m. The permissible voltage drop is 2% of supply voltage. The supply system is 3-phase, 400V, 50Hz. Current ratings of conductors is given in table below. [8]

Size of cable in sq. mm	25	35	50	70	95	120	150	185	240	300	400
Armoured Laid in ground Al (A)	95	114	134	164	197	223	249	282	327	369	420
Unarmoured Laid in duct Cu (A)	102	122	144	177	212	240	269	304	352	396	447

8. A road is illuminated using 200 W LED street lamps, each having a uniform luminous intensity of 2650 candle power (cd) in all directions below the horizontal. The following data are given: Height of lamp post = 8 m, Distance between two consecutive lamp posts = 30 m, Calculate the illuminance (in lux) contributed by each lamp at: (a) The foot of the lamp post. (b) A point 20 m away from the base of the lamp post. (c) The midway point between two adjacent lamp posts (i.e., 15 m from each pole), and determine the total illuminance at that point. [8]
9. Explain the purpose and components of an emergency supply system in an industrial plant, describe how an uninterrupted supply system can be provided for critical loads and why it is important, and give one typical example of a critical load in an industrial facility that requires uninterrupted supply. [8]
10. Explain the purpose of an electrical energy audit in an industrial plant and outline the main energy audit techniques used. Take a reference of a medium-sized factory and provide one practical example of how energy audit can be applied to improve efficiency. [8]

TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2082 Kartik

Exam.	Back		
Level	BE	Full Marks	80
Programme	BEL	Pass Marks	32
Year / Part	III / II	Time	3 hrs.

Subject: - Industrial Power Distribution and Illumination (EE 653)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

1. A small factory has the following loads:

- a) 40 lights of 80 W each.
- b) 20 fans of 75 W each
- c) 15 machines of 3 phase 10 kW load each
- d) 5 air conditioners of single phase 3 kW each

Calculate: (i) Total connected load (ii) Maximum demand (Assume suitable demand factors) (iii) Required transformer capacity if the power factor is 0.85.

2. Differentiate between system earthing and equipment earthing with suitable examples and diagrams.

3. Compare indoor and outdoor substations based on cost, maintenance, and safety. Which type would you recommend for a small industrial plant, and why?

4. Draw a clear layout of a typical 132/11 kV power system with a single-line diagram, including two 11 kV outgoing feeders, each with two 400 V outgoing lines. Ensure all essential components are shown in the diagram.

5. Compare incandescent filament lamps and fluorescent lamps based on construction, operating mechanism, energy efficiency, lifespan, and applications.

6. A conference hall 40 m x 25 m is to be illuminated by 60 W LED lamps. The lamps being mounted at height of 3 m from the working plane, the average illumination required is 250 lux. Calculate the number of lamps to be fitted in the hall, considering utilization factor 0.85, depreciation factor 1.25 and efficiency of lamp is 120 lumen/W. Decide light and power sub circuit. Draw layout diagram showing arrangement of lamps and power socket. Design the distribution board to supply lighting load and power load, the supply system is 3 phase, 4 wire system, 400V, 50 Hz.

7. Calculate the appropriate size of copper cable for a three phase circuit of 400 V connecting three loads. The loads 10 kW and 15 kW heaters at a distance of 75 m and 35 m from the supply end and one 10HP motor at a pf of 0.8 lagging at a distance of 70 m from the supply end. The permissible voltage drop is 2% of the rated voltage. Necessary table is given below.

Cross-section area in mm ²	1	1.5	2.5	4	6	10	16	25
Current rating of the cable (A)	10	21	27	36	45	60	77	99

8. Explain the factors that influence the selection of streetlight sources for outdoor lighting applications. Describe the key considerations when selecting luminaires for outdoor lighting systems.

9. What are different types of battery charging scheme? Describe each of them with their specific purpose.

10. What is energy audit and the importance of energy audit in any industry? Explain the procedure to conduct the energy audit.

TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2081 Chaitra

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BEL	Pass Marks	32
Year / Part	III / II	Time	3 hrs.

Subject: - Industrial Power Distribution and Illumination (EE 653)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

1. Explain the concept of a load center and describe the factors affecting its location in an industrial plant. [6]
2. Explain different methods of earthing. Which method is suitable for industrial equipment earthing? How can you find the size of electrode for the above earthing system? [8]
3. Explain different types of lighting scheme used in an industry. Also explain local lighting, general lighting and emergency lighting system used in an industry. [8]
4. Why the distribution substation is important? Explain with single line diagram of 132/11 kV distribution substation and provide a list of necessary equipment. [8]
5. A work shop hall 60 m × 20 m × 5 m is to be illuminated by twin 2 × 20 Watt LED tube lamp for industrial fittings. Required illumination for the space is 250 lux, maintenance factor and utilization factor are 0.75 and 0.85 respectively. The efficiency of LED tube is 130 lumen per watt. Calculate number of luminaries required to be fitted. Draw the lay out diagram for the lighting and power sub circuit. This workshop hall having the following loads: [16]
 - a) Two nos. of 6 kVA Milling Machine 10m apart from DB
 - b) Three nos. of 5 kVA Lathe Machine 15 m apart from DB
 - c) Two nos. of 5 kVA Arc Welding Machine 20 m apart from DB
 - d) Two nos. of 2 kVA Ventilation Fan 25 m apart from DB
 - e) One no. of 15 kVA Compressor 30 m apart from DB
 - f) Two nos. of 10HP water pump with 80% efficiency and 0.8 power factor 35 m apart from DB.

Draw the single line diagram for the power distribution for above load and calculate cable size for individual load. Use separate DB for power sub circuit and light sub circuit. Calculate the cable size for individual load from DB if the voltage drop is 2%. Current ratings of 4 core Cu conductor is given in the table below.

Cross-section area in mm ²	1	1.5	2.5	4	6	10	16	25
Current rating of the cable (A)	10	21	27	36	45	60	77	99

6. Explain the structure and working of an LED lamp. Discuss its advantages in terms of power consumption, efficiency, and environmental impact compared to conventional lamps. [8]
7. Describe the functions and application area of HRC Fuse, MCCB, MCB, and their role in industrial protection systems. [8]

8. A road is illuminated by 200-Watt LED street lamp having a luminous intensity 2650 candle power in all direction below the horizontal. The lamp post height is 8 meter and the distance between two lamp post is 30 m. Calculate the illuminance contributed by each lamp: [6]
- a) Foot of the lamp post
 - b) 20 m from the base.
 - c) The total illuminance at midway between the foot of each lamp post.
9. Outline the step-by-step process of performing an energy audit in an industrial plant. Include the tools and methods used to gather data and analyze energy consumption patterns. [8]
10. Discuss the charging methods and maintenance requirements for a battery supply system in an industrial setup. [4]

TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2081 Ashwin

Exam.	Back		
Level	BE	Full Marks	80
Programme	BEL	Pass Marks	32
Year / Part	III / II	Time	3 hrs.

Subject: - Industrial Power Distribution and Illumination (EE 653)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt **All** questions.
- ✓ The figures in the margin indicate **Full Marks**.
- ✓ Assume suitable data if necessary.

1. Why is the diversity factor significant in electrical systems, and how does it relate to the number of consumers? [4]
 - b) Consumer A has a load of 20kW for 5 hrs. and Consumer B has a load of 5kW for 20hrs. Find the load factor for both consumers and explain the significance of the load factor based on energy expenditure and utility point of view. [4]
 - c) Explain briefly about the pole mounted distribution substation in an industry along with a single line diagram and accessories used and advantages. [8]
2. a) Define Busway. Compare Busway and Cable-Conduit combination. [1+3]
 - b) Sketch 3.5 core armored cable used in industry with proper labels. [4]
 - c) Explain how you will select the size and number of lifts for a commercial complex building. [8]
3. a) Explain about the essential properties that should be taken into account when choosing security lighting for residential or commercial properties. [4]
 - b) What are some of the technical challenges associated with LED lamps in terms of achieving uniform illumination levels and how is the lux distribution affected in LED lighting systems? [4]
 - c) In the street lighting scheme, lamps having candle power of 600 Cd and 800 Cd are hung at a height of 6m and 8m respectively. Find the illumination under lamps and midway between the lamp post if the distance between lamps is 15m. [8]
4. a) A room measuring 15m x 7m x 3.6m high is to be illuminated by 32W LED lamps and the design illumination is 200 lux on the working plane (0.85 meters above the floor). The Utilization factor is 0.5 and the Maintenance factor is 0.8. If the lamp efficiency is 85 lumens/Watts and SHR=1, calculate; [10]
 - i) The number of fittings required
 - ii) The fittings layout
 - iii) Wiring and Switch layout
 - iv) Distribution layout
- b) Explain Earthing for Lightning Protection System. What are the limitations and reasons why the conventional method of earthing is not preferred? [3+3]
5. a) State the difference between Emergency power supply and Back-up power supply. [4]
 - b) What do you mean by detailed audit for energy auditing? A single-phase motor connected to 400 V, 50 Hz supply takes 31.7 A at a power factor of 0.7 lagging. Calculate the capacitance required in parallel with the motor to raise the power factor to 0.9. [8]
 - c) What is Load management? Explain different Load management techniques. [1+3]

TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2080 Ashwin

Exam.	Back
Level	BE
Programme	BEL
Year / Part	III / II
Full Marks	80
Pass Marks	32
Time	3 hrs.

