Name:……**En.No.:**……**Batch:**……**Sl.No.:**……

Date:……**Sign.(Student):**……**Sign.(Invigilator):**……

Indian Institute of Technology Roorkee
Roorkee – 247 667

Mid Term Examination – I
(Autumn Semester; Session 2018-19)
B.Tech. I Year; CE – 105: Environmental Studies

Time: 1.5 Hr **Max. Marks: 50**

Note: i) All questions are compulsory; ii) Wherever necessary, clarify assumptions and write answers in the required / correct units.

POOL OF EQUATIONS

$PV = nRT$

$P = g \times \eta \times Q \times H$

$BOD_t = L_o(1-e^{-kt})$

$k_t = k_{20}\theta^{T-20}$

$TSR = 2\pi RN/60v$

$Power = 9.81\eta QH$

$L_t = L_a e^{-kdt}$

$P^* = 0.37\eta_{M.}\eta_{E.}\eta_{T.}(v/10)^3$

$v_s = (H/L)v_h$

$v = Q/A_s$

Tip Speed Ration = Blade tip speed(m/s) / Wind speed(m/s)

$\Delta H = mc\Delta T$

$K.E. = \frac{1}{2}\, mv^2$

$Power\ potential = \frac{1}{2}\, \rho A v^3$

$E = 9.81t\eta QH$

$Power\ potential = 0.5\rho Av^3Cp\ (Cp \approx 0.37)$

$$RSC = (CO_3^{--} + HCO_3^{-}) - (Ca^{++} + Mg^{++})$$

$$SAR = \frac{Na^{+}}{\sqrt{\left(Ca^{2+} + Mg^{2+}\right)/2}}$$

BOD_t = (Initial DO – Final DO)/Dilution factor

PART A (7x1=7 Marks)

*(**Note:** Tick the right answer only; **multiple tick or cross marks will be considered as wrong answer**)*

1. Current atmospheric CO_2 levels in ppm are:
   - **a.** 100 – 200 ppm
   - **b.** 200 – 300 ppm
   - **c.** 400 – 500 ppm
   - **d.** 1000 – 1100 ppm

2. Annual flood in Chennai are caused by:
   - **a.** Excessive rains and monsoon alone
   - **b.** Mostly because of encroachment on wetlands and lakes
   - **c.** Dams are opened at once during monsoon flooding Chennai
   - **d.** Floods are unpredictable as they are an act of nature

3. Turbidity is the surrogate property of:
   - **a.** Total suspended solids
   - **b.** Total dissolved solids
   - **c.** Conductivity
   - **d.** Fecal coliforms

4. For the determination of BOD the incubation is carried out at
   - **a.** 25^oC for 7 days
   - **b.** 27^oC for 5 days
   - **c.** 20^oC for 5 days
   - **d.** 15^oC for 3 days

5. A visiting scholar to our department fell sick upon drinking locally available drinking water. How would you classify this disease?
   - **a.** Water related disease
   - **b.** Water borne disease
   - **c.** Water based disease
   - **d.** Water washed disease

6. What is not true for IIT Roorkee main building?
   - **a.** It lets sunlight into the building during winter
   - **b.** It uses passive building design to maintain the indoor temperature for weather comfort
   - **c.** It lets heat out in summer
   - **d.** It uses geothermal energy to heat the offices

7. An industrial effluent was analyzed and noticed that the BOD/COD was extraordinarily low (<0.0001). Which of the following industry is most likely to have produced this effluent?
   - **a.** Food industry
   - **b.** Sugarcane industry
   - **c.** Pharmaceutical industry
   - **d.** Pulp and paper industry

PART B (5x1=5 Marks) *(Fill in the Blanks)*

*(**Note:** Fill in the right answer without making corrections. **Answers filled in with corrections, overwriting, etc. will be considered as wrong answers**)*

1. A commercial product that is obtained as a byproduct of flue gas desulphurization process is _____
2. None of the nuclear reactors are based on _____ process.
3. _____ is a type of wind turbine that requires relatively lower wind velocity to produce wind power.
4. A solution contains Na^+, K^+, Ca^{2+} and Mg^{2+}. Which of these contribute to hardness?_____
5. _____is used as an indicator of fecal contamination of water.

