BIRLA INSTITUTE OF TECHNOLOGY & SCIENCE, PILANI

Environmental Pollution Control (CHE F411)

Comprehensive Examination

Date – 01/12/2016 Maximum Time – 3 Hrs Marks – **40**

Part – A (Closed Book) [15×1]

1. With temperature – altitude profile and plume diagram explain four types of plume behaviour under different meteorological conditions. [**4**]
2. Mention three techniques for measurement of particulate matter in air. Briefly explain the procedure of particulate matter monitoring using hi volume sampler. [**3**]
3. How the following physical water qualities are measured: [**4**]

   (i) Total Suspended Solids (ii) Total Dissolved Solids

   (iii) Colour (iv) Odour
4. The influent suspended solids concentration to a primary settling tank is 450 mg/l. The average flow rate is 0.1 m^3/s. The suspended solids removal efficiency is 60%. Determine the suspended solids concentration in the overflow and the quantity of sludge produced per day. [**3**]
5. Explain the different phases of bacterial growth? Explain the Monod equation describing the specific growth rate of microorganisms. [**4**]
6. Why sludge digestion is necessary in the waste water treatment? Describe the process of anaerobic method for sludge digestion. [**4**]
7. Explain the different process modifications in the method of air supply to the aeration tank of the activated sludge process? [**3**]
8. A laboratory solution containing 0.5 μCi/L of ^{32}P is to be disposed of. How long must the radioisotope be held to meet the allowable discharge activity of 9 x 10^{-5} μCi/mL? assume $T_{1/2}$ = 14.3 days. [**4**]
9. Differentiate between continuous, intermittent and impulsive noise. Mention two effects of noise on human health and two methods of source correction to minimize noise. [**4**]
10. Explain the L_N and L_{eq} method of noise rating. Traffic noise data are shown in the table below: [**7**]

Time(s)	10	20	30	40	50	60	70	80	90	100
dB	71	75	70	78	80	84	76	74	75	74

Compute L_{80} and L_{eq}

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Part – B (Open Book)

1. A settling chamber is installed in a plant for removal of particulate matter. Determine the overall collection efficiency of the settling chamber under the following operating conditions assuming laminar flow: [**12**]

   Chamber dimension: 12m × 2.5 m × 15 m; Particle specific gravity: 2.65

   Volumetric flow rate of contaminated air stream: $70 m^3/s$

   Flue gas temperature and pressure: 120^0C and 1 atm

Avg Particle diameter (μm)	10	25	35	45	55	65	75	85	94
Inlet wt%	2.7	6.9	9.4	10.5	10.5	9.5	7	9.5	34

2. The BOD results given below are observed on a sample of waste water at 20^0C:

T, days	0	1	2	4	6	8	10
BOD, mg/l	0	7	12	19	22	25	27

   This waste water is discharged at 25^0C to a stream having a reaeration rate of $0.6d^{-1}$. The DO deficit of the mixture of stream water and wastewater at the point of reference is 3 mg/l. Calculate:

   i. The DO deficit at a point one day distant from the point of reference
   ii. The critical DO deficit
   iii. The critical time

   Assume a temperature coefficient value of 1.056 **[4+2+2]**

3. The results of a settling test are as follows:

Time (min)	0	60	80	100	130	200	240	420
Conc (mg/l)	300	200	180	170	160	110	80	30

   What is the percentage removal of particles in a 4 m deep sedimentation tank if the hydraulic loading rate is 20 m^3/m^2day? Assume Type I settling. [**6**]

4. A secondary clarifier is to be designed to produce an underflow concentration of 25000 mg/l from an influent with mixed liquor solids content of 4000 mg/l. The waste water flow rate is 50 l/s. The following data were obtained from a settling test in a 100 m cylinder:

Time (min)	0	2	4	6	8	10	14	18	22	26	30
Interface height (cm)	100	87	75	63	53	46	36	29	25	23	20

   Calculate the required clarifier area. [**6**]

5. The effluent from the secondary clarifier in an effluent treatment plant has to meet the standard of BOD_5 of 30 mg/l and 30 mg/l suspended solids. The effluent flow rate from the primary treatment process is 0.03 m^3/s and this effluent has a BOD_5 of 250 mg/l. with the following information, calculate the required volume of the aeration tank.

   BOD_5 of the suspended solid is 80% of the allowable suspended solids concentration.

   Growth constant values are: Ks = 100 mg/l BOD5; $k_d = 0.06d^{-1}$, $\mu_m = 10d^{-1}$; Y = 0.8.

   The biomass concentration in the aeration tank is 3000 mg/l. [**8**]