Subject: - Industrial Power Distribution and Illumination (EE 653)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

1. a) Explain Electric Load Centre and Diversity Factor with appropriate examples. Also explain their importance in the power distribution. [2+2]
 b) Calculate the cross-sectional area of Aluminium Cable required to supply a single-phase load of 30 kW at a power factor of 0.8 lagging which is 40m away from the voltage source so that the voltage drop does not exceed 3% of the standard supply voltage. Also describe how the conductor is selected for the power supply. [4]
2. What are the points to be earthed? Calculate the size of the earth electrode for plate earthing system, if the soil resistivity is 60 ohm and requires earth resistance is 8 ohm. [8]
3. a) Sketch 3.5 core armored cable used in industry with proper labels. [4]
 b) As an Electrical Designer, you must recommend Residual Current Circuit Breaker (RCD) installation in industrial electrification. Why? Show a connection diagram for RCD of a three-phase industry. [4]
4. Explain briefly the distribution substation in an industry with a single line diagram. State some advantages of indoor substation. [8]
5. a) A conference hall 40 m × 20 m is to be illuminated by 2×20W LED tube lamps. The lamps being mounted at height of 3 m from the working plane, the average illumination required is 150 lux. Calculate the number of lamps to be fitted in the hall, considering utilization factor 0.8, depreciation factor 1.25 and efficiency of lamp is 100 lumen/W. Decide light and power sub circuit. Draw layout diagram showing arrangement of lamps and power socket. Design the distribution board to supply lighting load and power load, the supply system is 3 phase, 4 wire systems, 400V, 50 Hz. [12]
 b) Draw a schematic diagram of the 11/0.4kV H-Pole Distribution Substation explaining the components used. [4]
6. Explain constant current charging system for a battery. Calculate the (i) AH efficiency (ii) WH efficiency of a battery which is discharged at a uniform rate of 30A for 6 hours at an average terminal voltage of 2V. It is then charged at the uniform rate of 40A for 5 hours to restore it to its original condition. The terminal voltage during charging is 2.5V. [4+4]
7. In an industry, 40kW, 92% efficiency standard motors are used for the machine. There are totally 13 motors. The operating efficiency of these motors could be much less than the rated efficiency (92%), since these motors are operating as average load of 27kW. Expected operating efficiency of standard motor at 27kW is 91%. Calculate the energy savings, cost savings and payback period due to replacement of present standard efficiency motor with energy efficient motor of 34 kW (94.5% efficiency). The cost of new motor is Rs. 120,000.00 and energy cost is Rs. 10.50 per kWh. Operating time of motor 8000 hrs per year. [8]
8. Describe the major factors to be considered for outdoor lighting. Describe in detail the design criteria and guidelines of Street Lighting. [8]
9. State and explain Lambert's Cosine Law of Illumination. In a street lighting scheme, lamps having uniform C.P. of 500 are hung at a height of 6 m. The distance between the consecutive lamp posts is 8 m. Find the illumination under the lamp and at center in between the lamps. [2+6]

TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2080 Chaitra

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BEL	Pass Marks	32
Year / Part	III / II	Time	3 hrs.

Subject: - Industrial Power Distribution and Illumination (EE 653)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt **All** questions.
- ✓ The figures in the margin indicate **Full Marks**.
- ✓ Assume suitable data if necessary.



1. a) Describe the importance of complying with electrical rules and standards during the installation and testing phases of an electrical system. [4]
- b) There are four blocks in an industry having connected load of 250 kVA, 200 kVA, 150 kVA and 400 kVA and demand factor of 90%, 80%, 75% and 85% respectively. Use a diversity factor of 1.5. Calculate the size of transformer for the industry if transformer available in the market are 50kVA, 100kVA, 250kVA, 400kVA, 600kVA and 750kVA. [4]
- c) Explain about site evaluation criteria of Substation. Also, prepare a Bill of Quantity of 11/0.4kV 50 kVA H-Pole Distribution Substation. [8]
2. a) About 60% of fire accidents in Nepal are due to short circuits. How selection of cables can help to reduce fire accidents. Why Halogen-free cable is important for Fire Fighting? [4]
- b) Why Splicing cannot be avoided? Explain splicing techniques of an HV Cable. [1+3]
- c) An industrial building has the following loads. [8]
 - i) 5kW, 415V, 3-phase motor, $\eta = \text{pf} = 0.8$
 - ii) 10kW, 415V, 3-phase motor, $\eta = \text{pf} = 0.85$

Determine the size of the cable from MDB to SDB and SDB to the individual motor if the length of each cable is 10m and MCB size. Standard MCB size available are 6A, 10A, 16A, 32A and 40A.

Conductor Area(mm ²)	1.5	2.5	4	6	10
3.5Core XLPE Cu Cable's Current Ratings(A)	21	27	36	45	60

3. a) Why is color rendering important and how CRI help in selecting luminaries? [4]
- b) Explain the different lighting schemes in factory for visual task. [4]
- c) A vertical red wall of size 25 m x 10 m (High) of the monument is to be illuminated by a floodlight from a distance of 30m by fittings planted in the ground. Find the number of fittings/lamps, their arrangement and wattage of lamps if the Average Illumination required is 120 lux, Beam Factor is 0.5, the Maintenance Factor is 0.625, the waste factor is 1.2, Lamp Efficiency is 116 lumen/Watt and Beam Spread (vertical) Angle is 12.5°. [8]
4. a) An office has length of 20m, width of 10m and height of 3m. The ceiling to desk height is 2m and the area to be illuminated to a general is 250 lux using CFL Luminaire with a SHR(max) of 1.25. The maintenance factor is 0.63, Utilization factor is 0.69 and Efficiency of Lamp is 120lumen/Watt. Design a lighting system for this office with number of Lamps, sizing of lamps, luminaries layout, wiring layout and distribution system layout. [10]

- b) What are the methods to reduce earth resistance in an earthing? Explain the complete process of pipe earthing. [3+3]
5. a) Design a Battery Backup system with an inverter for the following loads for 1 days, if DC bus voltage is 48V. [8]

Devices	Qty.	Wattage	Backup Time
Computer	6	100	4
Tube light	24	10	6
Camera	1	60	24
Backup Supply	3	400	6
Induction Cooker	6	550	5
Water Pump	2	2000	6

Following are the battery available:

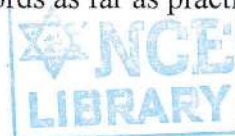
Option 1	12V	200Ah	80% DoD
Option 2	2V	1500Ah	80%DoD

- b) Define Energy Audit. Explain the process of carrying out energy audits in an industry. [2+6]

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BEL	Pass Marks	32
Year / Part	III / II	Time	3 hrs.

Subject: - Industrial Power Distribution and Illumination (EE 653)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.



