Ref.No. Ex/PG/PE/T/1210B/2019

MASTER OF POWER ENGINEERING EXAMINATION, 2019

(1ST Year 2nd Semester)

ENVIRONMENTAL ENGINEERING

Time: Three hours **Full Marks 100**

Use of Turner's Stability Curves Permitted
Use of Log-Log Graph Paper Permitted

(Answer any ***five*** questions) (5X20=100)

No. Of Questions	QUESTIONS	Marks
Q1.	a) *A coal fired thermal power plant burns 8.25 tonnes of coal per hour, and discharges the combustion products through a stack having an effective height of 100 m. The coal has a sulphur content of 6%, and the wind velocity at the top of the stack is 9.5 m/sec. Atmospheric conditions are moderately to slightly unstable. Determine the maximum ground level concentration of SO_2 and the distance from the stack at which this maximum concentration prevails.*	5
	b) *Write the basic assumptions behind the Gaussian model. Write the basic Gaussian equation clearly stating the meanings of all the parameters. What will be the modified equation for obtaining i) plume centerline concentration, ii) ground level concentration, iii) ground level concentration at a point for downwind distance less than the ground reflection distance and iv) ground level concentration at a point for downwind distance more than the ground reflection distance.*	4
	c) *Determine the effective stack height with the following given data:* *i) Physical stack height is 200 m with 0.95 m inside diameter* *ii) Wind velocity is 3.00 m/sec and air temperature is 20^0C* *iii) Barometric pressure is 1000 mb* *iv) Stack gas velocity is 17.22 m/sec and stack gas temperature is 168^0C*	3

	d) Prove the followings from the basic Gaussian Modeling Equation subject to the following necessary conditions: i) $\sigma_z=0.47H$ & ii) $\sigma_z=0.707\ H$	6
	e) A rising parcel of dry air has a temperature of 40^0C at sea level. Assuming a dry adiabatic lapse rate determine the temperature at 3000 m.	2
Q2.	a) Derive the expression for atmospheric visibility.	4
	b) What do you mean by fractional transmittance? On what factors does it depend?	4
	c) Derive an expression for coefficient of haze (Coh). What is its significance?	4
	d) In connection with the determination of Coh value 80% was noted as the light transmittance after air had passed through a filter paper at 0.70 m/sec for 4 hrs. Determine the Coh units per 1000 m.	4
	e) If the limit of visibility is defined as the distance when I/I_o reaches 0.02 in value, then determine the percent extinction that occurs in the first (a) 30%, (b) 40%, and (c) 80% of the path length.	4
Q3.	a) What do you mean by potential temperature? Derive the expression for potential temperature?	2+4
	b) Derive an expression for the vertical gradient of potential temperature?	4
	c) Explain the significance of potential temperature.	3
	d) What do you mean by atmospheric lapse rate and dry adiabatic lapse rate?	3
	e) Explain atmospheric stability using the concept of potential temperature.	4
Q4.	a) Estimate the quantity of Carbon (Gt-C) in the atmosphere corresponding to a concentration of $1ppm_v$ of CO_2. Hence estimate the increase in atmospheric CO_2 that would result from the complete combustion of the world's entire fossil fuel resource which is estimated as 350 Gt-C. Assume that only 70% of carbon burnt in air remains as CO_2 in the atmosphere. Assume suitable data as required	8
	b) Based on the air quality standards as per Ministry of	

	Environment And Forests Gazette Notification, Govt. of India dated 16th November, 2009, comment on the Air Quality Index for the area (to be calculated with respect to sub index) based on following air quality data as reported for an industrial belt in a city in India on a particular day: i) PM_{10} Concentration= 300 $\mu g/m^3$ ii) SO_2 Concentration= 90 $\mu g/m^3$ iii) NO_2 Concentration= 270 $\mu g/m^3$ iv) $PM_{2.5}$ Concentration=280 $\mu g/m^3$	6
	c) A man is working in an abandoned well where the CO concentration is found to be 400 ppmv. Make a rough estimate of the saturation value of HbCO in his blood and also calculate the necessary exposure time required for this to develop. The following informations may be used if required: i) Oxygen content of air breathed in =21% by volume ii) M=230 iii) Physical Activity Level=3	6
Q5	a) A proposed source is to emit 120 gm/sec of NO_2 from a stack of 100 meters height with a diameter of 3.5 meters. The effluent gases are emitted at a temperature of 370^0 F with an exit velocity of 30 m/sec. Plot on log-log paper a graph of maximum GLC as a function of wind speed for stability class B. Determine the critical wind speed Assume that the design atmospheric pressure is 1000 mb and the design ambient temperature is 25^0 C.	15
	b) What is thermal inversion? Explain its role related to atmospheric pollution.	5
Q6	Write short notes on any five of the followings: a) Environmental Impact Assessment b) Pathogens c) Dissolved Oxygen d) Air Quality Indexing e) Photochemical Smog & PAN	5X4=20

