

Complete Course Grid and Syllabus

Diploma in Chemical Engineering

From Academic Year 2020-2021



Course Grid for Diploma in Chemical Engineering
Assam Energy Institute, Sivasagar
Rajiv Gandhi Institute of Petroleum Technology, Jais, Amethi

Course: Diploma in Chemical Engineering

Total Number of Credits: 360

SEMESTER I					
Subject Code	Subject	L	T	P	Credits
IS101	Mathematics-I	3	1	0	11
IS102	Physics-I	3	1	0	11
IS103	Chemistry-I	2	1	0	8
IE101	Fundamentals of Computer Engineering	2	0	2	8
EP101	Engineering Drawing	0	0	3	3
EP102	Engineering Workshop Practice	0	0	3	3
IE102	Engineering Thermodynamics	3	1	0	11
IS104L	Physics Lab	0	0	2	2
	TOTAL				57
HU101	Universal Human Values	1	1	0	5
LM101	Communication Skills*	2	0	1	7

*For selective students with less proficiency in English

SEMESTER II					
Subject Code	Subject	L	T	P	Credits
IS105	Mathematics-II	3	1	0	11
IS106	Physics-II	3	1	0	11
IS107	Chemistry-II	3	0	0	9
IE103	Fundamentals of Mechanical Engineering	2	0	0	6
IE104	Fluid Mechanics & Fluid Flow Operations	3	1	0	11
IE105	Computer Programming	2	0	2	8
IS108L	Chemistry Lab	0	0	2	2
HU102	Community Internship	1	1	0	5
	TOTAL				58

SEMESTER III					
Subject Code	Subject	L	T	P	Credits
DC201	Materials and Energy Balance	3	1	0	11
IE202	Materials Science	3	0	0	9
DC203	Fluid Particle Mechanics & Mechanical Operations	2	0	0	6
DC204	Heat Transfer Operations	3	0	0	9
DC205	Chemical Engineering Thermodynamics	2	1	0	8
IE201	Fundamental of Electrical & Electronics Engineering	3	1	2	13
DC206L	Unit Operations Lab-I	0	0	2	2
TOTAL					58

SEMESTER IV					
Subject Code	Subject	L	T	P	Credits
DC207	Mass Transfer Operations- I	3	0	0	9
DC208	Chemical Technology - Inorganic	2	0	0	6
DC209	Process Instrumentation & Control	3	0	0	9
DC210	Chemical Reaction Engineering	3	1	0	11
DC211	Petroleum Refinery Operations	3	0	0	9
DC212	Process Plant Utilities	2	0	0	6
DC 213L	Unit Operations Lab-II	0	0	2	2
DC210L	Chemical Reaction Engineering Lab	0	0	2/2	1
DC209L	Process Instrumentation & Control	0	0	2/2	1
DP201	Project	0	0	5	5
	Total				59
DP201	Industrial Training	0	0	5	5

SEMESTER V					
Subject Code	Subject	L	T	P	Credits
DC301	Mass Transfer Operations- II	2	0	0	6
DC302	Process Equipment Design	2	0	2	8
DC303	Chemical Technology- Organic	3	0	0	9
HU301	Humanities	2	0	0	6
LM301	Engineering Economics	2	1	0	8
DC304	Fire, Safety & Hazard	2	0	0	6
DC305	Corrosion & Material Selection	2	0	0	6
EP 301	AUTOCAD	0	0	2	2
DP 301	Project	0	0	10	10
TOTAL					61

SEMESTER VI					
Subject Code	Subject	L	T	P	Credits
DC 306	Modeling, Simulation & Optimization	3	0	0	9
DC307	New Separation Techniques	3	0	0	9
DC 308	Industrial Pollution & control	2	0	0	6
DC309	Plant Design	2	0	0	6
OE 301	Open Elective	3	0	0	9
DE 301	Departmental Elective	3	0	0	9
DC306L	Modeling, Simulation & Optimization Lab	0	0	2/2	1
DC308L	Industrial Pollution & control Lab	0	0	2/2	1
DP 302	Project	0	0	10	10
TOTAL					60

Department Electives:

DE 301 Department Elective
1. Fluidization Engineering
2. Polymer & Petrochemicals
3. Electrochemical Engineering
4. Management for Engineers
5. Entrepreneurship