1. a) Define Load Factor. Consumer A has a load of 20 kW for 5 hrs and Consumer B has a load of 5 kW for 20 hrs. Find the load factor for both consumers and explain the significance of the load factor based on energy expenditure and utility point of view. [4]
- b) How actual load estimation is done in the industrial plants? Explain with the help of proper examples. [4]
2. What are the factors affecting the earth resistance? Explain briefly the earthing process for lightening arrester. [8]
3. Determine the size of cable used from MDB to SDB-1 and SDB-2 for following conditions. The total power on the SDB-1 and SDB-2 are 80 kW and 10 kW respectively. The distance between MDB to SDB-1 and SDB-2 are 10 m and 100 m respectively. The supply is 3 phase system and current ratings of Cu conductor laying in ground are given as. [8]

CS area (mm ²)	1.5	2.5	4	6	10	16	25	35	50
3.5 core cable I rating (A)	21	27	36	45	60	77	99	120	145

4. Explain with an example how will you select the size of the motor of the Lift System for an industry. [8]
5. A hall 120 m×30 m is to be illuminated by twin tube 40W LED fitting. Required illumination for the space is 300 lux, maintenance factor 0.8, and utilization factor 0.8, luminous efficiency of 2×20W LED Tube is 100 lumens/watt. Calculate no. of luminaries required to be fitted. Draw the layout for the Lighting and Power sub-circuit. This hall space will house a Workshop having the following loads: [16]

Types of Loads	Workshop
Lathe Machine (5kVA)	3
Pedestal Drill (2 kVA)	2
Ventilation (2.5kVA)	2
Compressor (15kVA)	1
Oven (15 kVA)	1
7.5 hp pump with $\eta = 80\%$, $p.f = 0.8$	2

Draw the Single Line Diagram and DBs for the power distribution of above loads. Use separate DB for power loads and Lights load. Assuming suitable k_u and k_s , and with the load calculation, determine the size of transformer and CBs required this workshop.

6. Explain different types of lighting scheme used in an industry. Also explain local lighting general lighting and emergency lighting system used in an industry. [4+4]
7. Why is distribution substation important? Explain with single line diagram of 11 kV distribution sub-station. [4+4]
8. Explain the need for power correction. A 1250 kVA generator set is operating at rated load with a pf of 0.8. An additional load of 170 kW at 0.85 pf is to be added. What value of capacitors is required so that the generator is not overloaded? [2+6]
9. What are the main purposes of Installation of Emergency Lighting in Industry? Explain the Trickle Charging method for a battery charging system. [4+4]

Exam.	Regular	
Level	BE	Full Marks 80
Programme	BEL	Pass Marks 32
Year / Part	III / II	Time 3 hrs.

Subject: - Industrial Power Distribution and Illumination (EE 653)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.



1. Why Electrical Load Estimate is important in electrical installation? What are the key features of the supply system to industry? Explain different sources of supply to Industrial Plant. [2+2+4]
 2. What is earthing? Explain its purpose with an example. Mention the points to be earthed in an industrial plant. [2+2+4]
 3. a) Explain the construction of 3.5 armored core power cable used in an industry with a neat sketch diagram. [4]
b) Define distribution substation for an industrial plant. What are the factors to be considered for the selection of location of site for the substation? [4]
 4. a) A factory hall size of 55.75m×40.25m is to be illuminated by LED panel of 30W. Inside hall, an average illumination of 250 lum/m² is to be provided on the working plane. The walls and ceiling are brightly painted. Calculate number of luminaries required to be fitted in the hall. Draw layout diagram showing arrangement of luminaries, switches, and distribution board. Decide the light sub-circuits and the supply is 400V, 3-phase, 4 wire system. Assume value for utilization and maintenance factor are 0.8 and 0.6 respectively, the lamp efficiency is 100 lum/watt. [12]
b) What is an emergency lighting system? Explain about escape lightning system for escape routes. [1+3]
 5. a) Explain the operating principle of MCB. What are the differences between MCB, MCCB and RCCB? What are the cut-off current characteristics of HRC fuse. [4]
b) Define distribution substation for an industrial plant. What are the factors to be considered fore the selection of location of site for the substation? [4]
 6. An industrial building has the following loads.
a) 5kW, 415V, 3-phase motor, pf=0.8
b) 10kW, 415V, 3-phase motor, pf=0.85
Determine the size of the cable from MDB to SDB and SBD to the individual motor if the length of the cable is 10m and MCB size. Standard MCB size available are 6A, 10A, 16A, 32A and 40A. [8]
- | | | | | | |
|--|-----|-----|----|----|----|
| Conductor Area (mm ²) | 1.5 | 2.5 | 4 | 6 | 10 |
| 3.5C XLPE Cu Cable Current ratings (A) | 21 | 27 | 36 | 45 | 60 |
7. Explain diffusion principle and specular reflection principle of street lighting. State the design procedure of flood lighting system. [8]
 8. Explain battery Charger with neat sketch circuit diagram. Explain any two methods for battery charging system. [4+4]
 9. a) Explain the execution phase of Energy Audit. [4]
b) What is Load Management? Explain different Load Management Techniques. [4]

TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2077 Chaitra

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BEL	Pass Marks	32
Year / Part	III / II	Time	3 hrs.

Subject: - Industrial Power Distribution and Illumination (EE 653)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt **All** questions.
- ✓ The figures in the margin indicate **Full Marks**.
- ✓ Assume suitable data if necessary.

1. What is load center? Explain the advantage of the electric load in an industry. [4]
2. How does the size of the transformer is determined for any industrial Power Distribution. Explain in detail with proper examples. [4]
3. Write down general electrical rules related to electrical installation. [4]
4. A drawing hall $40\text{m} \times 20\text{m} \times 6\text{m}$ is to be illuminated with metal filament gas filled lamps to an average illumination of 150 lm/m^2 on a working plane 1m above the floor. Estimate suitable number, size and mounting height of lamps. Assume coefficient of utilization of 0.8 , depreciation factor of 1.2 . Size of lamps is $40 \text{ Watt LED panel light}$ and luminous efficiency of lamp 100 lm/watt . Draw layout diagram showing arrangement of luminaries, switches, power socket and distribution board. Assume the supply system to be $3\text{-phase, } 400\text{V, } 50\text{Hz}$. [12]
5. Calculate the appropriate size of Cu cable for a single phase circuit of 230V connecting three loads. The loads 10kW and 12kW heaters at a distance of 75m and 35m from the supply end and one 10HP motor at a pf of 0.8 lagging at a distance of 70m from the supply end. The permissible voltage drop is 2% of the rated voltage. Necessary table is given below. [4]

Conductor area in sq. mm	1	1.5	2.5	4	6	10	16	25	50
Current rating in Amp	10	13	18	20	30	40	50	70	90
6. State the various type of substation. Draw single line diagram of 11kV distribution substation. [4]
7. State the difference between Emergency power Supply and Back-up power supply. Explain on-line UPS and off-line UPS. [2+6]
8. Explain the need of energy audit for an industry and energy audit technique. [8]
9. What is the main objective of an equipment earthing? Calculate the size of the earth electrode for plate earthing system, if the soil resistivity is 60Ω and required earth resistance is 8Ω . [8]
10. A walkway is illuminated by 250W lamps each having a luminous intensity of 4750 candela in all directions below the horizontal. Each lamp is installed at a height of 6m and the distance between them is 16 meters. Calculate the illuminance contributed by each lamp: [8]
 - a) (i) directly underneath,
 - (ii) 16 meters from the base,
 - b) The total illuminance at Midway between the base of each lamp post.
11. Explain different types of lighting scheme used in an industry. [4]
12. What are technical aspect of energy efficient induction motors? [4]
13. What are the electrical characteristics of the lead-acid cell? Explain the methods of battery charging system. [8]



2076 Bhadra



TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2076 Bhadra

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BEL	Pass Marks	32
Year / Part	III / II	Time	3 hrs.

Subject: - Industrial Power Distribution and Illumination (EE 653)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Necessary figures are attached herewith.
- ✓ Assume suitable data if necessary.

