NORTH MAHARASHTRA UNIVERSITY,

JALGAON (M.S.)

Second Year Engineering

(Chemical Engineering)

Faculty of Science and Technology

'A' Grade
NAAC Re-Accredited
(3rd Cycle)

COURSE OUTLINE

Semester - III

W.E.F. 2018 – 19

Syllabus Structure for Second Year Engineering (Semester – III) Chemical Engineering
(With effect from 2018-19)

Name of the Course	Group	Teaching Scheme				Evaluation Scheme					Credits
						Theory		Practical		Total	
		Theory Hrs / week	Tutorial Hrs / week	Practical Hrs / week	Total	ISE	ESE	ICA	ESE		
Industrial Chemistry	B	3	1	-	4	40	60	-	-	100	4
Thermodynamics-I	C	3	-	-	3	40	60	-	-	100	3
Chemical Engineering Materials	C	3	-	-	3	40	60	-	-	100	3
Fluid Mechanics	D	3	-	-	3	40	60	-	-	100	3
Industrial Organization and Management	A	3	-	-	3	40	60	-	-	100	3
Thermodynamics-I Lab	C	-	-	2	2	-	-	25	25 (OR)	50	1
Fluid Mechanics Lab	D	-	-	2	2			25	25 (OR)	50	1
Chemical Engineering Lab-I	D	1	-	2	3	-	-	25	25 (PR)	50	2
		16	**1**	**6**	**23**	**200**	**300**	**75**	**75**	**650**	**20**

ISE: Internal Sessional Examination **ESE: End Semester Examination** **ICA: Internal Continuous Assessment**

Syllabus Structure for Second Year Engineering (Semester – IV) Chemical Engineering
(With effect from 2018-19)

Name of the Course	Group	Teaching Scheme				Evaluation Scheme					Credits
						Theory		Practical		Total	
		Theory Hrs / week	Tutorial Hrs / week	Practical Hrs / week	Total	ISE	ESE	ICA	ESE		
Biology	B	3	1	-	4	40	60	-	-	100	4
Material Science	C	3	-	-	3	40	60	-	-	100	3
Thermodynamics - II	D	3	-	-	3	40	60	-	-	100	3
Material and Energy Balance Computations	D	3	-	-	3	40	60	-	-	100	3
Project Management and Entrepreneurship	A	3	-	-	3	40	60	-	-	100	3
Material Science Lab	C	-	-	2	2	-	-	-	-	-	1
Thermodynamics – II Lab	D	-	-	2	2	-	-	25	25 (OR)	50	1
Material and Energy Balance Computations Lab	D	-	-	2	2	-	-	25	25 (OR)	50	1
Chemical Engineering Lab-II	D	1	-	2	3	-	-	25	25 (PR)	50	2
*Environmental Studies	H	-	-	-	-	-	-	-	-	-	-
		16	**1**	**8**	**25**	**200**	**300**	**75**	**75**	**650**	**21**

*Environmental Studies will be applicable to the Direct Second Year Admitted Students Only

ISE: Internal Sessional Examination ESE: End Semester Examination ICA: Internal Continuous Assessment

Industrial Chemistry					
COURSE OUTLINE					
Course Title:	**Industrial Chemistry**	**Short Title:**	**IC**	**Course Code:**	

Course description:

The objective of the course is to strengthen the fundamentals of basic industrial chemistry to undergraduate engineering students, so that they can apply the knowledge in the manufacturing of different types of industrially important chemical products. It is designed to provide students with the skills, knowledge and learning tools required to carry out professional research& development for the production activities in chemical industries.

Lecture	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**
	3	14	42	3
Tutorial	1	14	14	1

Prerequisite course(s):

Applied Chemistry-I&II

Course objectives:

1.To introduce the basics of chemistry and its significance in chemical process industry.
2.To study the basic mechanism of electrophilic substitution reactions and its significance in industrially important products preparations.
3.To know the basics of manufacturing of chemicals and work of chemical engineer in chemical process industries.
4.To learn the unit processes and unit operations with symbols involved in manufacturing of useful chemical products.
5.To study the techniques of drawing of flow diagram for the conversion of reactants into finished valuable products.

Course outcomes:

After successful completion of this course the student will be able to:

1. Draw symbols and flow diagrams for the manufacturing of chemical products.
2. Understand the importance of unit operations and unit processes in chemical process industries.
3. Understand the basics of conversion of raw materials into finished products.

COURSE CONTENT

Industrial Chemistry		**Semester:**	**III**
Teaching Scheme:		**Examination scheme**	
Lectures:	**3 hours/week**	**End semester exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exams (ISE):	**40 marks**

Unit–I:	**No. of Lectures: 08 Hours**	**Marks: 12**

General Aspects of industrial Chemistry **:** Introduction, chemical processing, chemical conversion & yield, characteristics of chemical conversions, unit process and unit operations, flowcharts, batch and continuous processes, role of chemical engineer in chemical process industries.

Petroleum: Origin and composition , Petroleum mining, refining, compositions and uses of main petroleum fractions., Cracking & its importance in chemical industries, Octane number , Improving octane number, Chemicals from petroleum.

Unit–II:	No. of Lectures: 08 Hours	Marks: 12
Industrial Synthesis from Petroleum: Manufacture of methanol from synthesis gas, Isopropanol from propylene, Glycerol from propylene via allyl chloride, Acetone by catalytic dehydrogenation of isopropanol. Alkylation & Acylation, alkylation of benzene, phenol, hydrogenation and reductive alkylations, hydrogenation of nitrobenzene, reductive alkylation		
Unit–III:	**No. of Lectures: 08 Hours**	**Marks: 12**
Oxidation: Types of oxidative reactions, oxidation of acetylene, oxidation of toluene, oxidation of xylene, oxidation of methanol. Nitration: Nitrating agents, Mechanism of nitration of benzene, working of Schmidnitrator, Biazzinitrator, Typical industrial nitration processes: Nitration of benzene with HNO_3-fortified spent acid, Manufacture of p-nitroacetanilide, Manufacture of α-nitronaphthalene		
Unit–IV:	**No. of Lectures: 08 Hours**	**Marks: 12**
Sulphonation: Mechanism of sulphonation of benzene, working of batch sulfonation kettle, ball-mill sulfonator. Technical indusrial sulphonation processes: Continuous partial pressure sulphonation of benzene ,Sulfation of lauryl alcohol, dimethyl ether. Halogenation: mechanism of halogenation. Manufacture of chloral, monochloroacetic acid, chlorination of toluene, vinyl chloride from acetylene.		
Unit–V:	**No. of Lectures: 08 Hours**	**Marks: 12**
Manufacturing of Industrial Gases**:** Hydrogen, Oxygen, Nitrogen, Carbon Dioxide, Acetylene. Manufacturing of Fuels and Fuel gases: Producer gas, Water gas, Natural gas, Synthesis gas		
Text Books:		
1. George T. Austin, Shreve's Chemical Process Industries 5 th Edition 2. C.E. Dryden, Outline of Chemical Technology, Affiliated East WestPress.1973 3. P. H. Groggins, Unit Processes in Organic Synthesis- , Tata McGraw-Hill 4. ArunBahl & B.S.Bahl, Textbook of organic chemistry: S.Chand &Co.Ltd. New Delhi		
Reference Book:		
1.Chris A Clausen III and Guy Mattson, Principles of Industrial Chemistry, A Wiley –Inter Science Publication .John Wiley and sons, New York 2. B.K.Sharma, Industrial Chemistry, GOEL Publishing House 3. Satyaprakash, Engineering Chemistry, Khanna Book Publishing, Delhi 4. ShashiChawla, A Text Book of Engg. Chemistry, Dhanpat Rai& Co. (P) Ltd.		

