Department of Environmental Science and Health

College of Science

University of Salahaddin-Erbil

Subject: Air Pollution

Course Book – (3rd Year)

Lecturer's name Prof. Dr. Yahya Ahmed Shekha

Academic Year: 2023/2024

Course Book

1. Course name	**Air Pollution**
2. Lecturer in charge	**Dr. Yahya A. Shekha** **Jamal Kamal Muhhamed Amin (MSc)**
3. Department/ College	**Environmental Science and Health- Science**
4. Contact	**e-mail: yahya.shekha@su.edu.krd** **e-mail: Jamal.muhhamedamin@su.edu.krd**
5. Time (in hours) per week	**Theory: 2, Practical: 2**
6. Office hours	**Every day 9- 12 am except the day off**
7. Course code	
8. Teacher's academic profile	**Prof. Dr. Yahya A. Shekha** **I was accepted in Salahaddin University in 1988- 1989 as a student in BSc and graduated in 1991- 1992, then directly I accepted an MSc studies in 1992 and completed it in 1995 with in specialization Environmental Microbiology (Aquatic microbiology), for ten years served as assistant lecturer in Biology Department/ College of Science, I teach under and postgraduate student all subjects related to environment to biology student, I attained Lecturer degree in 2003. Accepted in Biology Department- College of Science- Baghdad University 2004 for Ph.D. studies, completed it in 2008 in Ecology and Pollution (Invertebrate Ecology and Aquatic Microbiology), attained assistant Prof. in 2009 and Professor degree in 2017. I published more than 52 manuscripts in local and international Journals, participated in local conferences and workshops, till now graduated four MSc students and 1 PhD student, and I have other two MSc students and two PhD students.** **Jamal Kamal Muhhamed Amin** **I earned an MSc. in Environmental Science/Environmental Pollution in 2014 at the Environmental Department at the College of Science-Salahaddin University. In addition, I got a Bachelor's degree in 2009 from the biology department at Salahaddin University. I participated in different training courses such as English and teaching method courses.**
9. Keywords	**Environment, air, water, pollution, human health**

10. Course overview:

In this course, students will learn about environmental pollution sources related to air pollution and relation to their effects on human health. Furthermore, they will learn about the ecosystems of Erbil city and familiarize themselves with various anthropogenic activities which are posing a threat to the existence of these ecosystems, and the ways in which these ecosystems can be preserved. Students will also learn about the ways sources of air

pollutants, types, and effects. In addition, the difference between indoor and outdoor pollution will be discussed followed by the ways to reduce indoor pollution will also be evaluated.

11. Course objective:

Air Pollution become one of the most important subjects for all communities categories, it, directly and indirectly, affects human life, so it is important to study this subject for the following reasons: learn students information about the atmosphere, its components, constituents, living and non-living things in this environment and the balance between the component in virgin or in a clean environment, then known about all types of a pollutant that may be physical, chemical or biological, or it may be from natural or artificial sources, or it may come from urban, industrial, agriculture source, then and how it may be the effect on a human being, what is the guidelines for these pollutants, their safe ranges for human, animal or plant life.

Teach students how to protect the air from pollutants and pollution sources, conserve and restore the environment, and put legislation and laws for each topics, to control the level of pollution in different environment.

Awareness is another point that should be taken account in this subject to learn even the community about the importance of environment and keep them clean with references to pollution's impact to our life activities.

12. Student's obligation

The attendance of students in the hall is the most important thing for the lecturer because it is the way to collect information for students, then participate students through lecture time by asking them, to know their background, conversation, homework, quiz, report, etc.

13. Forms of teaching

Different forms of teaching will be used to reach the objectives of the course: PowerPoint presentations for the head titles and definitions and summary of conclusions, description of the types of pollution and their sources, and any other illustrations, worksheets will be designed to let the chance for practicing on several aspects of the course in the classroom.

Graduate students will be required to review a scientific paper that relates to one of the course topics. The review will consist of a paper that is a maximum of five pages (typed) in length and an oral presentation of the review (15 minutes in length). The goal is to have each student relate to the types and sources of environmental pollution. The format for the paper and presentation will be discussed in class.

