

Study Schemes and Syllabus of  
Regular Courses of  
Course work of  
Doctorate of Philosophy



# SLIET LONGOWAL

## 2.2.1 - CHEMICAL ENGINEERING (Ph.D. - CE)

### Course work Subject codes and subject names

SUB CODE	SUBJECT NAME	L	T	P	CREDIT
CH-10001	Bio-based Polymers and their Degradation	3	1	0	4
CH- 10002	Advanced Polymer Composite Technology	3	1	0	4
CH-10003	Advanced Reaction Engineering	3	1	0	4
CH-10004	Advanced Energy Technology	3	1	0	4
CH-10005	Advances in Environmental Engineering	3	1	0	4
CH-10006	Waste Management and Recycling	3	1	0	4

PG subjects can also be offered to Ph.D. scholars



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## 2.2.1 - CHEMICAL ENGINEERING (Ph.D. - CE)

### CH-10001: BIO-BASED POLYMERS AND THEIR DEGRADATION

L	T	P	CREDIT
3	1	0	4

#### Unit-I

Introduction and need of Biodegradable polymers, classification of Biodegradable polymer, structure, chemistry and properties of some biodegradable polymers like TPS, PLA. Disadvantages and challenges for the use of biodegradable polymers.

Plastic Waste – sources and types of plastic waste, methods of recycling of plastics such as land filling, incineration, mechanical recycling and chemical recycling, methodology for plastic waste recycling.

#### Unit-II

(10)

**Polymer degradation:** types of polymer degradation, criteria used in the evaluation of biodegradable polymers, factors affecting the degradability of polymers, chemistry of polymer biodegradation, biodegradation of common plastics vis a vis biodegradable plastics.

#### Unit-III

(10)

**Testing:** Screening test for ready biodegradability, test for inherent biodegradability, test for simulation studies, Petri dish screen, environmental chamber methods- soil burial test, CO<sub>2</sub> evaluation method, enzymatic degradation method.

#### Unit-IV

(10)

Recycling technology for biodegradable plastics – conventional and complicated recycling. Environmental implication of polymer degradation.

#### Recommended Books:

1. Handbook of Plastic Technology, Vol. II by Allen, Baker & Bhatia.
2. Chemistry & Technology of Biodegradable Polymers, Academic Professional London 1994, G.J.L. Griffin Blackie (ed)
3. Plastic waste recycling, AICTE.
4. Handbook of Biodegradable Polymers, Abraham J. Donb & others (ed.)



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## 2.2.1 - CHEMICAL ENGINEERING (Ph.D. - CE)

### CH-10002: ADVANCED POLYMER COMPOSITE TECHNOLOGY

L	T	P	CREDIT
3	1	0	4

#### Unit -I (14 Lecture)

**Introduction to composites:** Types of composites (particulate, fibrous, laminates), advantages of composites over nacent material; Fiber reinforcement; long fiber reinforcement; fiber ( glass, carbon, aramid, ceramic, mettalic fiber formals; natural fiber reinforcement; Mineral powder filler; surface treatment of fillers; Study of thermoplastic composite; Application of thermoplastic structural composite; glass fiber filled thermoplastic polymers.

**Polymer composites :** Introduction; BMC/ SMC ; prepag; Applications of composites Brief idea of nanocomposites. Advantages over conventional composites.

#### Unit -II (08 Lecture)

**Mechanical properties :** Tensile, compressive and flexural properties, Influences of resin characteristics and resin reinforcement interaction on composite strength ; Interfacial adhesion & coupling agent ; Dynamic Mechanical properties; fatigue behavior ; Impact behavior;

#### Unit -III (12 Lecture)

**Fabrication Methods:** Manual (Hand-lay- up, Spray-up. Auto clove molding); Semi auto (cold press molding. Hot press molding, resin injection, vacuum injection), automatic (filament winding, centrifugal casting, pultrusion, injection molding, compression molding). sandwich constructions.

