

INSTITUTE	DIPLOMA STUDIES
PROGRAM	DIPLOMA ENGINEERING (CHEMICAL ENGINEERING)
SEMESTER	5
COURSE TITLE	CHEMICAL REACTION ENGINEERING & THERMODYNAMICS
COURSE CODE	09CH2502
COURSE CREDITS	5

Objective:

- 1 To learn the basic mechanism behind fluid behavior in various reactors and to solve heat & work requirement problems in chemical industries

Course Outcomes: After completion of this course, student will be able to:

- 1 Identify & classify various types of chemical reactions
- 2 Analyze various chemical reactors
Calculate rate, rate constant, activation energy and order of reaction
- 3 Apply concept of various laws of thermodynamics to solutions
- 4 Analyze PVT behaviors of various fluids

Pre-requisite of course: Basic knowledge Chemical Process Industries, Heat Transfer operation and Mass & Energy balances

Teaching and Examination Scheme

Theory Hours	Tutorial Hours	Practical Hours	ESE	IA	CSE	Viva	Term Work
3	2	0	50	30	20	25	25

Contents : Unit	Topics	Contact Hours
1	Introduction to Chemical Reaction Engineering Scope and importance of chemical reaction engineering, Classification of chemical reactions (Homogeneous vs. Heterogeneous, Catalytic vs. Non-catalytic, Reversible vs. Irreversible, By Molecularity, Exothermic vs. Endothermic, By order of reaction), Reaction rate on various basis and variables affecting the rate of reaction, Activation energy, Arrhenius equation.	6
2	Types of Reactors & Characteristics Batch, Semi-Batch, Continuous stirred tank reactor, Tubular, Multiphase, Trickle bed, Fluidized bed, Selection criteria of various reactors, Ideal reactors, Space time, Space velocity	6

Contents : Unit	Topics	Contact Hours
3	Kinetics of Homogeneous Reactions Rate equation/ Rate law, Concentration dependent term of rate (Equation, Rate constant, Elementary and non-elementary reactions), Molecularity and order of reaction.	6
4	Introduction & Basic concept of thermodynamics Rate equation/ Rate law, Concentration dependent term of rate (Equation, Rate constant, Elementary and non-elementary reactions), Molecularity and order of reaction.	10
5	Laws of thermodynamics First law of thermodynamics, Definitions of Internal Energy, Enthalpy and Heat capacity, Simple numerical on first law and energy - Internal Energy, Enthalpy and Heat capacity, Limitations of first law, Statements of Second law, Heat reservoir, Heat engine and Heat pump, Concept of Entropy, Carnot cycle.	8
6	PVT Behaviour PVT behavior of pure fluids, Ideal gas and equation of state, Ideal gas Process (Constant Volume process, Constant Pressure process, Constant Temperature process, Adiabatic Process) Vander Waals Equation, Virial Equation, Simple examples	6
Total Hours		42

Suggested List of Experiments:

Contents : Unit	Topics	Contact Hours
1	Tutorial 1 Activation energy	2
2	Tutorial 2 Half-life test method	4
3	Tutorial 3 Mixed reactor in series	2
4	Tutorial 4 Rate equation from CSTR data	4
5	Tutorial 5 Rate equation from PFR data	4
6	Tutorial 6 PFR & CSTR parallel	2
7	Tutorial 7 Enthalpy	2
8	Tutorial 8 Heat & Work requirement	4
9	Tutorial 9 Gibbs free energy	2

Suggested List of Experiments:

Contents : Unit	Topics	Contact Hours
10	Tutorial 10 Total pressure	2
Total Hours		28

Textbook :

- 1 Chemical Reaction Engineering – I & II, K.A.Gavhane, NiraliPrakashan, 2017
- 2 Chemical Engineering Kinetics, J.M.Smith, McGraw-Hill Education, 2013

References:

- 1 Essentials of Chemical Reaction Engineering, Essentials of Chemical Reaction Engineering, H. Scott Fogler, Prentice Hall International, 2006
- 2 Chemical Reaction Engineering, Chemical Reaction Engineering, Octave Levenspiel, John Wiley and Sons, 2012

Suggested Theory Distribution:

The suggested theory distribution as per Bloom's taxonomy is as follows. This distribution serves as guidelines for teachers and students to achieve effective teaching-learning process

Distribution of Theory for course delivery and evaluation					
Remember / Knowledge	Understand	Apply	Analyze	Evaluate	Higher order Thinking
40.00	40.00	10.00	10.00		

Instructional Method:

- 1 The course delivery method will depend upon the requirement of content and need of students. The teacher in addition to conventional teaching method by black board, may also use any of tools such as demonstration, role play, Quiz, brainstorming, MOOCs etc.
- 2 The internal evaluation will be done on the basis of continuous evaluation of students in the laboratory and class-room
- 3 Practical examination will be conducted at the end of the semester for evaluation of the performance of students in the laboratory
- 4 Students will use supplementary resources such as online videos, NPTEL videos, e-courses, Virtual Laboratory

Supplementary Resources:

- 1 <https://nptel.ac.in/course.php>
- 2 <http://www.library.iitkgp.ac.in>