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| **Course code** | **Course name** | **Course Category** | **L-T-P** | **Credits** |
| 20CHXXXX | Environmental Pollution and Control For Chemical Engineers | PEC | 3-0-0 | 3 |

**Course Learning Objectives:**

1. Emphasize on this course is on the fundamentals of pollution control aspects
2. Learn about different air pollutants sampling and analysis methods
3. Learn air pollution control equipment.
4. Know the primary, secondary and advanced wastewater treatment process.
5. Understand the solid, hazardous waste and their treatment and disposal methods.
6. Learn about EIA

**Course Content:**

**Unit I (10 Contact hours)**

Industrial Pollution Emissions and Indian Standards: Types of emissions from chemical industries and effects on environment, Type of pollution and their sources, Effluent guide lines and standards, Characterization of effluent streams, Oxygen demands and their determination (BOD, COD, and TOC), Oxygen sag curve, BOD curve interpretation, Controlling of BOD curve.

**Unit II (7 Contact hours)**

Air Pollution Sampling: Criteria and toxic air pollutants, Air pollution sampling and measurement: Ambient air sampling: collection of gaseous air pollutants, Collection of particulate air pollutants, stack sampling: Sampling system, particulate and gaseous sampling

**Unit III (7 Contact hours)**

Air pollution control methods and equipments: Particulate emission control: collection efficiency, Control equipments like gravity settling chambers, Cyclone separators, Fabric filters, Electrostatic precipitator, Scrubbers (Spray towers and Venturi scrubbers)

**Unit IV (7 Contact hours)**

Wastewater treatment Process-Methods of primary treatment; Screening, sedimentation, flotation, neutralization, secondary treatment: Biological treatment of wastewater and bacterial growth curve, suspended growth processes (activated sludge, aerated lagoon and stabilization pond), attached growth processes (trickling filter and rotating biological contactor).Advanced waste water treatment.

**Unit V (7 Contact hours)**

Solid waste management: Sources and classification, Methods of collection, Disposal methods (Landfill and incineration)

Health and environment effects, sources and disposal methods, Chemical wastes; Health and environment effects, Treatment and disposal.

**Unit VI (7 Contact hours)**

Environmental Management: Sustainable development, Environmental Impact Assessment (EIA), Environmental Ethics, Legal aspects.

**Learning Resources:**

**Text book:**

1. C.S. Rao, ‘*Environmental Pollution and Control Engineering’*, 2ndEdition, Wiley, India, 2006.

**Reference Books:**

1. S.P.Mahajan, ‘*Pollution Control in Processes Industries’*, TMH, 1985.
2. M.NarayanaRao and A.K.Datta, ‘*Waste water treatment’*, 3rdEdition., Oxford and IBH, 2005.
3. M.N.Rao,H. V.N.Rao, ‘*Air Pollution’*, Tata McGraw Hill Education Private Limited, India,2010.
4. H.S.Peavy, P.R. Rowe, G. Tchobanoglous, ‘*Environmental Engineering’*, McGraw Hill, 1985.

**Web resources:**

1. <https://nptel.ac.in/courses/123105001/>

**Course outcomes:** At the end of the course, the student will be able to

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| CO 1 | List different types of pollution and apply knowledge for the protection and improvement of the environment |
| CO 2 | Identify suitable sampling, analysis for air pollutants. |
| CO 3 | Design suitable equipment for air pollutants. |
| CO 4 | Select and use suitable wastewater treatment technique |
| CO 5 | Elaborate the most appropriate technique to manage the solid waste. |
| CO 6 | Discuss strategy of EIA |

**Assessment Method**

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| --- | --- | --- | --- | --- |
| Assessment Tool | Weekly tests/Assignments  (In semester) | Monthly tests  (In semester) | End Semester Test | Total |
| Weightage (%) | 10% | 30% | 60% | 100% |

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| **Course code** | **Course name** | **Course Category** | **L-T-P** | **Credits** |
| 20CHXXXX | Solid Waste to Energy Conversion | PEC | 3-0-0 | 3 |

**Course Learning Objectives:**

The course content enables the students to:

1. Learn the characterization of wastes
2. Learn the concepts of production of energy from different types of wastes through thermal, biological and chemical routes
3. Know the concepts the pyrolysis, gasification and syngas utilization
4. Learn how to improve the efficiency of power plant and energy production from waste.
5. Learn the concepts of anaerobic digestion and fermentation and microbial fuel cells.
6. Keep their knowledge upgraded with the current thoughts and newer technology options along with their advances in the field of the utilization of different types of wastes for energy production.

**Course Content:**

**Unit I (6 Contact hours)**

Introduction, characterization of wastes

**Unit II (6 Contact hours)**

Energy production form wastes through incineration, energy production through gasification of wastes.

**Unit III (8 Contact hours)**

Energy production through pyrolysis, gasification of wastes and syngas utilization.

**Unit IV (7 Contact hours)**

Densification of solids, gas cleanup.

introduction to microbial fuel cells.

**Unit V (8 Contact hours)**

Energy production from organic wastes through anaerobic digestion and fermentation

**Unit VI (10 Contact hours)**

Energy production from wastes through fermentation and trans esterification Cultivation of algal biomass from wastewater and energy production from algae.

**Learning Resources:**

**Text Books:**

1. Rogoff, M.J. and Screve, F., ‘*Waste-to-Energy: Technologies and Project, Implementation’*, Elsevier Store.
2. Young G.C., ‘*Municipal Solid Waste to Energy Conversion processes’*, JohnWiley and Sons.

**Reference Books:**

1. Harker, J.H. and Backhusrt, J.R., ‘*Fuel and Energy’*, Academic Press Inc.
2. EL-Halwagi, M.M., ‘*Biogas Technology- Transfer and Diffusion’*, Elsevier applied Science.
3. Hall, D.O. and Overeed, R.P., ‘*Biomass - Renewable Energy’*, John Willy and Sons.

**Web resources:**

1. http://nptel.ac.in/courses/103107125/#video

**Course outcomes:** At the end of the course, the student will be able to

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| --- | --- |
| CO1 | Analyzing the characterization of wastes |
| CO2 | Learn the concepts of production of energy from different types of wastes through thermal, biological and chemical routes |
| CO3 | Evaluate concepts the pyrolysis, gasification and syngas utilization |
| CO4 | Methods to improve the efficiency of power plant and energy production from waste. |
| CO5 | Get the concepts of anaerobic digestion and fermentation and microbial fuel cells. |
| CO6 | Explore knowledge upgraded with the current thoughts and newer technology options along with their advances in the field of the utilization of different types of wastes for energy production. |

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| **Course Nature** | | | **Theory** | | |
| **Assessment Method** | | | | | |
| Assessment Tool | Weekly tests/Assignments  (In semester) | Monthly tests  (In semester) | | End Semester Test | Total |
| Weightage (%) | 10% | 30% | | 60% | 100% |

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