Cat.	Component Distribution	Min
HU	Humanities and Social Science	16
IS	Basic Science	65
IE	Institute Requirement Engineering	66
EP	Engineering Drawing (Manual and Computer Aided), Manufacturing Practices and Practice course of Department	8
LM	Language and Management	8
DC	Department/Programme Core	157
DE	Department/Programme Elective	9
OE	Open Elective	9
DP	Project/ Industrial visit/ Training	30
Total		368

Syllabus

Semester I

Subject Code	Subject Name	Credit Lecture			Total Credits
IS101	Mathematics-I	3	1	0	11

Unit-I: Complex Numbers:

Definition of Complex numbers; Real and imaginary parts of a Complex number; Polar and Cartesian form of a complex number and its conversion from one form to other; Conjugate of a complex number; Modulus and amplitude of a complex number; Addition, Subtraction, Multiplication and Division of complex numbers. De-Moivre's theorem and its application.

Unit-II: Partial fractions:

Definition of polynomial proper fraction & improper fractions and definition of partial fractions; To resolve proper fraction into partial fraction with denominator containing non-repeated linear factors, repeated linear factors and irreducible non-repeated quadratic factors; To resolve improper fraction into partial fraction.

Unit-III: Permutations and Combinations:

Fundamental principle of counting; Fundamental principle of multiplication, Fundamental principle of addition; Factorial notation; Permutations; Combinations; Practical problems on permutations and combinations.

Unit-IV: Binomial theorem:

Binomial theorem (without proof) for positive integral index ; General and middle term in Binomial expansion; Binomial theorem for any rational number (without proof); Simple applications

Unit-V: Trigonometry:

Concept of angle; Measurement of angle in degree, grades and radians and their conversions; Trigonometric ratios; Sum, difference formulae and their applications (Without proof); Product formula (Transformation of Product to Sum and Differences and vice versa); Trigonometric Ratios of multiple angle, sub-multiple angles (2A,3A,A/2); Graph of $\sin x$, $\cos x$, $\tan x$, $\operatorname{cosec} x$, $\operatorname{sec} x$ and $\operatorname{cot} x$.

Unit-VI: Differential Calculus

Definition of function; Concept of limits; Four standard limits

$\lim_{x \rightarrow a} \frac{x^n - a^n}{x - a}$, $\lim_{x \rightarrow 0} \frac{\sin x}{x}$, $\lim_{x \rightarrow 0} \frac{a^x - 1}{x}$ and $\lim_{x \rightarrow 0} (1 + x)^{1/x}$. Differentiation by definition of

x^n , $\sin x$, $\cos x$, e^x and $\log_a x$. Differentiation of sum, product and quotient of functions;

Differentiation of function of a function; Differentiation of trigonometric and inverse trigonometric functions; Logarithmic differentiation; Exponential functions.

TEXT BOOKS:-

1. B.S. Grewal, Higher Engineering Mathematics, Khana Publishers, New Delhi, 40th Edition, 2007.
2. Murray R. Spiegel, Robert E. Moyer, College Algebra, Tata McGraw Hill, New Delhi, 2nd Edition, 2000.

REFERENCE BOOKS:-

1. G. B. Thomas, R.L. Finney, Calculus and Analytical Geometry, Addison Wesley, 9th Edition, 1995
2. Frank Ayers, Elliot Mendelson, Calculus, McGraw Hill, New York, 4th Edition.

Subject Code	Subject Name	Credit Lecture (L-T-P)			Total Credits
		L	T	P	
IS102	Physics-I	3	1	0	11

Unit 1: Physical world, Units and Measurements

Physical quantities; fundamental and derived, Units and systems of units (FPS, CGS and SI units).

Dimensions and dimensional formulae of physical quantities, Principle of homogeneity of dimensions, Dimensional equations and their applications (conversion from one system of units to other, checking of dimensional equations and derivation of simple equations), Limitations of dimensional analysis.

Measurements: Need, measuring instruments, least count, types of measurement (direct, indirect), Errors in measurements (systematic and random), absolute error, relative error, error propagation, error estimation and significant figures.

Unit 2: Force and Motion

Scalar and Vector quantities – examples, representation of vector, types of vectors. Addition and Subtraction of Vectors, Triangle and Parallelogram law (Statement only), Scalar and Vector Product, Resolution of a Vector and its application to inclined plane and lawn roller.

