Program Elective-II

UG	Department: **Chemical Engineering**
Course Code: **CH411**	Course Name: **Polymer Science and Technology**
Credit: **3**	L-T-P: **3-0-0**
Version: **1**	Approved on:
Prerequisite Course: **Nil**	

Chemistry of Polymerization Reactions

Functionality, polymerization reactions, polycondensation, addition free radical and chain polymerization. Copolymerisation, block and graft polymerizations, stereospecific polymerization.

Polymerization Kinetics

Kinetics of radical, chain and ionic polymerization and co-polymerization systems.

Molecular Weight Estimation

Average molecular weight: number average and weight average. Theoretical distributions, methods for the estimation of molecular weight.

Polymerization Processes

Bulk, solution, emulsion and suspension polymerization.

Thermoplastic composites, fibre reinforcement fillers, surface treatment reinforced thermoset composites – Resins, Fibres, additives, fabrication methods.

Rheology

Simple Rheological response, simple linear viscoelastic models – Maxwell, Voigt, material response time, temperature dependence of viscosity, Rheological studies.

Books

1. Rodringuez, "*Principles of Polymer Systems*", Tata McGraw Hill,1970.
2. Billmayer Jr. and Fred. W., "*Textbook of Polymer Science*", Wiley Tappers, 1965.
3. David, J. W., "*Polymer Science and Engineering*", Prentice Hall, 1971.
4. Schmidt, A. K. and Marlies, G. A., "*High Polymers - Theory and Practice*", McGraw Hill, 1948.
5. McKelvey, J. M., "*Polymer Processing*," John Wiley, 1962.
6. Manoriffs, R. W., "*Man-made Fibres*," Wiley Inter Science.

UG Department: **Chemical Engineering**
Course Code: **CH413** Course Name: **Bioprocess Engineering**
Credit: **3** L-T-P: **3-0-0**
Version: **1** Approved on:
Prerequisite Course: **Nil**

Interaction of chemical engineering principles with biological sciences. Life processes, unit of living system, microbiology, reaction in living systems, biocatalysts, model reactions. Fermentation mechanisms and kinetics : kinetic models of microbial growth and product formation. Fermenter types; Modeling of batch and continuous fermentor. Bioreactor design, mixing phenomena in bioreactors. Sterilization of media and air, sterilization equipment, batch and continuous sterilize design. Biochemical product recovery and separation. Membrane separation process: reverse osmosis, dialysis, ultrafiltration; Chromatographic methods: adsorption chromatography, gel filtration, affinity chromatography etc. Electro-kinetic separation: electro-dialysis, electrophoresis. Waste water treatment: activated sludge process, anaerobic digestion, trickling filter.

Books

1. Shuler, M.L. and Kargi, "Bioprocess Engineering Basic Concepts," 2nd ed, Prentice Hall of India, New Delhi, 2002.
2. Bailey & Ollis, Biochemical Engg. Fundamentals, McGraw Hill.
3. Dubey R.C., "A Textbook of Biotechnology", S. Chand and Co., New Delhi 2002.
4. Schugerl, K. and Bellgardt, K. V., Bioreaction Engineering: Modeling and Control, Springer Verlag, Heidelberg, 2000.
5. Blanch H. W. and Clark D. S., Biochemical Engineering, Dekker, NewYork, 1996.
6. Doran P., Bioprocess Engineering Principles, Academic Press, NewYork, 1995.
7. Aiba, S., Humphrey, J. Biochemical Engineering, Academic Press, 1973.

UG Department: **Chemical Engineering**
Course Code: **CH415** Course Name: **Non-Conventional Energy Sources**
Credit: **3** L-T-P: **3-0-0**
Version: **1** Approved on:
Prerequisite Course: **Nil**

Introduction: Energy scene of supply and demand in India and the world, energy consumption in various sectors, potential of non-conventional energy resources. Detailed study of the following sources with particular reference to India.

Solar Energy: Solar radiation and its measurement, limitations in the applications of Solar Energy, Solar collectors – types, and constructional details. Solar water heating, applications of Solar Energy for heating, drying, space cooling, water desalination, solar concentrators, photovoltaic power generation using silicon cells.

