MODEL ANSWER
B.Tech 6th Sem Mid-Term Examination, 2019
ENVIRONMENTAL ENGINEERING-I
Subject Code: 011X18

Qu1

Ans (i) D (v) C
(ii) A (vi) C
(iii) D (vii) B
(iv) D

Qu2

Ans The computation of population by various methods can be illustrated through table given below:—

Prediction of Population

Year	Population	Increase per decade	Incremental Increase	Percentage Increase	Decrease in Percentage Increase
1940	20,000	—	—	—	
1950	24,500	4,500	—	22.5	—
1960	29,500	5,000	500	20.4	2.1
1970	35,200	5,700	700	19.3	1.1
Total		15,200	12,00	62.2	3.2
Average		5,070	600	20.7	1.6

Population in 1980 :—

1) Arithmetical Progression Method = 35,200 + 5,070 = 40,270

2) Geometrical Progression Method

$$= 35,200 + \frac{20.7}{100} \times 35,200 = 42,486$$

3) Incremental Increase Method

$$= 35,200 + 5,070 + 600 = 40,870$$

4) Changing Increase Rate method

$$= 35,200 + \frac{19.3 - 1.6}{100} \times 35,200$$

$$= 41,430$$

Qn 6 Design a rapid sand filter unit for 4.5 mld

Ans

a) Filter size

Design discharge = 4.5 mld

With 4% as the allowance for washwater, total discharge to be treated in the filter = $\frac{4.68 \times 24}{23.5} = 4.78$ mld

Let rate of filtration be 5,000 lits/m²/hr.

$= 5 \text{ m}^3/\text{m}^2/\text{hr}$.

Filter area required

$= \frac{4.78 \times 10^6}{24 \times 5000} = 39.8 \text{ m}^2$

Providing 2 No filter units, each of size 5m × 4m

$\left(\frac{L}{B} = 1.25\right)$

Total area provided $= 2 \times 5 \times 4 = 40 \text{m}^2$

b) Depth of sand bed

Assume depth of sand = 60cm

effective size = 0.65 mm

Terminal loss of head = 2.5 m

Break-through index B = 4×10^{-4}

$H_s = \frac{2 \times 5 \times 0.65^3 \times 2.5}{29323 \times 4 \times 10^{-4}} = 0.58 \text{ m}$

c) Depth of Gravel bed

Assuming gravel size gradation of 3 mm at top increasing to 50 mm

Provide a gravel depth of 45cm

d) underdrains

Total area perforations

= 0.2% of total filter area.

$= \frac{1}{500} \times 5 \times 4$ [for each unit]

$= 0.04\ m^2$

Laterals may be assumed to have a spacing of 15cm (Max^{m} 30cm)

Total no. of laterals

$= \frac{5 \times 100}{15} = 33.3$ say 34

Length of lateral = $\frac{1}{2}$ width of filter $-\frac{1}{2}$ dia of a manifold

$= 4 \times 100/2 - 45/2 = 177.5cm$

$= 1.775\ m$

Let n be of total no of perforations of 13mm dia

Total area of perforations $= 0.04\ m^2$

$= 400\ cm^2$

$$n \times \frac{\pi}{4} \times 13^2 = 400$$

$$n \times 1.33 = 400$$

$$n = 300$$

No of perforations per lateral

$= \frac{300}{68} = 4.47$

Area of perforations per lateral

$= 4.47 \times 1.33 = 5.94\ cm^2$

Now area of lateral = 2x area of perforation per lateral

$= 2 \times 5.95 = 11.88\ cm^2$

Dia of lateral = 3.89 cm

$$\frac{\text{Length of lateral}}{\text{Dia of lateral}} = \frac{177.5}{3.89}$$

$$= 45.6 < 60$$

Let rate of washing be 45 cm/mt

Then wash water discharge

$$= \frac{45 \times 5 \times 4}{100 \times 60} = 0.15 \text{ cumecs}$$

$$\text{Velocity of flow in lateral} = \frac{0.15 \times 10{,}000}{68 \times 11.88}$$

$$= 1.86 \text{ m/sec}$$