	f) Photolytic Cycle of NO_x g) Environmental Management Planning a) State the basic assumptions of Streeter-Phelps model.	
Q7	Derive the basic Streeter- Phelps Equation, clearly defining all the notations used in the derivation. b) Explain the dependency of absorbance and transmittance of a solution with respect to turbidity. c) What is MPN? How is it determined? d) Explain the significance of BOD, COD, THOD.	10 4 3 3

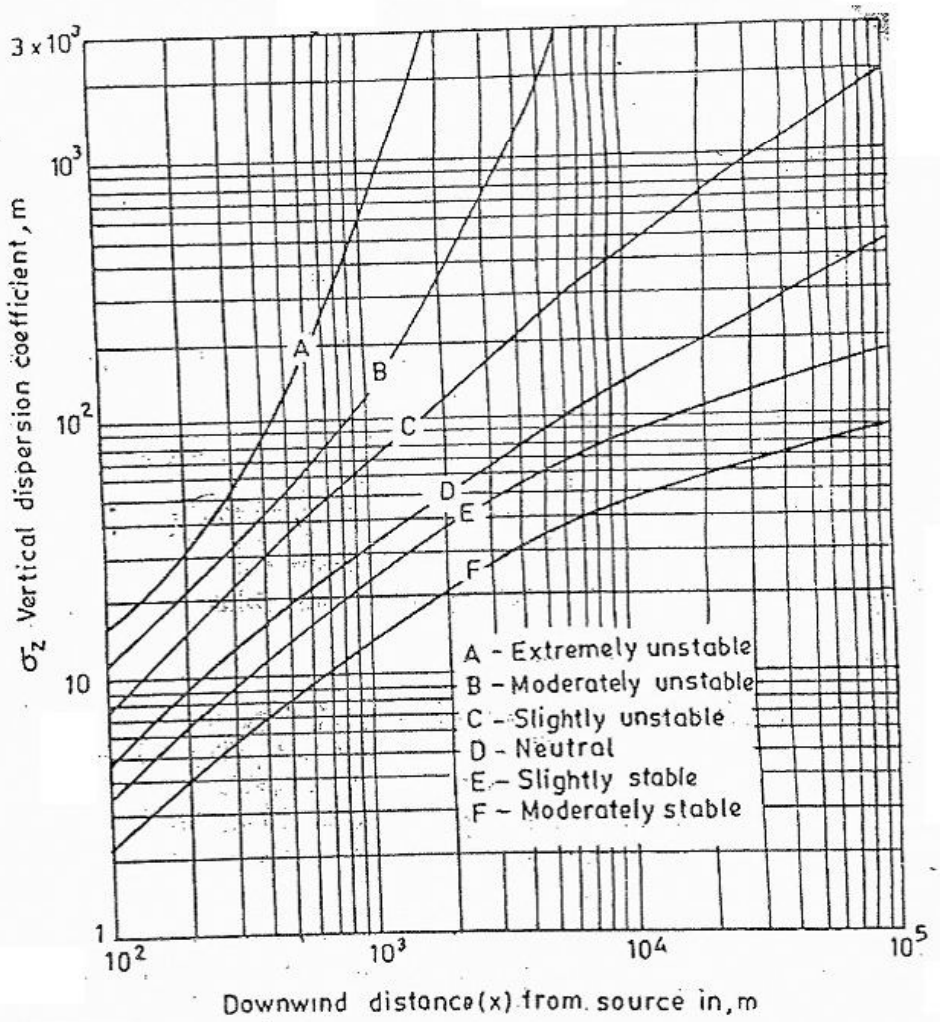

Fig. ~~11.6.~~ 1 σ_z *Vs x* for different atmospheric stabilities.