Bio-Fuels: Importance, combustion, pyrolysis and other thermo chemical processes for biomass utilization. Alcoholic fermentation, anaerobic digestion for biogas production.

Wind Power: Principle of energy from wind, windmill construction and operational details and electricity generation and mechanical power production.

Tidal Power: *Its meaning, causes of tides and their energy potential, enhancement of tides, power generation from tides and problems. Principles of ocean thermal energy conversion (OTEC) analysis and sizing of heat exchangers for OTEC.*

Geothermal Energy: Geo technical wells and other resources dry rock and hot aquifer analysis , harnessing geothermal energy resources.

Energy Storage and Distribution: Importance, biochemical, chemical, thermal, electric storage. Fuel cells, distribution of energy.

Books

1. Rai, G.D., "*Non-Conventional Energy Sources,"* Khanna Publishers, New Delhi, 2001.
2. Sorenson, B, "Renewable Energy", 3rd ed., Elsevier Science, 2004.
3. Twiddle, J. Weir, T. "*Renewable Energy Resources*," Cambridge University Press, 1986.
4. Kreith, F. and Kreider, J. F., "*Principles of Solar Engineering*," McGraw Hill, 1978.
5. Duffie, J. A., Beckman, W. A., "*Solar Engineering of Thermal Processes*," John Wiley, 1980.
6. Veziroglu, N., "*Alternative Energy Sources*," Volume 5 & 6, McGraw-Hill, 1978.
7. Sukhatme, S. P., "*Solar Energy: Principles of Thermal Collection and Storage*," 2nd ed., Tata McGraw-Hill, 2001.
8. Garg, H.P. and Prakash, J., "*Solar Energy: Fundamentals and Applications*," Tata McGraw-Hill, 2001.

UG Department: **Chemical Engineering**
Course Code: **CH417** Course Name: **Mechanical Design of Process Equipment**
Credit: **3** L-T-P: **3-0-0**
Version: **1** Approved on:
Prerequisite Course: **Nil**

Pressure Vessels: Introduction of codes for pressure vessel design; Classification of pressure vessels; Design of cylindrical and spherical shells under internal and external pressure; Selection and design of closures; Optimum length to diameter ratio of pressure vessel using common types of closures; Design of jacketed portion of vessels; Selection and design of nozzles; Elementary idea of compensation for openings; Selection of gaskets; Selection and design of flanges; Pipe thickness calculation under internal and external pressure; Introduction to inspection and non-destructive testing; Complete design calculations and shop drawing for at least one pressure vessel using heads and flanges as per code specifications.
Tall Tower Design: Design of shell, skirt, bearing plate and anchor bolts for tall tower used at high wind and seismic conditions.
Supports: Design of lug support and saddle support including bearing plates and anchor bolts.
Storage Tanks: Filling and breathing losses; Classification of storage tanks; Design of liquid and gas storage tanks.
Heat Exchange Equipment: Mechanical design and drawing of heat exchangers
Foundation and Supports: Foundation and supports for equipment/vessels, tall towers.

Books

1. Bhattacharya, B. C., "*Introduction to Chemical Equipment Design: Mechanical Aspects*," 5th ed., CBS Pub., Delhi., 1991.
2. Joshi, M. V. and Mahajani, V. V., "*Process Equipment Design*," 3rd ed., Macmillan, Delhi, 1996.
3. Sinnott, R.K., "Coulson and Richardson's *Chemical Engineering*," Vol. 6, 3rd ed., Butterworth Heinmann, New Delhi, 2002.
4. Brownell, L. E. and Young, H. E., "*Process Equipment Design*," John Wiley, 1959.
5. Dawande, S. D., "*Process Design of Equipments*," 2nd ed., Central Techno. Pub. Nagpur, 2000.
6. IS: 2825-1969, "*Code of Practice for Mechanical Design of Unfired Pressure Vessels*".
7. IS:803-1962, "*Code of Practice for Design, Fabrication and Erection of Mild Steel Cylindrical Welded Oil Storage Tanks*".
8. IS: 1239-1968, "*Specification of Mild Steel Tubes*".
9. IS: 4503-1967, "*Specifications for Shell and Tube Type Heat Exchanger*".

IS Code for Pipe Line.