1. Calculate the size of transformer for the given industry (attached figure) considering factor of maximum utilization K_u and factor of simultaneity K_s . [8]
2. a) Explain the cut-off current characteristics of HRC fuse. [4]
b) What are the factors affecting the earth resistance? Calculate the diameter of Rod Earthing system, so that the resistance is 10Ω . Use the length of rod in 5 m and take the soil resistivity to be $65 \Omega\text{-m}$. [4]
3. Explain the procedure for selection of rating of main panel board rating and distribution board with suitable example. [8]
4. a) A building elevation is $50\text{m} \times 16\text{m}$ is to be illuminated by flood lighting projectors situated at 25 meters away. If the illumination is 100 lumen/m^2 , coefficient of utilization is 0.5, depreciation factor 1.5, waste light factor 1.2, estimate the number and size of projectors. Also find out angle of spread. [4]
b) An Industrial shop of size $30\text{m} \times 25\text{m}$ is to be illuminated using 40W LED lamps. Inside the hall an average illumination of 150 lumen/m^2 is to be provided on the working plane. The walls and ceilings are brightly painted. Calculate the number of luminaries required to be fitted in the hall. Draw layout diagram showing arrangement of luminaries, switches, power sockets. Design the distribution board to supply lighting and power load if the supply is 3 phase, 400 V, 50 Hz. Assume suitable value for utilization and maintenance factor and take lamp efficiency as 100 lumen/watt . [12]
5. A main road 2 km long and 7m wide is required to be illuminated by 125 watt sodium vapour lamps. The lamps are mounted on poles 9m high, so that the minimum level of illumination is 1.5 lux. Design a suitable street lighting scheme using 3.5 core underground cable feeder, if coefficient of utilization is 0.5 and efficiency of sodium vapour lamp is 85 lumen per watt. Assume length of span between lamp posts is 30m. [8]
6. In a industry transformer has following details:
a) Rating of the transformer = 1000 kVA
b) Average loading on transformer = 800 kVA
c) Power factor = 0.6 lag
d) No load loss = 1600 watt
e) Full load loss = 13500 watt
Calculate the kVA require to improve p.f. to 0.95, reduction of kVA demand and techno-economic analysis, if the cost of capacitor bank with controlling switches NRs. 1500/kVA and demand charge is NRs. 210/kVA/month. [8]
7. State the difference between Emergency power Supply and Back-up power Supply. Explain on-line UPS and off-line UPS. [8]



2076 Bhadra



8. a) Determine the size of 3.5 core copper cables for MDB to SDB required to carry the maximum current of 60A. It is given that length of cable is 200m. The permissible voltage drop is 2% of supply voltage. The supply system is 3-phase, 400V, 50 Hz. Current ratings of copper conductor is given in table below. [4]

Conductor area in sq.mm	1.5	2.5	4	6	10	16	25	35	50	70	95	120	150
3.5 core cable current rating (A)	21	27	36	45	60	77	99	120	145	175	210	240	270

- b) Explain the trickle charging method for a battery charging system. Calculate the (i) ampere-hour efficiency and (ii) watt-hour efficiency of a secondary cell which is discharged at a uniform rate of 30 A for 6 hr. at an average terminal voltage of 2 V. It is then charged at the uniform rate of 40 A for 5 hr. to restore it to its original condition. The terminal voltage during charging is 2.5 V. [4]
9. Explain the types of electrical installation used in buildings and industries. What type of installation is suitable for a particular function, explain with reason? [8]



15 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2075 Bhadra

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BEL	Pass Marks	32
Year / Part	III / II	Time	3 hrs.

Subject: - Industrial Power Distribution and Illumination (EE653)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Necessary figures are attached herewith.
- ✓ Assume suitable data if necessary.

- How can you locate the distribution substation within the premises of an industry? What factors should be considered when deciding the location of floor distribution board in a building? [8]
- Explain the different factors influencing the Earth Resistance. Calculate the size of the earth electrode for the Plate Earthing system, if the soil resistivity is $50 \Omega\text{-m}$ and required earth resistance is 10Ω . [8]
- Determine the size of cable used from MDB to SDB1 and SDCB2 for following conditions. The total power on the SDB1 and SDB2 are 70 kW and 90 kW respectively. The distance between MDB to SDB1 and SDB2 are 30 m and 120 m respectively. The supply system is 3 phase 4 wire system with 400 volts. Current rating of Copper conductor for laid in ground is given: [4]

Conductor area in sq.mm	1.5	2.5	4	6	10	16	25	35	50	70	95	120	150
3.5 core cable current rating (A)	21	27	36	45	60	77	99	120	145	175	210	240	270

- State various types of sub-station. Draw single line diagram of 11kV distribution sub-station. [4]
- What are the difference between Fuse and MCB? Explain the operating principle of MCB. Discuss about rupturing capacity of HRC fuse. [8]
- State various types of lighting schemes. Explain local lighting, general lighting and emergency lighting used in an industry. [8]
- A hall of size $16 \text{ m} \times 12 \text{ m}$ is to be illuminated by 55 watt LED lamp. Inside the hall, an average illumination of 300 lumen/m^2 is to be provided on the working plane. The walls and ceiling are brightly painted. Calculate the no. of luminaries required to be fitted in the hall. Draw lay-out diagram showing arrangement of luminaries, switches and distribution board. Decide the light sub-circuits if the supply is 400 V, 3-phase 4 wire system. Assume value for utilization and maintenance factor are 0.8 and 0.8 respectively, the lamp efficiency is 90 lumen/watt. [8]
- Explain trickle charging method for battery charging system. A lead acid cell is discharged at a steady current of 4 A for 12 hours, the average terminal voltage being 1.2 volt to restore it to its original state of charge, a steady current at 3 A for 20 hours is required the average terminal voltage being 1.44 volt. Calculate the ampere-hour efficiency and watt-hour efficiency in this particular case. [8]

9. The 750 kVA transformer (iron loss 1500 W and copper loss 11500 W) is estimated to cost approximately Rs. 7,21,577/00. An equivalent transformer of another manufacture is quoted at Rs 7,00,767. The iron loss of the second transformer are 1430 W and copper loss are 9845 W. Is it worth considering the purchase of second transformer instead? Assume per unit cost of electricity be Rs. 7.5. [8]
10. Calculate the size of transformer for given industry (attached figure). Considering factor of maximum utilization K_n and factor of simultaneity k_s . [8]
11. Sketch the 3.5 core armored power cable using in an industry and explain each of the material used in this cable. [8]

Exam.	Details		
Level	BE	Full Marks	80
Programme	BEL	Pass Marks	32
Year / Part	III / II	Time	3 hrs.

Subject: - Industrial Power Distribution and Illumination (EE653)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

1. Explain with examples, select the size of distribution transformer for different application considering factor of maximum utilization and factor of simultaneity. [8]
2. a) A consumer has the following connected loads: 12 lamps of 80 W each and 4 heaters of 100 W each. His maximum demand is 1500 W. On the average consumer uses 8 lamps 6 hours a day and each heater for 4 hours a day. Find load factor and demand factor. [4]
b) Draw and explain a single line diagram of 11 KV supply system used for industrial complex. [4]
3. a) A department store 36m × 15m is illuminated by 45W by LED panel light of output 4800 lumens. The lamp being mounted at a height of 3m from the working plane, the average illumination required is 200 lux. Calculate the number of luminaries required to be fitted in the department store, assuming the coefficient of utilization to be 0.8 and maintenance factor to be 0.8. Also design distribution board and layout of lamps, switches power sockets and sub-circuits, if the supply system is 3-Phase, 400V, 50 Hz. [12]
b) Determine the size of cable used from MDB to SDB-1 and SDB-2 for the following conditions. The total power on the SDB-1 and SDB-2 are 60 kW and 75 kW respectively. The distance between MDB to SDB-1 and SDB-2 are 80m and 125m respectively. The supply system is 3-phase, 4 wire with 400V, 50 Hz. The current ratings of Cu conductor laid in ground are given as follow. [4]

Conductor area (sq.mm)	1.5	2.5	4	6	10	16	25	35	50	70	95	120	150
3.5 core Cu cable current rating (A)	21	27	31	45	60	77	99	120	145	175	210	240	270

4. Explain briefly the design procedure of flood lighting system. A building frontage 50m × 15m is to be illuminated by floodlighting projectors situated 25m away. If the illumination is 100 lux, coefficient of utilization is 0.5, depreciation factor is 1.5, and waste light factor 1.2, estimate the number of projectors of each of size 200W with luminous efficiency of 90 lumen/watt. [4+4]
5. What are the major purposes of the outdoor lighting? Explain methods of street lighting and factors to be considered while designing street lighting. [8]
6. The power factor on an industrial 3φ load 490 kW is to be improved from 0.7 lagging to 0.97 lagging by connecting loss free delta connected capacitor across 11 kV, 50 Hz supply. The cost of Var controlling device with switching is Nrs.2000 per kVAR. [8]
7. Explain the importance of emergency supply system in industrial plant? Differentiate between on-line and off-line UPS with proper schematic diagrams. [8]
8. Why is load scheduling important for industry? Explain about load management in industrial plant. [8]
9. What is the main objective of an equipment earthing? Calculate the size of the earth electrode for plate earthing system, if the soil resistivity is 60 Ω and required earth resistance is 8 Ω. [4+4]

Exam.	New Back (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BEL	Pass Marks	32
Year / Part	III / II	Time	3 hrs.