Thermodynamics-I					
COURSE OUTLINE					
Course Title:	**Thermodynamics-I**	**Short Title:**	**THD-I**	**Course Code:**	
Course description:					
The purpose of this course is to introduce thermodynamics – I and its importance to study the phase behavior of fluids with applications. The course covers the application of the first and second law of thermodynamics.					
Lecture	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**	
	3	14	42	3	
Prerequisite course(s):					
Applied Chemistry I and II					
Course objectives:					
1.To study principles and application of first and second law of thermodynamics. 2.To study the thermodynamic properties of fluids and phase equilibria.					
Course outcomes:					
After successful completion of this course the student will be able to:					
1.Apply mass and energy balances to closed and open systems. 2.Evaluate the properties of non-ideal gases. 3.Solve problems involving liquefaction, refrigeration.					
COURSE CONTENT					
Thermodynamics-I		**Semester:**	**III**		
Teaching Scheme:		**Examination scheme**			
Lectures:	**3 hours/week**	**End semester exam (ESE):**	**60 marks**		
		Duration of ESE:	**03 hours**		
		Internal Sessional Exams (ISE):	**40 marks**		
Unit–I:	**No. of Lectures: 08 Hours**	**Marks: 12**			
Introduction- scope of thermodynamics, Dimensions and Units, Temperature, Pressure, Work,Energy, Heat Energy conservation & first law of thermodynamics; State functions; Equilibrium; Reversible process; Constant P,V, T processes; Mass and energy balances for open systems					
Unit–II:	**No. of Lectures: 08 Hours**	**Marks: 12**			
Phase Rule; Phases, single component water system, 2-phase systems, phase transitions, PVT behavior, Ideal gas law, Vander Waals virial and cubic equations of state; Reduced conditions & corresponding states theories, Heat effects-latent heat, sensible heat, standard heats of formation					
Unit–III:	**No. of Lectures: 08 Hours**	**Marks: 12**			
Limitations of first law, Statements of the second law, significance of entropy, Mathematical statement of the second law; Carnot's cycle, Entropy; Entropy changes of an ideal gas. Entropy balance for open systems, Calculation of ideal work, Lost work.					
Unit–IV:	**No. of Lectures: 08 Hours**	**Marks: 12**			
Thermodynamic property of fluids, graphs and tables of thermodynamic properties, Application of thermodynamics to flow processes-pumps, compressors and turbines,Rankine cycle, Enthalpy & free energy, Effect of temperature on enthalpy change, Gibbs Helmholtz equation. Chemical equilibrium, criteria, characteristics, Le-Chateliers principle & its applications in manufacture of ammonia, sulphuric acid & nitric acid.					

Unit–V:	No. of Lectures: 08 Hours	Marks: 12
Carnot Cycle, Vapor-compression cycle; Absorption refrigeration; Heat pump, compressibility factor, critical constants, Liquefaction processes, liquefaction of gases, Heat capacity of gases: C_p & C_v problems. Differentiating features between thermodynamics & kinetics.		
Text Books:		
1. B.S.Bahl, G.D.Tuli, ArunBehl, Essentials of Physical Chemistry: S.Chand & Co. Ltd. Delhi. 2. Puri, Sharma, Pathania,Principles of Physical Chemistry, Vishal Publishing Company		
Reference Books:		
1.M.J. Moran, H.N. Shapiro, D.D. Boettner and M.B. Bailey, Principles of Engineering Thermodynamics, 8^{th} Edition, Wiley. 2. Peter Atkins, Physical Chemistry, Oxford University Publication 3. Rao, An Introduction to Thermodynamics, John Wiley		

Chemical Engineering Materials					
COURSE OUTLINE					
Course Title:	**Chemical Engineering Materials**	**Short Title:**	**CEM**	**Course Code:**	

Course description:

This course provides the knowledge of materials to undergraduate engineering students, and is designed to strengthen the fundamentals so that they can build their own interface of material selection in chemical industries with their industrial applications in the branch of chemical engineering.

Lecture	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**
	3	14	42	3

Prerequisite course(s):

Applied Chemistry-I&II

Course objectives:

1.To introduce the basics of material science and its significance in chemical process industry.
2.To study the metallurgical & mechanical properties of materials in chemical process industry.
3.To study industrially important materials.

Course outcomes:

After successful completion of this course the student will be able to:

1. To know sources and importance of materials in context to chemical process industries.
2. Identify technique of selection of linings to be used in chemical process industries.
3. Recognize industrially important materials on the basis of their mechanical, physical and chemical properties.

COURSE CONTENT

Chemical Engineering Material		**Semester:**	**III**
Teaching Scheme:		**Examination scheme**	
Lectures:	**3 hours/week**	**End semester exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exams (ISE):	**40 marks**

Unit–I:	**No. of Lectures: 08 Hours**	**Marks: 12**

Introduction to materials and their properties:
Simple stresses and strains, Concept of stress, strain, shear stress, shear strain, Hooks law, Elastic limit, stress-strain curve for mild steel and elastomeric materials, factor of safety, Poisson's ratio, Strain energy due to axial load and impact. Introduction to determination of mechanical properties of materials ASTM methods.

Unit–II:	**No. of Lectures: 08 Hours**	**Marks: 12**

Metallic Materials:
Cast iron, Wrought iron and steel, effect of addition of elements such as Si, C,P, Mn,N to Iron. Elastic and plastic deformation, heat treatments alloys such as stainless steel, brass, bronze, duralumin, alnico, Nichrome, solder material.

Unit–III:	No. of Lectures: 08 Hours	Marks: 12
Selection of materials for fabrication and erection of chemical plant: Testing of materials, destructive and nondestructive tests, structure of atom and chemical bonds, crystal structures and their influence on material properties, Deformation and slip processes		
Unit–IV:	**No. of Lectures: 08 Hours**	**Marks: 12**
Electrical and Magnetic Materials: Factors affecting the resistivity of conductors, properties of materials such as Ag, Cu, Al, Nichrome and Ca as dielectric characteristics, insulating materials such as mineral oil, PVC, Mica fibers, glass and asbestos, Magnetisation, soft and hard magnetic materials such as a silicon iron, Alnico types alloys and ferrites.		
Unit–V:	**No. of Lectures: 08 Hours**	**Marks: 12**
Selection of materials and linings: 1. Selection of Material of Construction a) Selection materials of construction for sulfuric acid, Nitric acid, phosphate fertilizers, hydrogen, ammonia plants. b) Selection of materials for Urea synthesis by reactors and CO_2 absorption systems. 2. Linings for process equipments Metal lining, glass linings, ceramic linings, plastic linings, glass steel for process equipment, thermomechanical properties of glass lined equipments. Membrane linings for vessels holding corrosive liquids		
Text Books:		
1 R.B. Gupta, Material Science, Satya Prakashan, 1981 2. V.K. Manchanda, A text book of Material Science. New India Publishing House 3. V. Raghavan, Material science and engineering, Prentice Hall of India 4. James F. Shacketford, Introduction to material science, McMillan publishing company, New York ISBN 1990.		
Reference Books:		
1. D.Z. Jestrazebaski, Properties of Engg. Materials, 3rd Ed. Toppers. Co. Ltd. 2. J.L.Lee & Evans "Selecting Engineering materials for chemical & process plants" Business Works 1978. 3.KenneinMcNaughton and staff , Materials Engineering-II-Controlling corrosion in process equipments, McGraw Hill Publication Co. ,New York		

Fluid Mechanics					
COURSE OUTLINE					
Course Title:	**Fluid Mechanics**	**Short Title:**	**FM**	**Course Code:**	

Course description:

This course provides the students basic understanding of fluids (liquids and gases) and the forces on them. Fluid mechanics can be divided into fluid statics, the study of fluids at rest; fluid kinematics, the study of fluids in motion; and fluid dynamics, the study of the effect of forces on fluid motion. It includes fluids transportation, filtration and solids fluidization.

Lecture	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**
	3	14	42	3

Prerequisite course(s):

Introduction to Civil Engineering & Engineering Mechanics, Applied Mathematics I & II

Course objectives:

1. To study fluid properties
2.To study velocity concept, the continuity equation, Eulers equation of motion a long streamline, Bernoullis equations for different conditions.
3. To study flow through pipeline system: Reynolds experiment, Laws of friction, Major and minor losses, friction factor chart, effect of heat transfer on friction factor, distribution of flowing fluids through branched pipes, hydraulic gradient line and total energy line.
4. To understand flow of compressible fluids, Continuity equation, energy balance, ideal gas equations, flow past immersed bodies, drag coefficient, Boundary layer theory:
5. To study flow and pressure measurement
6. To understand pumping of fluids

Course outcomes:

After successful completion of this course the student will be able to:

1.Understand the role of mechanical and hydro dynamical unit operations in the field of chemical engineering.
2.Understand key concepts and fundamental principles, together with the assumptions made in their development, pertaining to fluid behavior, both in static and flowing conditions.
3.Learn to deal effectively with practical engineering situations, including analysis and design of engineering systems and devices involving fluids and flow.
4.Understand the knowledge of piping & pumping system important in chemical industries

COURSE CONTENT

Fluid Mechanics		**Semester:**	**III**
Teaching Scheme:		**Examination scheme**	
Lectures:	**3 hours/week**	**End semester exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exams (ISE):	**40 marks**

Unit–I:	**No. of Lectures: 08 Hours**	**Marks: 12**

Fundamental concepts of fluid flow, mechanism of compressible and non compressible fluid flow, equation of continuity, Reynolds number, significance, Bernoulli's theorem, distribution of velocities and fluid flow profiles, friction factor and friction losses in pipes, roughness factor and its significance, pipe fittings, equivalent length of fittings etc. Energy losses due to sudden contraction and expansion.

