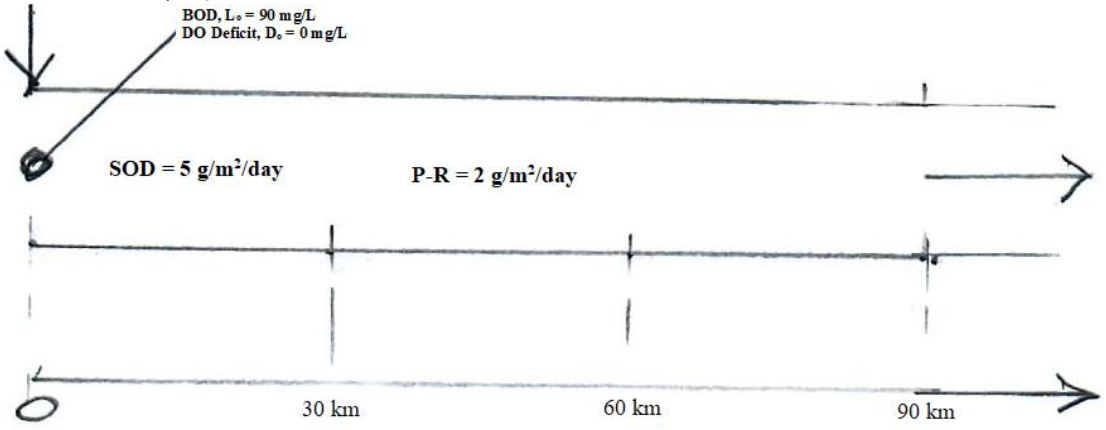
BIRLA INSTITUTE OF TECHNOLOGY AND SCIENCE, PILANI
FIRST SEMESTER 2023-2024
COMPREHENSIVE EXAMINATION (OPEN BOOK/NOTES)

COURSE NO.: CE G525 TIME: 3 Hours MAX. MARKS: 35
COURSE TITLE: Water Resources Planning and Management DATE: 07/12/2023

Note: (i) Attempt all questions.
(ii) Make necessary assumptions, if required.

Q.1 A river is subjected to a point source of BOD and diffuse sources of oxygen deficit, as shown in Fig. Q.1. Compute the BOD and oxygen concentration at 30 km, 60 km and 90km downstream from the origin points as shown in the Figure Q.1. Assume k_d = rate of BOD removal (dissolved form only, excluding settling effects) coefficient; k_r = rate of overall BOD removal (both settling and dissolved form) coefficient; k_a = rate of aeration coefficient; DO_s = saturated dissolved oxygen concentration; H = depth of river water; V = stream flow velocity; L_o = initial BOD concentration; D_o = initial DO deficit.



Flow Velocity, V (m/s)	0.10	0.15	0.15
Flow Depth, H (m)	0.6	1	1
Overall Deoxygenation constant k_r (day^{-1})	0.2	0.1	0.1
Deoxygenation constant, k_d (day^{-1}) (excl. settling)	0.1	0.1	0.1
Reaeration constant k_a (day^{-1})	1	1.1	1.1
DO Saturation (mg/L)	10	9	9

Fig. Q.1

(8.0 M)

Q.2(a) A river and a canal 1000 m apart receive 24 mm of rainfall per hour. Depth of water in river and canal taken from a common horizontal impervious stratum is 12 m and 8.2 m respectively. Compute the discharge/meter length if 50% of rain water infiltrates into the ground. Take permeability of soil as 10 m/day. What will be the seepage during rain less period? Make necessary assumptions, if required. (5.0 M)

Q.2(b) A pumping well of diameter 30 cm is being pumped at the rate of 2240 Lpm. The incremental drawdown observed in an observation well located at 15 m from the pumping well corresponding to one log cycle is 0.35 m. Obtain transmissivity of the aquifer using Cooper Jacob's method. (3.0 M)

Q.3(a) Sustainability is a concept applied to renewable resource management. In your words define what that means and how it can be used in a changing and uncertain environment both with respect to water supplies and demands. Over what space and time scales is it applicable, and how can one decide whether or not some plan or management policy will be sustainable? How does this concept relate to the adaptive management concept? (2.0 M)

Q.3(b) How would you distinguish application of a simulation mathematical model with an optimization model in water resources systems? Clearly explain with an example of water resources management problem. (2.0 M)

Q.3(c) Biochemical oxygen demand (BOD) and theoretical oxygen demand (ThOD) for selected chemical wastes are presented in the following table. Which chemical waste listed in the table is the most likely to be biologically degradable and why? (2.0 M)

	BOD (g/g)	ThOD (g/g)
Chemical waste A	1.34	2.15
Chemical waste B	1.85	1.92
Chemical waste C	1.64	2.91
Chemical waste D	2.15	2.52

(2.0 M)

Q.3(d) Describe a water resources development/management problem with conflicting objectives that is current in the world today. What are the components? Objectives? Discuss why you think they are important? Explain it through any example. (2.0 M)

Q.4 A farmer produces two crops: rice and wheat. The farmer has a production capacity of 40 ton of crops. Because of limited sale opportunity, he can sell a maximum of 24 tons of rice and 30 tons of wheat. The gross margin from the sale of 1-ton rice is 80 units and for wheat, it is 40 units.

(i) Develop a model to determine optimum production. Write the mathematical equations of the objective function and all appropriate constraints for your model.

(ii) Using graphical method, calculate optimum profit which can be collected for this problem.

(iii) Write the Lagrangian for your optimization model. (7.0 M)

Q.5 Write short notes on **<u>two</u>** of the following: (2 x 2 = 4.0 M)

(a) Groundwater contamination and plume size determination

(b) Design of Water Distribution Networks

(c) Assessment of drought and its resilience strategies.

------WISH YOU ALL THE BEST-----