

Exam.	Regular
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. 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 $55.75\text{m} \times 40.25\text{m}$ is to be illuminated by LED panel of 30W. Inside hall, an average illumination of 250 lum/m^2 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]

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Examination Control Division
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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 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-phase, 400V , 50Hz . [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]



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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 $65 \Omega \cdot m$. [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 $50m \times 16m$ is to be illuminated by flood lighting projectors situated at 25 meters away. If the illumination is $100 \text{ lumen}/\text{m}^2$, 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 $30m \times 25m$ is to be illuminated using 40W LED lamps. Inside the hall an average illumination of $150 \text{ lumen}/\text{m}^2$ 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 kVAr 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/kVAr 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]



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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]



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Exam.		Regular	
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1. 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]

2. 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]

3. 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

4. State various types of sub-station. Draw single line diagram of 11kV distribution sub-station. [4]

5. What are the difference between Fuse and MCB? Explain the operating principle of MCB. Discuss about rupturing capacity of HRC fuse. [8]

6. State various types of lighting schemes. Explain local lighting, general lighting and emergency lighting used in an industry. [8]

7. 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]

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]

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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 $36m \times 15m$ 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 $50m \times 15m$ 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 60Ω and required earth resistance is 8Ω . [4+4]

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

Subject: - Industrial Distribution and Illumination (EE653)

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- ✓ Attempt All questions.
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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]

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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 $30m \times 20m$ 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/ m^2 . 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 unearthing 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:
 - a) The leading KVAR supplied by motor
 - b) KVA rating of the motor and
 - c) Power factor at which the motor operates [8]
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]

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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, maximumm 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	50
Level	BEL	Pass Marks	32
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Subject: - Industrial Power Distribution and Illumination (EE453)

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- ✓ Attempt All questions.
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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:

- Capacity of substation required.
- 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 unearthing 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 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.

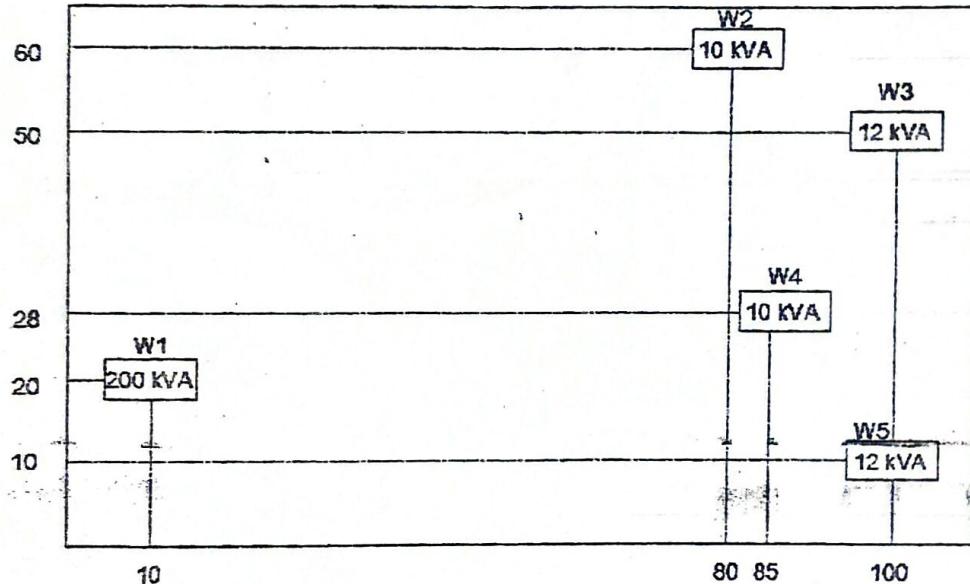
[8]

Exam.	New Basis (2060 & Later)		
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- ✓ Attempt All questions.
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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.

[16]

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

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 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 $15 \text{ m} \times 12 \text{ m}$ is to be illuminated by metal halide lamp of 70 W. Inside the hall, an average illumination of 200 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 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 kVA_r controlling device with switching is NRs. 1200.00 per kVA_r. Calculate: (i) the total kVA_r required, (ii) the required value of capacitance and (iii) payback period. [5]

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 INSTITUTE OF ENGINEERING
Examination Control Division
 2071 Magh

Exam.	No. Back	Full Marks	Time
Level	BE	Full Marks	80
Programme	BEL	Pass Marks	32
Year / Part	III / II		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 $30 \text{ m} \times 15 \text{ m} \times 5 \text{ m}$ 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 kVA_r controlling device with switching is NRs. 1200.00 per kVA_r. Assume kVA demand charge is Rs. 200/kVA/Month. Calculate: [8]
 - a) the total kVA_r required
 - b) the required value of capacitance
 - c) pay back period

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 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 $40\text{m} \times 15\text{m}$ 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 1x36 watt fluorescent tubes and 200 numbers of 2x 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 0.5b) 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.	Date: 15-03-2066 V.L. No. 100		
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. 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. 8
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. 8
- Current ratings of 3.5 core copper conductor cable for laid in ground are given below.
- | 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. year	Regular / Back
BE	Full Marks 20
Programme BEL	Pass Marks 12
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.
 b) A department store $30\text{m} \times 15\text{m}$ 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:
 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 [8]
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
Programme	BEL	Poss Marks
Year / Part	III / II	Time

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 $1.016 \times 10^{-6} \Omega\text{-m}$. [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.
 b) Calculate the number of luminaries for the process room in an industry. The size of room is $40\text{m} \times 20\text{m}$ 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:
 a) 60kW of 40W fluorescent lamp each with copper ballast
 b) 40kW of incandescent lamp with 200W each [8]
 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
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	Full Marks	80
Programme	Pass Marks	32
Year / Part	III / II	Time

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 $42.5 \mu\Omega\text{-cm}$. 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?