Unit–II:	No. of Lectures: 08 Hours	Marks: 12
Boundary layer theory, Velocity profile and boundary layer growth along a flat plate, thickness of boundary layer (definition and formulae only), separation of boundary, boundary layer calculations for turbulent flows. Dimensional analysis and model studies: Dimensional analysis, Buckingham's PI theorem, dimensionless numbers, application to fluid flow problem.		
Unit–III:	**No. of Lectures: 08 Hours**	**Marks: 12**
Flow measuring devices for incompressible and compressible fluids: orificemeter, venturimeter, pitot tube, rotameters, notches and weirs, gas flow meters, coefficient of discharge and calculations.		
Unit–IV:	**No. of Lectures: 08 Hours**	**Marks: 12**
Transportation of fluids, reciprocating and centrifugal pumps, pump characteristics, Diaphragm pumps, rotary pumps, screw pumps, gear pumps, pump power calculations, pump selection and trouble shooting of pumps, priming, cavitation , NPSH of pumps.		
Unit–V:	**No. of Lectures: 08 Hours**	**Marks: 12**
Fluidization, aggregate and particulate fluidization, minimum fluidization velocity, entrainment in fluidization. Packed Bed, pressure drop in packed beds, packing materials and their selection criteria, Loading and flooding in packed beds, Kazenger karma equation,- Industrial application.		
Text Books:		
1. Dr.R.K. Bansal, Fluid Mechanics: Laxmi Publications, New Delhi. 2.Coulson J.M. and Richardson J.F.; Backhurst J.R. and Harker J.H.; Chemical Engineering, Vol. I , II & IV, Publishers: Butterworth - Heinmann, 2001-2002. 3.R.P.VyasFluid Mechanics, Denett Publication. 4.W.L. McCabe & J.C. Smith, Unit operations in chemical engineering: McGraw Hill/Kogakusha Ltd 5.I P. Chattopadhyay Unit operations of chemical engineering-volume I: Khanna Publication New Delhi, 2nd edition 1996.		
Reference Books:		
1.M.White Fluid Mechanics Eighth Edition Tata McGraw Hill, 2016 2. Perry's Handbook of chemical engineers McGraw-Hill: New York 3. R.L.Panton, Incompressible Flow, Third Edition, Wiley – India 2005 4. Sadhu Singh, Fluid Mechanics, Khanna Book Publishing 5. Som & Biswas, Introduction to Fluid Mechanics and Fluid Machines, TMH		

Industrial Organization and Management					
COURSE OUTLINE					
Course Title:	**Industrial Organization and Management**	**Short Title:**	**IOM**	**Course Code:**	

Course description:

This course provides basic understanding and importance of organization and organization structure and different management aspects and the importance of different management types in industrial development. The course intents to develop ability to create lead and coordinate different section of Organization among students using managerial skills.

Lecture	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**
	3	14	42	3

Prerequisite course(s):

Communicative English

Course objectives:

1. To understand Management and Administration, types and structure of organization.
2. To study concepts of personnel management, importance of communication.
3. To study concepts of sales management and marketing management.
4. To study importance of Inventory Control, purchasing and materials management.
5. To study importance of plant maintenance, leadership, importance of motivation.

Course outcomes:

After successful completion of this course the student will be able to:

1. Understand and apply the principles of management with scientific view, and will contribute to the profitable growth of industry.
2. Study various managerial skills which will help them to share responsibilities and will make them able to work effectively in diverse, multicultural environments.
3. Demonstrate ability to work in multidisciplinary team and will display communication skills.
4. Design, develop, implement, and improve integrated systems that include people, materials, information, equipment, and energy and will provide engineering solutions in a global, economic, environmental, and societal context.

COURSE CONTENT

Industrial Organization and Management		**Semester:**	**III**
Teaching Scheme:		**Examination scheme**	
Lectures:	**3 hours/week**	**End semester exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exams (ISE):	**40 marks**

Unit–I:	**No. of Lectures: 08 Hours**	**Marks: 12**

Management, its growth, concepts of Administration, Management and Organization. Definition of management, importance and characteristics and functions of Management, authority and responsibility, unity of command and direction decision making in management by objectives.

Business organization, Different forms of organization, their formation and working, different organization structure- line organization, functional organization, line and staff organization.

Unit–II:	No. of Lectures: 08 Hours	Marks: 12
Personnel Management, Manpower Planning, Recruitment, Selection & Training, Job Evaluation Methods, Merit Rating, Industrial Safety. Communication: Principles, Types, Characteristics and Role of Communication in Management		
Unit–III:	**No. of Lectures: 08 Hours**	**Marks: 12**
Sales and Marketing Management, Sales Management and functions of sales Manager, Salesman's quota. Selling Vs Marketing Concept, Principle and Functions of Marketing. Management, Marketing Research and Techniques, The Marketing Mix, Channels of Distribution, Advertising		
Unit–IV:	**No. of Lectures: 08 Hours**	**Marks: 12**
Inventory Control and Management, Objectives, Functions of Inventories, Inventory Models. Materials Management and its Functions, Importance of Materials Management, Purchasing Techniques and Purchasing Cycle.		
Unit–V:	**No. of Lectures: 08 Hours**	**Marks: 12**
Plant Maintenance, Objective and Importance of Plant Maintenance, Duties, Functions and Responsibilities of Maintenance Department, Types of Maintenance. Leadership in Business and Qualities, Morale, Motivation: Definition, Need, Principle, Factors. Industrial fatigue.		
Text Books:		
1. O.P.Khanna, Industrial Engineering & Management, Dhanpat Rai Publications (P) Ltd New Delhi 2. Banga& Sharma, Industrial Engineering Science & Management, Khanna Publishers New Delhi. 3. C.R.Basu, Business Organisation and Management, Tata McGraw Hill Publishing CompanyLtd. New Delhi.		
Reference Books: 1. L.M.Prasad, Principles of Management , Himalaya Publications Ltd 2. Philip Kotler, Marketing Management, Tata McGraw Hill 3. SK Sharma, Industrial Engineering & Operations Management		

Thermodynamics-I Lab					
LAB COURSE OUTLINE					
Course Title:	**Thermodynamics-I Lab**	**Short Title:**	**THD-I Lab**	**Course Code:**	

Course description:

This laboratory course is intended to develop understanding of fundamental aspects of first and second laws of thermodynamics and basic themochemistry principles.

Laboratory	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**
	2	14	28	1

End Semester Exam (ESE) Pattern:	**Oral (OR)**

Prerequisite course(s):

Applied Chemistry I & II, Applied Physics I&II

Course objectives:

1.To induce knowledge of fundamental principles of first & second law of thermodynamics through experimentation.
2.To impart practical knowledge of heat, work & energy conversion & themochemistry principles
3.To train the students for applying the practical knowledge of thermodynamics in Chemical industries.

