Q.1 The peak load on a power plant is 60 mw. The loads having max. demands of 30 mw, 20 mw, 10 mw & 14 mw are connected to the power plant. The capacity of the power plant is 80 mw and the annual load factor is 0.50 Estimate (a) The avg. load on the power plant

(b) The energy supplied per year

(c) The demand factor

(d) The diversity factor

(a) Load factor = $\dfrac{\text{Average load}}{\text{Peak load}}$

$$0.5 = \frac{\text{avg. load}}{60 \text{ mw}}$$

Average load = 30 mw

(b) Energy supplied per year = avg. load × 8760h

$$= 30 \times 8760 \text{ mwh} = 262.8 \times 10^6 \text{ kwh}$$

(c) Demand factor = $\dfrac{\text{Max. demand}}{\text{Connected load}} = \dfrac{60}{30+20+10+14}$

$$= \frac{60}{74} = 0.811$$

(d) Diversity factor = $\dfrac{\text{Sum of Individual max. demands}}{\text{Simultaneous max. load}}$

$$= \frac{30+20+10+14}{60} = \frac{74}{60} = 1.233$$

Q.2

Explain the factors which are considered in location of power plant

The location of Hydro electric power plants is usually predetermined by the availability of water and the water head which is utilized. For Conventional base load thermal power plants, the following factors are to be considered

1. Availability of Cooling water (if cooling towers are used the possibility of adequate make up water.)

2. Availability of fuel (water, rail or pipe connection to the fuel source, and the cost of fuel transport.

3. Distance from the centre of gravity of load demand.

4. Cost of land (including space for extension, maintenance workshop & storage yard).

5. Character of soil.

6. Main. wind direction and water currents in cooling water source (sea, lake or river) in order to minimize atm & water pollution and other ecological considerations

7. with Coal - fired stations, disposal of ash.

8. If the plant is erected far from a town, accomodation for staff.

9. Rail & Road connections.

10. Security considerations.

Q.3 Explain two other factors for Nuclear power plant

For Nuclear power plant two additional factors are to be considered.

01 Density of population in the vicinity
02 Danger of earthquakes

Q.4 Fixed cost mainly consists of
Taxes

Q.5 Operation & maintenance cost consists of miscellaneous expenses.

Q.6 Explain the points of power plant economics

A power plant should provide a reliable supply of electricity at minimum cost to the consumer. The cost per kWh ₁₀ is determined by :-

1   Fixed cost (FC), mainly interest, depreciation, insurance, taxes, depending on the capital invested i.e, on the construction costs of the plant including the cost of the land.

2   Operation & maintenance (O&M) costs covering salaries & wages, overhauling of equipment, repairs including spare parts, water, lubricating oil, chemicals & miscellaneous expenses.

3 | Fuel costs, depends on the amount of electricity generated.

4 | Kwh_{net} of electricity sent out per year.

The total annual costs (c_t) in a power plant can be calculated from

$$c_t = \frac{I+D+T}{100} \, c_c + (w + R + m) + c_f \quad \text{──①}$$

Where I = Interest, %., D = Depreciation, %
T = Taxes & Insurance, %, c_c = Construction cost
w = wages & salaries, R = Repairs (maintenance)
m = miscellaneous & , & c_f = Fuel cost

The annual cost of electricity sent out by a power plant (Kwh_{net}) is given by

$$Kwh_{net} = Kw_{inst} \times 8760 \times \left(1 - \frac{l_{aux}}{100}\right) \times \eta \quad \text{──②}$$

Where Kw_{inst} = Rated (installed) output of generators
L_{aux} = power Consumption by the auxiliaries, %
η the plant capacity factor, and
8760 = 24 × 365 hours per year.

A measure for the relieability of a power plant is the forced outage rate defined by the annual ratio of

$$\frac{\text{Forced outage hours}}{\text{Service hours} + \text{Forced outage hours}}$$