Chemical and Biochemical Engineering

Semester V						
S.No	**Course Code**	**Course Name**	**L**	**T**	**P**	**C**
1	CL 301	Process Equipment Design and Economics	3	0	0	6
2	HS 201	Economics	3	0	0	6
3	CL 212	Chemical Engineering Lab III (mass transfer and reaction engineering)	0	0	3	3
4	CL 213	Chemical Engineering Lab III (mass transfer and reaction engineering)	0	0	3	3
5		Programme elective I	3	0	0	6
6	CH 306	Electrochemistry	3	0	0	3
7	CH 304	Introduction to computational chemistry	3	0	0	3
8		Programme elective-II	3	0	0	6
		Total Credits				36

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1	**Title of the course** (L-T-P-C)	**Process Equipment Design and Economics** **(3-0-0-6)**
2	**Pre-requisite courses(s)**	Nil
3	**Course content**	Mechanical design of process equipment: pressure vessels, tall columns, etc., process piping design; Materials and Fabrication Selection; Design Strategy and Optimum Equipment Design: Economic Design criteria; Cost and Asset Accounting; Cost Estimation; Interest and Investment Costs; Taxes and Insurance; Depreciation; Profitability, Alternative Investments and Replacement; Illustrative Case Study in Process Equipment Design and Costing of Equipment in each of the following categories: Material Transfer, Handling and Treatment Equipment Heat Transfer Equipment: Shell and tube heat exchangers (Kern and Bell-Delaware design methods), Plate heat exchangers, Evaporators Mass Transfer Equipment: Absorption/ Stripping columns (packed/tray), Multicomponent distallation colum (FenskeUnderwood-Gilliland correlations) Reactors: choice of reactors, non-isothermal reactors, reactor
4	**Texts/References**	• R.E.Treybal, Mass Transfer Operations, 3rd Edition, McGraw Hill, New Delhi, 1983. • E.D. Cussler, Di usion - Mass Transfer in Fluid Systems, Cambridge University Press, Cambridge 1984. • A. S. Foust, Principles of Unit Operations, 2nd Edition, Wiley, New York, 1980. • C.J. Geankoplis, Transport Processes and Unit Operations, 3rd Edition, Prentice Hall, India, 1993.

1	**Title of the course (L-T-P-C)**	**Economics (3-0-0-6)**
2	**Pre-requisite courses(s)**	--
3	**Course content**	Basic economic problems. resource constraints and Welfare maximizations. Nature of Economics: Positive and normative economics; Micro and macroeconomics, Basic concepts in economics. The role of the State in economic activity; market and government failures; New Economic Policy in India. Theory of utility and consumer choice. Theories of demand, supply and market equilibrium. Theories of firm, production, and costs. Market structures. Perfect and imperfect competition, oligopoly, monopoly. An overview of macroeconomics, measurement, and determination of national income. Consumption, savings, and investments. Commercial and central banking. Relationship between money, output, and prices. Inflation - causes, consequences, and remedies. International trade, foreign exchange and balance payments, stabilization policies: Monetary, Fiscal and Exchange rate policies.
4	**Texts/References**	**1.** P. A. Samuelson & W. D. Nordhaus, Economics, McGraw Hill, NY, 1995. **2.** A. Koutsoyiannis, Modern Microeconomics, Macmillan, 1975. R. Pindyck and D. L. Rubinfeld, Microeconomics, Macmillan publishing company, NY, 1989. **3.** R. J. Gordon, Macroeconomics 4th edition, Little Brown and Co., Boston, 1987. **4.** William F. Shughart II, The Organization of Industry, Richard D. Irwin, Illinois, 1990. **5.** R.S. Pindyck and D.L. Rubinfeld. MicroeconomicsThe (7^{th} Edition), Pearson Prentice Hall, New Jersey,2009. **6.** R. Dornbusch, S. Fischer, and R. Startz. Macroeconomics (9th Edition), McGraw-Hill Inc. New York, 2004.

1	**Title of the course (L-T-P-C)**	**Chemical Engineering Lab III (mass transfer and reaction engineering) (0-0-3-3)**
2	**Pre-requisite courses(s)**	--
3	**Course content**	Mass transfer: Experiments on hydrodynamics of a packed column, Differential distillation, drying, Cooling tower, gas liquid absorption Reaction engineering: Experiments on esterification kinetics, Batch reactive distillation, mi-cellar catalysis, homogeneous reaction, metal recovery from dilute solutions, reaction in CSTR, reaction in PFR
4	**Texts/References**	

1	**Title of the course** (L-T-P-C)	**Electrochemistry** **(3-0-0-3)**
2	**Pre-requisite courses(s)**	Fundamental concepts and applications of chemistry (CH101)
3	**Course content**	Introduction to electrochemistry, electrode potentials, galvanic and electrolytic cells, electrode kinetics, dynamic electrochemistry, Liquid and solid electrolytes. Solid and liquid ionic conductors. The electrochemical double layer- theory and models. Overpotentials. Cyclic voltammetry, chronoamperometry, chronopotentiometry. Electrochemical syntheses of solid materials. Solid state electrochemistry. Intercalation processes. Industrial Electrochemical Processes: Fundamentals, Electrochemical Extraction of Metals, electrochemical synthesis of organic compounds.
4	**Texts/References**	1. L. I. Antrapov, Theoretical Electrochemistry, Mir Publishers, 1972. 2. J. J. O'M. Bockris and A. K. N. Reddy, Modern Electrochemistry, Vol. 1 and 2, 2nd edition, Plenum Press, 1998. 3. P. Atkins and J. de Paula, Atkins' Physical Chemistry, 8th edition, Oxford University Press, 2006. 4. Fundamentals of Electrochemistry, 2nd ed, Bagotsky, V.S., Hoboken: Wiley-Interscience 2006.

1	**Title of the course** (L-T-P-C)	**Introduction to computational chemistry (3-0-0-3)**
2	**Pre-requisite courses(s)**	Fundamental concepts and applications of chemistry (CH101)
3	**Course content**	Interpolation and Curve Fitting, Roots of Equations, Matrix Methods, Differential Equations, Numerical Integration, Integral Transforms, Ab initio methods, Density functional methods, Softwares for quantum mechanical calculations, Different forms of inputs for Ab initio calculations, Computation of single point energies, Geometry optimization, Electron densities and electrostatic potentials, Analysis of output for Gaussian programmes, Molecular frequencies, Modelling in solutions
4	**Texts/References**	1. I. R. Levine, *Quantum Chemistry*, Prentice Hall India (Ltd.), 1995. 2. A. Szabo and N. S. Ostlund, *Modern Quantum Chemistry*, McGraw- Hill, 1989. J. 3. GAMESS Program, Gaussian-11 Program