Course outcomes:

Upon successful completion of lab Course, student will be able to:

1.Understand concepts of heat, work, and energy, basic thermodynamic properties and units.
2.Apply the knowledge of fundamental thermodynamic properties & thermochemistry principles in chemical industries**.**

LAB COURSE CONTENT

Thermodynamics-I Lab		**Semester:**	**III**
Teaching Scheme:		**Examination scheme**	
Practical:	**2 hours/week**	**End semester exam (ESE):**	**25 marks**
		Internal Continuous Assessment (ICA):	**25 marks**

(Amongst the following any eight experiments / assignments are to be performed)

1. Determination of heat of solution of KNO_3./NH_4Cl
2. Determination of water equivalent of copper calorimeter
3. To determine heat of neutralization of strong acid & strong base by calorimeter.
4. To determine the gas constant R by Eudiometer method.
5. To determine the heat of hydration of $CuSO_4$
6. Determination of critical solution temperature of phenol-water system.
7. Determine the integral heat of dilution of H_2SO_4 starting with solution of different concentration.
8. To determine ΔH, ΔG, ΔS of a reaction.
9. Determination of ΔG, ΔH, ΔS of silver benzoate by solubility product and by Conductometery
10.Determination of partial molar volume of ethanol in dilute aqueous solutions.
11.To study first law of thermodynamics
12.To study second law of thermodynamics

Text Books:
1.J.B.Yadav , Advanced Practical Physical Chemistry, Goel publishing House Meerut. 2.Rajbhoj&Chondekar, Systematic experimental Physical Chemistry, Anjali Publication. 3.R.C. Das &B.Behhra, Experimental Physical Chemistry, Tata McGraw Hill.
Reference Books:
1. Wilson, Experiments of Physical Chemistry by, NewCombe, Denaro Pergaman Press Rickett. 2. Anupma Rajput, Laboratory Manual Engg. Chemistry, Dhanpat Rai& Co.
Guide lines for ICA:
Internal Continuous Assessment shall be based on continuous evaluation of Student performance throughout semester and practical / assignments submitted by the student in the form of journal
Guidelines for ESE: End Semester Examination shall be based on practical / oral evaluation of Student performance and practical / assignments submitted by the student in the form of journal.

Fluid Mechanics Lab						
LAB COURSE OUTLINE						
Course Title:	**Fluid Mechanics Lab**		**Short Title:**	**FM Lab**	**Course Code:**	
Course description: This course intended to fulfill the need for comprehensive laboratory course in. Fluid Mechanics						
Laboratory	**Hours/week**	**No. of weeks**	**Total hours**		**Semester credits**	
	2	14	28		1	
End Semester Exam (ESE) Pattern:		**Oral (OR)**				
Prerequisite course(s):						
Applied Physics I & II						
Course objectives:						
1.To induce knowledge of flow of fluids through experimentation. 2.To impart practical knowledge of study of measurement of flow of fluids						
Course outcomes:						
Upon successful completion of lab Course, student will be able to:						
1.Apply the knowledge of fluid flow for controlling heat and mass transfer. 2.Get knowledge about properties of fluids, designing piping, pumping systems. 3.Measure the flow rate of fluids which is important in chemical industries.						
LAB COURSE CONTENT						
Fluid Mechanics Lab		**Semester:**	**III**			
Teaching Scheme:		**Examination scheme**				
Practical:	**2 hours/week**	**End semester exam (ESE):**	**25 marks**			
		Internal Continuous Assessment (ICA):	**25 marks**			
(Amongst the following any eight experiments / assignments are to be performed) 1.Study of Bernouillis theorem 2.Measurement of coefficient of discharge for venturimeter 3.Measurement of coefficient of discharge for orificemeter 4.Measurement of coefficient of discharge for nozzlemeter 5.Study of Rotameter 6.Study of manometers 7.Study of Reynolds experiment 8.Study of characteristics of centrifugal pump 9.Study of characteristics of reciprocating pump 10.Study of characteristics of diaphragm pump						
Text Books:						
R.K.Bansal "A textbook of fluid mechanics and hydraulic machines "Firewall Media, 2005						
Reference Books:						
Perry's Handbook of Chemical Engineers						
Guide lines for ICA:						
Internal Continuous Assessment shall be based on continuous evaluation of Student performance throughout semester and practical / assignments submitted by the student in the form of journal.						
Guidelines for ESE: End Semester Examination shall be based on practical / oral evaluation of Student performance and practical / assignments submitted by the student in the form of journal.						

Chemical Engineering Lab-I					
LAB COURSE OUTLINE					
Course Title:	**Chemical Engineering Lab-I**	**Short Title:**	**CEL – I**	**Course Code:**	

Course description:

This course applies theoretical principles, learnt in earlier and concurrent chemical engineering course, in a laboratory programme. The laboratory covers most aspects of analysis, estimations & purification techniques which are the backbone of chemical process industries.

Laboratory	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**
	2	14	28	1
Theory	1	14	14	1

End Semester Exam (ESE) Pattern:	**Practical (PR)**

Prerequisite course(s):

Applied Chemistry-I & II(PR)

Course objectives:

1.To provide firsthand experience of verifying various theoretical concepts learnt in theory courses.
2.To study laboratory techniques of analysis, estimations & purification.

Course outcomes:

Upon successful completion of lab Course, student will be able to:

1. Learn how to experimentally verify various theoretical principles.
2. Apply experimental skills in purification, estimations,& analysis.

LAB COURSE CONTENT

Chemical Engineering Lab-I		**Semester:**	**III**
Teaching Scheme:		**Examination scheme**	
Practical:	**2 hours/week**	**End semester exam (ESE):**	**25 marks**
		Internal Continuous Assessment (ICA):	**25 marks**

(Amongst the following any eight experiments / assignments are to be performed)

1. 2– 3 experiments on purification techniques for solid & liquid substances by crystallization & distillation.
2. 3-4 experiments on sample analysis by volumetric estimations methods.
3. 2-3 experiments on analysis of petroleum products / oil samples.

Text Book:

S.K.Bhasin, Laboratory manual on engg. Chemistry: Dhanpat RaiPub.New Delhi

Reference Books:

1.Vogel's,Text book of Quantitative Chemical Analysis : ELBS with Longman
2. Practical Chemistry : ManaliPublications, Pune

Guide lines for ICA:

Internal Continuous Assessment shall be based on continuous evaluation of Student performance throughout semester and practical / assignments submitted by the student in the form of journal.

Guidelines for ESE:

End Semester Examination shall be based on practical / oral evaluation of Student performance and practical / assignments submitted by the student in the form of journal.

NORTH MAHARASHTRA UNIVERSITY,

JALGAON (M.S.)

Second Year Engineering

(Chemical Engineering)

Faculty of Science and Technology

'A' Grade
NAAC Re-Accredited
(3rd Cycle)

COURSE OUTLINE

Semester - IV

W.E.F. 2018 – 19

Biology					
COURSE OUTLINE					
Course Title:	**Biology**	**Short Title:**	**BIO**	**Course Code:**	

Course description:

This course is introduced for learning the basic fundamentals of Lifesciences (zoology &Botany) to undergraduate students. The prospectus includes a prior knowledge of Biotechnology. The goals of the course are to understand the basic principles of Biology and its applications in the field of Engineering.

Lecture	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**
Lecture	03	14	42	04
Tutorial	01	14	14	

Prerequisite course(s):

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Course objectives:

1.Students will understand the structures and characteristics or functions of basic components of prokaryotic and eukaryotic cells, especially macromolecules, membranes, and organelles.
2.Students will learn the basic principles of inheritance at the molecular, cellular and Organism levels.
3.Students will test and deepen their mastery of genetics by applying this knowledge in a variety of problem-solving situations.

Course outcomes:

After successful completion of this course the student will be able to:

1.Use current techniques and analysis methods in molecular biology and genetics.
2.Understand the current concepts in Cell Biology, Stem Cell Biology and Development.
3.Know the structure/function of the basic components of prokaryotic and eukaryotic cells including macromolecules and organelles.
4.Demonstrate proficiency with at least one instrument commonly used in biological research (microscope, etc).

COURSE CONTENT

Biology		**Semester:**	**IV**
Teaching Scheme:		**Examination scheme**	
Lectures:	**3 hours/week**	**End semester exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exams (ISE):	**40 marks**

Unit–I:	**No. of Lectures: 08 Hours**	**Marks: 12**

Diversity of Organism and Cell Biology
Introduction: Living systems, Bio-mimicry, Metabolism, Taxonomy, Concept of species, Structural organization of life, Concepts of modern cell, history of cell, Cell theory, Structure of cell:- Cell shape, size and cell number, Types of cells:- Prokaryotic cells and Eukaryotic cells, Chemistry of cells.
Cell Division: Cell cycle, mitosis, meiosis, mitotic cell division, cell cycle check points, meiotic cell division, embryonic cell division, cell death.

