Name : ....

Roll No. : ....

Invigilator's Signature : ....

CS/B.Tech/CE(OLD)/SEM-6/CE-603/2013

2013
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)
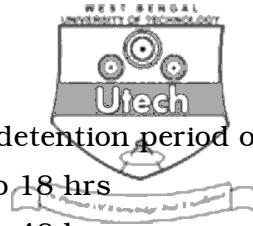
1.   Choose the correct alternatives for any *ten* of the following :

                                                            $10 \times 1 = 10$

   i)   The ratio of BOD_5 to ultimate BOD is

         a)   0·60   b)   0·68

         c)   0·63   d)   0·75.

   ii)   With increase in temperature of sewage dissolved
         oxygen content

         a)   decreases   b)   increases

         c)   remains unaffected   d)   none of these.

   iii) A water having pH = 9 will have hydroxyl ion
         concentration equals to

         a) 10^9 moles/L   b) 10^{-5} moles/L

         c) 10^{-9} moles/L   d) 10^5 moles/L.

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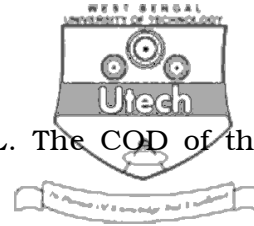
iv) The BOD_5 of a sample is 300 mg/L. The COD of the sample will be

 a) > 1500 mg/L   b) > 1000 mg/L

 c) 500–600 mg/L   d) 440–480 mg/L.

v) Average temperature of sewage in India is generally assumed to be

 a) 20°C   b) 30°C

 c) 15°C   d) 25°C.

vi) Pyrolysis is highly

 a) endothermic

 b) exothermic

 c) none of these.

vii) Refuse generally consists of

 a) human excreta and sullage

 b) all solid and semisolid wastes excluding human excreta and sullage

 c) human excreta

 d) none of these.

viii) The range of average density of refuse for a typical Indian city is

 a) 200–400 kg/m^3 b) 400–600 kg/m^3

 c) 600–800 kg/m^3 d) 800–1000 kg/m^3.

ix) Hydraulic Mean Depth for a circular sewer is

 a) D/2   b) D/4

 c) 3D/4   d) D.

x) In Indian net quantity of sewage produced is taken as .... of the accounted water supplied from the water works.

   a) 75%   b) 85%

   c) 90%   d) 60%.

xi) Sewage treatment works are normally designed for a designed period of

   a) 40–50 yrs   b) 30–40 yrs

   c) 15–20 yrs   d) 5–10 yrs.

xii) The detention period adopted for sewage sedimentation tanks is of the order of

   a) 1–2 hrs   b) 4–8 hrs

   c) 8–16 hrs   d) 24–36 hrs.

xiii) A grit chamber, having higher detention period (about 3 – 4 times) is called a

   a) grit basin   b) detritus tank

   c) vacuator   d) grit channel.

xiv) Dissolved organic solids in waste water treatment may be removed by

   a) coagulation   b) hypochlorination

   c) reverse osmosis   d) none of these.

xv) The maximum efficiency of BOD removal is achieved in

   a) oxidation ditch   b) oxidation pond

   c) aerated lagoon   d) tricking filter.

xvi) The secondary treatment of sewage is caused by

   a) bacteria   b) algae

   c) coagulants   d) none of these.

xvii) Septic tank is usually designed for a detention period of

    a)   6 to 12 hrs   b)   12 to 18 hrs

    c)   18 to 24 hrs   d)   24 to 48 hrs.

xviii) The flowing through velocity in an Imhoff tank should not exceed

    a)   0·1 m/min   b)   0·3 m/min

    c)   0·7 m/min   d)   1 m/min.

xix) Dissolved organic solids in sewage treatment may be removed by

    a)   coagulation   b)   hypochlorination

    c)   reverse osmosis   d)   adsorption.

xx) Composting lagooning are the methods of

    a)   sludge digestion   b)   sedimentation

    c)   sewage disposal   d)   filtration.

xxi) Grease and fatty oils present in sewage are removed in

    a)   grit chamber   b)   sedimentation tanks

    c)   aeration tanks   d)   skimming tanks.

GROUP – B

(Short Answer Type Questions)

Answer any *three* of the following. $3 \times 5 = 15$

2. If 5 ml of raw sewage has been diluted to 400 ml and DO_i of the diluted sample was 12 mg/L, and it was 8 mg/L after 5 days incubation at 20°C, then find the COD of the raw sewage with respect to its BOD_5.

3. Differentiate between the combined and separate sewerage systems.

4. Derive Shield's expression for self cleansing velocity in a sewer with a neat diagram.

5. What are the hydraulic characteristics of circular sewer sections running full or partially full ?

6. Distinguish between primary treatment and secondary treatment.

7. What do you understand by flow equalization ? How is it achieved in sewage treatment ?

8. Under what conditions chemical-aided sedimentation is preferred to plain sedimentation ? What are the advantages and disadvantages of chemical-aided sedimentation ?

GROUP – C
(Long Answer Type Questions)

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

9. a) Write down the expressions for :

(i) Proportionate depth of flow

(ii) Proportionate area

(iii) Proportionate wetted perimeter

(iv) Proportionate hydraulic mean depth. 5

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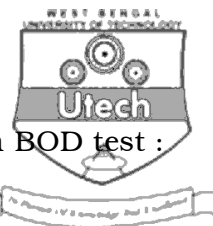
10. a) The following observations were made on BOD test :

    (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)   40,000 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 compound 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 :

    BOD_5 = 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
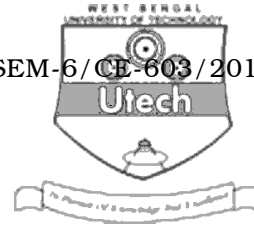
12. Calculate the following :

    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 ($C_6H_{12}O_6N$) = 10 mg/L.

   c) What is the formula weight of organic matter present in this solution ?   3 × 5

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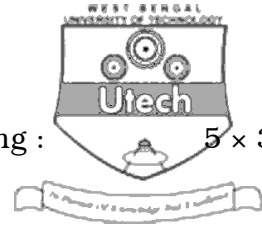
14. Write short notes on any *five* of the following :   5 × 3

   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.

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

   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/meter.   4 + 5 + 6