Ref No. –Ex/PG/CE/T/128E/2018

M.E. CIVIL ENGINEERING 1ST YEAR EXAMINATION, 2018
(2nd Semester)
SUBJECT: Process Design in Environmental Engineering

Time: Three hours | Full Marks 100

Use separate Answer-Scripts for each part

No. of Questions

Part I (40 marks for this part)

Marks

Answer any two questions. Answer should be brief and to the point. All the notations have their usual meaning. Assume relevant data if not provided

Q1. a) With a neat sketch describe the operation of a Rotating Biological Contractor (RBC) to treat waste water. With a neat sketch explain staging of a RBC? 5+5

b) The following data are available for a staged RBC system: 1st stage sBOD=15g/m^3, 9300 m^{2}area per shaft, 3 trains with 3 stages per train.

Parameter	Unit	Primary Effluent	Target Effluent
Flow rate	m^3/d	4500	--
BOD	g/m^3	200	30
SBOD	g/m^3	100	15
TSS	g/m^3	80	30

Determine:

i. Disc area required 2×5

ii. Number of shafts

iii. Flow rate per train

iv. SBOD per each train

v. Organic and hydraulic loadings

Q2. a) Explain what do you mean by plugflow, completely mixed flow and dispersed flow in a reactor? 2×3

b) Draw a complete flow sheet of waste water treatment using oxidation ditch. 4

c) For an aerated lagoon to treat a waste water flow of 5000m^3/day the following data are given:

i. Influent SBOD=200g/m^3

ii. Effluent SBOD=30g/m^3

iii. Kinetic coefficients at 20-25°C: Y=0.6g/g, k_s=80g/m3, kd=0.06d-1, k=5g/g-d

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iv. TVS produced=0.8TSS

v. Influent TSS=200g/m^3

vi. K_{20}=2.5/d at 20°C

vii. Temperature coefficient, θ=1.06

a. Summer air temperature and waste water temperature during summer are 30 and 20 °C respectively

b. Aerator O_2 transfer rate=1.5kgO_2/KWh

viii. Power required for mixing=8KW/1000m^3

ix. Elevation= 300m

x. Depth of the lagoon =2.5m

xi. Design hydraulic retention time=3days

xii. Aeration constant:α=0.85,β=1

Determine:

a. The surface area of the lagoon

b. Soluble effluent BOD_5

c. Summer lagoon temperature

d. O_2 requirement in the lagoon assuming BOD to COD ratio 0.625

2×3+4

Q3.a) Discuss the aerobic, anaerobic and facultative stabilization pond mentioning their specific features along with the place of application. What is dispersion number? 3×3+1

b) For a waste stabilization pond for 60000 people the following data are given:

i. Waste water flow=150lit/capita-day

ii. BOD5 contribution at 20°C=50g/capita-day

iii. Final BOD5 in the effluent should be less than 50mg/L

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No. of Questions	Part I (40 marks for this part)	Marks
	iv. Latitude of the place 23°N	
	v. Maximum solar radiation=126cal/cm2-day, Minimum solar radiation=70cal/cm2-day, sky clearance factor =70% and conversion efficiency =6%, Oxygenetion factor=1.3	
	vi. Ambient temperature=20°C and waste water temperature=15°C	
	vii. Kp at 20°C=0.132×log(BODu)-0.169	
	viii. $Kp(t)=Kp(20°C)\times(1.035)^{t-20}$	
	Determine:	
	a. The oxygen production b. Detention time for plug flow system	3×2
	c. Pond area d. Pond depth	2×2

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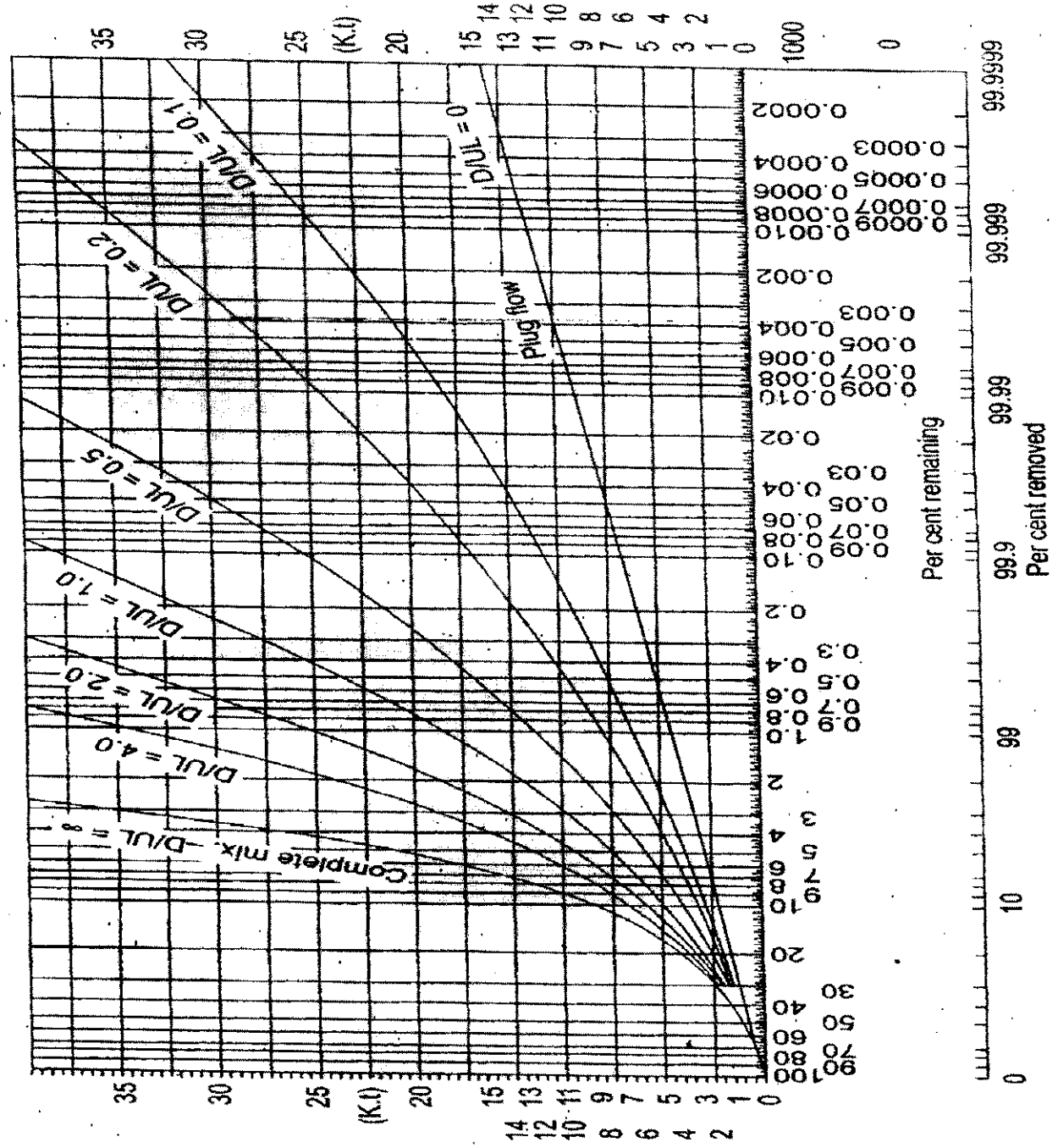
(2nd Semester)
SUBJECT: Process Design in Environmental Engineering

