Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

(A constituent unit of MAHE, Manipal)

II SEMESTER M. TECH (CHEMICAL ENGINEERING)

END SEMESTER EXAMINATIONS, MAY 2023

SUBJECT: PE– I AIR POLLUTION MONITORING AND CONTROL [CHE 5001]

REVISED CREDIT SYSTEM

Time: 3 Hours Date: 26/05/2023 Time: 9:30 am-12:30 pm Max. Marks: 50

Instructions to Candidates:

- **Answer all the questions.**
- **Each question carries equal marks (5 X 10 = 50).**
- **Missing data, if any, may be suitably assumed.**
- **Write specific and precise answers, Usual notations shall apply.**

1A.	(i) Analyze the current air pollution scenario in a city of your choice. What solutions do you provide?	**[03]**
	(ii) Write the various legislative framework in India.	**[02]**
1B.	(i) Explain the different objectives of air pollution monitoring.	**[02]**
	(ii) Discuss the measurement of various meteorological parameters (any 3 parameters)	**[03]**
2A.	Describe in detail the various types of plume behavior in a stack-based on atmospheric conditions with a neat sketch	**[05]**
2B.	A city is located near an airport. The smelter stack is 300 m in height and has a plume rise of 100 m. It is emitting 10,000 g/s of SO_2. Assume the stability class is C and that the wind speed is 3 m/sec. A flight path for the airport is perpendicular to the plume and 5 km downwind of the smelter. The wind speed is perpendicular to the emission. The airport safety office has determined that it is unsafe for planes if the plume concentration is 500 $\mu g/m^3$. They have also decided that it is unsafe to fly under the plume. Assume that the Gaussian plume dispersion takes place. (i) What is the minimum altitude in the vertical direction (z) the plane can fly safely above the plume, without considering the ground reflection of the plume? (ii) List steps you would propose to reduce the effect of the air pollution caused by the plant if the other contaminant from the plant includes particulate matter.	**[05]**
3A.	(i) Summarize the various types of inversion in the atmosphere with a suitable schematic representation.	**[03]**
	(ii) Compare and contrast between packed and plate towers for the removal of gaseous pollutants with suitable technical criteria (write any 4 points).	**[02]**
3B.	Derive an expression to determine the height (Z) of the packed bed absorption tower with suitable assumptions.	**[05]**
4A.	(i) Explain the dry-injection type dry scrubber system for the removal of SO_x with suitable reactions and a neat flow sheet.	**[04]**
	(ii) What are the strategies to reduce CO_2 pollution?	**[01]**

4B.	Water vapour present in atmospheric air is removed by using silica gel in a single-stage cross-current adsorbent. The equilibrium water vapour adsorbed by a silica gel in contact with moist air varies linearly with the humidity of $Y = 3.4435 \times 10^{-2} X$, Where X = kg water vapour adsorbed/kg dry silica gel, Y= humidity of the air, kg moisture/kg dry air. 0.5 kg of silica gel containing 5 % (dry basis) adsorbed water vapour is placed in a collapsible vessel in which there is 10 m^3 of air, the partial pressure of water vapour being 15 mm Hg. The total pressure and temperature were kept constant at 1 atm. and 25°C respectively. For gas mixtures following ideal gas law. (i) What is the amount of water vapour picked up from the moist air in the vessel by the silica gel in terms of kg? (ii) Calculate the percentage adsorption of water vapour on silica gel and the final partial pressure of water vapour in the vessel after adsorption.	**[05]**
5A.	(i) Describe the various types of NOx with a suitable graphical representation. (ii) With the help of a neat diagram, discuss the combustion modification techniques for the removal of NOx.	**[2.5]** **[2.5]**
5B.	(i) With a neat diagram derive the expression for the fixed box model of air pollution and list the assumptions. (ii) With a neat sketch explain the principle and working operation of a Non-dispersive infrared analyzer (NDIR) for the measurement of gaseous pollutants.	**[2.5]** **[2.5]**