#### Unit -IV (08 Lecture)

**Polymer Alloys/ Blends:** Introduction; nature of polymer blends; factors affecting nature of polymer blends; melt flow & Morphology of blends; polymer / Polymer miscibility; compatibility ; Rubber toughening of plastics; blends of stiff compounds; preparation; processing; development of thermoplastic alloys.

#### Recommended Books:

1. Polymers & Composites
2. Thermoplastic Aromatic Polymer composite : F.N Cogswell
3. Polymer Alloys / Blends : Ultracki
4. Hand-Book of composite : Peters
5. Engg. Polymers : Dyson



# SLIET LONGOWAL

## 2.2.1 - CHEMICAL ENGINEERING (Ph.D. - CE)

### CH-10003: ADVANCED REACTION ENGINEERING

<b>L</b>	<b>T</b>	<b>P</b>	<b>CREDIT</b>
3	1	0	4

#### Unit -I (10 Lecture)

**Homogeneous Reaction in Ideal Reactors:** Kinetics of Homogenous reactions, Interpretation of Batch Reactor Data; Integral method of analysis and Differential Method of Analysis.

#### Unit -II (10 Lecture)

**Design of Ideal Reactors:** Design of Ideal Reactors; Concept of Design; Important parameters controlling Design of fixed and varying volume reactors.

#### Unit -III (14 Lecture)

**Non-Ideal Reactors:** Concept of Non- Ideal flow, Compartment Models, Dispersion Model, The tanks in series Model, the convection Model for Laminar flow, Earliness of mixing, Segregation and RTI.

#### Unit -IV (10 Lecture)

**Catalytic Reactors:** Reaction Catalyzed by solids: Heterogeneous reaction; The packed Bed Catalytic Reactor.

#### Recommended Books:

Sr. No.	Title	Author	Publishers
1.	Chemical Reaction Engg.	Octave Levenspiel	Wiley International Ed.
2.	Elements of Chemical Reaction Engineering	Fogler, H.S.	PHI
3.	Advanced Polymer Chemistry: A problem solving guide	Manoj chanda	Marshal Deccar Inc.
4.	Fundamentals of Polymers International Ed. 1990	Anil Kumar & Rakesh K. Gupta	McGraw Hill
5.	Polymer Reactor Engineering, First Ed. 1994	C. McGreavy	Blackie Academic and Professional,
6.	An introduction to Polymer	Charles	Rammond B. Seymquer



# SLIET LONGOWAL

## 2.2.1 - CHEMICAL ENGINEERING (Ph.D. - CE)

### CH- 10004 : ADVANCED ENERGY TECHNOLOGY

L	T	P	CREDIT
3	1	0	4

**Unit -I** (11 Lecture)

**Introduction:** Energy scenario. Energy sources & their availability. Prospects of renewable energy sources. Classification of energy sources. Quality & concentration of an energy sources. Resources of energy & energy use pattern in different regions of the world .

**Energy Audit:** Energy audit concepts, elements, measurements, mass & energy balances, evaluation of energy conserving opportunities, presentation of reports case study.

**Unit -II** (10 Lecture)

**Energy Conservation:** An economic concept of energy conservation, laws of energy efficiencies, energy recovery from waste, waste heat recovery systems and applications. Energy savings by recycling & by network analysis, application of pinch technology to energy conservation.

**Unit -III** (11 Lecture)

**Solar Energy and Wind Energy:** Solar radiation, its measurement & prediction. Solar water heating, solar dryers, solar stills, solar cooling & refrigeration. Thermal storage. Solar PV.

Basic principles of wind energy conversion. Basic components, classification, advantages & disadvantages of WECS (Wind Energy Collectors System), Types of wind machines (Wind Energy Collectors), energy storage, application of wind energy.

**Hydrogen and fuel cells:** Salient features of hydrogen as energy carrier. Hydrogen production technologies. Fuel cells, types and operation. Fuel cells in CHP mode.

**Unit -IV** (10 Lecture)

**Bio Energy:** Biomass as a source of energy, assessment of biomass availability using GIS and remote sensing, biomass characterization. Biomass conversion technologies, biogas generation, classification of bio gas plants, digester design considerations, thermal gasification of biomass. Classification and design of biomass gasifiers. Downstream processing of syngas. First, second and third generation biofuels, biochemical /chemical processing steps.