Time: Three hours | Full Marks 100

Use separate Answer-Scripts for each part

No. of Questions | **Part I (40 marks for this part)** | **Marks**



Ref No. –Ex/PG/CE/T/128E/6/2018

MASTER OF CIVIL ENGINEERING EXAMINATION, 2018
2nd year , 2nd Semester

SUBJECT: **PROCESS DESIGN IN ENVIRONMENTAL ENGINEERING**

Time: ~~Two hours~~/Three hours/~~Four hours/ Six hours~~

Full Marks ~~30~~/100

Use a separate Answer-Script for each part

No. of Questions		Marks
	PART - II (Marks:60)	
	Answer any three(3) questions. Assume relevant data if necessary.	
Q1.		
(a)	Discuss the following hydraulic configuration with reference to reactor. Derive necessary equation s for determining the hydraulic retention time also. Batch fed reactor. Continuous reactor	7
(b)	Derive an expression to calculate the reactor volume to obtain a desired concentration of any pollutant undergoes ' n' nos of CMBR.	5
(c)	Determine the reaction order and the reaction rate constant using the following data obtained from a laboratory experiment.	
	Time in hrs:- 0 0.25 0.50 0.60 0.70 0.75 1.0 1.5 2 3 4 Concentration in mg/L :-50 48 36 30 24 20 16 12 8 6 5	8
Q 2.		
(a)	A city requires 105,000 M^3/day of potable water for which rapid gravity filter is to be installed. The backwash water is 2% of the total requirement. The operation time is 20 hrs a day out of which half an hour is kept for service time. Determine the following components of the filtration unit. a) No. of filter beds including 25% extra as stand bye. b) Size and No. of Laterals. c) No and spacing of orifices (use 15mm dia) d) Spacing of Laterals. e) Size of Manifold. f) Size of Back wash water troughs. Assume relevant data.	12
(b)	Derive an expression for estimation of head loss through filter in cleaned bed condition.	8

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MASTER OF CIVIL ENGINEERING EXAMINATION, 2018
2nd year , 2nd Semester

SUBJECT: **PROCESS DESIGN IN ENVIRONMENTAL ENGINEERING**

Time: ~~Two hours~~/Three hours/~~Four hours/ Six hours~~

Full Marks ~~30~~/100

Use a separate Answer-Script for each part

No. of Questions	(Marks:60)	Marks
Q3.		
(a)	Following information are available for designing of a mixing and flocculation unit. Flow rate = 10MLD Rapid mixing time = 60sec Viscosity of water = 1.08×10^{-3} N-sec/m^2 The depth of rapid mixing unit = 3.6 m The depth of flocculation basin = 4.2 m Flocculation time = 20 min Determine 1) the power input in the above two units in KW 2) dimension of mixing and flocculation unit Assume G for fresh mixing unit 700 sec^{-1} G for flocculation unit 35 sec^{-1}	13
(b)	Design a suitable septic tank for 30 users. Assume simultaneous equivalent fixture units to be operative as 16. Draw also a suitable sketch of the reactor.	7
Q 4.		
(a)	Explain anaerobic digestion theory in connection with sludge treatment.	5
(b)	The thickened sludge is to be digested anaerobically in a standard rate digester.The sludge contains 68% organic out of which 65% is converted to liquid and gaseous end products after 26days time period. The digested sludge contains a solid content of 6% that should be stored for a cleaning period of 67 days. Determine the size of the digester assuming the depth of digester is 7.2m effective. Assume the raw sludge loading rate is 85 m3/day and mass of solids is 3200kg/day. The diameter of the digester shall not be more than 35m. Assume any other data if required.	10
(c)	Explain with examples, the principle of preparation of filter bed from river run off available sand	5