Subject: - Industrial Distribution and Illumination (EE653)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

1. What is Maximum Demand? With suitable example, explain the need to calculate Maximum Demand in an industrial building. [2+6]
2. Classify the distribution substation of industry according to service and design. Draw and explain the schematic diagram of a distribution substation of a typical industry from 11 kV to end use. [2+6]
3. What are High Intensity Discharge (HID) lamps? Explain the voltage variation effecting different lamps. [4]
4. A department store 30 m × 15 m is illuminated by twin 55W LED luminaries of output 4950 lumens. The lamp being mounted at a height of 3 m from the work plane, the average illumination required is 300 lux. Calculate and arrange the number of luminaries required to be fitted in the department store, assuming the coefficient of utilization to be 0.8 and the maintenance factor to be 0.8. Also design the number of sub-circuit, switches and distribution board, if the supply system is 3-phase, 400V, 50Hz. [12]
5. Explain trickle charging method for a battery charging system. A lead acid cell is discharged at a steady current of 4A for 12 hours, the average terminal voltage being 2.2V. To restore it to its original state of charge. steady current at 3A for 20 hours is required, the average terminal voltage being 2.44V. Calculate the ampere-hour efficiency and watt-hour efficiency in this particular case. [2+3+3]
6. Explain with example, how earthing can protect human from electrical shock. Explain different methods of equipment earthing system used in industrial building. [8]
7. Define current carrying capacity of cable. Write down the factors that affect the current carrying capacity of cable. Describe the method of calculation while determining the size of 3.5 core cable. [8]
8. Calculate the number of lift require to empty a office building having following details: [8]

S.N	Description	Quantity
1	Number of floor	20
2	Total rental area above ground floor (m ²)	20000
3	Estimate rental area per person (m ²)	10
4	Time required empty to building (minute)	60
5	Average floor height of building (m)	3.5
6	Lift capacity number of person in each car	10
7	Speed of lift (meter/minute)	135
8	Estimated stop	1 stop each 10 m
9	Time required at the ground floor for synchronizing	30 Sec
10	Time required above ground floor at each stop	10 Sec

9. a) A 1250 kVA turbine generator set is operating at rated load with a power factor of 0.8. An additional load of 150 kW at 0.85 power factor is to be added. What kVAR value of capacitors is required so that the generator is not loaded? [4]
- b) State the energy saving opportunity in an industrial plant. [4]
10. What are the major purposes of the outdoor lighting? Explain methods of street lighting and factors to be considered while designing street lighting. [8]

Exam.	Regular	
Level	BE	Full Marks 80
Programme	BEL	Pass Marks 32
Year / Part	III / II	Time 3 hrs.

Subject: - Industrial Power Distribution and Illumination (EE653)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

1. a) Explain with example, how does the proper size of transformer determined for a industry. Draw single diagram of electrical connection of 11KV feeder up to end user at 230 V. [4]
- b) Define Electric Load Centre. What are its importance in Industrial power Distribution? [4]
2. a) The size of the industry room is 30m × 20m and it is illuminated by 42 W LED lamp. The efficiency of lamp is 110 lumen/watt and the distance between working plane and mounting height of luminaries is 3 meters. The coefficient of utilization and depreciation factor are 0.75 and 1.2 respectively. Calculate the number of luminaries for the industrial room. Draw neat sketch showing the arrangement of lamps, switches, power sockets and decide the light and power sub-circuits. Design the distribution board to supply lighting loads and power if the supply system is 3 phase, 400V and 50 Hz. [12]
- b) The illumination at a point on a working plane directly below the lamp is to be 100 lumen/m². The lamp gives 250 c.p. uniformly below the lamp horizontal plane. Determine the height at which the lamp is suspended. Also find illumination at a point on the working table 1.2m away from the vertical axis of the lamp. [4]
3. a) What is the major purpose of earthing? Describe the consequences of earth and unearthed system. [4]
- b) Describe the operating principle of MCB. Compare HRC fuse with MCB. Explain the rupturing capacity of MCB and HRC fuse. [4]
4. Explain the purposes of substation in an industrial electrical system. Describe the functions and operating characteristics of indoor substation with proper schematic diagram. [8]
5. a) A 415 V conductor cable is rated at 235 Amperes but is carrying a load of 300A at 0.7 power factor. What KVAR of capacitor is required to reduce the current to its normal rated value? [4]
- b) Explain the classification of electrical installation. [4]
6. An induction motor improves the power factor of a load of 500 KW from 0.707 lagging to 0.95 lagging. Simultaneously the motor carries a load of 100 KW. Find: [8]
- a) The leading KVAR supplied by motor
- b) KVA rating of the motor and
- c) Power factor at which the motor operates
7. a) What is the main difference between power and lighting system? Describe different factors to be considered while determining the sizes of cables. [4]
- b) What do you mean by Vertical Rising Main System? Explain its benefits and uses. [4]
8. a) Explain the emergency supply system for industrial system. [4]
- b) Explain the various type of battery charging system in briefly. [4]
9. Explain briefly the different types of supply system in an industrial plant. Explain detail with necessary diagram one of them. [8]

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BEL	Pass Marks	32
Year / Part	III / II	Time	3 hrs.

Subject: - Industrial Power Distribution and Illumination (EE653)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

1. a) What is electric load center? Explain with example of following terminology [4]
(i) connected load (ii) maximum demand.
- b) Write down the short notes on: (i) Factor of maximum utilization K_u (ii) Factor of simultaneity K_s . [4]
2. a) Define stroboscopic effect. How it can be prevented in factory lighting design. [4]
- b) Explain about emergency power supply system for an industry. [4]
3. A drawing hall $40\text{m} \times 25\text{m} \times 6\text{m}$ high is to be illuminated with LED lamps to an average illumination of 250 lux on a working plane 1 m above the floor. Estimate suitable number, size and mounting height of lamps. Assume coefficient of utilization of 0.8 depreciation factor of 1.2 size of lamp is 45 watt and luminous efficiency of lamp is 90 lm/Watt.
Draw layout diagram showing arrangement of luminaries, switches, power socket and distribution board. Design 3-phase distribution system, if supply system is 400 V, 150 Hz. [12]
4. What are the main objectives of an equipment earthing? Explain in brief the various factors affecting the earth resistance. Calculate the size of plate earthing of the building if size resistivity is $40 \Omega \text{ m}$. [2+2+4]
5. State the types cable used in an industrial installation system. A 3-phase 15 hp, 400 V, 50Hz induction motor is to be installed in a workshop. Assuming the efficiency of the motor to be 85% and power factor 0.8, calculate the size of the unarmoured copper cable to be used if the distance between SDB and motor is 79m. [8]

Conductor area (sq.mm)	1.5	2.5	4	6	10	16	25	35	50	70	95	120	150
3.5 core Cu cable current rating (A)	21	27	36	45	60	77	99	120	145	175	210	240	270

6. a) Write down the general rules for wiring in an industry. [4]
- b) Discuss about fundamental consideration of planning and electrical installation system for industrial building. [4]
7. What is Waste Light Factor? Why is it necessary to be considered in floodlighting design? With a suitable example, explain the process of floodlight calculation? [2+2+4]

8. A factory takes an average load of 1020 kVA at 0.64 p.f.(lag) from the 1600 kVA transformer. The no-load loss and full load loss of transformer are 2.4kW and 18.57 KW respectively. If the unit cost of capacitor bank per kVAr is Rs.800, maximum demand charge is Rs.190 per kVA and unit charge of energy is Rs.7.50. Calculate: [2+2+2+2]
- i) kVAR required to improve p.f. to 0.95
 - ii) Reduction in loss in transformer if the loading duration is 2920 hours per year.
 - iii) Reduction in maximum demand charge
 - iv) Payback Period
9. What are different types of battery charging scheme? Describe each of them with their specific purposes. Which method is most effective? Classify the distribution sub-station of industrial plant according to service and design. Describe the functions and operating characteristics of indoor substation with proper schematic diagram. [4+4]
10. What is the importance of energy audit in any industries? How the energy audit is conducted? [4]

Exam.	BE	Full Marks	60
Level	BE	Full Marks	60
Programme	BEL	Time	3 hrs.
Year / Part	III / II		

Subject: - Industrial Power Distribution and Illumination (EE553)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

1. a) The load pattern of ABC complex is:

[4]

Time	(0:00-4:00)	(4:00-8:00)	(8:00-12:00)	(12:00-16:00)	(12:00-16:00)	(16:00-20:00)	(20:00-24:00)
Load of Block- A in KVA	5	13	18	9	16	22	8
Load of Block- B in KVA	7	19	22	34	17	14	6
Load of Block- C in KVA	3	12	16	24	40	35	4

