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.*

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 Ω-m and required earth resistance is 10 Ω. [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 Cupper 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 m× 12 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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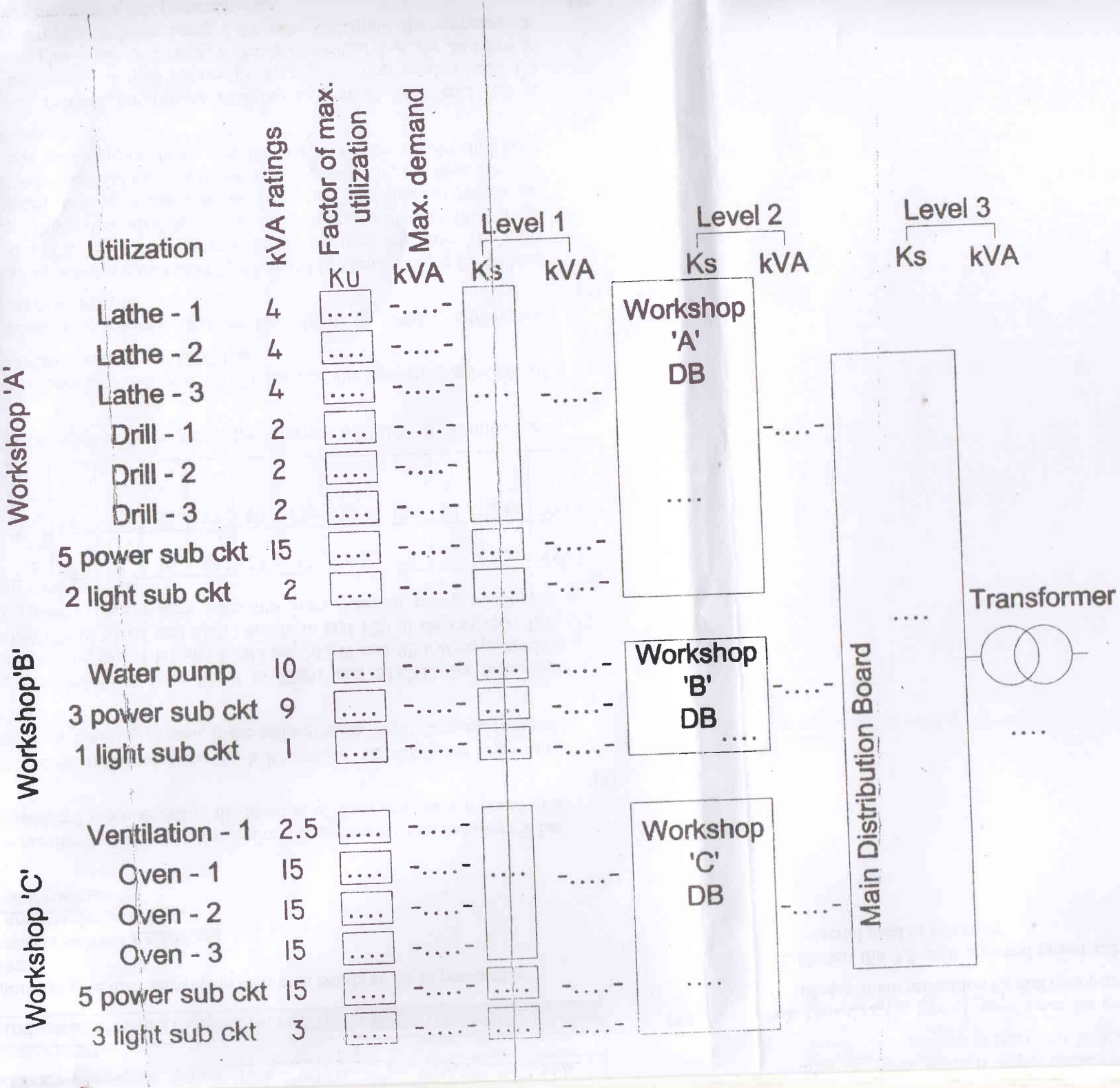
Utilization
kVA ratings
Factor of max. utilization
Ku
Max. demand
kVA
Level 1
Ks
kVA
Level 2
Ks
kVA
Level 3
Ks
kVA
Workshop 'A'
Lathe - 1 4
Lathe - 2 4
Lathe - 3 4
Drill - 1 2
Drill - 2 2
Drill - 3 2
5 power sub ckt 15
2 light sub ckt 2
Workshop 'A' DB
Workshop'B'
Water pump 10
3 power sub ckt 9
1 light sub ckt 1
Workshop 'B' DB
Workshop 'C'
Ventilation - 1 2.5
Oven - 1 15
Oven - 2 15
Oven - 3 15
5 power sub ckt 15
3 light sub ckt 3
Workshop 'C' DB
Main Distribution Board
Transformer

26 TRIBHUVAN UNIVERSITY
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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 × 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

TRIBHUVAN UNIVERSITY
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Exam.	Regular		
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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.
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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 × 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 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:
   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

26 TRIBHUVAN UNIVERSITY
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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.*
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1. a) What is electric load center? Explain with example of following terminology (i) connected load (ii) maximum demand. [4]

   b) Write down the short notes on:(i) Factor of maximum utilization K_u (ii) Factor of simultanity 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 40m×25m×6m 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 Ω 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 is 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]

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