14. Assessment scheme

Lecture Exams (4 x 100 Points)	400 Points
Attendance, quizzes, report, home works	100 Points
Total	500 Points

The mean of four examinations and other activities: 15%

Practical Examination 35%

Final examination: 50%

15. Student learning outcome:

Air pollution is the most important subject in our community because it has direct relation to our lives, authority, and NGOs and all companies give special importance to this subject. Student through studies in this course which cover all environmental properties, pollutants, sources, effects, controlling, guidelines, conservation, restoration, well attended good information and knowledge about pollution then can be used or applied in future during their work.

16. Course Reading List and References:

1- Mario J. Molina. (2010). Air Pollution: Health and environmental impacts. CRC Press. Taylor & Francis Group.
2- Jones, J.C. (2008). Atmospheric pollution. Ventus Publishing, APS. BookBoon.com
3- Peirce, J. Jeffrey; Weiner, Ruth E. and Vesilind, E. Aarne. (1998). Environmental Pollution and control. 4th.ed. Butterworth-Heinemann.

17. The Topics:	Lecturer's name
Week one: **Understanding pollution.**	
Week Two: **Overpopulation.**	
Week Three: **Bioaerosol**	
Week Four: Types and sources of air pollutants, particulate matter.	
Week Five: **Air pollutants (CO, CO_2, NOx)**	
Week Six: **Air pollutants (SO_2, H_2S, Hydrocarbons)**	
Week Seven: Examination	
Week Eight: **Dust Pollution and AQI**	
Week Nine: **Other phenomena resulting from pollution (Thermal inversion, El-Nino Southern Oscillation).**	
Week Ten: **Acid deposition.**	
Week Eleven: **Hazardous air pollutants, Health effects.**	
Week Twelve: Asthma, Emphysema, and Bronchtities	
Week Thirteen: Examination	
Week Fourteen: **Light pollution.**	
Week Fifteen: **Visual pollution.**	
Week Sixteen: **Noise pollution**.	

18. The Topics of Practical Parts	Lecturer's name
-Introduction, course outline, Main safety rules of working in the laboratory	
-Acid Rain A. Effect of acid rain on seed germination. B. Effect of acid rain on building materials.	
-Particulate Matter (PM) Analysis A. Importance of PM in air pollution. B. Gravimetric and optical methods for PM measurement. C. Data interpretation and reporting.	
-Determination of pollutant gases in the air A. Importance of PM in air pollution. B. Gravimetric and optical methods for PM measurement. C. Data interpretation and reporting.	

-Indoor Air Quality Assessment A. Common indoor pollutants and sources. B. Sampling methods for indoor air quality.	
-Field Trip and Practical Exercises (if conditions allow). A. Field visit to a pollution monitoring station. B. Hands-on experience with air quality monitoring instruments. C. Sample collection and initial analysis	
-Role of plants in cleaning indoor pollution -Atmospheric CO_2 and temperature raising	
-Visual Pollution	
-Light Pollution	
-Noise pollution	
- Project and Presentation A. Group projects on pollution assessment and mitigation. B. Data collection, analysis, and interpretation. C. Presentation of findings and recommendations.	
-independent student experimentation" or "self-guided laboratory work."	

20. Extra notes:

Here the lecturer shall write any note or comment that is not covered in this template and he/she wishes to enrich the course book with his/her valuable remarks.

21. Peer review **پێداچوونەوەی هاوەڵ**

This course book has to be reviewed and signed by a peer. The peer approves the contents of your course book by writing a few sentences in this section.

(A peer is a person who has enough knowledge about the subject you are teaching, he/she has to be a professor, assistant professor, lecturer, or an expert in the field of your subject).

ئەم کۆرسبووکە دەبێت لەلایەن هاوەڵێکی ئەکادیمیەوە سەیر بکرێت و ناوەڕۆکی بابەتەکانی کۆرسەکە پەسەند بکات و جەند ووشەیەک بنووسێت لەسەر شیاوی ناوەڕۆکی کۆرسەکە و واژووی لەسەر بکات.

هاوەڵ ئەو کەسەیە کە زانیاری هەبێت لەسەر کۆرسەکە و دەبیت پلەی زانستی لە مامۆستا کەمتر نەبێت.

