

**Agricultural & Food Engineering Department
Indian Institute of Technology, Kharagpur
Autumn Mid-Semester Examination, 2015**

Date of Examination: 17-09-2015 (AN)

Full Marks: 30

Time: 2 hr

Course: M. Tech. (Aqua. Engg.)

No. of Students: 5

Subject No.: AG 61693

Sub. Name: Water Quality Management Practices

Instructions: Answer all questions Make reasonable assumptions wherever necessary

Q1.a) The data for an aquacultural pond of 8 ha and 1.5 m depth, was obtained under the following conditions:

The ratio of channel cat fish, rainbow trout and warm water fish are 1:2:3. Total production is 6000 kg of each 450 g size. Water temp. = 22 °C, DO dusk = 13.5 mg/l, COD = 75 mg/l. Fresh cow dung added: 0.1 Ton/ha (Oxygen demand of cow dung @ 22 °C and 15% dry matter is 0.32 g of O₂/kg manure/h). Make a night time oxygen budget for the given pond. Given A = 249 B = - 0.142 C = 0.024. O₂ solubility at 22 °C is 8.5. Given that DO_{pr} (mg/L.h) = 0.00845 + 0.00263 C (C = COD).

Also find out the no. of 2 KW aerators required if the OTR at standard condition is 1.56 kg of O₂/KWh, α = 0.9, β = 0.98.

b) If the same pond is located in an elevated place of 1000 m above MSL and the salinity of water is 5 g/L having a water temperature of 27 °C, what's the percent change in oxygen depletion during night time. Assume other conditions remain same.

c) Water exchange is being done @20 m³/min for 4 hours daily as a measure of water quality management in the above pond. During the culture evaporation and seepage of 0.5 and 0.2 cm/day was observed. Assuming the rainfall as zero, what percentage of the pond volume is exchanged? [4+3+3 = 10 M]

Q2.a) A standard test with aerator of 3.73 KW yielded a C_s value of 7.4 mg/L with a volume of 275 m³ of clean water at 25°C. The (C_s)₂₀ value is given as 9.57 mg/L. The time required to obtain 20% and 80% DO saturation is obtained from the graph are 9.8 and 57 min respectively. Determine the SOTR and SAE values of the said aerator.

b) Find out the no. of aerators required to manipulate the DO depletion in the problem No. 1 using the aerators tested in problem No. 2.

c) A 5 ha pond is required to be fertilized with N at 3.5 kg/ha, P₂O₅ at 1.6 kg/ha and K₂O at 0.6 kg/ha each time for 3 applications in the whole cycle. The choice of fertilizers available along with their cost and composition are given below.

Name of the fertilizer	Percentage N, P, K			Cost of fertilizer in Rs. Per kg
	N	P ₂ O ₅	K ₂ O	
Ammonium nitrate	33	0	0	8.50
Urea	45	0	0	9.50
Monoammonium Phosphate	11	48	0	9.50
Diammonium Phosphate	18	48	0	10.50
Muriate of potash	0	0	60	8.00
Filler materials	-	-	-	1.50

Find out the least cost combination of fertilizers that could be used annually. [3+2+5= 10 M]

- Q3.a) Explain the phosphate dynamics in an aquaculture pond with the help of phosphorous cycle.
- b) Explain the construction and working details of circular stepped cascade aerator system
- c) Write in brief about various components of recirculatory aquaculture system stating their specific purpose in the system. [4+3+3 = 10 M]

*** End of the Question paper ***

Tables may be useful for you

Table 1: Solubility of oxygen (mg/L) in water at different temperatures and salinities from moist air at 760 mm Hg

Temp °C	Salinity, g/L			
	0	5	10	15
0	14.60	14.11	13.64	13.18
5	12.76	12.34	11.94	11.56
10	11.28	10.92	10.58	10.25
15	10.07	9.77	9.47	9.19
20	9.08	8.81	8.56	8.31
25	8.24	8.01	7.79	7.57

Table 2: Solubility of oxygen (mg/L) in water at different temperatures and MSL exposed to moist air.

Temp °C	0	5	10	15	20	25	30	35	40
MSL, 0 m	14.60	12.76	11.28	10.07	9.08	8.24	7.54	6.93	6.41

Table 3: Gain and losses of DO due to diffusion during night hours with different DO saturation

DO Conc.%	Gain/Loss of DO	DO Conc.%	Gain/Loss of DO	DO Conc.%	Gain/Loss of DO
50	1.69	120	-0.18	190	-2.11
60	1.49	130	-0.55	200	-2.37
70	1.18	140	-0.94	210	-2.42
80	1.00	150	-1.48	220	-2.54
90	0.77	160	-1.64	230	-2.67
100	0.44	170	-1.82	240	-2.76
110	0.16	180	-1.98	250	-2.91