COURSE CODE: 14M31CE213

MAX. MARKS: 35

COURSE NAME: Industrial Wastewater Treatment

COURSE CREDIT: 3

MAX. TIME: 2 HRS

Note: Attempt all Questions. Carrying of mobile phones during exams will be treated as case of unfair means. Assume suitable data if required.

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1. With a neat flow sketch, if appropriate, discuss the different manufacturing steps involved in treatment of a suitable industry of your choice. Explain the different sources of wastewater generated during this process and discuss the different treatment alternatives for the same. **(4+4)**

2. Discuss the important considerations for design of a high rate digester system. Using the design considerations, design a high rate digester for a population of 30,000 with a combined feed of 60 m^3/d at an operating temperature of 27^0C. The variation of θ_c^m with temperature is as follows **(3+2)**

Temperature (^{0}C)	18	24	30		40
θ_c^m (days)	11	8	6	4	4

3. With a neat flow sheet and chemical reactions, explain the different processes involved in anaerobic digestion. **(4)**

4. Design a low rate digester system for a population of 90,000 with a fresh sludge generation of 0.20kg dry solids per capita. The volatile solids are 68% of dry solids. Dry solids are 5% of sludge production and the wet specific gravity is 1.03. About 70% of volatile solids are destroyed in the digestion process and there is no change in fixed solids concentration during digestion. The digested sludge has 6.5% dry solids with a wet specific gravity of 1.06. The operating temperature is 33^0C and the digestion time associated with this temperature is 28 days. The sludge storage time is 53 days. Assume that sludge occupies lower half of tank depth and supernatant and gas occupy upper half **(4)**

5. With chemical reactions and graphical representations, explain the different processes for chromium recovery. Discuss its merits and demerits for the same. **(3)**

6. Design the heat requirements for a low rate digester system for a population of 50,000 with an overall fresh sludge generation of 0.20 kg dry solids per capita. The fresh sludge has 5% dry solids and the operating temperature is 38^0C and the sludge temperature during coldest month is 10^0C. **(3)**

7. Explain the concept of free reactive oxygen (O^*). In this context, write down the general equation for ultimate conversion of an organic compound to mineralization with O^*. With chemical reactions explain the use of O^* in mineralizing phenol with H_2O_2 and MnO_4^-. **(5)**

8. A metal plating firm needs to remove zinc using precipitation tank and hydroxide solution. Determine the control pH for achieving an effluent zinc concentration of 0.3 mg/l. K_{sp} of $Zn(OH)_2 = 7.5 \times 10^{-17}$ **(3)**