BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI
(END SEMESTER EXAMINATION)

CLASS: BE SEMESTER : VII
BRANCH: CIVIL SESSION : MO/19

SUBJECT: CE8009 SEWERAGE AND SEWAGE TREATMENT

TIME: 3.00Hrs. FULL MARKS: 60

INSTRUCTIONS:
1. The question paper contains 7 questions each of 12 marks and total 84 marks.
2. Candidates may attempt any 5 questions maximum of 60 marks.
3. The missing data, if any, may be assumed suitably.
4. Before attempting the question paper, be sure that you have got the correct question paper.
5. Tables/Data hand book/Graph paper etc. to be supplied to the candidates in the examination hall.

Q.1(a) Describe the factors affecting quantity of stormwater. [2]
Q.1(b) Describe the appurtenances used in sewer systems. [4]
Q.1(c) A 350 mm dia sewer is to flow at 0.4 m depth on a grade ensuring self-cleansing equivalent to that obtained at full depth at a velocity of 0.9 m/sec. Find required grade, associated velocity, and discharge rate at this depth. (Available data is : n – 0.014, proportionate area – 0.315, proportionate wetted perimeter – 0.472, proportionate HMD - 0.7705). [6]

Q.2(a) Briefly describe an imperfect trench conduit. [2]
Q.2(b) What are the different types of sewer materials? Discuss the important points to be considered for materials selection for sewer construction. [4]
Q.2(c) Explain the requirements for trench and tunnel for sewer system. [6]

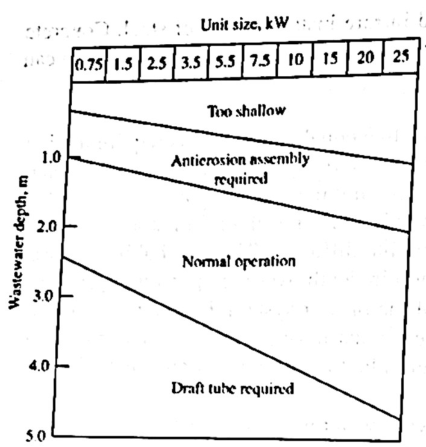
Q.3(a) What are the important physical characteristics of sewage? [2]
Q.3(b) The dilution factor *P* for an unseeded mixture of waste and water is 0.020. Initial DO of the mixture is 9.5 mg/L and DO after 5 days - 3.8 mg/L. Reaction rate constant *k* was 0.23/day. Based on these determine the following: (a) 5day BOD of the waste? (b) Ultimate CBOD of the waste? (c) Oxygen demand remaining after 5 days? [4]
Q.3(c) Explain the multiple tube fermentation technique for testing of coliforms in sewage. [6]

Q.4(a) What are the different types of reactors? [2]
Q.4(b) Explain the needs for tracer analysis, types of tracers and analysis of tracer response curve. [4]
Q.4(c) Discuss the modeling of nonideal flow in reactors. [6]

Q.5(a) Describe the theory of grit removal in STP. [2]
Q.5(b) Select an appropriate aerator and aerator configuration for an equalization basin of 1350 m^3. Use the table and figure for selection of aerator. [4]

Selection table for floating mechanical aerators"

Size, kW	OTR[b], kg/MJ	Nominal operating, depth, m	Complete mix zone, m	Complete O_2 dispersion zone, m
0.75	0.20	1.8	6	20
1.5	0.23	1.8	8	30
2.5	0.23	1.8	12	45
3.5	0.23	1.8	14	50
5.5	0.22	2.4	15	50
7.5	0.20	3.0	15	55
10	0.21	3.0	19	60
15	0.19	3.0	22	70
20	0.20	3.0	24	80
25	0.21	3.0	26	85



Q.5(c) Evaluate the headlosses through a mechanically cleaned bar rack for a STP with a clean bar rack and with partial blockage of the screen. Average flow rate at design capacity for a STP is 40,000 m^3/d. Given data: channel width – 1.6 m, depth of flow in channel – 1.4 m, approach velocity – 0.5 m/s, *k* – 1.67 for clean screen, *k* – 1.43 for partially clogged screen, Bar width – 15 mm, bar spacing – 20 mm, angle from vertical - 30°, differential headloss for activation of cleaning operation of rakes is 150 mm, maximum flow area blockage to initiate continuous operation of rakes is 40%. [6]

PTO

Q.6(a) Discuss the alternatives/modifications that may be used for primary treatment. [2]

Q.6(b) With the help of a neat sketch present a circular primary settling tank. [4]

Q.6(c) STP is being designed to treat 70,000 m^3/d wastewater. The STP will have 10 identical circular primary settling tank, each pair of PST will be served by one splitter box. Using a sharp-crested weir, design a splitter box for two identical circular clarifiers. Assume peak factor value of 2.3 for the STP. [6]

Q.7(a) Describe the N removal process during wastewater treatment. [2]

Q.7(b) Explain the suspended and attached growth processes used for CBOD removal from wastewater. [4]

Q.7(c) Design a CMR type ASP as secondary treatment unit for wastewater for a town with flow rate – 12,960 m^3/d and BOD_5 – 90 mg/L. Assume the following: Ks = 100 mg/L BOD_5, μm – 2.5 d^{-1}, k_d – 0.06 d^{-1}, Y – 0.5 mg VSS/mg BOD_5 removed. Also, assume that the secondary clarifier can produce effluent with 30 mg/L TSS and that MLVSS – 2 g/L. [6]

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