Examinations:

Q1/ **Discuss the following: (Choose only *five*)** **(20 Marks)**

1. **Thermal inversion?**
2. **Formation and breakdown of ozone shield (only by equation).**
3. **Effects of adrenocorticotropic hormone (ACTH) on human health.**
4. **Metals fume fever.**
5. **What are your suggestions to reduced indoor bioaerosols?**
6. **Air conditioning and nasal defence mechanisms.**
7. **Asthma.**

Q2/ **Fill the following blanks with correct word:** **(10 Marks)**

1. **Major gases that caused asphyxiation to humans are …… and ……**
2. **Fluoride are an air pollutant that attack……..as tissues target.**
3. **Dustfall can be calculated = …….**
4. **UVA wavelength ranged from ……, while UVB have wavelength range ……**
5. **Bioaerosols particles size ranging from …… to …….µm.**
6. **Factors serving as checks on human population ……., …….. and ……..**
7. **Dust sources can be originated from……., …….. and ……..**
8. **The result of equal values between crude birth and death rates is called…….**
9. **Most air contaminants that monitor by many countries for assessment AQI are ……., ……., ……, …… and ……...**

***Q3/* Illustrate one of the following by sketching: (10 Marks)**

1. **El- Nino, La- Nina and normal condition.**
2. **Airborne transmission indoor and the general governing flows of droplet dispersion nuclei.**

Q4/ Count only the following: (10 Marks)

1. **The EPA major types of air pollutants**
2. **The problems of overpopulation**

Typical answers:

A1:

1. **Thermal inversion**: The temperature of the air decreases with an increase in altitude at a given rate, called the adiabatic lapse rate. That rate is theoretically 5.4°F for every 1000 ft in height in dry air. When such a situation exists, the air is said to be unstable and warm surface air rises rapidly.

   A temperature inversion or **thermal inversion** is a condition wherein temperature increases with altitude within a layer in some part of the troposphere. In other words, there is a layer of warm air over some cold air. There the rising air is suddenly not warmer (less dense) than the air above or around it, and so it stops rising. In a **radiation thermal inversion** or **ground inversion**, the ground is cooled at night by thermal radiation and cools the air above it but not the air farther up; this causes an inversion. This is a normal nighttime phenomenon usually erased by the morning sun. If the ground air is cooled too much or if, because of clouds, the sun cannot reverse an inversion, it hangs on. Another kind of inversion is called a **subsidence inversion**. In this case,

upper air masses (in high-pressure areas) compress lower air masses such that the upper portion of the lower air mass is compressed more and thus heated more.

2.

$$O_2 \xrightarrow{UV} O^{\bullet} + O^{\bullet} \quad (1)$$

$$O^{\bullet} + O_2 + M \rightarrow O_3 + M \ (M = \text{inert third body}) \quad (2)$$

When ozone absorbs UVB, it is converted back to free oxygen and molecular oxygen:

$$O_3 \xrightarrow{UV} O_2 + O^{\bullet} \quad (3)$$

Not all of the molecular oxygen is converted to ozone, however, because free oxygen atoms may also combine with ozone molecules to form two oxygen molecules:

$$O^{\bullet} + O_3 \rightarrow O_2 + O_2 \quad (4)$$

3. **Adrenocorticotropic hormone (ACTH).** ACTH in turn stimulates the adrenal gland, which secretes several different hormones. Through a variety of influences, these hormones in turn (1) enhance the body's sensitivity to adrenaline, (2) increase blood sugar levels, (3) suppress the immune system, and (4) decrease the liver's ability to detoxify blood.
4. Fumes of certain metals -particularly manganese and zinc but also oxides of antimony, arsenic, ….-can cause temperature elevations in people who breathe them. **Metal fume fever**, as this is called, is also accompanied by a dry throat, chest constriction, fatigue, headache, back pain, nausea, and muscle pain.
5. Install and use exhaust fans that are vented to the outdoors in kitchens and bathrooms and vent clothes dryers outdoors – These actions can eliminate much of the moisture that builds up from everyday activities. There are exhaust fans available that produce little noise, an important consideration for some people.
6. The airway lining fluid of the nose has an important role in respiratory defense. The bacteriostatic proteins lactoferrin and lysozyme inhibit the growth of bacteria in the nose, and secretory antibodies help to prevent and limit viral infections. More recently, it has been shown that nasal airway lining fluid contains antioxidants such as uric acid and glutathione, which limit oxidative damage from air pollutants such as ozone.