Unit–II:	No. of Lectures: 08 Hours	Marks: 12
Plant and Animal Kingdom Plant Kingdom: Introduction to plants, Salient features of major plant groups: Bryophyta, Pteridophyta, Gymnospermae, Angiospermae, Plant Growth & Development: Introduction, Seed Dormancy, Seed Germination, Phases of growth, Plant growth hormones. Animal Kingdom:Animal Classification, Salient features of non-chordates upto phylum level: Phylum porifera, phylum Cnidaria, Phylum Ctenophora, Phylum Platyhelminthes.		
Unit–III:	**No. of Lectures: 08 Hours**	**Marks: 12**
Plant Cell and Animal cell culture and Applications Plant Cell Culture: Brief introduction to cell culture with respect to the properties of plant cells, Media requirements, Typical media used, Classification of tissue culture, callus culture, cell suspension culture, Application of callus culture and cell suspension culture, Plant cell cultivation Bioreactors Animal Cell Culture: Brief introduction to animal cell culture, Culture medium: Natural and Artificial media, introduction to balanced salt solutions and simple growth medium, Brief discussion on the chemical, physical and metabolic functions of different constituents of culture medium, Animal Bioreactors.		
Unit–IV:	**No. of Lectures: 08 Hours**	**Marks: 12**
Microbial Culture and Applications: Introduction, Microbial Culture Techniques, growth curve, Pure culture techniques – microbial culture media, isolation, identification and maintenance of cultures, incidences of microorganisms in soil, water, air, food and sewage, food spoilage organisms, Applications of Microbial Culture Technology.		
Unit–V:	**No. of Lectures: 08 Hours**	**Marks: 12**
Biotechnology and its Applications: Definitions, scope of Biotechnology, Recombinant DNA Technology: Making Recombinant DNA, Tools in Genetic Engineering, Polymerase Chain reaction (PCR). Applications of Biotechnology: Bioinformatics, Biomechanics, Biotechnology of waste treatment, Biosensors, Forensic science, Food Biotechnology, Fermentation Technology.		
Text Books:		
1.B.D. Singh " Genetics" Kalyani Publications Third Edition. 2.C.B. Pawar"Cell Biology" Himalaya Publications, Third Edition. 3.C.B. Pawar"Cell and Molecular Biology" Himalaya Publications. 4.V.K. Agrawal, Text book of Zoology,S. Chand Publication. 5.Dr. B.P. Pandey, Text book of Botany, S. Chand Publication. 6.R.C. Dubey,Text book of Biotechnology, S. Chand Publications.		
Reference Books:		
1.P. K Gupta, Introduction to Biotechnology, Rastogi Publications. 2.B.D.Singh, Biotechnology: Expanding Horizons, Kalyani Publishers, New Delhi, Second Revised Edition, 2008. 3.S.S.Purohit, Biotechnology: Fundamentals and Applications, Agrobios (India), 4th Edition, 2005.		

Material Science					
COURSE OUTLINE					
Course Title:	**Material Science**	**Short Title:**	**MS**	**Course Code:**	

Course description:

The objective of the course will be to give the students a basic introduction to the different classes of materials relevant to engineering in general, and Chemical Engineering in particular. The intent of the course will be to relate the underlying molecular structure of the materials to their physical and chemical properties, and their processing and performance characteristics.

Lecture	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**
	3	14	42	3

Prerequisite course(s):

Applied Chemistry I & II, Industrial Chemistry

Course objectives:

1.To differentiate between the essential features and properties of covalent, ionic and metallic bonding.
2.To understand structure-properties relationship.
3.Manipulate atomic/micro structural processes to create desired structure & properties.
4.To study the inorganic engineering materials & composites.
5.Learn to use the experimental, analytical, statistical, and computational tools for engineering practice in the materials discipline
6.Learn the fundamental principles underlying and connecting the structure, processing, properties, and performance of materials systems.

Course outcomes:

After successful completion of this course the student will be able to:

1. Learn contemporary issues relevant to materials science.
2. Apply core concepts to solve engineering problems.
3. Possess the skills and techniques necessary for modern materials engineering practice.

COURSE CONTENT

Material Science		**Semester:**	**IV**
Teaching Scheme:		**Examination scheme**	
Lectures:	**3 hours/week**	**End semester exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exams (ISE):	**40 marks**

Unit–I:	**No. of Lectures: 08 Hours**	**Marks: 12**

Introduction to materials, classification of engineering materials, bonding between atoms: metallic bonding, electron sea model, ionic bonding, Born-Haber cycle, covalent bonding, Vander Waals bond, variation in bonding character & properties, thermal expansion, melting point, elasticity of materials. Factors affecting the selection of materials for engineering purposes, levels of structure, space lattices & crystal structure, miller indices, close packing structures.

Unit–II:	No. of Lectures: 08 Hours	Marks: 12
Imperfections in solids: vacancies, equilibrium concentration of vacancies, interstitial and substitutional impurities in solids, dislocations, types and characteristics of dislocations, interfacial defects, stacking faults. Structure of materials and Strength of Materials: Yield strength, tensile strength and ductility of materials: stress strain behaviour of metals, ceramics and polymers, tensile test, plastic deformation, necking, creep behaviour and fatigue.		
Unit–III:	**No. of Lectures: 08 Hours**	**Marks: 12**
Semi-crystalline materials, Ceramics: classification, basic raw materials, chemical conversion, glazing, whitewares, structural clay products. Polymers: Basic concept, classification, types of polymerization, effect of polymer structure on properties, mechanical properties of polymers, Plastics: properties &applications. copolymers, liquid crystals and amphiphiles, silicates.		
Unit–IV:	**No. of Lectures: 08 Hours**	**Marks: 12**
Composites: Introduction & constituents, Types of composites, Processing of fiber-reinforced composites. Polymer nano-composite materials, role of reinforcement-matrix interface strength on composite behavior. Glass: Introduction, Manufacture of glass, Types of glasses & their applications. Abrasives: Introduction, Natural abrasives & synthetic abrasives		
Unit–V:	**No. of Lectures: 08 Hours**	**Marks: 12**
Corrosion: Dry & wet corrosion, Pilling & Bedworth rule, formation & growth of films, pitting corrosion, hydrogen embrittelement, hydrogen evolution, oxygen absorption, corrosion control by proper selection of materials, proper design & fabrication procedures. Introduction to experimental techniques: XRD, NMR,IR etc. for material characterization		
Text Books:		
1.V. Raghavan, Materials Science and Engineering: A First Course, 5 th Edition Prentice Hall India, 2004. Jain & Jain, Engineering Chemistry :Dhanpat Rai& Sons, New Delhi. 2. S. Upadhyaya and A. Upadhyaya, Material Science and Engineering, Anshan Publications, 2007. 3.V.D.Kotgire,S.V.Kotgire, Material Science and Metallurgy for Engineers, , Everest Publishing House 4.Jain&Jain, Engineering Chemistry, Dhanpat Rai Publishing Compony		
Reference Book:		
1.William D. ,Callister, David G. Rethwisch, Material Science and Engineering: An Introduction,Wiley Publisher. 2. Suryanarayanan, A.V.K., Testing of Metallic Materials, Tata McGraw		

Thermodynamics - II					
COURSE OUTLINE					
Course Title:	**Thermodynamics - II**	**Short Title:**	**THD-II**	**Course Code:**	

Course description:

The purpose of this course is to introduce thermodynamics – II and its importance to study the phase behavior and properties of pure fluids with applications. The course covers the application of the first and second law of thermodynamics to non-flow and steady-flow processes.

Lecture	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**
	3	14	42	3

Prerequisite course(s):

Applied Physics- I & II, Applied Chemistry-I & II, Thermodynamics-I

Course objectives:

1.To study the laws of thermodynamics.
2.To study equations of state.
3.To study concept of entropy.
4.To study Vapour-Liquid Equilibria (VLE) and test of VLE data.
5.To study phase equilibria for single component system.
6.To study the determination of partial molar quantities, fugacity and fugacity coefficient.
7.To study properties of solutions.
8.To study phase equilibrium.
9.To study chemical reaction equilibria.
10.To study and construct pressure-composition & boiling point diagrams.

Course outcomes:

After successful completion of this course the student will be able to:

1. Execute knowledge of basic science and engineering after study of the laws of thermodynamics and state functions.
2. Capable of identifying, formulating, designing and providing the solution to chemical engineering problems by study of calculations of entropy changes, Vant' Hoff equation.
3. Display the research ability by designing, conducting, interpreting and analyzing to experimental data for preparing reports by study of the thermodynamic consistency test of VLE data.

COURSE CONTENT

Thermodynamics - II		**Semester:**	**IV**
Teaching Scheme:		**Examination scheme**	
Lectures:	**3 hours/week**	**End semester exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exams (ISE):	**40 marks**

Unit–I:	**No. of Lectures: 08 Hours**	**Marks: 12**

Introduction to the subject, The laws of Thermodynamics, Cyclic rule, Coefficient of Thermal Expansion, Compressibility Coefficient ,First Law of Thermodynamics : Basic Laws, Law of corresponding state, Heat Capacities, Enthalpy as a function of Temperature & Pressure, Joule-Thomson Coefficient , Relation between C_p and C_v, Thermodynamic relations, Generalized Equation of State, Redlich-kwong equation of state, Soave-Redlich-Kwong equation of state.

