Hall Ticket Number:

II/IV B.Tech(Regular) DEGREE EXAMINATION

August, 2022 — **Civil Engineering**

Fourth Semester — **Environmental Engineering**

Time: Three Hours — **Maximum:70 Marks**

Answer question 1 compulsory. **(14X1 = 14 Marks)**

Answer one question from each unit. **(4X14=56 Marks)**

1.	a)	List out the various sources of water.	CO1	
	b)	Define design period	CO1	
	c)	What are the objectives of water supply schemes	CO1	
	d)	Define fire demand	CO1	
	e)	What is the principle of slow sand filters	CO2	
	f)	Define coagulation	CO2	
	g)	What is Pre chlorination process	CO2	
	h)	Define sullage.	CO3	
	i)	Define BOD	CO3	
	j)	What are catch basins	CO3	
	k)	What is attached growth system?	CO4	
	l)	What is the principle of Activated sludge process	CO4	
	m)	Define MLSS and where do you encounter this term?	CO4	
	n)	What is the function of grit chambers?	CO4	

Unit –I

2.	a)	Explain the factors affecting per capita demand.	CO1	7M
	b)	List out the methods of population forecasting and Explain any one method in brief.	CO1	7M

(OR)

3. a) Estimate the population for the year 2021 and 2031 for a town, whose census data are given below, by Arithmetical Increase and Geometrical Increase method — CO1 — 14 M

Year	1961	1971	1981	1991	2001	2011
Population	1,82,564	2,10,300	2,66,000	3,20,400	3,80,000	4,60,000

Unit –II

4. a) Derive stokes law for settling velocity with its limitations. — CO2 — 14M

(OR)

5.	a)	Differentiate between rapid and slow sand filters.	CO2	7M
	b)	Explain coagulation process in brief also list out the types coagulants used.	CO2	7M

Unit –III

6. a) Derive an expression for the estimation of ultimate first stage BOD? — CO3 — 14M

(OR)

7.	a)	Discuss any two Sewer Appurtenances with neat sketch.	CO3	7M
	b)	Explain the Physical and Chemical characteristics of sewage.	CO3	7M

Unit –IV

8. a) Explain briefly the components, principle and working of trickling filters with neat sketch — CO4 — 14 M

(OR)

9.	a)	Explain Sludge bulking and sludge volume index.	CO4	4M
	b)	Explain the various methods of aeration in activated sludge process.	CO4	10M

SCHEME

(II/IV B.Tech Regular Degree Examination)

Subject: Environmental Engg.

20CE402

(70M)

I (1X14M=14M)

a) List out various sources of water.

Sources of water → Surface sources ex. Rivers, Lakes, streams etc.
→ Sub-surface sources (Groundwater sources) ex. Wells.

b) Define design period?

- is the period in to the future for which the estimate is to be made.

The period should neither be too long nor too short.

W/S scheme D.P is varying b/n 20-30 years.

c) What are the objectives of water supply schemes.

1) To supply safe & wholesome water to the consumers
2) To supply water in adequate quantity.
3) To make water available within easy reach of consumers.

d) Define fire demand?

The amount of water required for fire fighting is called fire demand.

e) What is the principle of SSFs?

Slow sand filter works on gravity principle.

f) Define coagulation.

Certain chemicals when added to water, form an insoluble, gelatinous pricipitate for

absorbing suspended and colloidal matter to help in removing fine particles completely and rapidly. This process is called coagulation.

g) What is prechlorination
Chlorine (or) Chlorine compounds are added before filtration is called prechlorination.

h) Define Sullage?
Sullage is wastewater coming from bathrooms, kitchen and wash basins.

i) Define BOD?
The amount of oxygen required for stabilizing organic matter under aerobic condition.

j) What are catch basins?
Catch basins are some type of inlets, here collected sewage is settled and drained to storm water drain.

k) What is attached growth process?
Trickling Filter works on the principle of attached growth process. In this process medium is provided to attach and grow for microbes

l) What is the principle of Activated Sludge process
Principle of ASP is Suspended growth process.

m) Define MLSS and where do you encounter this term?

MLSS: Mixed Liquor suspended Solids. Suspended Solids present in mixed liquor of Aeration tank in Asp.

n) What is the function of grit chambers? are provided to remove inorganic Grit of sand, silt, cinders, broken glass, small fragments of metal and other small inorganic materials.

Grit → egg shells, bone chips

sp. gravity > (2.4 - 2.65)

UNIT-I

2) a) Explain the factors affecting per capita demand? --- (7M)

1. Climate.
2. Class of Consumer
3. Industrial and Commercial activities
4. Quality of water
5. pressure in the distribution system
6. Extent of metering
7. sewage facilities
8. system of supply
9. Number of inhabitants
10. Public services
11. Availability of Supplementary Sources
12. Cost of water.

| Any Seven points with explanation

2)b) List out the methods of population forecasting and Explain any one method in brief. (7M)

population forecasting methods:

1. Arithmetical Increase method
2. Geomentrical Increase method
3. Incremental Increase Method
4. Graphical Methods
   - Graphical Extention Method
   - Graphical Comparision Method

etc.

List of methods --- 3M

Any one method

Explanation --- 4M

(Equation)

7M

[OR]

3)a) Estimate the population for the year 2021 & 2031 for a town, whose census data are given below by Arithmetical Increase and Geometrical Increase method.

