



PART B — (5 × 13 = 65 marks)

11. (a) The population of a town as per census record is furnished below. Forecast the population in the year 2041 and 2051 using the following methods:

- (i) Arithmetical increase method  
 (ii) Geometrical increase method  
 (iii) Incremental increase method

Census Year	1941	1951	1961	1971	1981	1991	2001	2011	2021
Population	25300	34642	40487	46816	55859	61458	68543	78131	106500

Estimate the water demand at 135 Lpcd for the year 2041 and 2051 by incremental increase method.

Or

- (b) Enumerate and explain the characteristics of surface water and ground water. Also state their environmental significance.
12. (a) What are the important considerations, which govern the selection of site of an intake? Draw a neat sketch of a reservoir intake and explain the salient features.

Or

- (b) A centrifugal pump is installed in a water supply system with a population of 62000 at a per capita water supply rate of 90 Lpcd to raise water from one reservoir to another. The water surface elevation in the first reservoir is 150 m and that in the second reservoir is 200 m. The pipeline connecting the reservoir is 3.6 km and it is proposed to operate the pumping system continuously for 16 hours per day. Design the economic diameter of the pumping main. Also calculate the power requirement of motor by assuming overall efficiency as 80%. What will be the annual energy consumption charges? Assume  $C_H$  value of pipe as 110 and energy charge per unit is Rs.6/- (Rupees Six only)

13. (a) Explain the working principle of a clarifloculator with a neat diagram and give the design criteria.

Or

- (b) Explain the different unit operations and processes involved in surface water treatment and their functions.

14. (a) Design a zeolite softener for an industrial establishment working for 2 shifts of 8 hours each for the following data and draw a neat sketch of the unit.

Soft water requirement =  $2 \times 10^6$  L/d in 16 hours

Raw water hardness = 400 mg/L as  $\text{CaCO}_3$

Product water hardness = 50mg/L as  $\text{CaCO}_3$

Exchange capacity of the resin = 30 kg ( $\text{CaCO}_3$ )/ $\text{m}^3$

Salt required for regeneration = 50 kg (NaCl) /  $\text{m}^3$  of resin

Or

- (b) Explain the working principle of desalination plant and explain the design procedure.
15. (a) Find the flow in each pipe in the Loop shown in Fig.1. Use Hardy Cross method for analyzing the Loop. Consider  $C_H$  as 110 for all pipes

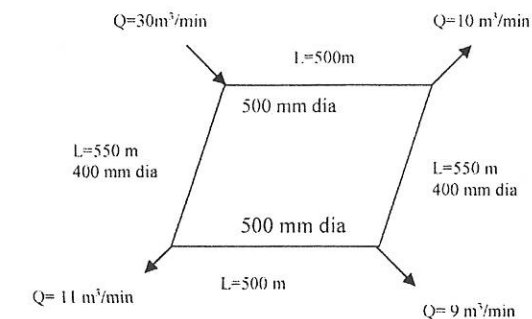


Fig.1

Or

- (b) Draw a neat sketch of a water supply service connection from the street main to a residential building and state the functions of each fitting.

PART C — (1 × 15 = 15 marks)

16. (a) A centrifugal pump with the following characteristics is installed in a system to raise water from one reservoir to another. The water surface elevation in the first reservoir is 150 m and that in the second reservoir is 200 m. The pipeline connecting the reservoir is 3 km of 300 mm diameter. Determine the operating point in the system. Take  $C_H = 110$ . Also compute WHP and BHP of the pump assuming pump efficiency of 70%.

Pump discharge, Lpm    0    650    1400    2150    3000    3650

Total dynamic head, m    63.0    60.5    56.0    49.5    36.5    21.0

Or