Name : .....

Roll No. : .....

Invigilator's Signature : .....

CS/B.Tech (CE-NEW)/SEM-6/CE-603/2010

2010

ENVIRONMENTAL ENGINEERING-II

Time Allotted : 3 Hours | Full Marks : 70

The figures in the margin indicate full marks.

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

GROUP – A

(Multiple Choice Type Questions)

1. Choose the correct alternatives for any *ten* of the following : 10 × 1 = 10

i) The waste from bathrooms, kitchen etc. is called

a) Refuse b) Sullage

c) Sewage d) Garbage.

ii) Stale sewage is usually

a) neutral b) acidic

c) alkaline d) of pH value 7.

iii) The solid content of sewage is usually

a) 99% b) 80-85%

c) 10-15% d) 0·1%.

iv) The self cleaning velocity normally adopted for sewers is

a) 0·1 m/sec b) 0·2 m/sec

c) 0·4 m/sec d) 0·85 m/sec.

v) In a combined sewer when only the industrial or sanitary sewage is flowing, then it is termed as

a) storm water flow b) industrial flow

c) ordinary flow d) dry weather flow.

vi) The process of removing suspended and colloidal matter from sewage is called

a) Purification b) Clarification

c) Suspension d) Dewatering.

vii) In combined sewers the velocity of flow of sewage should not be less than

a) 0·6 m/sec b) 0·75 m/sec

c) 1 m/sec d) 6 m/sec.

viii) While designing a sewerage system, the span of design period is generally taken as

a) 1 year b) 5 years

c) 10 years d) 20 years.

ix) pH value of fresh sewage is expected to be

a) 1 b) 3·5

c) 7 d) 8 to 11.

x) The gas that is mainly responsible for explosion in sewer is

a) Ammonia b) Methane

c) Oxygen d) Carbon monoxide.

xi) The inlet with a basin which makes grit, sand or debris to settle and thus prevents it from entering into the sewer is called

a) Manhole b) Catch Basin

c) Street Inlet d) Inspection Hole.

xii) The cycle of life, death and decay involving organic nitrogenous matter, is known as

a) the nitrogen cycle

b) the life cycle

c) the hydrological cycle

d) the sulphur cycle.

xiii) The bacteria which live on free oxygen of air or on the oxygen dissolved in water are called

a) Aerobic bacteria b) Anaerobic bacteria

c) Facultative bacteria d) all of these.

xiv) The maximum efficiency of BOD removal is achieved in

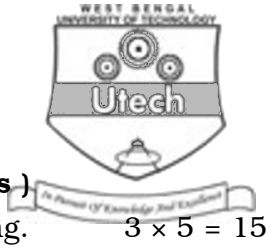
a) Oxidation Ditch b) Trickling Filters

c) Aerated Lagoons d) Digestion Tanks.

xv) The septic tank should be cleaned at regular interval but should not exceed

a) 5 years b) 1 year

c) 6 months d) 3 years.



GROUP – B

(Short Answer Type Questions)

Answer any *three* of the following. 3 × 5 = 15

2. Differentiate between aerobic and anaerobic decompositions.

3. Name the various units which are usually adopted for the treatment of sewage. State their functions and draw the flow diagram.

4. Write short notes on the following :

   a) Nitrogen cycle

   b) Sulphur cycle.

5. Write short notes on the following :

   a) Catch basin

   b) Inverted siphon.

6. State the characteristics of domestic sewage in respect of any *three* of the following :

   a) Total solids

   b) BOD

   c) Relative stability

   d) Odour

   e) Grease, fat and oil

   f) Turbidity.

7. Write down the comparison between conservancy and water carriage system.

8. What do you understand by combined system, separate system and partially separate system ?

GROUP – C

(Long Answer Type Questions)

Answer any *three* of the following. 3 × 15 = 45

9. a) Write down the expressions for the following : 5

   i) Proportionate depth of flow

   ii) Proportionate area

   iii) Proportionate wetted perimter

   iv) Proportionate hydraulic mean depth.

   b) A population of 30000 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 minutes, calculate the discharge for which the sewers of a proposed combined system will be designed for the town in question. Make suitable assumptions where needed. 10

10. a) The following observations were made on BOD test :

   i) 4% waste water in diluted sample

   ii) DO of aerated water required for dilution = 4 mg/L

   iii) DO of diluted sample after 5 days incubation at 20°C = 0·6 mg/L

   iv) DO of original sample = 0·5 mg/L

   Calculate the BOD_5 and ultimate BOD of the sample considering the BOD rate constant as 0·15 d^{-1}. 7

b) If the per capita contribution of suspended solids and BOD is 90 gm and 55 gm, then find the population equivalents of —

i) a combined system serving 1000 persons and having 75 gm per capita daily of BOD.

ii) 40000 litres daily of industrial waste water containing 1800 mg/L of suspended solids. 8

11. a) Given a waste water sample containing 300 mg/L of an organic compund having chemical formula $CH_3COC_2H_5$. Calculate the COD value of the sample. Assuming a '*K*' value to the base 10 as 0·1 d^{-1}, calculate the ultimate BOD and the 5-day BOD of the waste. 10

b) The following data has been obtained from a waste water sample characterization :

BOD5 = 400 mg/L, '*K*' (to the base *e*) = 0·29 d^{-1}, NH_3 = 80 mg/L

Calculate the total quantity of oxygen required in mg/L that may be furnished to completely stabilize the waste water. Also calculate the COD value of the sample. Comment on the theoretical oxygen demand of the sample. 5

12. Calculate the following : 3×5

a) Theoretical oxygen demand

b) The organic carbon concentration of water that contains the following chemical compounds :

i) Glucose ($C_6H_{12}O_6$) = 200 mg/L

ii) Benzene (C_6H_6) = 25 mg/L

iii) Algae ($C_6H_{15}O_6N$) = 10 mg/L.

c) What is the formula weight of organic matter present in this solution ?

13. a) Calculate the diameter and discharge of a circular sewer laid at a slope of 1 in 400 when it is running half full, with a velocity of 1·9 m/sec. Given '*n*' in Manning's formula is 0·012. 7

b) A 350 mm dia sewer is to flow at 0·35 depth on a grade ensuring a degree of self-cleansing equivalent to that obtained at full depth at a velocity of 0·8 m/sec.

Find :

i) the required grade

ii) associated velocity

iii) the rate of discharge at this depth.

Given :

i) Manning's rugosity coefficient = 0·014

ii) Proportionate area = 0·315

iii) Proportionate wetted perimeter = 0·472

iv) Proportionate HMD (r/R) = 0·7705. 8

14. Write short notes on any *five* of the following : 5 × 3

a) Imhoff tanks

b) Trickling filter

c) Sludge digestion

d) Oxidation pond

e) Oxidation ditch

f) Septic tank

g) Skimming tank

h) Detritus tank.

15. a) Why are coagulants used in the sewage treatment ? Name a few common coagulants used. 4

b) Explain with a neat sketch the working of a percolating filter (trickling filter). What is the principle on which it works ? 5

c) Compute diameter of a circular trickling filter for 250 users. Dry weather flow is 120 lits/capita/day. Rate of filtration of trickling filter may be taken as 10 million lits per hectare/metre. 6