Calculate:

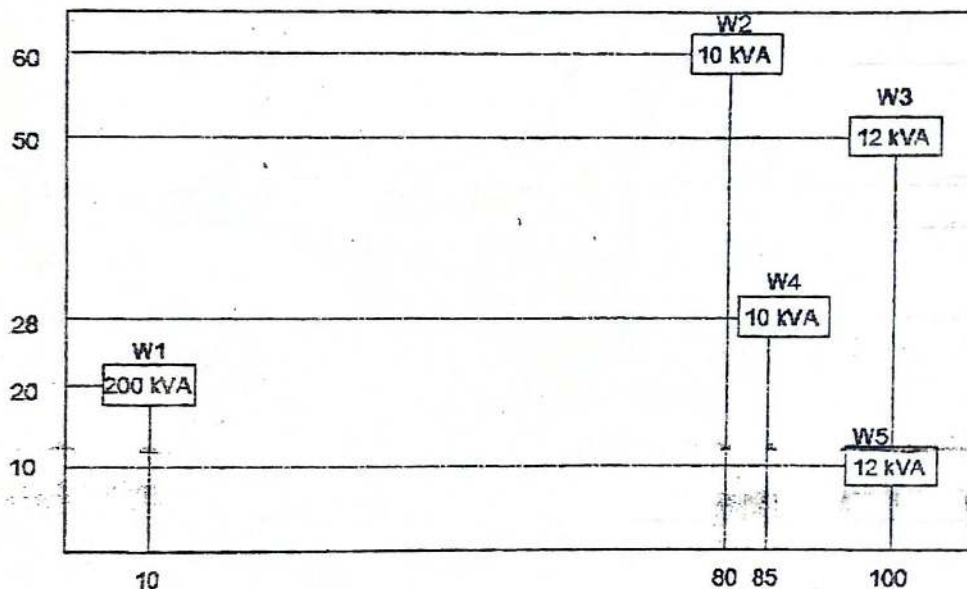
- i.) Capacity of substation required.
 - ii.) Diversity factor
- b) Explain about lighting arrestor used in industrial power distribution. [4]
2. a) Calculate the cross-sectional area of Aluminum cable require to supply a single phase load of 25 KW at power factor of 0.7 lagging which is 40 m away from the voltage source so that voltage drop in the cable does not exceed 3% of the standard supply voltage of 220 V. [4]
- b) Write down general electrical rules related to electrical installation. [4]
3. a) Describe the construction of 3 ½ core armoured aluminum cable. [4]
- b) A person comes in contact with the metallic body of an energized microwave oven. Discuss the consequences during unearthed and earthed conditions. [4]
4. Draw a neat single line diagram of a 11 KV start from 11 KV to end use 230 V. Explain briefly about each component. [8]
5. In a conference hall 20 m × 40 m × 5.5 m is to be illuminated using 2×36 W CFL lamps. Inside hall an average illumination of 108 lumen/m² is to be provided on the working plane. Calculate the number of lamp set required to be fitted in the hall. Decide light and power sub-circuit. Draw layout diagram showing arrangement of lamp set, switches and power socket. Design the distribution board to supply lighting load and power load, the supply system is 3 phase 4 wire system and efficiency of lamp is 60 lm/W. [16]
6. a) A 415 V conductor cable is rated at 235 Amperes but is carrying a load of 300A at 0.7 power factor. What KVAR of capacitor is required to reduce to current to its normal rated value? [4]
- b) Explain about load management in industry. [4]
7. a) What do you understand by generalized lighting? Explain with suitable example why localized lighting cannot be employed alone. [4]
- b) Explain the methods of selection of size and number of lift for office building. [4]
8. Explain the operating principle of MCB. What are the difference between MCB and MCCB? Compare HRC fuse with MCCB. What is rupturing capacity of MCB, MCCB and HRC fuse? [8]
9. What is outdoor lighting? Explain about calculation for flood lighting and street lighting. [8]

Exam.	New Back (2060 & Later Back)		
Level	BE	Full Marks	80
Programme	BEL	Pass Marks	32
Year / Part	III / II	Time	3 hrs.

Subject: - Industrial Power Distribution and Illumination (EE653)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

1. a) Discuss the methodology of selection of transformer for apartment building, residential building and industry. [4]
- b) In the figure below, select the best option for setting the sub-station with suitable justifications. [4]



2. a) How is the size of cable chosen for electrical installation from transformer to MDB, MDB to SDB and SDB to end use? On what factors does the selection primarily depend? [4]
- b) Explain the different types of fuse? Why is a fuse inserted in phase instead of neutral? [4]
3. a) Write down main purposes for installation of emergency lighting in industry. [4]
- b) Describe about prevention of stroboscopic effect in factory lighting. [4]
4. a) Explain various factors influencing the earth resistance. [4]
- b) Why UPS is required for industrial electrification? Explain about On-line UPS. [4]

5. A drawing hall $40\text{ m} \times 25\text{ m} \times 6\text{ m}$ high is to be illuminated LED lamps to an average lux is 90 lm/m^2 on a working plane 1 m above the floor. Estimate suitable number of lamps. Assume coefficient of utilization of 0.8 depreciation factor of 1.2 and spacing / height ratio of 1.2 .

Size of lamps	45 W
Luminous efficiency (in lm/W)	90

[16]

Draw layout diagram showing arrangement of luminaries, switches, power socket and design the distribution board, if the supply system is 3- ϕ , 4-wire system.

6. Calculate the annual cost savings of a 25 hp motor operating at 90% efficiency compared to 85% efficiency, if the operating hours is 8000 hrs/year and the energy cost is $\text{Rs } 7.5$ per kWh .

[8]

7. What is an energy audit? Explain energy audit technique. List out the energy saving opportunities for industrial electrical system.

[8]

8. Explain with examples of following terminology:

[8]

- i) Connected load
- ii) Maximum demand
- iii) Demand factor
- iv) Diversity factor
- v) Load factor

9. Explain the various factors to be taken in to account while designing street lighting and flood lighting scheme.

[8]

Exam.			
Level	BE	Full Marks	80
Programme	EEL	Pass Marks	32
Year / Part	III / II	Time	3 hrs.

Subject: - Industrial Power Distribution and Illumination (EE653)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

1. a) What is electric load center? Explain the advantages of the electric load center in an industry. [8]
- b) Describe the various types of wires or cables usually used in industrial building for power and lighting system. [4]
- c) Determine the size of cable used from MDB to SDB1 and SDB2 for following conditions. The total power on the SDB1 and SDB2 are 80 kW and 10 kW respectively. The distance between MDB to SDB1 and SDB2 are 10 m and 100 m respectively. The supply system is 3 phase 4 wire system with 400 volts. Current ratings of cu. Conductor for laid in ground is given: [4]

Conductor area in sq. mm	1.5	2.5	4	6	10	16	25	35	50	70	95	120	150
3.5 core cable current rating (A)	21	27	36	45	60	77	99	120	145	175	210	240	270

2. Why earthing resistance is kept low? State the methods for equipment earthing systems. Explain one of them. [8]
3. With the help of single line diagram, explain 11 kV to end use of an industry. [8]
4. Classify and explain briefly the distribution sub-stations in an industry, according to service and design. [8]
5. List and explain briefly various types of lighting sources and different methods of lighting schemes used in indoor lighting. [8]
6. A factory hall size of 15 m × 12 m is to be illuminated by metal halide lamp of 70 W. Inside the hall, an average illumination of 200 lumen/m² is to be provided on the working plane. The walls and ceiling are brightly painted. Calculate the no. of luminaries required to be fitted in the hall. Draw lay-out diagram showing arrangement of luminaries, switches and distribution board. Decide the light sub-circuits and the supply is 400 V, 3-phase 4 wire system. Assume value for utilization and maintenance factor are 0.7 and 0.6 respectively; the lamp efficiency is 90 lum/watt. [8]
7. Explain the design procedure of flood lighting system and selection of luminaries for it. [8]
8. Explain trickle charging method for a battery charging system. Calculate the (i) ampere-hour efficiency and (ii) watt-hour efficiency of a secondary cell which is discharged at a uniform rate of 30 A for 6 h at an average terminal voltage of 2 V. It is then charged at the uniform rate of 40 A for 5 h to restore it to its original condition. The terminal voltage during charging is 2.5 V. [8]
9. a) What are the technical aspects of energy efficient motors? [8]
- b) The p.f. of an industrial three-phase load of 490 kW is to be improved from 0.7 lagging to 0.97 lagging by connecting loss free delta connected capacitor across 6.6 kV, 50 Hz supply. The cost of kVAR controlling device with switching is NRs. 1200:00 per kVAR. Calculate: (i) the total kVAR required, (ii) the required value of capacitance and (iii) payback period. [3]

10/05 D.

