

INDIAN INSTITUTE OF TECHNOLOGY KHARAGPUR

EV20001 Environmental Science
End-Semester Exam - Section 5
B. Tech. (MI and MF); No. of Students: 112

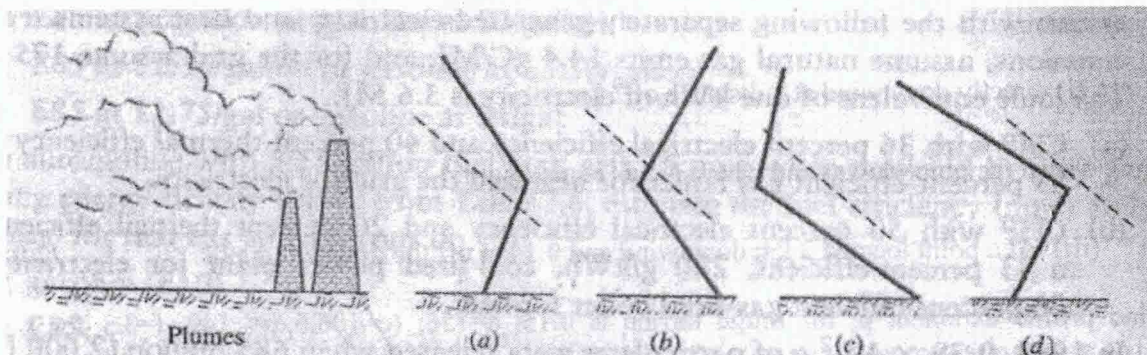
Autumn 2018-19
Time: 3 Hrs
Full Marks: 50

(Answer all questions)

Q1. (a) Suppose we stock an island with 250 rabbits and find that the population is 450 after one year (with no harvesting). After a number of years, the population stabilizes at what we think must be the carrying capacity of the island, 3,500 rabbits. Assuming growth to be logistic, find out what population size should be maintained to achieve the maximum sustainable yield and what would be the maximum sustainable rabbit yield, if we want to start harvesting the rabbits to sell. Assume that the harvesting of rabbits possible per year from the island. (3.0+3.0=6.0)

(b) Describe the logistic growth model with species competition, assuming there are two species present in the ecosystem. What will happen to the species if interspecific competition is aggressive? (3+1=4.0)

Q2. (a) A tall stack and a nearby short stack have plumes as shown in figure below. Which atmospheric temperature profile would be most likely to cause that pair of plumes. The dotted lines represent the dry adiabatic lapse rate. (2.5)



(b) Write short notes on (2×2=4.0)

- (i) Atmospheric stability and Mixing Depth
- (ii) Temperature Inversion

(c) Write a short note on photochemical smog? (1.5)

Q3. (a) What is energy and biomass pyramid? Is the law of thermodynamics violated as you move from bottom to top of these pyramids? Justify your answer. (2.0)

(b) Consider a box model for an air shed over a city 1×10^5 m on a side, with a mixing depth of 1200m. Winds with no SO_2 blow at 4m/s against one side of the box. SO_2 is emitted in the box at a rate of 20kg/s and is considered to be conservative. Assume that emission occur only on weekdays. If emissions stop at 5 PM on Friday, estimate the SO_2 concentration at midnight. If they start again on Monday at 8AM, what would be the concentration by 5PM. Assume that office is 5days a week. (3.0+3.0=6.0)

Q4. (a) Suppose atmospheric CO_2 is growing at 2 ppm/yr, fossil fuel and cement emissions are 9GtC/yr, and the airborne fraction is 38%. If the only other carbon emissions are associated with land use changes, estimate their net carbon emission rate. (2.5)

(b) An air conditioner generates a noise level of 75 dB for five minutes every hour, an electric fan generates a noise level of 60dB for ten minutes every hour in a house. If the background noise level of the house is 55 dB, compute the equivalent continuous level. (2.5)

(c) If the distance between the source and the receiver is doubled then find out the noise level for a point source. (2.0)

Q5. (a) Write a short note on different climate feedbacks. (2.0)

(b) Write on global warming potential (2.0)

(c) A stack emitting 80g/s of NO has an effective stack height of 100m. The wind speed is 4m/s at 10m, and it is a clear summer day with the sun nearly overhead. Estimate the ground-level NO concentration

(i) directly downwind at a distance of 2 km.

(ii) at the point downwind where NO is a maximum.

(iii) At a point located 2 km downwind and 0.1 km off the downwind axis. (2.0×3=6.0)

[wind profile exponent p, for rough terrain is 0.15; a=156; (c=106.6,d=1.149, f=3.3 for $x \leq 1\text{km}$); (c=108.2, d=1.098,f=2.0 for $x > 1\text{km}$)]

Q6. (a) Describe different methods used to control the soil erosion. (2.0)

(b) Describe different indicators of soil degradation. (3.0)

(c) Write short note on Octave band. (2.0)