#### Recommended Books:

1. Hand book of Energy Conservation by Robert and Collins Vol. 1& Vol.2.
2. Non-conventional Energy Sources by G.D.Rai.
3. Energy Technology by S.Rao
4. Solar Energy by S.P. Sukhatme



# SLIET LONGOWAL

## 2.2.1 - CHEMICAL ENGINEERING (Ph.D. - CE)

### CH- 10005 : ADVANCES IN ENVIRONMENTAL ENGINEERING

L	T	P	CREDIT
3	1	0	4

**Unit -I** (10 Lecture)

**Introduction:** Environmental pollution, monitoring & control; effects of pollutants on living systems and structures. Effluent guidelines & standards for air, water & land disposals. Conservation of material resources & energy through recycling.

**Unit -II** (12 Lecture)

**Water Pollution:** Waste-water characterization. Waste-water treatment; primary treatment, secondary treatment, advanced waste-water treatment techniques. Industrial waste -water treatment & disposal, design of major water pollution control equipments.

**Unit -III** (12 Lecture)

**Air Pollution:** Types of air pollutants and their effects on environment. Greenhouse effect. Depletion of ozone layer. Dispersion of air pollutants; plume characteristics. Design of chimney, settling chamber, cyclone separator, filter bag house, ESPs and scrubbers.

**Unit -IV** (08 Lecture)

**Solid Waste Pollution:** Characterization of solid waste, disposal of solid waste, solid waste management, reuse of solid waste materials, recovery of materials & metals, conversion into useful products. Landfill gases and leachates.

**Environment Impact Assessment & Auditing:** Environment impact assessment, project data, environment data, prediction & evaluation of impacts, environment Impact assessment in Indian context. Environment auditing and analysis of data, cost benefit analysis in pollution control.

#### Recommended Books:

1. Manual on emergency Preparedness for Chemical Hazards Ministry of environment & Forests, govt. of India.
2. Environmental engineering -G.N.Panday, G.C.Carney. Tata McGraw
3. Sustainable Business -Regency Corporation Ltd.,
4. Waste water treatment "Concept and Design Approach" G.L.Karia, R.A Christian.
5. Air Pollution Control Engineering, Martin Crawford
6. Air Pollution Control Engineering, W.Licht
7. Environmental Engineering by Peavy, Rowe, Tchobanoglous



# SLIET LONGOWAL

## 2.2.1 - CHEMICAL ENGINEERING (Ph.D. - CE)

### CH-10006: WASTE MANAGEMENT & RECYCLING

L	T	P	CREDIT
3	1	0	4

#### Unit I

**Introduction:** (10 Lectures)

Environmental Education and Management; Treatment of Wastes; Recovery, Recycling and Reuse; Waste Management Planning, Monitoring and Control.

#### Unit II

(12 Lectures)

##### Agro-Residues:

Various Types of Agro-Residues; Their Characterization; Gasification Technology; Liquefaction Technology ; Biethanol, Plant Vegetable Oil, Bio diesel; Combustion Technology ; Pyrolysis Technology.

#### Unit III

(12 Lectures)

##### Briquetting Technology:

Piston Press Technology; Screw Press Technology; Various Parameters Controlling Briquetting; Economic Evaluation.

#### Unit IV

**Case studies:** (10 Lectures)

Bio-Diesel from Trash; Any agro-based Gasifier; Combustor; Paper manufacture from agro- residue

\*Students will be expected to present seminar on Advances topics of “Waste Management and Recycling”.

#### Recommended Books

S.No.	Title	Author	Publishers
1.	Waste to Energy	Upender Pandel;Poonia; J. Mathur and S.Mathur	Prime Publishers
2.	Prospects and Perspectives of Solid	B.B.Hosetti	New Age International Pub.
3.	Env. Edu. And Solid	A.Nag;k.Vizayakumar	New Age International Pub