# SWJTU-OSU 2024-2025(1)

# Midterm Exam for Air pollution Control Engineering

## Part I

### Gap-Fillings (20points)

1. The federal criteria pollutants are $SO_2$, $NO_2$, CO, _____, _____ and $O_3$.
2. Particulate matter can be a solid or _____.
3. VOC is the abbreviation of _____.
4. Ozone depletion and ozone pollution generally occurs in the _____ and _____ of the Earth's atmosphere, respectively.
5. $CO_2$、 _____、 _____、 and CFCs are major greenhouse gases.
6. _____ is secondary pollutant ($NO_2$ 、 $SO_3$ ).
7. CO is contributed mostly from _____sources in the US.
8. The _____ Act marks the most significant and far-reaching legislation in the history of air pollution regulation in the United States.
9. $NO_x$ formation mechanism can be classified into three classes: _____, _____ and _____.
10. The two main factors that determine the total VOC removal rate during VOC incineration are _____ and _____.
11. The two basic methods of classifying FGD systems are (1) _____, and (2) _____.
12. Technology such as _____ or _____can reduce both $SO_2$ and $NO_x$ emissions.

## Part II

1. Briefly compare the two types of standards in the US. (10points)

2. Please list the major sources of atmospheric particulate matter ($PM_{2.5}$ and $PM_{10}$) and briefly discuss the characteristics of the particle size distribution of particles produced by different sources. (10points)

3. Briefly describe the main principles of Selective Catalytic Reduction (SCR) and Selective Non-Catalytic Reduction (SNR) and tell the differences between them in terms of process efficiency and temperature requirements. (10points)

4. Define adsorption and absorption, and give examples of their applications in air pollution treatment? (10points)

## Part III (40points)

1. **Calculate the AQI and give a description of air** that contains 15 ppm CO (8-hour average), 200 $\mu g/m^3$ PM-10 (24-hour average), and 0.15 ppm $SO_2$ (24-hour average). (10points)

2. A particle dispersoid consists of 200 spherical particles:
   100 10-μm particles; 100 100-μm particles.
A device is 80% efficient on the 10-μm particles, and 95% efficient on the 100-μm particles. All particles have the same density, and the 10-μm particles have unit mass. Calculate **the number efficiency and the mass efficiency of collection.** (10points)

3. An ESP must treat 849600$m^3$/hr with 99% efficiency. Assuming an effective drift velocity of 12.2cm/sec, **calculate the required plate area in $m^2$, and the number of plates** if each is 6096mm tall by 3048mm long, and there are 4 mechanical fields. (10points)

4. For $K_e = 471.368\ p_a \cdot \text{min/m}$ and $K_s = 11.548\ p_a \cdot \text{min} \cdot \text{m/g}$, **design a reverse-air baghouse** to filter $33984\ m^3/hr$ of air with $5.72\text{g/m}^3$ of flour. In your design, **specify the number of compartments, the filtering velocity, the cloth area per compartment, and the total number of bags required** if each bag is 3048mm long and 305mm in diameter. (10points)