PART C (2x10 = 20 Marks) (Brief Answers)

1. Concentration of thorium in Monazite sand in Kerala is 0.04 micro-g/L. How much thorium is present in 100 kg of sand? Bulk density of the sand is 1,650 kg/m^3. **(2)**

2. Lis four characteristics that would make a site best suited for installing a wind turbine? **(2)**

3. In a BOD test, initial DO of a sample having 20 times dilution is 9 mg/L. DO after 5 days is 1 mg/L. What is the BOD_5 of the sample? **(2)**

4. A wastewater contains 46 mg/L of ethyl alcohol and 45 mg/L of phenol. Ethyl alcohol is biodegradable while phenol is not. Find out the ratio of $COD/BOD_{ultimate}$ in the wastewater. **(2)**

5. What is the calorific value of coal, given that the efficiency of power plant = 0.30, and the coal usage of the power plant is 0.6 kg/kWh. **(2)**

6. Concentration of SO_2 in atmosphere is 15 ppm (V/V). Express it in µg/L considering standard temperature and pressure. (R = 0.082 L.atm/mol.K) **(2)**

7. BOD_5 of a sample was 101 mg/L and BOD_{20} was 160 mg/L. What is the value of first order BOD decay rate constant? **(2)**

8. Thermal power plants A and B have the same capacity with same amount of similar quality of coal being used. Plant A requires more cooling water for cooling tower. Which plant's boiler is more efficient? Explain. **(1+1)**

9. Match the following: (If you match more than one option for a given contaminant, no marks will be given) **(1+1)**

Contaminant	**Effects**
i. Fluoride	a. blue baby syndrome
ii. Arsenic	b. skeletal disorders
iii. Nitrite	c. laxative and upon reduction corrodes the pipes
iv. Sulfate	d. skin keratosis and cancer

10. A water sample is known to contain calcium, sodium chloride and bicarbonate. The result of an analysis were as follows: Calcium 60 mg/L, Sodium 46 mg/L, Chloride 71 mg/L Calculate SAR and comment on suitability of water for irrigation
(Mol. wt.: Ca^{++} 40, Na^{+} 23, Cl^{-} 35.5, HCO_3^{-} 61) **(2)**

PART D (5+3+3+7 =18 Marks)

(**Note:** Clearly write formula(s), assumptions, etc. and show all necessary steps to solve the numerical problems)

1. In a typical BOD test, 25 mL of wastewater was taken and rest of the volume of a flask of 300 mL volume was filled with deionized water with no organic content. The initial DO could not be measured due to instrument failure. It was measured in the beginning of the 2nd day and the value was 6.3 mg/L. DO measured after the 5 day experiment was 4.6 mg/L. Determine the BOD_5 of the wastewater sample. Assume that the BOD reaction is a first order reaction and the rate constant is 0.23/day.

(4)

2. A power plant is using coal with heating value of 26.51 MJ/kg and is consuming it at a rate of 600 tonnes per hour. Coal has sulphur content of 1.7%. What is the rate of emission of SO_2 in kg/day. The Sulphur going in ash may be assumed as 5%. **(3)**

3. Calculate the hydro power plant generation capacity for a proposed hydropower scheme on a river having a head of 200 m and discharge of $400 m^3/s$. If this power plant runs for 65% time in a year, calculate the annual energy generated in kWh. Also determine the number of households which could be provided the electricity by this plant. [Assume hydro turbine efficiency of 79.53%, alternator efficiency of 88.25%, gear box efficiency of 67.28% and per household consumption of electricity as 2500 units per annum]. (1 year has 365 days and 1 kWhr is referred to as 1 unit) **(3)**

4. A water sample has pH of 7.2 and has the following concentration of ions:

Ca^{2+}	Mg^{2+}	Na^{+}	K^{+}	HCO_3^{-}	SO_4^{2-}	Cl^{-}
60 mg/L	20 mg/L	15 mg/L	5 mg/L	120 mg/L	75 mg/L	11 mg/L

Calculate total hardness, carbonate hardness, and non-carbonate hardness. **(6)**

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