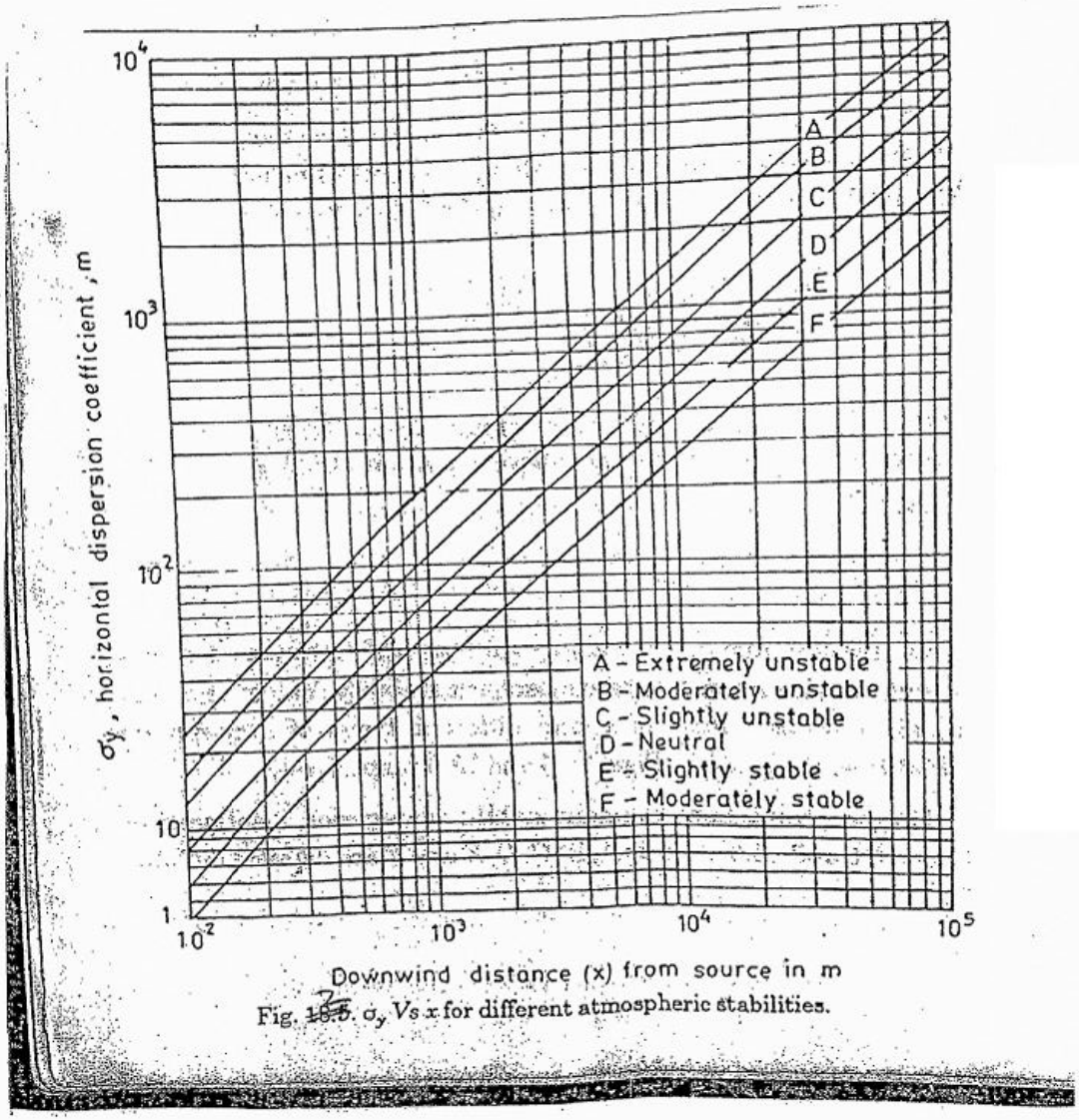

Fig. ~~10.5~~ 7. σ_y *Vs* x for different atmospheric stabilities.