Exercises on Load and Energy Calculations

1. What are the major components of space cooling load? Draw a flow-chart diagram to explain the basic principles of cooling load calculation.

2. Determine the cooling load due to sensible and latent heat gains from the occupants for an office building as described below.

• Office building:	• Cooling load estimation data:

- Floor area = 150 m x 70 m
 - Working time = 8 hours
 - Occupant density = 12.5 m^2/person
	- Cooling load factor (CLF) = 0.84
	 - Heat gain from occupants:-
	   - Total heat = 115 W per person
	   - Sensible heat = 70 W per person

3. Explain the three common steady-state methods for energy calculation in buildings. What is the major limitation of these methods?

4. An engineer has performed load and energy calculations for a building using a building energy simulation program. A brief summary of the results is given below.

    *   Design space cooling load:

        - Total sensible cooling load = 75.9 kW
        - Total latent cooling load = 52.5 kW

    *   Building energy performance:

        - Annual energy consumption = 589,000 MJ
            - Lighting = 204,000 MJ   - Fans = 84,000 MJ
            - Equipment = 77,000 MJ   - Heat reject = 5,000 MJ
            - Space heat = 55,000 MJ   - Pumps & miscell. = 3,000 MJ
            - Space cool = 141,000 MJ - Domestic hot water = 20,000 MJ

    Calculate the sensible heat ratio and the design flow of the cooling supply air if the temperature difference between the supply air and room air is 11 ºC. Assume air density is 1.2 kg/m^3 and specific heat of air is 1.02 kJ/kg.K.

    If the total floor area of the building is 929 m^2, determine the energy utilization index (kWh/m^2/year) of the building energy consumption and calculate the percentage of energy use due to HVAC systems.