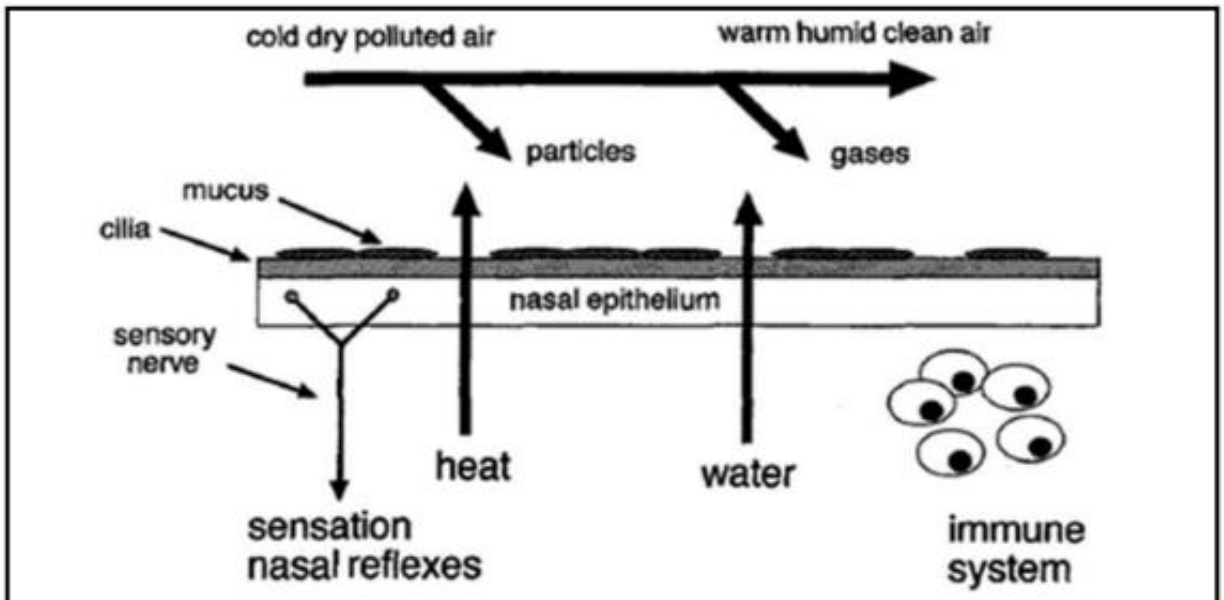


Fig. 1. Air conditioning and nasal defence mechanisms. Cold dry polluted air is conditioned to warm humid clean air by the nose. Particulate matter is deposited on the moving blanket of mucus and soluble gases are absorbed in the fluid layer lining the nose. Sensory nerves monitor the composition of the inspired air and trigger

7. **Asthma**: Asthma is characterized by an increased responsiveness of the trachea and bronchi to various stimuli and is manifested by the widespread narrowing of the airways or bronchioles. The narrowing may be caused by a muscle spasm, a swelling of the mucous membrane, or the thickening and increase in mucus secretions. There are various forms of asthma: Extrinsic asthma is precipitated by external factors; intrinsic asthma can be precipitated, apparently in the absence of external factors, by such things as emotion and exercise.

A2:

