



# INDIAN INSTITUTE OF TECHNOLOGY, KHARAGPUR

Mid-Autumn Semester Examination, 2018

Subject : Industrial Pollution Control

Date: 20.09.2018(AN)

Time: 2 Hrs

Subject No.: CH62007

Full Marks: 60

Extra

**Instructions:** Answer **all Questions**. Assume any missing data suitably.

## PART-A

1. a) What are the types of inversions? Explain each type of inversion with example and discuss the influences of inversion on dispersion air pollutants?  
b) Discuss the sampling and monitoring procedure for PM, NO<sub>x</sub>, CO and SO<sub>2</sub> in ambient air and stack with diagrams.  
c) What are the major air pollutants emitted from coal fired thermal power plants and their effects on human health and environment?  
d) Explain the various types of plumes with diagram for the dispersion of air pollutants.

[ 1+2+1+2 = 6]

2. It is proposed to install a 20 MW Power Plant within existing premises of Sponge Iron plant (5X100 TPD) by CFBC. The fuel used in CFBC boiler is coal of Grade F (Cal. value: 3000 kcal/kg). The amount of coal to be used is 360 tons per day containing 0.48 % sulphur. The plant emits the flue gases into the atmosphere through a stack of inside diameter of 1.5 m and height of 120 m. The velocity and the temperature of the flue gas at the exit are 5.6 m/s and 125 °C respectively. The ambient air temperature is 37 °C and the wind speed at a height of 10 m height is 2.5 m/s. The barometric pressure is 775 millibar. Assume a moderately stable plume. The exponential factor value ( P ) is provided in the following table.

Stability Class	A	B	C	D	E	F
Values of P in urban areas	0.15	0.17	0.20	0.25	0.30	0.35

- I) Calculate the effective height of the stack.  
II) What is the downwind SO<sub>2</sub> concentration at a distance of 10 km?  
III) Calculate the maximum concentration of SO<sub>2</sub> along the central line of the plume and at what downwind distance it will occur ?  
IV) Show a concentration profile of SO<sub>2</sub> upto 25 km downwind distance and 800 m along the cross wind distance. Also state with justification whether this plant would require any pollution control device if there exists a residential area at a distance of 2 km. Justify.

[ 6]

3. H<sub>2</sub>SO<sub>4</sub> spray mist in air at 35 °C and 1.02 atmospheric pressure is to be removed by a simple gravity settling chamber. The unit is 3 m high, 6 m wide, and 9 m long. The volumetric flow rate of the gas passing through the settler is 3000 m<sup>3</sup>/hr. The Sp. Gv. of the mist is 1.24 and viscosity of gas = 0.018 centipoises.  
Calculate

