ESE 913 CO_2 Capture, Utilization and Sequestration

Course Objectives

1. The objectives of this CO2 Capture, Utilization and Sequestration course are:
    a. Explain different carbon capture approaches and carbon separation technologies
    b. Demonstrate an in-depth understanding of post-combustion carbon capture with chemical absorption
    c. Evaluate critically the advantages and limitations of various carbon capture approaches and separation technologies
    d. Demonstrate the ability to select different carbon separation technologies for different scenarios.
    e. To describe the sequestration techniques especially geological sequestration
    f. Explain different technologies for the utilization of CO_2

Course Contents

2. Contents with suggested contact hours

No.	Topics	Contact Hours
a.	**Carbon, Energy and Atmosphere** • Primary carbon sources, scales and the challenge • Large emission sources of CO_2 • The carbon cycle • Coal-fired power plants • Oil and gas operations • Industrial activities such as chemical, fertilizer and cement manufacturing	5
b.	**Overview of carbon capture and utilization** • Carbon dioxide capture and storage (CCS) Technology • Carbon dioxide capture and Utilization (CCU) Technology	5

	• Economic Aspects of CCS and CCU	
c.	**CO_2 Capture** • Separating CO_2 from regular flue gas • Modifying the fossil fuel combustion technology	4
d.	**Post-Combustion Carbon Capture Technology** • Process of post combustion Carbon Capture Technology • Solvents and Sorbents • Advanced Membranes Technology • Chemical Looping	7
e.	**Pre-Combustion Carbon Capture Technology** • Process of pre combustion carbon capture technology • Reforming and gasification • Integrated Gasification Combined Cycle (IGCC) as commercial application • Clean hydrogen production	7
f.	**Oxyfuel combustion Carbon Capture Technology** • Process of oxyfuel combustion carbon capture technology • Oxyfuel-combustion plant with near zero emissions	6
g.	**CO_2 Utilization** • Enhanced oil/ Gas recovery application • CO_2 as Feedstock to produce fine chemicals (fuels and polymers • Breakthrough Concepts • Direct Utilization of Carbon Dioxide via Microalgae • Carbon Dioxide to Energy Products • CO_2 neutral or green fuels • Applications for the desalinated water	6
h.	**Carbon storage/ sequestration** • Overview of carbon storage • Geologic Storage Technology • Oil and gas reservoirs	5

	• Coal bed methane • Saline Formations • Risk assessment for carbon storage	
		45

3. **Recommended Reading (including Textbooks and Reference books).**

S. No.	Title	Author(s)	Books
1.	Introduction to Carbon Capture and Sequestration, Imperial College Press, 2014	Berend Smit, Jeffrey R Reimer, Curtis M Oldenburg, Ian C Bourg	Reference
2.	Carbon Capture, Storage, and Utilization, The Energy and Resources Institute, TERI, 2014	Malti Goel, M Sudhakar, R V Shahi	Reference
3	Carbon Dioxide Utilization, 1st Edition, Closing the Carbon Cycle, Elsevier, 2014	Styring & Quadrelli & Armstrong	Reference