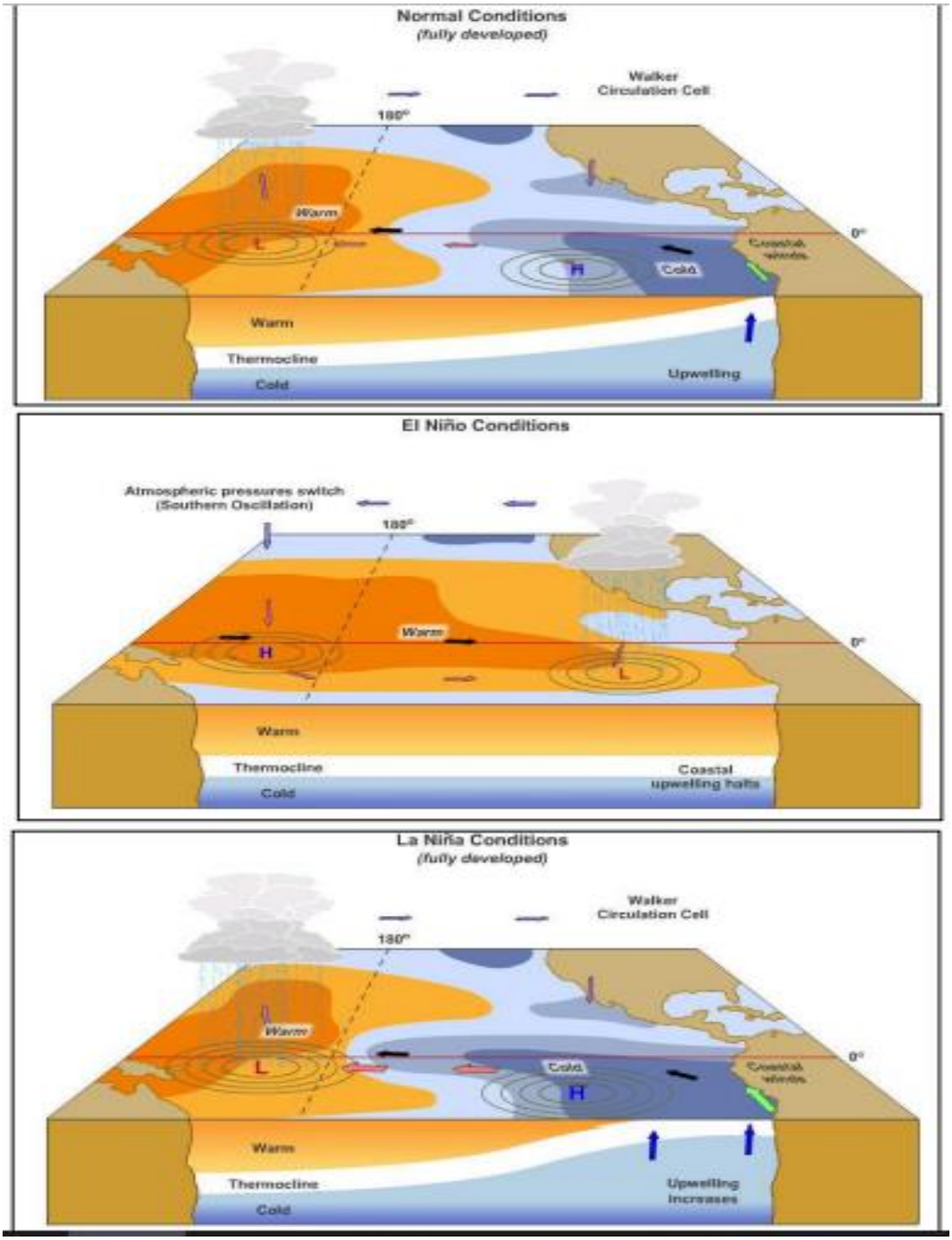
1. CO & H_2S
2. Dental

$$\text{Dustfall} = \frac{\text{wt of dust (mg)}}{\text{area (cm}^2\text{)} \times \text{time (days)}} \times 30 \ \frac{\text{days}}{\text{month}}$$

3.
4. **320 to 400 & 280 to 320nm.**
5. **0.001 to 100 µm**
6. **War, Disease & Famine**
7. **Construction, Roads, Agricultural fields or Deserts or Volcanic eruption**
8. **ZPG (zero population growth)**
9. **Ground-level ozone, particulates, sulfur dioxide, carbon monoxide and nitrogen dioxide**

A3:

1.


Normal Conditions
(fully developed)
Walker
Circulation Cell
180°
Warm
L
H
Cold
0°
Warm
Thermocline
Cold
Upwelling
El Niño Conditions
Atmospheric pressures switch
(Southern Oscillation)
180°
H
Warm
L
0°
Warm
Thermocline
Cold
Coastal
upwelling halts
La Niña Conditions
(fully developed)
Walker
Circulation Cell
180°
Warm
L
Cold
H
0°
Warm
Thermocline
Cold
Upwelling
increases

2.