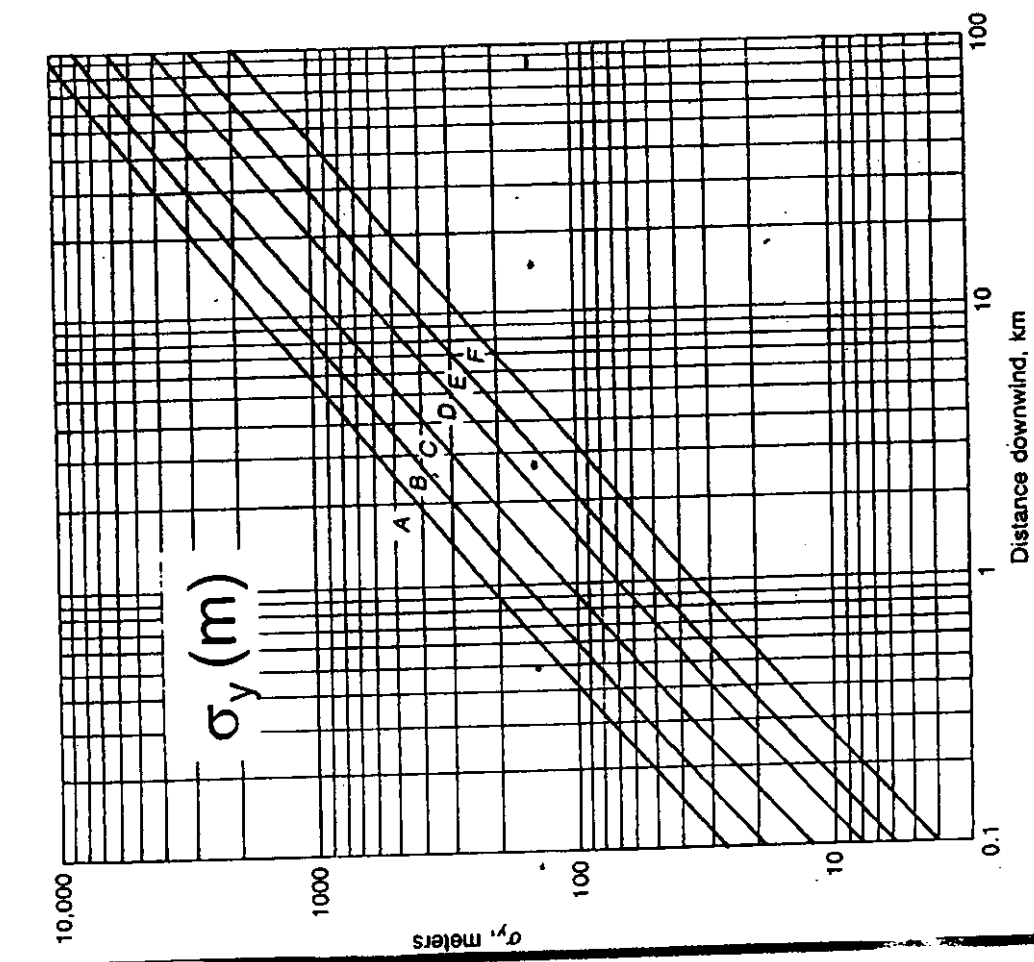
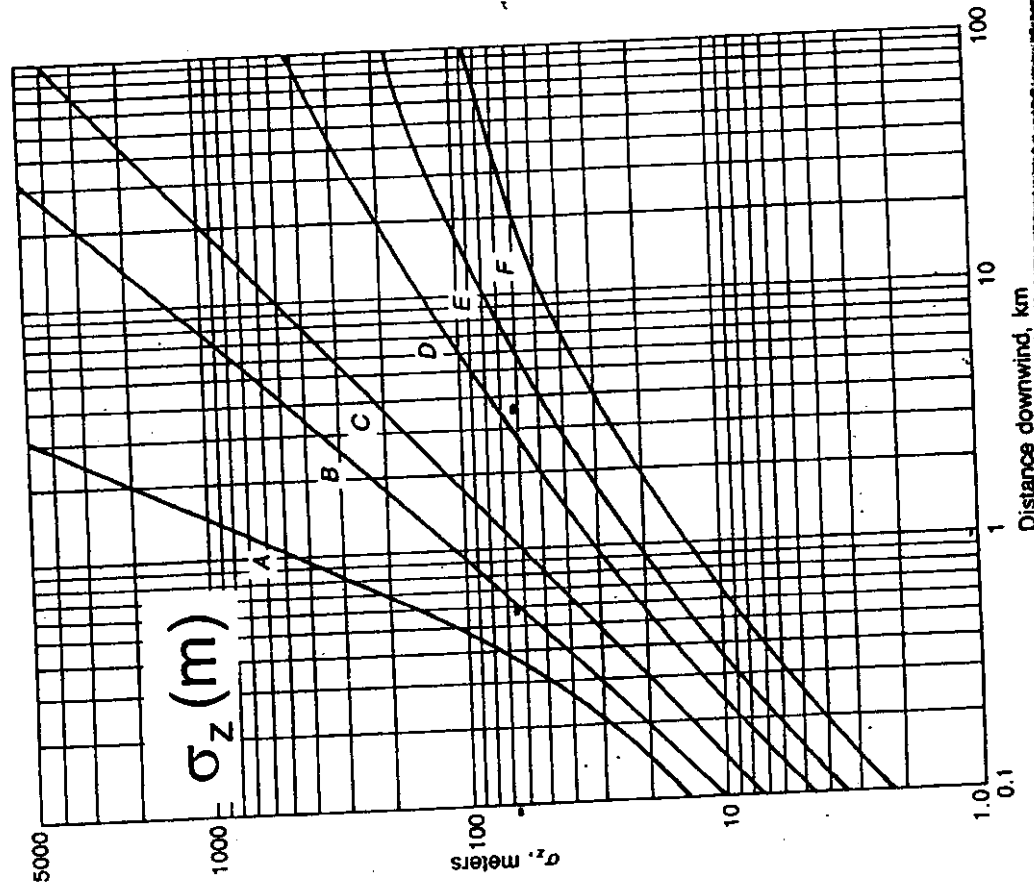
- i) The smallest size of spray that can be completely removed by settler.  
ii)  $D_{P,50}$   
iii) If flow rate is increased by three times of the flow rate what should be the  $D_{P,Min}$ .

[3]

## **PART-B**

1. a) What is the basic purpose of Primary treatment of wastewater.  
b) List and briefly explain the typical primary treatment processes to be utilized for wastewater generated in an Oil-refinery.  
c) Justify why "End of Pipe-Solution" is no longer acceptable in the waste water engineering. [1 +2+2]
2. a) List and briefly describe the major principles of green engineering  
b) Describe the significance LC25 and IC 25.  
c) How Cyanides and Cr (6+) can be removed from the industrial effluents. [2+1+2]
3. a) Define BOD<sub>5</sub>. What should be the BOD and DO respectively for a clean river.  
b) What processes are responsible for affecting the DO content of water, Briefly Explain.  
c) The total COD of an industrial effluent is 1000 mg/lit, Calculate the BOD<sub>5</sub> if the K is 0.3/day [2+1+2].

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Stability Class      A      B      C      D      E      F      Stability Class

- A very unstable
- B unstable
- C slightly unstable
- D neutral
- E slightly stable
- F stable