Unit–II:	No. of Lectures: 08 Hours	Marks: 12
The Second Law of Thermodynamics, Mathematical Treatment of Entropy Concept, Combined form of First and Second Law of Thermodynamics, Thermodynamic Relations based on Second Law of Thermodynamics, Calculations of Entropy Changes, Third Law of Thermodynamics.		
Unit–III:	**No. of Lectures: 08 Hours**	**Marks: 12**
Partial Molar Quantities: General Aspects, Determination of Partial Molar Volume and Enthalpy, Fugacity and Fugacity Coefficient, Fugacity coefficient through equation of state, Fugacity coefficient through virial coefficient correlation. Ideal solution: General Aspects, Phase equilibrium: General Aspects, Gibbs-Duhem Equation, Gibbs-Duhem-Margules Equation, Application of Gibbs-Duhem Equation.		
Unit–IV:	**No. of Lectures: 08 Hours**	**Marks: 12**
Vapour-Liquid Equilibria (VLE): Basic equations for VLE, Reduction of VLE data, Excess Gibbs free energy Model, Margules Equation & Van Laar Equation, Thermodynamic consistency test of VLE data Phase Equilibria for Single Component System: Gibbs-Helmholtz Equation, The Clapeyron Equation, Clausious-Clapeyron Equation, Application of Clapeyron Equation.		
Unit–V:	**No. of Lectures: 08 Hours**	**Marks: 12**
Chemical Reaction Equilibria: The criteria for chemical equilibrium, Equilibrium constant, Law of chemical equilibrium, Relations between equilibrium constant, Homogeneous gaseous equilibria, Temperature dependence of the equilibrium constant (The Van't Hoff Equation), Integrated form of the Van't Hoff equation, Pressure dependence of the equilibrium constant. Applications of Phase Equilibrium in Ideal Solutions: To construct pressure-composition and boiling point diagrams.		
Text Books:		
1.K.V. Narayanan, A Text book of Chemical Engineering Thermodynamic, Prentice Hall India Pvt. Ltd., New Delhi. 2.R.R.Rastogi and R.R.Mishra, An Introduction to Chemical Thermodynamics, Vikas Publishing House Pvt.Ltd, New Delhi 3.J.M.Smith,H.C.Van Ness, M.M.Abbott, Introduction to Chemical Engineering Thermodynamics, Fifth Edition, McGrow-Hill Companies Inc.		
Reference Books:		
1.B.G.Kyle, Chemical and Process Thermodynamics, Prentice Hall India Pvt. Ltd., New Delhi. 2.G.N. Pandey and J.C.Chaudhari, Chemical Engineering Thermodynamics, Khanna Publishers, Delhi. 3.Y.V.C. Rao, Chemical Engineering Thermodynamics, University Press (INDIA) Ltd., Orient Longman Ltd., Hyderabad.		

Material and Energy Balance Computations					
COURSE OUTLINE					
Course Title:	**Material and Energy Balance Computations**	**Short Title:**	**MEBC**	**Course Code:**	

Course description:

This course provide the students basic understanding of Material and Energy Balance Computations of Industrial Processes and to apply this in designing the various chemical process equipments.

Lecture	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**
	3	14	42	3

Prerequisite course(s):

Applied Physics- I & II, Applied Chemistry-I & II, Industrial Chemistry , Thermodynamics-I

Course objectives:

1.To present fundamentals of chemical engineering in a simple manner.

2.To provide broad background for applying principles to industrial and theoretical problems.

Course outcomes:

After successful completion of this course the student will be able to:

1.Analyze a particular process in whole or part.

2. Evaluate the economics of the various processes, design the various equipments and help in identifying the losses in processes.

3.Apply the techniques for increasing the efficiency of the chemical processes.

COURSE CONTENT

Material and Energy Balance Computations		**Semester:**	**IV**
Teaching Scheme:		**Examination scheme**	
Lectures:	**3 hours/week**	**End semester exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exams (ISE):	**40 marks**

Unit–I:	**No. of Lectures: 08 Hours**	**Marks: 12**

Properties of Gases ,liquid and solids:

Units their dimensions and conversions , Mass and volume relations, Stoichiometric and composition relations, Excess reactants, Degree of completion, Conversion, selectivity and yield.

Ideal gas law, Dalton's Law, Amagat's Law, and Average molecular weight of gaseous mixtures.

Effect of temperature on vapour pressure, Vapour pressure plot (Cox chart), Vapour pressures of miscible and immiscible liquids and solutions, Raoult's Law and Henry's Law

Unit–II:	**No. of Lectures: 08 Hours**	**Marks: 12**

Humidity

Humidity and saturation, Relative Humidity and percent saturation, Dew point, Dry and Wet bulb temperatures, Use of humidity charts for engineering calculations, problems on psychometric chart.

Unit–III:	No. of Lectures: 08 Hours	Marks: 12
Stoichiometry & Material Balance Material balance for systems without chemical reactions, species and elemental balance. Analysis of systems with by-pass, recycle and purge.		
Unit–IV:	**No. of Lectures: 08 Hours**	**Marks: 12**
Fuels & Combustion Material balance with chemical reactions, Heating value of fuels, calculations involving theoretical and excess air. Heat & material balances of combustion processes. Chemical , metallurgical and petrochemical processes.		
Unit–V:	**No. of Lectures: 08 Hours**	**Marks: 12**
Energy balance Energy capacity of gases, liquids and solutions, Heat of fusion and vaporization, Steady state energy balance for systems with and without chemical reactions. Calculations and application of heat of reaction, combustion, formation, neutralization and solution. Enthalpy-concentration charts. Combustion of solids, liquids and gaseous fuels, Calculation of theoretical and actual flame temperatures.		
Text Books:		
1.Bhatt., B.I. and Vora S.M."Stoichiometry*"* IInd edition, Tata McGraw Hill (1984) 2.O.A. Hougen, K.M. Watson and R.A. Ragatz "Chemical Process Principles" Part-I,CBS Publishers & distributors ,New Delhi. 3.K.A.Gavhane "Introduction to process calculations" Nirali Publications		
Reference Books:		
1. Perry's Handbook of chemical engineers McGraw-Hill: New York 2. Felder, R.M. &Rousseau, R.W**.** *"*Elementary Principles of Chemical Processes *",* 3rd edition. JohnWiley. (1999). 3. Narayanan &Lakshmikutty, "Stoichiometry and Process Calculations" , PHI 4. Richard M. Felde,Ronald W. Rousseau, John Wiley & sons, New Delhi 5. S. N. Ghosh, BidishaKhatua "A textbook of Chemical Calculations" Dhanpat Rai& C0., Delhi 6. Himmelblau, D.M**.** ″Basic Principles and Calculations in Chemical Engineering″, 6th edition. Prentice Hall . 7. Durga Prasad Rao and V.S.Murthy, "Process Calculation for Chemical Engineers" McMilan Education Publication.		

Project Management and Entrepreneurship					
COURSE OUTLINE					
Course Title:	**Project Management and Entrepreneurship**	**Short Title:**	**PME**	**Course Code:**	

Course description:

This course aims to provide entrepreneurs for systematic management of various projects and ventures. The course intents to develop entrepreneurs to take special challenges starting new projects and ventures for overall societal development.

Lecture	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**
	3	14	42	3

Prerequisite course(s):

Industrial Organization & Management

Course objectives:

1. To understand Conceptualizing the Project, Project Planning and Project Management.
2. To study Project Planning and Design, preparation of Project Report.
3. To study Theories and Models of entrepreneurship, characteristics of successful entrepreneur.
4. To study Financial requirements of a new Enterprise, study and identify sources of finance.
5. To study Challenges of small Enterprises.
6. To study Industrial policies for development of Enterprise.

Course outcomes:

After successful completion of this course the student will be able to:

1. Understand the importance of project planning and management of the project to become successful entrepreneur.
2.Display ability to design and develop newer products.
3.Demonstrate ability to work in multidisciplinary teams and understand the impact of engineering solutions in a global, economic, environmental, and societal context.