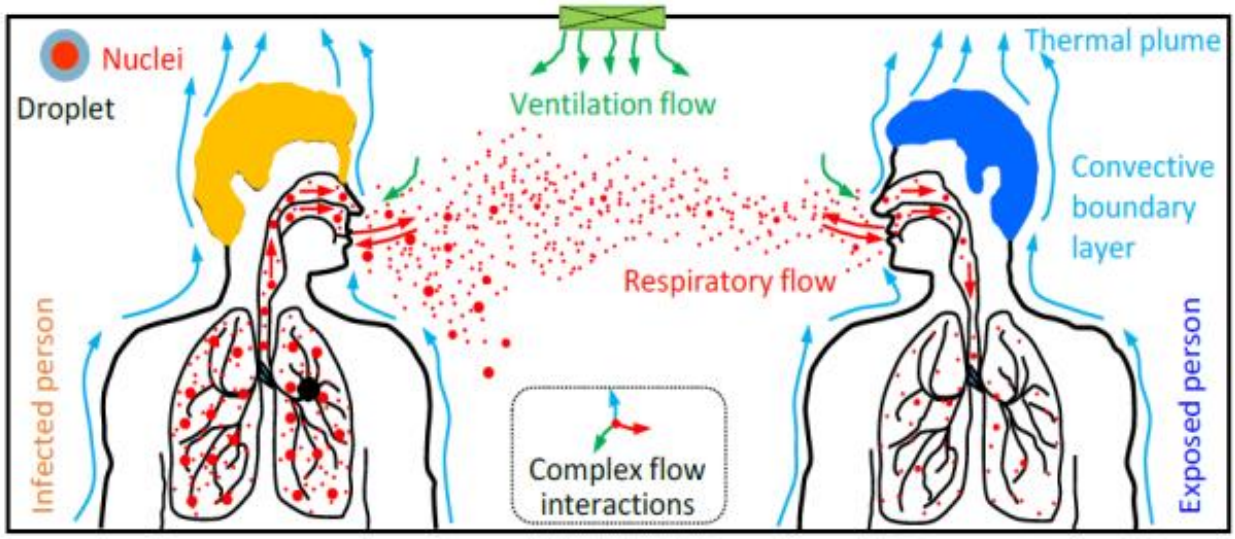


Figure 3 A schematic view of the whole process of airborne transmission indoors and the general governing flows of droplet nuclei dispersion.

A4:

1. The EPA closely tracks 6 major types of pollutants: 1- Carbon monoxide (CO), 2- Sulfur dioxide (SO_2), 3- Nitrogen dioxide (NO_2), 4- Troposphere ozone (O_3), 5- Lead (Pb), 6- Particulate matter.
2. The problems of overpopulation: 1. Shortage of food 2. Shortage of social facilities, like houses, schools and hospitals. 3. Shortage of jobs 4. Environmental pollution 5. Traffic congestion.

The Topics (For the Practical part):

Course program

-Introduction, course outline, Main safety rules of working in the laboratory

-Acid Rain

C. **Effect of acid rain on seed germination.**

D. **Effect of acid rain on building materials.**

-Particulate Matter (PM) Analysis

- **D. Importance of PM in air pollution.**
- **E. Gravimetric and optical methods for PM measurement.**
- **F. Data interpretation and reporting.**

-Determination of pollutant gases in the air

- **D. Importance of PM in air pollution.**
- **E. Gravimetric and optical methods for PM measurement.**
- **F. Data interpretation and reporting.**

First Examination

-Indoor Air Quality Assessment

- **C. Common indoor pollutants and sources.**
- **D. Sampling methods for indoor air quality.**

-Field Trip and Practical Exercises (if conditions allow).

- **D. Field visit to a pollution monitoring station.**
- **E. Hands-on experience with air quality monitoring instruments.**
- **F. Sample collection and initial analysis**

-Role of plants in cleaning indoor pollution

-Atmospheric CO_2 and temperature raising

-Visual Pollution

-Light Pollution

-Noise pollution

- Project and Presentation

- **D. Group projects on pollution assessment and mitigation.**
- **E. Data collection, analysis, and interpretation.**
- **F. Presentation of findings and recommendations.**

-independent student experimentation" or "self-guided laboratory work."