Reg. No.

MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

VII SEMESTER B.TECH. (CHEMICAL ENGINEERING)

END SEMESTER EXAMINATIONS, NOV/DEC 2017

SUBJECT: PE – VI : INDUSTRIAL WASTEWATER ENGINEERING

[CHE 4006]

REVISED CREDIT SYSTEM

Date : 28/11/2017 Time: 2 – 5 PM MAX. MARKS: 50

Instructions to Candidates:

- Answer ALL the questions.
- Missing data may be suitably assumed.

1A.	Derive an expression for horizontal settling velocity to prove that it is independent on depth of the tank in type 1 settling.	**(2 marks)**
1B.	The effluent contains considerable amount of NaCl from which Na^+ ions should be removed by strong acid exchange resin. Write a reaction for this scenario and write the equations to determine selectivity coefficient and separation constant. Also comment on the advantage and disadvantage of using a strong acid exchange resin.	**(4 marks)**
1C.	Draw the flow diagram of the following treatment systems: (i) Secondary treatment with contact filtration and carbon adsorption (ii) Extended aeration process.	**(4 marks)**
2A.	Explain the typical operating parameters for aerobic treatment process and anaerobic treatment process.	**(2 marks)**
2B.	A municipal wastewater having a BOD of 250 g/m^3 is to be treated by a two stage trickling filter. The desired effluent quality is 25 g/m^3 of BOD. If both of the filter depth are to be 1.83 m and the recirculation ratio is 2:1.Find the required trickling filter diameter. Data are given below: Flow rate = 7570 m^3/day, Wastewater temperature = 20°C and $E_1 = E_2$	**(6 marks)**
2C.	Draw a sketch of circular peripheral fed, center take-off sedimentation tank with hydraulic suction sludge removal system.	**(2 marks)**
3A.	Derive an expression for mean cell residence time, Sludge production rate and mass balance with biomass and with substrate using suitable mass balance equations for the sludge wastage from aeration tank.	**(8 marks)**

3B. Mention any four differences between slow sand and rapid sand filters (2 marks)

4A. What do you mean by sloughing and bulking? (2 marks)

4B. A mechanically cleaned bar screen has bars of 8 mm thick and 30 mm clear spaces between the bars. If the flow rate is 0.20 m^3/s, velocity through the bars is 0.90 m/s, determine the approach velocity, head loss through the screen and effective cross-sectional area. (3 marks)

4C. A river is having discharge of 22 m^3/s receives wastewater discharge of 0.5 m^3/s. The initial DO of the river water is 6.3 mg/L, and DO content in the wastewater is 0.6 mg/L. The five day BOD in the river water is 3 mg/L, and the wastewater added to river has five day BOD of 130 mg/L. Consider saturation DO of 8.22 mg/L and deoxygenation and reaeration constant values of 0.1 and 0.3 per day, respectively. Find critical DO deficit and DO in the river after one day. The average velocity of flow in the stream after mixing of wastewater is 0.18 m/sec. **(5 marks)**

5A. Explain about the following:

(i) Stern layer and Zeta potential for colloids in solution

(ii) Concept of zero liquid discharge

(iii) Mechanism of photo catalysis with a neat sketch

(iv) Rate limiting steps of adsorption process. **(5 * 2 = 10 marks)**

(v) Working principle of bundle of hollow fiber membrane with a neat sketch