COURSE CONTENT

Project Management and Entrepreneurship		**Semester:**	**IV**
Teaching Scheme:		**Examination scheme**	
Lectures:	**3 hours/week**	**End semester exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exams (ISE):	**40 marks**

Unit–I:	**No. of Lectures: 08 Hours**	**Marks: 12**

Meaning of Projects, Product Planning and Development, Concepts of Projects, Importance, Dimensions and Aspects of Project, Project Classification, Conceptualizing the Project, Project Life Cycle, Characteristics of Project, Project Identification, Project formulation, Feasibility Report.

Unit–II:	**No. of Lectures: 08 Hours**	**Marks: 12**

Project Analysis, Project Risks, Project Planning: Selection, Infrastructure, Machinery, Raw Materials, Finance, Marketing, Incentives, Project Design and Network Analysis, Project Report, Project Appraisal, Location of an Enterprise

Unit–III:	No. of Lectures: 08 Hours	Marks: 12
Introduction, Concept of entrepreneurship: Significance of entrepreneurship, Theories of entrepreneurship, Models of entrepreneurship development, Definition of entrepreneur: Traits and characteristics of successful entrepreneur , Functions of an entrepreneur, Types of entrepreneurs, Factors influencing entrepreneur, Professional vs. family entrepreneurs, Entrepreneurial leaders vs. managers, Entrepreneurial process: Entrepreneurial motivation, Entrepreneurial barriers, Women as entrepreneur, Role of woman entrepreneurs in society, Barriers to women entrepreneurs, Myths of entrepreneurship, Problems faced by entrepreneurs and capacity building for entrepreneurship, Profiles of successful entrepreneurs.		
Unit–IV:	**No. of Lectures: 08 Hours**	**Marks: 12**
Financial requirements of a new Enterprise: Estimating financial requirements, Estimation of fix capital requirements, Estimation of working capital requirements Identifying the sources of finance –sources of long-term financing: Sources of medium term financing , Sources of short-term financing Institutions providing financial assistance: Venture capital funding-venture capital funding in the Indian scenario, Venture capital funding process, Importance of financial management, Working capital management, Accounting and book keeping, Financial statement, Financial ration analysis.		
Unit–V:	**No. of Lectures: 08 Hours**	**Marks: 12**
Challenges for small Enterprises Problem faced by small enterprises: Managerial problems, Marketing management, Human resource, Production management, Technological problems Role of central and state governments in promoting small enterprises: Fiscal and tax concessions for small enterprises, Industrial policies for small enterprises, Importance of marketing, Customer relationship management (CRM), Marketing services		
Text Books:		
1. Vasant Desai, Project Management, Himalaya Publishing House, New Delhi. 2. AlpanaTrehan, Entrepreneurship, Dreamtech Press. 3. O.P.Khanna, Industrial Engineering & Management, DhanpatRai Publications (P) Ltd New Delhi 4. Poornima M. Charantimath, Entrepreneurship Development –Small Business Enterprises, Pearson Publication.		
Reference Books:		
1. Jack M. Kaplan, Patterns of Entrepreneurship, Wiley. 2. K. Nagarajan, Project Management, New Age International Pvt. Ltd.		

Thermodynamics - II Lab					
LAB COURSE OUTLINE					
Course Title:	**Thermodynamics - II Lab**	**Short Title:**	**THD-II Lab**	**Course Code:**	

Course description:

The purpose of this course is to study the phase behavior and properties of pure fluids with applications.

Laboratory	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**
	2	14	28	1

End Semester Exam (ESE) Pattern:	**Oral (OR)**

Prerequisite course(s):

Applied Physics- I & II, Applied Chemistry-I & II, Thermodynamics-I

Course objectives:

1. To study the laws of thermodynamics.
2. To study equations of state.
3. To study concept of entropy.
4. To study Vapour-Liquid Equilibria (VLE) and test of VLE data.
5. To study phase equilibria for single component system.
6. To study the determination of partial molar quantities, fugacity and fugacity coefficient.
7. To study properties of solutions.
8. To study and construct pressure-composition & boiling point diagrams.

Course outcomes:

Upon successful completion of lab Course, student will be able to:

1. Understand the Laws of thermodynamics,.
2. Understand Vapour-Liquid Equilibrium, partial molar properties, activity coefficient and the equilibrium constant of a chemical reaction.

LAB COURSE CONTENT

Thermodynamics - II Lab		**Semester:**	**IV**
Teaching Scheme:		**Examination scheme**	
Practical:	**2 hours/week**	**End semester exam (ESE):**	**25 marks**
		Internal Continuous Assessment (ICA):	**25 marks**

(Amongst the following any eight experiments / assignments are to be performed)

1. To study Joule Thompson experiment.
2. To study second law of thermodynamics.
3. To study Vapour-Liquid Equilibrium
4. To determine partial molar enthalpy
5. To determine activity coefficient of liquid
6. To study Van't Hoff Equation
7. To determine the equilibrium constant of a chemical reaction
8. To determine the entropy changes in physical process
9. To construct Boiling Point diagram
10. To construct pressure composition diagram.

Text Books:
1. R.R. Rastogi and R.R. Mishra, An introduction to Chemical Thermodynamics, Vikas Publishing House Pvt. Ltd. New Delhi 2. J.M. Smith, H.C. Van Ness, M.M. Abbott Introduction to Chemical Engineering Thermodynamics, Fifth Edition Tata McGraw-Hill Companies Inc.
Reference Book:
Perry's Handbook of Chemical Engineers
Guide lines for ICA:
Internal Continuous Assessment shall be based on continuous evaluation of Student performance throughout semester and practical / assignments submitted by the student in the form of journal
Guidelines for ESE:
End Semester Examination shall be based on practical / oral evaluation of Student performance and practical / assignments submitted by the student in the form of journal.

Material and Energy Balance Computations Lab					
LAB COURSE OUTLINE					
Course Title:	**Material and Energy Balance Computations Lab**	**Short Title:**	**MEBC Lab**	**Course Code:**	

Course description:

This course provide the students basic understanding of Material and Energy Balance Computations of Industrial Processes.

Laboratory	Hours/week	No. of weeks	Total hours	Semester credits
	2	14	28	1

End Semester Exam (ESE) Pattern:	Oral (OR)

Prerequisite course(s):

Applied Physics- I & II, Applied Chemistry-I & II, Industrial Chemistry , Thermodynamics-I

Course objectives:

1. To study fundamentals of chemical engineering.
2. To provide broad background for applying principles to industrial and theoretical problems.

Course outcomes:

Upon successful completion of lab Course, student will be able to:

1.Perform the material balance and energy balance calculations.
2.Know the use of humidity charts.
3. Calculate various heats such as heat of reaction, combustion, formation, neutralization and solution.

LAB COURSE CONTENT

Material and Energy Balance Computations Lab		Semester:	IV
Teaching Scheme:		**Examination scheme**	
Practical:	**2 hours/week**	**End semester exam (ESE):**	**25 marks**
		Internal Continuous Assessment (ICA):	**25 marks**

(Amongst the following any eight experiments / assignments are to be performed)

1. Solving material balance problems without chemical reaction
2.Material balances for systems with chemical reactions
3. Use of humidity charts for engineering calculations
4. Heat of fusion and vaporization
5. Analysis of systems with by-pass, recycle and purge
6. Calculations and application of heat of reaction, combustion, formation.
7. Calculations and application of heat of neutralization and solution.
8. Calorific Value of Coal.
9. Energy capacity of gases, liquids and solutions
10. Heat of fusion and vaporization

Text Book:

Himmelblau D.M. "Basic Principles and Calculations in Chemical Engineering" VIth edition, Prentice Hall.

Reference Book:

Perry's Handbook of Chemical Engineers

Guide lines for ICA:
Internal Continuous Assessment shall be based on continuous evaluation of Student performance throughout semester and practical / assignments submitted by the student in the form of journal
Guidelines for ESE:
End Semester Examination shall be based on practical / oral evaluation of Student performance and practical / assignments submitted by the student in the form of journal.

Chemical Engineering Lab-II					
LAB COURSE OUTLINE					
Course Title:	**Chemical Engineering Lab-II**	**Short Title:**	**CEL-II**	**Course Code:**	

Course description:

This course gives the students basic knowledge about the analysis of chemical reaction rates. The course also applies earlier learned knowledge for the preparation of chemical compounds on laboratory scale through single stage preparations.

