

ENVIRONMENTAL ENGINEERING
(CIVL 3103)

Time Allotted : 2½ hrs

Full Marks : 60

Figures out of the right margin indicate full marks.

*Candidates are required to answer Group A and
any 4 (four) from Group B to E, taking one from each group.*

Candidates are required to give answer in their own words as far as practicable.

Group – A

1. Answer any twelve:

12 × 1 = 12

Choose the correct alternative for the following

- (i) Which of the following is a by-product of chlorination in water treatment that needs to be monitored due to its potential health risks?
(a) Oxygen (b) Carbon dioxide
(c) Chloramine (d) Hydrogen peroxide.
- (ii) What is the term for the process of removing salt and other impurities from seawater or brackish water to make it safe for drinking?
(a) Filtration (b) Coagulation (c) Desalination (d) Aeration.
- (iii) Which of the following water treatment processes is most effective at removing hardness-causing ions like calcium and magnesium?
(a) Sedimentation (b) Flocculation
(c) Softening (d) Desalination.
- (iv) What is the purpose of adding lime (calcium hydroxide) during water treatment?
(a) To reduce pH (b) To increase pH
(c) To remove organic matter (d) To disinfect water.
- (v) Which of the following is a common source of Nitrogen in wastewater?
(a) Oxygen gas (b) Ammonia
(c) Carbon dioxide (d) Hydrogen sulfide.
- (vi) What is the term for the microbial layer that forms on the trickling filter media and plays a crucial role in treatment?
(a) Scum layer (b) Bio-film
(c) Floc (d) Sludge cake.
- (vii) What is the purpose of the distributor arms in a trickling filter?
(a) To measure influent flow rate
(b) To evenly distribute wastewater over the filter media
(c) To remove settled sludge
(d) To provide aeration.

- (viii) What is the key principle behind sedimentation in a tank?
 (a) Mixing chemicals to precipitate solids
 (b) Applying heat to evaporate water
 (c) Allowing gravity to settle suspended solids
 (d) Using a centrifuge to separate solids.
- (ix) In a vertical / Up flow sedimentation tank, where is the cleanest water typically withdrawn from?
 (a) Top of the tank (b) Middle of the tank
 (c) Bottom of the tank (d) Any level within the tank.
- (x) Which of the following is considered a primary alkalinity component in water?
 (a) Sulfates (b) Nitrates
 (c) Carbonates (d) Chlorides.

Fill in the blanks with the correct word

- (xi) The Indicator used to measure total hardness is _____.
- (xii) The permissible limit of Arsenic in drinking water _____.
- (xiii) The minimum domestic water consumption for weaker section in India is _____.
- (xiv) Coincident draft is the summation of _____.
- (xv) The unit of turbidity is _____.

Group - B

2. (a) Compute the population of the year 2000 and 2008 for a city whose population in the year 1930 was 27000 and in the year 1970 was 47000. Make Use of geometric increase method. [[CO2](Analyse/HOCQ)]
- (b) Describe in brief with the graph about the Variation in water demand in a day. [[CO1](Apply/IOCQ)]
8 + 4 = 12

3. Write Short notes on:
 (i) Hardy Cross Method
 (ii) Different types of distribution networks
 (iii) Meter in Distribution system. [[CO5](Understand/LOCQ)]
(3 × 4) = 12

Group - C

4. Write short notes on any of the following 3 topic:
 (i) Chlorination
 (ii) Rapid Sand filter
 (iii) Coagulation & flocculation
 (iv) Softening. [[CO3](Understand/LOCQ)]
(3 × 4) = 12

5. (a) A water sample contains the following dissolve ions . $\text{Na}^+ = 56 \text{ mg/l}$ $\text{Ca}^{+2} = 40 \text{ mg/l}$, $\text{Mg}^{+2} = 30 \text{ mg/l}$, $\text{Al}^{+3} = 3 \text{ mg/l}$, $\text{HCO}_3^- = 190 \text{ mg/l}$, $\text{Cl}^- = 165 \text{ mg/l}$. Calculate (i) Total Hardness (ii) Non-Carbonate Hardness. *[[CO3)(Analyse/HOCQ]]*
- (b) Draw the flowchart showing the different process of water treatment. *[[CO3)(Apply/IOCQ]]*
- 7 + 5 = 12**

Group - D

6. (a) Calculate the diameter and discharge of a circular sewer laid at a slope of 1 in 400 when it is running half full, and with a velocity of 1.9 m /sec . ($n=0.012$). *[[CO6)(Analyse/HOCQ]]*
- (b) A population of 30,000 is residing in a town having an area of 60 hectares. If the average coefficient of runoff for this area is 0.60, and the time of concentration of the design rain is 30 mins, calculate the discharge for which the proposed combined system will be designed for the town in question. Make suitable assumptions where needed. *[[CO6)(Analyse/HOCQ]]*
- 6 + 6 = 12**
7. (a) What do you mean by variation in flow of sewage? Explain average flow, dry weather flow, and maximum flow. *[[CO5)(Understand/LOCQ]]*
- (b) Write a short note on following terms:
 (i) Self cleansing velocity (ii) Non-scouring velocity. *[[CO5)(Apply/IOCQ]]*
- 6 + 6 = 12**

Group - E

8. (a) A wastewater treatment plant (WWTP) is designed to treat a flow rate of 1,000,000 litres per day ($1,000 \text{ m}^3/\text{day}$) of domestic wastewater. The influent BOD5 concentration is 250 mg/L, and the desired effluent BOD5 concentration is 10 mg/L. The WWTP uses the activated sludge process with an aeration tank volume of 4000 m^3 and a hydraulic retention time (HRT) of 6 hours. Calculate the required mass of microorganisms (mixed liquor suspended solids, MLSS) in the aeration tank to achieve this effluent BOD5 concentration. *[[CO4)(Analyse/HOCQ]]*
- (b) Describe briefly 'Screening' and 'Grit Chamber'. *[[CO4) (Remember/LOCQ]]*
- 7 + (2.5 + 2.5) = 12**
9. (a) A 2% solution of a sewage sample is incubated for 5 days at 20°C. The depletion of oxygen was found to be 4ppm. Determine the BOD of the sewage. *[[CO4)(Analyse/HOCQ]]*
- (b) Design a conventional activated sludge plant to treat domestic sewage, given the following data:
 Population: 35,000
 Average sewage flow: 180 lpcd
 BOD of sewage: 220 mg/L
 BOD removed in primary treatment: 30%
 Overall BOD reduction desired: 80%. *[[CO4)(Analyse/HOCQ]]*
- 4 + 8 = 12**

Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	36.46	15.62	47.92

Course Outcome (CO):

After the completion of the course students will be able to

1. Identify the nature and quality of water & waste water as per its characteristics like physical, chemical & biological.
2. Estimate the future water demand by using various population forecasting methods.
3. Define and design in detail about the various water treatment units.
4. Define and design in detail about the various waste water treatment units.
5. Estimate the quantity of sewage produced and design the sewerage system.
6. Analysis and design of water distribution networks

**LOCQ: Lower Order Cognitive Question; IOCQ: Intermediate Order Cognitive Question; HOCQ: Higher Order Cognitive Question.*