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JAYPEE UNIVERSITY OF INFORMATION TECHNOLOGY, WAKNAGHAT

TEST -3 EXAMINATION - 2018

M.Tech II Semester

COURSE CODE: 14M31CE212 **MAX. MARKS: 35**

COURSE NAME: CONTAMINANT TRANSPORT

COURSE CREDITS: 03 **MAX. TIME: 2 Hr**

Note: All questions are compulsory. Carrying of mobile phone during examinations will be treated as case of unfair means.

Q1.a) Distinguish between "Direct" and "Indirect" photodegradation. Explain the two processes by giving examples **[02 Marks]**

b) What is the light intensity at 1-m depth in a lake, given an intensity of 3000μE/ (m^2.sec) just beneath the lake's surface and an extinction coefficient (base e) of 0.6/m? If an aquatic plant has a light compensation point (the light intensity at which respiration rate equals photosynthetic rate) of 150 μE/ (m^2.sec), what is the maximum depth at which the plant may be expected to grow? **[02 Marks]**

Q2.a) Discuss why hydrolysis reaction are important and significant processes in the aquatic environment **[02 Marks]**

b) What are the important parameters that affect the rates of hydrolysis in the environment? **[02 Marks]**

Q3.a) How do you measure Hydraulic Conductivity in the laboratory? Discuss with the help of a neat figure. **[03 Marks]**

b) A cylindrical column of 1.5 m in length and 10 cm in diameter is packed with Sand with a mean grain size of approximately 0.5 mm. Water flows through the column with a seepage velocity of 1 m/hr. Porosity is 0.3. Five milligrams of salt are injected into the column (i.e., as a pulse injection). **[03 Marks]**

i) What will be the concentration of salt after one hour at a distance 0.9 m down the column?

ii) When the tracer mass is centred 1.3m down the column, what is the concentration of tracer at this location?

iii) What will be the concentration of salt at a distance of 0.9 m down the column after 1 hr if the inflow of pure water is replaced by inflow of a solution with a salt concentration of 5 mg/L in beginning at t = 0.

Q4.a) Define "Retardation Factor". Derive the relationship between retardation factor, distribution coefficient, bulk density and porosity. What are the reasons for nonideality in Retardation. **[02 + 02 + 01 Marks]**

b) Write a note on i) Black Carbon and ii) Ion Exchangers **[02 Marks]**

c) The porous material of an aquifer has a bulk density of $2g/cm^3$ and contains 0.5% organic carbon. Estimate the retardation factor for naphthalene ($C_{10}H_8$). If the porosity of the aquifer is 0.24, the hydraulic conductivity is 10^{-3} cm/sec, and the hydraulic gradient is 0.001, how fast will a plume of naphthalene advance in the aquifer? $\log K_{oc} = 0.937 \log K_{ow} - 0.006$; $\log K_{ow} = 3.36$ **[04 Marks]**

Q5.a) What are the dry deposition mechanisms by which physical removal of particles takes place in atmosphere? Discuss on any one mechanism. **[02 Marks]**

b) An underground nuclear bomb test results in deposition of particles into the atmosphere at a height of 1.5km over the site. If the soil particles have a density of 2.3 g/cm^3, and the wind speed is 1.5 m/sec, what would be the maximum size of the particles that could be transported beyond the border of the test site, which is 200km downwind? Assume dynamic viscosity of air = 1.83×10^{-4} g/(cm.sec) **[03 Marks]**

Q6.a) What are the two major differences between the settling of particles in water and air? How particulate chemicals are removed from atmosphere through wet deposition processes. **[02Marks]**

b) Estimate the dry deposition rate of nitric acid (HNO_3) aerosol on a forest, if atmospheric concentration of HNO_3 is $5\mu g/m^3$. Assume a deposition velocity of 1 cm/sec. **[03 Marks]**

TABLE 3.4 The Complementary Error Function[a]

x	erfc(x)	x	erfc(x)
0	1.0		
0.05	0.943628	1.1	0.119795
0.1	0.887537	1.2	0.089686
0.15	0.832004	1.3	0.065992
0.2	0.777297	1.4	0.047715
0.25	0.723674	1.5	0.033895
0.3	0.671373	1.6	0.023652
0.35	0.620618	1.7	0.016210
0.4	0.571608	1.8	0.010909
0.45	0.524518	1.9	0.007210
0.5	0.479500	2.0	0.004678
0.55	0.436677	2.1	0.002979
0.6	0.396144	2.2	0.001863
0.65	0.357971	2.3	0.001143
0.7	0.322199	2.4	0.000689
0.75	0.288844	2.5	0.000407
0.8	0.257899	2.6	0.000236
0.85	0.229332	2.7	0.000134
0.9	0.203092	2.8	0.000075
0.95	0.179109	2.9	0.000041
1.0	0.157299	3.0	0.000022

$$\text{erfc}(x) = 1 - (2/\sqrt{\pi}) \int_0^x e^{-\epsilon^2} d\epsilon$$

$$\text{erfc}(-x) = 2 - \text{erfc}(x)$$

[a] *Adapted from Freeze and Cherry (1979).*