Laboratory	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**
	2	14	28	1
Theory	1	14	14	1

End Semester Exam (ESE) Pattern:	**Practical (PR)**

Prerequisite course(s):

(LAB) Chemical Engineering Lab-I

Course objectives:

1.To provides students the first hand experience of verifying various theoretical concepts learnt in theory courses.
2. To learn single stage preparations in stepwise manner.
3. To become familiar with laboratory techniques for determination of rate constants for Reactions.

Course outcomes:

Upon successful completion of lab Course, student will be able to:

1. Learn how to experimentally verify various theoretical principles
2.Develop experimental skills
3.Visualize practical implementation of proper techniques for the conversion of raw materials into finished products.

LAB COURSE CONTENT

Chemical Engineering Lab-II		**Semester:**	**IV**
Teaching Scheme:		**Examination scheme**	
Practical:	**2 hours/week**	**End semester exam (ESE):**	**25 marks**
		Internal Continuous Assessment (ICA):	**25 marks**

(Amongst the following any eight experiments / assignments are to be performed)

1. 2–3 experiments on investigation of reaction rates for elementary reaction.
2. 5-6 experiments on single stage preparations.

Text Book:

F.G.Mann&B.C.Saunders, Practical Organic Chemistry, Orient Longman

Reference Books:

1.S.K.Bhasin, Laboratory manual on engg. Chemistry: DhanpatRaiPub.New Delhi
2. Practical chemistry : Manali publications, Pune

Guide lines for ICA:
Internal Continuous Assessment shall be based on continuous evaluation of Student performance throughout semester and practical / assignments submitted by the student in the form of journal
Guidelines for ESE:
End Semester Examinationshall be based on practical / oral evaluation of Student performance and practical / assignments submitted by the student in the form of journal.

Environmental Studies					
COURSE OUTLINE					
Course Title:	**Environmental Studies**	**Short Title:**	**EVS**	**Course Code:**	**Non Credit**
Course description:					
The course aims to percolate the importance of environmental science and environmental studies.					

COURSE CONTENT			
Environmental Studies	**Semester:**	**IV**	
	Examination scheme		
	End Semester Exam (ESE):		**80 marks**
	Duration of ESE:		**03 hours**
	Internal Continuous Assessment (ICA):		**20 marks**

Unit–I:	**No. of Lectures: 02 Hours**	

Multidisciplinary nature of environmental studies

Definition, scope and importance

Need for public awareness.

Unit–II:	**No. of Lectures: 08 Hours**	

Natural Resources :

Renewable and non-renewable resources

Natural resources and associated problems.

a. Forest resources : Use and over-exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forest and tribal people.
b. Water resources : Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems.
c. Mineral resources : Use and exploitation, environmental effects of extracting and using mineral resources, case studies.
d. Food resources : World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies.
e. Energy resources : Growing energy needs, renewable and non renewable energy sources, use of alternate energy sources. Case studies.
f. Land resources : Land as a resource, land degradation, man induced landslides, soil erosion and desertification.

• Role of an individual in conservation of natural resources.
• Equitable use of resources for sustainable lifestyles.

Unit–III:	**No. of Lectures: 06 Hours**	

Ecosystems

- Concept of an ecosystem.
- Structure and function of an ecosystem.
- Producers, consumers and decomposers.
- Energy flow in the ecosystem.
- Ecological succession.
- Food chains, food webs and ecological pyramids.
- Introduction, types, characteristic features, structure and function of the following ecosystem :-
  a. Forest ecosystem
  b. Grassland ecosystem

c. Desert ecosystem
d. Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

Unit–IV:	No. of Lectures: 08 Hours	

Biodiversity and its conservation

- Introduction – Definition : genetic, species and ecosystem diversity.
- Biogeographic classification of India
- Value of biodiversity : consumptive use, productive use, social, ethical, aesthetic and option values
- Biodiversity at global, National and local levels.
- India as a mega-diversity nation
- Hot-sports of biodiversity.
- Threats to biodiversity : habitat loss, poaching of wildlife, man-wildlife conflicts.
- Endangered and endemic species of India
- Conservation of biodiversity : In-situ and Ex-situ conservation of biodiversity.

Unit–V:	No. of Lectures: 08 Hours	

Environmental Pollution

Definition

- Cause, effects and control measures of :-
  a. Air pollution
  b. Water pollution
  c. Soil pollution
  d. Marine pollution
  e. Noise pollution
  f. Thermal pollution
  g. Nuclear hazards
- Solid waste Management : Causes, effects and control measures of urban and industrial wastes.
- Role of an individual in prevention of pollution.
- Pollution case studies.
- Disaster management : floods, earthquake, cyclone and landslides.

Unit–VI:	No. of Lectures: 07 Hours	

Social Issues and the Environment

- From Unsustainable to Sustainable development
- Urban problems related to energy
- Water conservation, rain water harvesting, watershed management
- Resettlement and rehabilitation of people; its problems and concerns. Case Studies
- Environmental ethics : Issues and possible solutions.
- Climate change, global warming, acid rain, ozone layer depletion, nuclear
- accidents and holocaust. Case Studies.
- Wasteland reclamation.
- Consumerism and waste products.
- Environment Protection Act.
- Air (Prevention and Control of Pollution) Act.
- Water (Prevention and control of Pollution) Act
- Wildlife Protection Act
- Forest Conservation Act
- Issues involved in enforcement of environmental legislation.
- Public awareness.

Unit–VII:	No. of Lectures: 06 Hours	

Human Population and the Environment

- Population growth, variation among nations.
- Population explosion – Family Welfare Program
- Environment and human health.
- Human Rights.
- Value Education.
- HIV/AIDS.
- Women and Child Welfare.
- Role of Information Technology in Environment and human health.
- Case Studies.

Unit–VIII:	No. of Lectures:	

Field work

- Visit to a local area to document environmental assets, river / forest / grassland / hill / mountain
- Visit to a local polluted site-Urban/Rural/Industrial/Agricultural
- Study of common plants, insects, birds.
- Study of simple ecosystems-pond, river, hill slopes, etc. (Field work Equal to 5 lecture hours)

Guide lines for ICA:

Students must submit ICA in the form of journal. Each assignment should be well documented. Faculty in charge will assess the assignments continuously and grade or mark each assignment on completion date declared for each assignments.

Reference Books:

1. Agarwal, K.C. 2001 Environmental Biology, Nidi Publ. Ltd. Bikaner.
2. BharuchaErach, The Biodiversity of India, Mapin Publishing Pvt. Ltd., Ahmedabad – 380 013, India, Email:mapin@icenet.net (R)
3. Brunner R.C., 1989, Hazardous Waste Incineration, McGraw Hill Inc. 480p
4. Clark R.S., Marine Pollution, Clanderson Press Oxford (TB)
5. Cunningham, W.P. Cooper, T.H. Gorhani, E & Hepworth, M.T. 2001, Environmental Encyclopedia, Jaico Publ. House, Mumabai, 1196p
6. De A.K., Environmental Chemistry, Wiley Eastern Ltd.
7. Down to Earth, Centre for Science and Environment (R)
8. Gleick, H.P. 1993. Water in crisis, Pacific Institute for Studies in Dev., Environment & Security. Stockholm Env. Institute Oxford Univ. Press. 473p
9. Hawkins R.E., Encyclopedia of Indian Natural History, Bombay Natural History Society, Bombay (R)
10. Heywood, V.H &Waston, R.T. 1995. Global Biodiversity Assessment. Cambridge Univ. Press 1140p.
11. Jadhav, H &Bhosale, V.M. 1995. Environmental Protection and Laws. Himalaya Pub. House, Delhi 284 p.
12. Mckinney, M.L. & School, R.M. 1996. Environmental Science systems & Solutions, Web enhanced edition. 639p.
13. Mhaskar A.K., Matter Hazardous, Techno-Science Publication (TB)
14. Miller T.G. Jr. Environmental Science, Wadsworth Publishing Co. (TB)
15. Odum, E.P. 1971. Fundamentals of Ecology. W.B. Saunders Co. USA, 574p
16. Rao M N. & Datta, A.K. 1987. Waste Water treatment. Oxford & IBH Publ. Co. Pvt. Ltd. 345p.
17. Sharma B.K., 2001. Environmental Chemistry. Geol Publ. House, Meerut
18. Survey of the Environment, The Hindu (M)

19. Townsend C., Harper J, and Michael Begon, Essentials of Ecology, Blackwell Science (TB)
20. ErachBharucha, Textbook of Environmental Studies, University Press
21. MP Poonia& SC Sharma, Environmental Studies, Khanna Publishing House
22. Rajagopalan, Environmental Studies, Oxford University Press