YEAR	POPULATION	Increase in Population per decade	% increase in Population per decade
1961	1,82,564	-	-
1971	2,10,300	27736	15.19
1981	2,66,000	55,700	26.49
1991	3,20,400	54,400	20.45
2001	3,80,000	59,600	18.60
2011	4,60,000	80,000	21.05
	Total	277436	101.78
	Average	$I = \frac{277436}{5} =$	$I_g = \frac{101.78}{5}$
		$I = 55487.20$	$I_g = 20.36\%$

Population in the year of 2021

Arithmetical Increase Method

$n = \frac{(2021 - 2011)}{10} = 1$

$n = 1$

$P_{2021} = [P + nI]$ P = present population = 460000

$= 460000 + 1 \times 55487$

$n = 2 = 515487$

$P_{2022} = 460000 + 2 \times 55487$

$= 570974$

Geometrical Increase method

$P_n = P\left(1 + \frac{I_g}{100}\right)^n$

$P_{2021} = 460000\left(1 + \frac{20.36}{100}\right)^1$

$= 553656$

$P_{2022} = 460000\left(1 + \frac{20.36}{100}\right)^2$

$= 662400$

Each method 7M x 2 = 14M

UNIT-II

4) Derive Stoker law for settling velocity with its limitations.

Settling Velocity

$(V_s) = \frac{g}{18}(S_s - 1)\frac{d^2}{\vartheta}$

Derivation --- 10M

Limitations -- 4M

14M

[OR]

5) a) Differentiate between Rapid and Slow Sand filter. Compare w.r.to → Rate of filtration, Washing phenomina, Area etc.

Comparison (7) points × 1M = 7M

b) Explain coagulation process in brief also list out the types of Coagulants used. (7M)

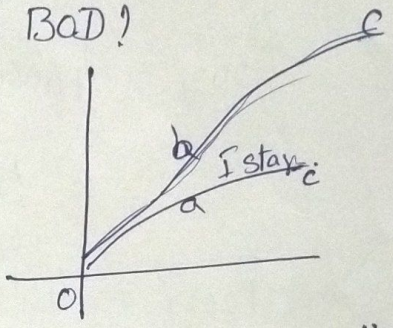
Explanation about Coagulation } ~~4M~~ 3M — Mechanism of Coagulation { Floc formation, Electric Charge

List of Coagulants with chemical formulae — ~~3M~~ 4M, ~~4M~~ 7M

Alum, ferric salts & Sodium Aluminate — Explanation of any two (2×2M)

UNIT-III

6) Derive an expression for the estimation of ultimate first stage BOD? (14M)

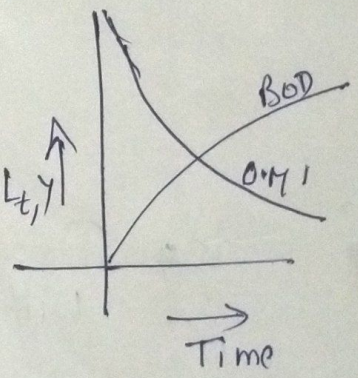


$$\frac{dL_t}{dt} \propto -L_t$$

$$\frac{dL_t}{dt} = -K_1 L_t$$

$$\int \frac{1}{L_t} dL_t = -\int K_1 dt$$

Take integration on both side.



$$\log L_t = -K_1 t + C$$

$$\log L_t = -K_1 t + C \quad \text{---} (1)$$

at $t = 0$ $L_t = L$ boundary Condition

$$\text{Log } L = -K(0) + C \rightarrow \boxed{C = \log L}$$

Substitute C value in Eqn (1).

$$\log L_t = -K_1 t + \log L$$

$$\log \frac{L_t}{L} = -K_1 t$$

$$\frac{L_t}{L} = e^{-K_1 t} \rightarrow \boxed{L_t = L e^{-K_1 t}}$$

$$y = (L - L_t) = (L - L e^{-K_1 t}) = L(1 - e^{-K_1 t})$$

$$y = L(1 - e^{-K_1 t}) \text{ (or) } L(1 - 10^{-K_1 t})$$

--- (10M)

at $t=\infty$ $Y_t = Y_u$

$Y_0 = L[1-10^{-K_1(\infty)}]$

$\boxed{Y_0 = L}$ So the ultimate BOD is the OM present in the waste.

$\boxed{Y_u = L}$ ---(4M)

$(K_1 t) = K_{20}(1.047)^{T-20}$ (temperature relation equation)

14M

[OR]

(7) a) Discuss any two Sewer Appurtenances with neat sketch.

Sewer Appurtenances: Manhole, Drop Manhole, Street inlets, Storm water Regulators, etc.

explanation - 4M
sketch - 3M
7M

Sketches = 2×2M = 4M
Explanation 2×1½ = 3M
7M

~~(7) Appurtenances × 7M 14M~~

b) Explain the physical and chemical characteristics of sewage. --(7M)

Physical characteristics - 3M
Chemical Characteristics - 4M
7M

Physical: colour, odour, tem., turbidity etc.
Chemical: Characteristic Chlorides, Hardness, PH, BOD, COD etc.

UNIT - IV

(8) Explain briefly the Components, principle and working of T.F' with neat sketch. (14M)

Components, principle - 4M
Working -- 5M
Sketch (Diagram) -- 5M
14M

[OR]

9)a) Explain sludge bulking and sludge volume Index. (4M)

Sludge bulking --(2M)

Sludge Volume Index - 2M

4M

Defin Volume occupied by 1 gm of settled sludge

$$SVI = \frac{V_s \times 1000}{MLSS}$$

it Signifies the Settleability Characte of sludge.

Sludge. SVI > 100 - Bad sludge.

< 100 good sludge

b) Explain the various methods of aeration in ASP. --(10M)

Methods of Aeration in ASP } (4M)

① Diffused air aeration

② Mechanical aeration

③ Combination aeration. } - (6M)

Explanation with neat sketches of each in ② M x 3 = 6M

10M.

× × ×

Scheme prepared by

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