MECH3422 Building Services Engineering I

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Exercise 01 – Electrical Services Systems

1. Calculate the total current demand of a residential flat (single phase 220V) with and without the diversity factor: (see Appendix for the diversity factor)
   - 6 nos. of 100 W light bulbs and 4 nos. of 40 W fluorescent lights
   - 1 no. of 1.5 HP and 2 nos. of 1 HP air conditioners
   - 1 no. of 3000 W electric heater (thermostatically controlled)
   - 2 set of 30 A ring circuits for 13A socket outlets

   Notes:
   - For fluorescent lights, add 80% for ballast & control
   - Typical current demand of air conditioners:

Cooling capacity	Current demand
3/4 HP (7000 Btu/h)	3.5 A
1 HP (9000 Btu/h)	4.3 A
1.5 HP (12000 Btu/h)	6.5 A
2 HP (17000 Btu/h)	10 A

2. Calculate the total current demand of a shop (3 phase 380V) with the diversity factor:
   - 40 nos. of 100 W light bulbs
   - 24 nos. of 60 W fluorescent lights
   - 2 sets of 12 kW 3-phase machines with 0.87 power factor and 90% efficiency
   - 3 nos. of 18 kW 3-phase electric heaters (instantaneous)
   - 3 sets of 30 A ring circuits for 13A socket outlet

3. Define clearly the following terms used in electrical protection and safety. Illustrate with diagrams if necessary.

   i) Earthing
   ii) Equipotential bonding
   iii) Exposed conductive part
   iv) Extraneous conductive part
   v) Short-circuit current

4. Briefly explain the scope of protection and safety for electrical supply systems under the following two categories. What are the three common types of earthing systems used in buildings?

   i) Protection from fire & burns
   ii) Protection against electric shock

Appendix: Allowance for Diversity

This table is applicable to installations having a current demand not exceeding 400A in each phase. (Extracted from Code of Practice for Electricity (Wiring) Regulations 2009 Edition)

Purpose of Conductors or Switchgear to which Diversity Applies	Type of Premises		
	Individual Household Installations, Individual Dwellings of a Block	Small shops, Stores, Offices and Business Premises	Small Hotels, Boarding Houses, Guest Houses, etc.
1. Lighting	66% of total current demand	90% of total current demand	75% of total current demand
2. Heating and Power (Also see 3 to 10 below)	100% of total current demand up to 10 amperes + 50% of any current demand in excess of 10 amperes	100% f.l. of largest appliance + 75% f.l. of remaining appliances	100% f.l. of largest appliance + 80% f.l. of 2nd largest appliance + 60% f.l. of remaining appliances
3. Cooking Appliances	10 amperes + 30% f.l. of connected cooking appliances in excess of 10 amperes + 5 amperes if socket outlet incorporated in unit	100% f.l. of largest appliance + 80% f.l. of 2nd largest appliance + 60% f.l. of remaining appliances	100% f.l. of largest appliance + 80% f.l. of 2nd largest appliance + 60% f.l. of remaining appliances
4. Motors (other than lift motors, see 8)	---	100% f.l. of largest motor + 80% f.l. of 2nd largest motor + 60% f.l. of remaining motors	100% f.l. of largest motor + 50% f.l. of remaining motors
5. Water-Heaters (instantaneous type)	100% f.l. of largest appliance + 100% f.l. of 2nd largest appliance + 25% f.l. of remaining appliances	100% f.l. of largest appliance + 100% f.l. of 2nd largest appliance + 25% f.l. of remaining appliances	100% f.l. of largest appliance + 100% f.l. of 2nd largest appliance + 25% f.l. of remaining appliances
6. Water-Heaters (thermostatically controlled)	No diversity allowable Note: It is important to ensure that the distribution board is of sufficient rating to take the total load connected to it without the application of any diversity.		
7. Thermal Storage Space Heating Installations			
8. Lift motors	Note: Subject to requirements specified by the lift engineer registered under Cap. 327, Lifts & Escalators (Safety) Ordinance.		
9. Water Pumps	100% f.l. of largest pump motor + 25% f.l. of the remaining motors		
10. Air conditioners	100% f.l. of the air-conditioner(s) in the bed-room(s) or in the living room(s), whichever is larger and 40% f.l. of the remaining air-conditioner(s)	100% of current demand of largest point of utilisation + 75% of current demand of every other point of utilisation	100% of current demand of largest point of utilisation + 75% of current demand of every other point of utilization
11. Arrangements of Final Circuits in accordance with code 6D	100% of current demand of largest circuit + 30% of current demand of every other circuit	100% of current demand of largest circuit + 40% of current demand of every other circuit	
12. Arrangements of Final Circuits in accordance with code 6E	100% of current demand of largest circuit + 40% of current demand of every other circuit	100% of current demand of largest circuit + 50% of current demand of every other circuit	