22 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2071 Magh

Exam.	Ne Back 2066 & 2067		
Level	BE	Full Marks	80
Programme	BEL	Pass Marks	32
Year / Part	III / II	Time	3 hrs.

Subject: - Industrial Power Distribution and Illumination (EE653)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

1. With suitable example, explain the detail procedure for selection of MCCB and MCB for MDB and SDB in industrial electrification. [8]
2. What do you mean by starting, lighting and ignition and station battery in an industry? What are the different methods of battery charging system? [8]
3. a) What is the main objective of an equipment earthing? Explain various factors affecting the earth resistance. [4]
b) What is the coefficient of utilization and explain the factors should be considered while selecting the above. [4]
4. Explain the method calculating total electric load in an industry for selection of a transformer. [8]
5. A process room measuring 30 m × 15 m × 5 m is to be provided with illumination of 200 lux. Assuming the coefficient of utilization and maintenance factors are 0.8 and 0.7 respectively. Calculate the number of luminaries for the process room in an industry, illuminated by twin 40 watt fluorescent lamps. The efficiency of lamp is 60 lum/watt and distance between working plane and mounting height of luminaries is 3 m. Draw a neat sketch showing the arrangement of lamps and switches with light sub-circuits. [8]
6. With an example, explain the various factors to be taken into account for designing schemes for flood lighting and street lighting system. [8]
7. Explain the voltage variation effect in efficiency for the following lamps: [8]
 - a) Incandescent filament lamps
 - b) Compact fluorescent lamps
 - c) Fluorescent lamps
 - d) LED lamps
8. Explain the various systems of cable laying in underground distribution system in an industry. [8]
9. What is distribution substation? Classify the industrial substations with explanation. [8]
10. The p.f. of an industrial three-phase load of 490 kW is to be improved from 0.7 lagging to 0.97 lagging by connecting loss free delta connected capacitor across 6.6 kV, 50 Hz supply. The cost of kVAR controlling device with switching is NRs. 1200.00 per kVAR. Assume kVA demand charge is Rs. 200/kVA/Month. Calculate: [8]
 - a) the total kVAR required
 - b) the required value of capacitance
 - c) pay back period

26 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2070 Bhadra

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BEL	Pass Marks	32
Year / Part	III / II	Time	3 hrs.

Subject: - Industrial Power Distribution and Illumination (EE653)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

1. State the power supply system for industrial plant. Explain detail with necessary diagram one of them. [8]
2. Explain the types of cable normally used in an industrial plant and method of installation for above cable. [8]
3. Explain the procedure for selection of rating of main panel board and distribution board with suitable example. [8]
4. An illumination on the working plane of 75 lux is required in a room 40m × 15m in size. The luminaries are required to be hung 4m above the work bench. Assuming a suitable space height ratio, a utilization factor of 0.8, a lamp efficiency of 60 lumen per watt and maintenance factor is 0.7. Estimate the number and disposition of lamp and switches. Design the sub-circuits, distribution board if supply system is 3 phase 4 wire system and consider 1 × 36 watt FTL with electronic ballast. [8]
5. With an example, explain the procedure for street lighting scheme design. [8]
6. Explain different types of earthing system with neat diagram. [8]
7. Explain various types of battery charging system with sketch. [8]
8. State various types of sub-station. Draw single line diagram of 11 kV distribution sub-station. [8]
9. Explain the need of energy audit for an industry and energy audit technique. [8]
10. Explain different types of lighting scheme used in an industry. [8]

Exam.	New Back (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BEL	Pass Marks	32
Year / Part	III / II	Time	3 hrs.

Subject: - Industrial Power Distribution and Illumination (EE653)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ All questions carry equal marks.
- ✓ Assume suitable data if necessary.

1. Explain the importance of earthing and write the point to be earthed in an industry.
2. With the help of single line diagram, explain the distribution substation in an industry.
3. Explain the general requirements and types of installation of factory lighting system.
4. What is emergency supply system for industrial plant? Differentiate between Ah efficiency and Wh efficiency of battery.
5. In an industry, there are 100 numbers of 1×36 watt fluorescent tubes and 200 numbers of 2×36 watt fluorescent tubes with copper ballast. The p.f. with copper ballast is very poor and is below 0.5. Also, losses in that ballast are very high. Replacing the electronic ballast can avoid these two problems. By laboratory test conducted on 36W fluorescent tube followings are finding: (a) with cu. Ballast power consumed 44W and p.f. is 0.5 (b) with electronic ballast power consumed 37 watt and p.f. 0.9. Calculate the energy cost saving and payback period with electronic ballast; if operating hours are 8 hours/day and electronic ballast cost is NRs 300 per piece, energy tariff is:
6 AM - 6 PM, Rs.5.75 paisa
6 PM - 11 PM, Rs.6.55 paisa
11 PM - 6 PM, Rs.4.00 paisa
And kVA charge per month
Rs. 210.00 paisa
6. Point out factors to be considered while determining the sizes of conductor. Explain construction features of 3.5 core armoured cable.
7. A drawing hall 40m×25m×6m height is to be illuminated with 2×36W fluorescent lamp to an average illumination of 90 Lm/m² on a working plane 1 m above the floor. Estimate suitable numbers, sizes of lamps. Mounting height 1m below the ceiling. Sketch the spacing layout. Assume: coefficient of utilization 0.8 depreciation factor 1.2, space height ratios 1.4 and the lamp efficiency is 60lumen/watt.
8. State 10 factors to be considered while:
 - a) Designing of flood lighting system
 - b) Designing of street lighting system
 - c) Selection of luminaries
9. A factory has an average annual demand of 50 KW and an annual load factor of 0.5. The power factor is 0.75 lagging, the tariff is Rs. 190/KVA/month and energy charge is Rs.7.50 Kwh. If loss free capacitors costing Rs. 600/KVAR are to be utilized. Find the value of power factor at which maximum saving will result. Also determine the saving after improving p.f. and payback period.
10. Explain:
 - a) Electric load centre
 - b) Energy conservation program
 - c) Electrical installation in a factory
 - d) Connected load in an industry.

Exam.	EE	Full Marks	80
Level	EE	Pass Marks	32
Programme	BEL	Time	3 hrs.
Year / Part	III / II		

Subject: - Industrial Distribution and Illumination (EE653)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

- 1 a) Calculate the size of the earth electrode for plate earthing system, if the soil resistivity is 60Ω and required earth resistance is 8Ω . 4
b) What is stroboscopic effect? How can it be minimized? 4
 - 2 State the classification of cables and discuss the general construction features of $3\frac{1}{2}$ core armoured cable. 8
 - 3 An industrial consumer takes steady load of 200 kW at p.f. of 0.707 lagging. He is charged according to two part tariff 'Rs.10/- per kWh and Rs. 200/- per kVA/month. The cost of power factor correcting equipment with switching device is Rs. 1200/- per kVAR.
a) What will be the optimum p.f. at which consumer should take power for minimum annual over all expenditure 8
b) What will be the capacity of the p. f. correcting equipment for maximum economy
c) The annual energy bill if he takes power for 16 hours daily for 350 days in a year.
 - 4 What is electric load centre? In an industry, substation supplies power for four blocks. Block-1 has 6 no. of machines with rating of 70kW, 90kW, 20kW, 50kW, 10kW and 20kW respectively, while maximum demand of block-1 is 200kW. Block-2 has 5 no. of machines of 60kW, 40kW, 40kW, 70kW and 30kW and maximum demand of block-2 is 160kW. Block-3 and 4 has maximum demand of 150kW and 200kW respectively. Determine demand factor of block-1 and 2. If the maximum demand of substation is 600kW, find the diversity factor of the substation. 8
 - 5 What are the power and light sub circuits in an electrification of building? Determine the size of cable used from MDB to SDB₁ and SDB₂, if the total power on SDB₁ and SDB₂ are 50 kW and 60kW, respectively. The distance between MDB to SDB₁ and SDB₂ are 60m and 100m respectively. The supply system is 3phase 4wire system with 400V, 50Hz. Current ratings of 3.5 core copper conductor cable for laid in ground are given below. 8
- | | | | | | | | | | | | | | |
|----------------------|-----|-----|----|----|----|----|----|-----|-----|-----|-----|-----|-----|
| Area in sq. mm | 1.5 | 2.5 | 4 | 6 | 10 | 16 | 25 | 35 | 50 | 70 | 95 | 120 | 150 |
| Current rating (Amp) | 21 | 27 | 31 | 45 | 60 | 77 | 99 | 120 | 145 | 175 | 210 | 240 | 270 |
- 6 Explain the general layout of an indoor-substation with single transformer in an industry. 8
 - 7 A production room of a factory size of 27 m × 45 m is to be illuminated by twin fluorescent tube of 36W. Inside the room an average illumination of 150 lum/m² is to be provided on the working plane. The walls and ceiling are brightly painted. Calculate the no. of luminaries required to be fitted in the room. Draw single line diagram showing arrangement of luminaries, switches and distribution board. Decide the light sub-circuits and the supply is 3-phase 4 wire system. Assume suitable value for utilization and maintenance factor and lamp efficiency is 70lum/watt. 8
 - 8 List and explain briefly various types of light sources and explain the specular reflection principle of street lighting system 8
 - 9 While designing the power and lighting system for an industry, What factors should be considered explain briefly each of them. 8
 - 10 State the difference between emergency and back-up supply system for an industry. Explain the 'ON' and 'OFF' line UPS. 8

