

## SEMESTER V

Course Code: CHE5D01

### Open Course 1: ENVIRONMENTAL CHEMISTRY

Total Hours: 48; Credits: 3; Hours/Week: 3; Total Marks 75 (Internal 15 & External 60)

#### Course outcomes

At the end of the course, students will be able to:

CO 1: Recall the technical/scientific terms involved in pollution.

CO 2: Understand the causes and effects of air pollution.

CO 3: Understand the sources, types and effects of water pollution.

CO 4: Describe water quality parameters.

CO 5: Know soil, noise, thermal and radioactive pollutions and their effects.

CO 6: Study various pollution control measures.

CO 7: Understand the basics of green chemistry.

#### Module I: Introduction to Environment and Environmental pollution (4 hrs)

Environmental chemistry - introduction, Environmental segments – Lithosphere: components of soils, Hydrosphere: water resources, Biosphere, Atmosphere - regions of atmosphere – Troposphere, stratosphere, mesosphere, thermosphere.

Environmental pollution – Concepts and definition – Pollutant, contaminant, receptor and sink – Classification of pollutants – Global, regional, local, persistent and non-persistent pollutants.

#### References

1. A. K. De, *Environmental Chemistry*, 7<sup>th</sup> Edn., New Age International, 2012.
2. A. K. Ahluwalia, *Environmental Chemistry*, The Energy and Resources Institute, 2017.
3. Balram Pani, *Textbook of Environmental Chemistry*, I. K. International Pvt Ltd, 2010.

#### Module II: Air Pollution (8 hrs)

Tropospheric pollution – Gaseous air pollutants – Hydrocarbons, oxides of sulphur, nitrogen and carbon – Global warming, green house effect, acid rain – Particulates – Smog: London smog and photochemical smog – effects and control of photochemical smog – stratospheric pollution - depletion of ozone layer, chlorofluorocarbons - Automobile pollution. Control of air pollution – Alternate refrigerants – Bhopal Tragedy (a brief study). Air pollution in Indian cities (Delhi, Agra and Kanpur).

**References**

1. S. K. Banerjee, *Environmental Chemistry*, 2<sup>nd</sup> Edn., Prentice-Hall of India Pvt. Ltd., New Delhi, 2005.
2. V. N. Bashkin, *Environmental Chemistry: Asian Lessons*, Springer Science & Business Media, 2003.
3. S. E. Manahan, *Environmental Chemistry*, 8<sup>th</sup> Edn., CRC Press, Florida, 2004.
4. A. K. Ahluwalia, *Environmental Chemistry*, The Energy and Resources Institute, 2017.
5. Balram Pani, *Textbook of Environmental Chemistry*, I. K. International Pvt. Ltd., 2010.

**Module III: Water Pollution (10 hrs)**

Impurities in water – cause of pollution – natural and anthropogenic – Marine water pollution – Underground water pollution.

Source of water pollution – Industrial waste, Municipal waste, Agricultural waste, Radioactive waste, Petroleum, Pharmaceutical, heavy metal, pesticides, soaps and detergents.

Types of water pollutants: Biological agents, physical agents and chemical agents – Eutrophication - biomagnification and bioaccumulation.

Water quality parameters: DO, BOD, COD, alkalinity, hardness, chloride, fluoride and nitrate. Toxic metals in water and their effects: Cadmium, lead and mercury – Minamata disaster (a brief study), itai-itai disease, oil pollution in water. International standards for drinking water.

**References**

1. S. K. Banerjee, *Environmental Chemistry*, 2<sup>nd</sup> Edn., Prentice-Hall of India Pvt. Ltd., New Delhi, 2005.
2. J. M. H. Selendy, *Water and Sanitation-Related Diseases and the Changing Environment*, John Wiley & Sons, 2011.
3. P. K. Goel, *Water Pollution: Causes, Effects and Control*, New Age International, 2006.
4. V. N. Bashkin, *Environmental Chemistry: Asian Lessons*, Springer Science & Business Media, 2003.
5. S. E. Manahan, *Environmental Chemistry*, 8<sup>th</sup> Edn., CRC Press, Florida, 2004.
6. A. K. Ahluwalia, *Environmental Chemistry*, The Energy and Resources Institute, 2017.
7. Balram Pani, *Textbook of Environmental Chemistry*, I. K. International Pvt. Ltd., 2010.

**Module IV: Soil, Noise, Thermal, light and Radioactive Pollutions (8 hrs)**

Soil pollution: Sources by industrial and urban wastes. Pollution due to plastics, pesticides, biomedical waste and e-waste (source, effects and control measures) – Control of soil

pollution - Solid waste Management – Open dumping, landfilling, incineration, re-use, reclamation, recycle, composting.

Non-degradable, degradable and biodegradable wastes. Hazardous waste.

Noise Pollution – physiological response to noise, Noise categories - effect of noise – biological effects.

Thermal pollution – definition, sources, harmful effects and prevention. Light pollution.

Radioactive pollution (source, effects and control measures) – Hiroshima, Nagasaki and Chernobyl accidents (brief study). Endosulfan disaster in Kerala (brief study).

### References

1. S. E. Manahan, *Environmental Chemistry*, 8<sup>th</sup> Edn., CRC Press, Florida, 2004.
2. A. K. Ahluwalia, *Environmental Chemistry*, The Energy and Resources Institute, 2017.
3. A. K. De, *Environmental Chemistry*, 6<sup>th</sup> Edn., New Age International.
4. Balram Pani, *Textbook of Environmental Chemistry*, I. K. International Pvt. Ltd., 2010.
5. Anindita Basak, *Environmental Studies*, Pearson Education India, 2009.
6. Pallavi Saxena, Vaishali Naik, *Air Pollution: Sources, Impacts and Controls*, CAB International, 2018.

### Module V: Pollution Control Measures (12 hrs)

Air pollution control measures – Gravitational settling chamber, fabric filter, wet scrubber, catalytic converters, stacks and chimneys, cyclone collectors, Cottrell electrostatic precipitator, extraction ventilator, zoning and green belt.

### References

1. N. P. Cheremisinoff, *Handbook of Air Pollution Prevention and Control*, 2002.
2. M. Senapati, *Advanced Engineering Chemistry*, 2006.
3. K. C. Schiffner, *Air Pollution Control Equipment Selection Guide*, CRC Press, 2013.
4. K. B. Schnelle, C. A. Brown, *Air Pollution Control Technology Handbook*, CRC Press, 2016.

### Module VI: Green Chemistry (6 hrs)

Introduction- Definition of green Chemistry, need of green chemistry, basic principles of green chemistry. Applications of green chemistry in daily life.

### References

1. V.K. Ahluwalia, M. Kidwai, *New Trends in Green Chemistry*, Springer Science & Business Media, 2012.
2. M. Lancaster, *Green Chemistry: An Introductory Text*, Royal Society of Chemistry, 2010.
3. S. C. Ameta, R. Ameta, *Green Chemistry: Fundamentals and Applications*, CRC Press,