

LOK JAGRUTI UNIVERSITY (LJU)
INSTITUTE OF ENGINEERING & TECHNOLOGY

Department of Chemical Engineering
Bachelor of Technology (B.E.) – Semester - VI

Course Code:	017083703
Course Name:	Sustainable Technology and Cleaner Production
Category of Course:	Professional Elective Course I (PEC I)
Prerequisite Course:	---

Teaching Scheme				
Lecture (L)	Tutorial (T)	Practical (P)	Credit	Total Hours
3	0	0	3	30

Syllabus				
Unit No.	Topic	Prerequisite Topic	Successive Topics	Teaching Hours
01	Solar thermal systems and applications	---	---	4 (13%)
	1.1 Advanced collectors: ETC, Solar Pond			
	1.2 Concentrators: optical design of concentrators			
	1.3 Solar water heaters, Solar dryers, Solar stills			
02	Biomass and biofuels	---	---	4 (13%)
	11.1 Introduction			
	11.2 Biofuel classification			
	11.3 Biomass production for energy farming			
	11.4 Direct combustion for heat			
	11.5 Pyrolysis (destructive distillation)			
	11.6 Further thermochemical processes			
	11.7 Alcoholic fermentation			
	11.8 Anaerobic digestion for biogas			
	11.9 Wastes and residues			
	11.10 Vegetable oils and biodiesel			
	11.11 Social and environmental aspects			
03	Hydro-power	---	---	3 (10%)
	3.1 Introduction			
	3.2 Principles			
	3.3 Assessing the resource for small installations			
	3.4 An impulse turbine			
	3.5 Reaction turbines			
	3.6 Hydroelectric systems			
04	Ocean thermal energy conversion (OTEC)	---	---	2 (7%)
	14.1 Introduction			
	14.2 Principles			
	14.3 Heat exchangers			
	14.4 Pumping requirements			
	14.5 Other practical consideration			
	14.6 Environmental impact			
05	Green Engineering	---	---	2 (7%)
	5.1 Green Design			
	5.2 Corporate Strategies			
	5.3 The Strategies of Green Engineering			
	5.4 Industrial Ecology			
	5.5 Product Design			
	5.6 Materials Management			
	5.7 Production Design			
06	Green Synthesis and Catalysis	---	---	2 (7%)
	6.1 he Principles of Green Chemistry			
	6.2 Selecting Raw Materials & Auxiliary Materials			
	6.3 Reaction Pathways			
	6.4 Biotechnology			
07	Sustainable Development	---	---	2 (7%)
	7.1 Introduction to Sustainable Development			
	7.2 Three principal dimensions: the ecological, the economic and the social dimension, including intergenerational justice			
	7.3 Use a systems perspective, to describe sustainability challenges and possibilities for major technical systems and for their transformation to meet sustainability requirements			
08	Concepts of Cleaner Technologies	---	---	4 (13%)
	8.1 Cleaner Production (CP), Definition, methodology			
	8.2 Role of CP in Achieving Sustainability, Benefits			

	8.3 Role of Industry, Government and Institutions, Environmental Management Hierarchy, 8.4 Relation of CP and EMS.			
09	Cleaner Production Case study			3 (10%)
	9.1 CP case studies: Dairy Industry, Pulp and Paper Industry, Textile Industry, Glass Industry, Chlor-Alkali Manufacturing Industry, Cement Manufacturing Industry.	---	---	
	9.2 Vernitas Textile Company – From Environmental Disaster to Environmental Recognition			
	9.3 Klaipėdos Baldai Furniture Manufacturing.			
	9.4 Greenchem Programme – Wax Esters as Wood Coating Material			
	9.5 Energy Management in a Meat Processing Company			
10	Energy Management and Auditing			4 (13%)
	10.1 Concept of energy management program	---	---	
	10.2 Basic components of an Energy audit			
	10.3 Types of energy audit			
	10.4 Industrial, commercial and residential audit planning			
	10.5 Duties and responsibilities of energy managers and auditors			
	10.6 Energy audit instruments/ tools			

**Proposed Theory + Practical Evaluation Scheme by Academicians
(% Weightage Category Wise and it's Marks Distribution)**

L : 3 T: 0 P: 0

Note : In Theory Group, Total 4 Test (T1+T2+T3+T4) will be conducted for each subject.

Each Test will be of 25 Marks.

Each Test Syllabus Weightage: Range should be 20% - 30%

Group (Theory or Practical)	Group (Theory or Practical) Credit	Total Subject Credit	Category	% Weightage	Marks Weightage	
Theory	3	3	MCQ	60%	60	
Theory			Theory Descriptive	40%	40	
Theory			Formulas and Derivation	0%	0	
Theory			Numerical	0%	0	
Expected Theory %	100%			Calculated Theory %	100%	100
Practical	0		Individual Project	0%	0	
Practical			Group Project	0%	0	
Practical			Internal Practical Evaluation (IPE)	0%	0	
Practical			Viva	0%	0	
Practical			Seminar	0%	0	
Expected Practical %	0%			Calculated Practical %	0%	0
Overall %	100%			100%	100	

Course Outcome

1	To understand, design, and implement solar thermal systems while also comprehensively exploring biomass and biofuel production methods and their social and environmental implications.
2	To understand and apply principles of hydropower, ocean thermal energy conversion (OTEC), and green engineering, fostering sustainable energy practices and environmental stewardship.
3	To apply principles of green chemistry and cleaner technologies, integrating them into sustainable development practices for environmentally responsible synthesis and catalysis processes.
4	To analyze case studies in cleaner production and energy management, identifying strategies for promoting sustainability and minimizing environmental impact in diverse industrial contexts.

Suggested Reference Books

1	Fundamentals of Ecology, MC Dass, Tata McGraw Hill.
2	Environmental Chemistry, De AK, New Age International Publishers.
3	Principles of Solar Engineering, Goswami DY. Kreith F. Kreider JF, Taylor & Francis.
4	Introduction to Green Chemistry, Matlack A.S. Publisher: Marcel Dekker, Newyork, 2001.
5	Green Chemistry: Theory and Practice, Anastas P.T. and Warner J.C. Oxford University Press, 1998.
6	Cleaner Production Audit Environmental System Reviews, Modak P., Visvanathan C. and Parasnis M. Asian Institute of Technology, Bangkok, 1995.
7	Introduction to Hydro Energy Systems: Basics, Technology and Operation, Wagner H. Mathur J., Springer.
8	Fundamental of Renewable Energy Sources, Tiwari GN. Ghoshal MK, Narosa.
9	General Aspect of Energy Management and Energy Audit, BEE Guide book.
10	Handbook of Energy Audit., Thumann, Younger, The Fairmount Press, 2003.
11	Renewable Energy Resources, John Twidell , Tony Weir, Taylor & Francis.
12	Sustainable Development, Tracey Strange and Anne Bayley, OECD INSIGHTS.

Proposed Evaluation Scheme by Academicians (Percentage of Weightage out of 100%)

Theory Descriptive Test

MCQ Test

Hands on Project

Formulas and Derivation Test

Numerical Test

Seminar