m.	Regular / Back		
	vel	BE	Full Marks
Programme	BEL		32
Year / Part	III / II		Time 3 hrs.

Subject: - Industrial Electrification

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

1. Why the HRC fuses are surrounded by quartz sand? Explain cut-off current characteristics of HRC fuse and state the advantages of HRC fuse over Kit-Kat fuse. [8]
2. What is the main objective of an equipment earthing? Explain in brief the various factors affecting the earth resistance. [8]
3. What is an electric drive? Discuss various factors which affect the selection of motor for a particular electric drive. [8]
4. A 30KW, 3 phase, 400V resistance furnace is to employ nickel-chrome strip 0.25cm thick for the 3 phase star connected heating elements. If the strip temperature is 1100°C and that of charge is to 700°C, calculate length and width of the strip per phase. The radiating efficiency is 0.6 and emissivity is 0.9. The specific resistance of the micron alloy is $1.03 \times 10^{-6} \Omega \text{m}$. State any assumption made. [8]
5. a) Explain point to point method of lighting calculation. [4]
b) A department store 30m x 15m is illuminated by twin 40W fluorescent luminaries of output 4800 lumens. The lamp being mounted at height of 3m from the work place, the average illumination required is 200lux. Calculate the number of luminaries required to be fitted in the department store, assuming the coefficient of utilization to be 0.8 and maintenance factor to be 0.8. Also design distribution board and layout the lamps, switches and sub-circuit. If the supply system is 3-phase, 400V, 50Hz. [12]
6. A factory takes an average load of 1020kVA at 0.64 p.f. (lag) from the 1600kVA transformer. The no-load loss and full load loss of a transformer are 2.4kW and 18.57kW respectively. If the unit cost of capacitor bank per kVAR is Rs. 800:00, maximum demand charge is Rs. 190:00 per kVA and unit charge of energy is Rs. 7:50. Calculate: [8]
 - a) kVAR required to improve p.f. to 0.95
 - b) Reduction in loss in transformer if the loading duration is 2920 hrs/year
 - c) Reduction in maximum demand charge
 - d) Payback period
7. Explain trickle charging method for a battery charging system. A lead acid cell is discharged at a steady current of 4A for 12 hours, the average terminal voltage being 1.2V. To restore it to its original state of charge, steady current at 3A for 20 hours is required, the average terminal voltage being 1.44V. Calculate the ampere-hour efficiency and watt-hour efficiency in this particular case. [8]
8. Explain the method of electric load calculation in an industry. [8]
9. Write the causes of poor power factor in an electrical power system and discuss the method of improving it. [8]

Exam.	Back		
Level	BE	Full Marks	70
Programme	BEL	Pass Marks	22
Year / Part	III / II	Time	3 hrs.

Subject: - Industrial Electrification

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

1. Write a detailed note on the construction, operation and use of SP, DP and TP miniature circuit breakers. [8]
2. How the size of cable is chosen for section of electrical installation. [8]
3. Workout the size and length of nichrome wire required for a furnace of 15kW capacity operating at 220V. Assume working temperature of wire 1000°C, temperature of charge 600°C, radiating efficiency as 0.6 and emissivity as 0.9 and resistivity of nichrome as $1.016 \times 10^{-5} \Omega\text{-m}$. [8]
4. With necessary sketch and circuit diagram, explain vapour compression refrigeration cycle and show how cooling effect is produced? [8]
5. a) State various types of lighting schemes and also mention their suitable applications. [4]
b) Calculate the number of luminaries for the process room in an industry. The size of room is 40m × 20m illuminated by twin 40 Watt fluorescent lamp. The efficiency of lamp is 60 lumen/watt and distance between working plane and mounting height of luminaries is 3m and coefficient of utilization and depreciation factor are 0.75 and 1.2 respectively. Draw neat sketch showing the arrangement of lamps, sub-circuit and switches. Design the distribution board to supply lighting loads, if the supply system is 3 phase, 400V and 50Hz. [12]
6. An industry has a lighting load of 100kW as: [8]
 - a) 60kW of 40W fluorescent lamp each with copper ballast
 - b) 40kW of incandescent lamp with 200W each

The lights are at present being used for 3500 hrs/year. Following an energy survey, the plant has decided to change all copper ballast to electronic ballast and all incandescent lamp to fluorescent lamp with electronic ballast. The energy awareness program is expected to result in 10% reduction in lighting hours. Calculate the energy and cost saving considering the following factors:

 - a) The price of electricity is Rs. 7.50 / kWh
 - b) The power consumption of copper ballast and electronic ballast are 8W and 1W respectively
 - c) The cost of electronic ballast is Rs. 500.00/piece
 - d) The cost of FTL fixture is Rs. 900.00 per set with electronic ballast

The lamp life of fluorescent lamp and incandescent lamp are 8000 hrs and 1000 hrs respectively.
7. What are the methods commonly adopted for charging a lead acid battery from an A.C. single phase source. What are the principle components of charger of the above type? [8]
8. Explain the importance of load scheduling in an industry. Discuss the bus arrangement system in an industry and explain with reason which system is more reliable. [8]
9. Define and elaborate with suitable example, "Connected load", "Maximum demand", "Demand factor" and "Load factor". [8]

Exam.		Back	
Level	BE	Full Marks	80
Programme	BEL	Pass Marks	32
Year / Part	III / II	Time	3 hrs.

Subject: - Industrial Electrification

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ All questions carry equal marks.
- ✓ Assume suitable data if necessary.

1. What is dielectric heating? How is it different from induction heating? State the applications of dielectric heating.
2. A 4.5 kW, 200V, single-phase resistance oven has nichrome wire heating elements. If the wire temperature is to be 1000°C and that of the material is 500°C, estimate the diameter and length of the wire. The resistivity of nichrome alloy is 42.5 $\mu\Omega$ -cm. Assume the radiating efficiency and emissivity of the element is 1 and 0.9 respectively.
3. Explain, why electric drive is preferred over mechanical drive? Also justify that individual drive is better than group drive.
4. How does the low power factor affect the rating of the transformers, generators and cables in distribution system of an industry?
5. Explain the various types of electric wiring system. Compare them on the basis of cost, life, maintenance and protection against mechanical injury, fire and moisture.
6. What are the different types of fuse? Why is a fuse inserted in the phase wire, not in the neutral wire? Why are HRC fuses used?
7. Explain the factors governing the amount of illumination at particular place and necessary points to be kept in mind for executing lighting schemes.
8. Explain methods of charging of lead acid battery. A 3-phase 15 hp, 400V, 50 Hz induction motor is to be installed in a workshop. Assuming the efficiency of the motor to be 85% and power factor 0.8, calculate the size of the unarmoured copper cable to be used if the distance between SDB and motor is 79m.

Conductor area in sq mm	1.5	2.5	4	6	10	16	25	35	50	70	95	120	150
Current rating of 3.5 core Cu. cable	21	27	31	45	60	77	99	120	145	175	210	240	270

9. Explain energy conservation opportunities in electrical system and equipments.
10. What are various methods employed for building heating system using electric energy?
