

M.E. CHEMICAL ENGINEERING 1<sup>st</sup> YEAR 2<sup>nd</sup> SEMESTER EXAM 2018

POLLUTION CONTROL AND SAFETY IN PROCESS INDUSTRIES

Time: Three hours

Full Marks 100

Answer any five questions

1. a) Write the different objectives of screen chamber in case of wastewater treatment. 4
- b) Design a screen chamber for the data given below:  
Maximum flow =  $0.42\text{m}^3/\text{s}$   
Average flow =  $0.21\text{m}^3/\text{s}$   
Minimum flow =  $0.084\text{m}^3/\text{s}$   
Assumptions :  
(i) Velocity of flow in the outfall sewer at peak =  $0.75\text{m/s}$   
(ii) Width of the screen chamber = 1.5 diameter of outfall sewer  
(iii) Minimum area of screen = 200% of the cross sectional area for the peak flow of incoming sewer. 16
2. a) What are the objectives of the Grit Chamber in case of treatment of sewage. 4
- b) Design a grit chamber for a city of 3 lakh population with a combined sewerage system. Water supply rate is 140l/d on an average basis. Grit concentration is 50mg/l. Grit of 0.2mm size and above with specific gravity of 2.65 is to be removed. Temperature =  $20^\circ\text{C}$ .  
Assumptions :  
i) Cleaning interval = 1 week  
ii) The proportion weir sides are made vertical for a height of 2.5 cm above the bottom. 16
3. a) Describe with sketch the operation of a horizontal rectangular settling tank treatment of wastewater. 5
- b) Design a primary settling tank to handle an average rate of flow of 10 MLD.  
Assumptions:  
i) Designed BOD removal in primary treatment unit = 32%  
ii) Surface settling rate =  $40,000\text{ l/m}^2/\text{day}$   
iii) Weir loading =  $185,000\text{ l/m/day}$   
iv) Slope of hopper = 2 vertical in 1 horizontal. 15

4. a) Describe with a flow diagram the working principle of an activated sludge process. 8
- b) Analyse a complete Mix-Cellular Recycle biological reactor either in terms of biological treatment kinetics or in terms of microbiological growth kinetics. 12
5. a) Discuss about the working principles of trickling filter process mentioning its operational problems. 12
- b) Design a low rate on standard filter to treat 6 Ml/day of sewage of BOD of 210mg/l. The final effluent should be 30mg/l and organic loading rate is 320g/m<sup>3</sup>/d. Assume 30% BOD removal in primary sedimentation and to find out the filter volume use NRC equation :

$$E_2 = \frac{100}{1 + 0.44 \sqrt{\frac{F_1^{BOD}}{V_1 R_{f1}}}}$$

The terms have their usual meaning 8

6. Write notes on (*any four*)
- i) Microbiological metabolism
  - ii) Proportional weir
  - iii) Sludge Volume Index
  - iv) Growth pattern of microorganisms
  - v) Theory of activated sludge process
  - vi) Biological treatment kinetics
  - vii) Return sludge line system 4x5
7. a) Design an oxidation pond for the population of 10,000 and sewage flow rate of 140 l/h/d. BOD of sewage is 300mg/l and effluent BOD required is not greater than 50mg/l. temperature = 24°C , K<sub>20</sub> = 0.25 d<sup>-1</sup>.  
Depth of pond = 1.2 m 10
- b) Write about classification of oxidation pond according to the type of biological activity. 10