Time : 2 hours   **Date: 28.11.2006**
Max. Marks: 50
Instructions to the students:
  1) All the 5 questions are compulsory and carry equal marks.
  2) Assume suitable data wherever necessary and mention the assumptions clearly.

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1. **A)** Develop a mathematical model for the biodegradation kinetics and reaeration that would predict the effect of organic pollution in natural water streams.

    B) In a 5-day seeded BOD test conducted at 20°C on a waste water sample, 20 ml of the waste water sample was added directly into a 300 ml BOD incubation bottle. The initial DO of the diluted sample was 8 mg/l and the final DO after 5 days was 2 mg/l. The corresponding initial and final dissolved oxygen of the seeded dilution water was 9.0 and 7.5 respectively. What is the 5 day BOD of the waste water sample? If the reaction rate constant is $0.3 d^{-1}$, determine the 1-day BOD and ultimate first stage BOD for this sample. What would have been the 5-day BOD if the test had been conducted at 30°C.

2. **A)** Determine the theoretical power requirement and the paddle area required for a waste water flocculator to achieve a velocity gradient of 50/s in a tank with a volume of 3000 m³. Assume that the water temperature is 15°C, the coefficient of drag C_D for rectangular paddles is 1.8, the paddle-tip velocity 'v' is 0.6 m/s, and the relative velocity of the paddles v_p is $0.75v$. Assume viscosity of water to be 1.139×10^{-3} N.s/m⁻³.

    B) Describe with suitable sketches the types of settling basins for idealized settling of discrete particles.

3. Estimate the mass and volume of the sludge produced from untreated waste water without and with the use of $FeCl_3$ for the enhanced removal of TSS. Also, estimate the amount of lime required for the specified dose. Assume that 60% of the TSS is removed in the primary settling tank without the addition of chemical and that addition of $FeCl_3$ result in an increase in TSS to 85%. Also assume that the following data apply to this.
    Waste water flow rate- 100 m³/day
    Wastewater TSS -220mg/l
    Wastewater alkalinity as $CaCO_3$ -136mg/l
    $FeCl_3$ added in kg/ 1000 m³ - 40
    Raw sludge properties: specific gravity – 1.03; moisture content - 94%
    Chemical sludge properties: specific gravity -1.05; moisture content - 92.5%

4. **A)** Describe in brief the various steps involved in Sludge treatment and disposal.

   B) A treatment plant for the effluent having the following characteristics has an equalization tank with volume 100m^3, out of which 20 m^3 is required for pump suction and free board. Determine whether this tank volume is sufficient to ensure uniform discharge rate from the lifting pump. Substantiate your answer with suitable explanation. How would you ensure mixing and aerobic condition in the chamber?

Time	Flow rate, m3/hr	Time	Flow rate m3/hr
00	5	12	30
02	2.5	14	25
04	2.5	16	25
06	10	18	20
08	25	20	12.5
10	35	22	7.5

5. **A)** Describe in brief, the manual and mechanical methods of composting.
   B) Write short notes on the following:
   (i) Advanced waste water treatment.
   (ii) Potential methods to recover and recycle metals in a solid waste management programme.
   (ii) Analytical methods used in a water pollution management laboratory.