Force, Momentum, Statement and derivation of conservation of linear momentum, its applications such as recoil of gun, rockets, Impulse and its applications.

Circular motion, definition of angular displacement, angular velocity, angular acceleration, frequency, time period, Relation between linear and angular velocity, linear acceleration and angular acceleration (related numerical), Centripetal and Centrifugal forces with live examples, Expression and applications such as banking of roads and bending of cyclist.

Unit 3: Work, Power and Energy

Work: Concept and units, examples of zero work, positive work and negative work.

Friction: concept, types, laws of limiting friction, coefficient of friction, reducing friction and its engineering applications, Work done in moving an object on horizontal and inclined plane for rough and plane surfaces and related applications.

Energy and its units, kinetic energy, gravitational potential energy with examples and derivations, mechanical energy, conservation of mechanical energy for freely falling bodies, transformation of energy (examples).

Power and its units, power and work relationship, calculation of power (numerical problems).

Unit 4: Rotational Motion

Translational and rotational motions with examples, Definition of torque and angular momentum and their examples, Conservation of angular momentum (quantitative) and its applications.

Moment of inertia and its physical significance, radius of gyration for rigid body, Theorems of parallel and perpendicular axes (statements only), Moment of inertia of rod, disc, ring and sphere (hollow and solid); (Formulae only).

Unit 5: Properties of Matter

Elasticity: definition of stress and strain, moduli of elasticity, Hooke's law, significance of stress-strain curve.

Pressure: definition, units, atmospheric pressure, gauge pressure, absolute pressure, Fortin's Barometer and its applications.

Surface tension: concept, units, cohesive and adhesive forces, angle of contact, Ascent Formula (No derivation), applications of surface tension, effect of temperature and impurity on surface tension.

Viscosity and coefficient of viscosity: Terminal velocity, Stoke's law and effect of temperature on viscosity, application in hydraulic systems.

Hydrodynamics: Fluid motion, stream line and turbulent flow, Reynold's number Equation of continuity, Bernoulli's Theorem (only formula and numerical) and its applications.

Unit 6: Heat and Thermometry

Concept of heat and temperature, modes of heat transfer (conduction, convection and radiation with examples), specific heats, scales of temperature and their relationship, Types of Thermometer (Mercury thermometer, Bimetallic thermometer, Platinum resistance thermometer, Pyrometer) and their uses.

Expansion of solids, liquids and gases, coefficient of linear, surface and cubical expansions and relation amongst them, Co-efficient of thermal conductivity, engineering applications.

TEXT BOOKS:-

1. Text Book of Physics for Class XI& XII (Part-I, Part-II); N.C.E.R.T., Delhi

REFERENCE BOOKS:-

1. Applied Physics, Vol. I and Vol. II, TTTI Publications, Tata McGraw Hill, Delhi.
2. Concepts in Physics by HC Verma, Vol. I & II, BhartiBhawan Ltd. New Delhi
3. Engineering Physics by PV Naik, Pearson Education Pvt. Ltd, New Delhi
4. Engineering Physics by DK Bhattacharya&PoonamTandan; Oxford University Press, New Delhi.
5. Comprehensive Practical Physics, Vol, I & II, JN Jaiswal, Laxmi Publications (P) Ltd., New Delhi
6. Practical Physics by C. L. Arora, S. Chand Publication.
7. E-books/e-tools/ learning physics software/websites etc.

Subject Code	Subject Name	Credit Lecture (L-T-P)			Total Credits
IS 103	Chemistry-I	2	1	0	8

Unit – 1: States of matter

States of matter, Gas laws, Ideal gas equation, Gas constant, Dalton's law of partial pressure, Graham's law of diffusion, Avogadro's hypothesis and its applications, Mole concept and problems, Standard solution, normal solution and molar solution, concentration terms-normality, molarity, gm/l, ppm, normality equation, acid-base titration.

Unit – 2: Chemical equation

Chemical equation-definition, qualitative and quantitative significance, limitations, balancing by partial and ion-electron method, electronic concept of oxidation and reduction, Stoichiometric calculations.

Unit – 3: Acids, bases and salts

Acids, bases and salts, Theories of acids and bases- Arrhenius, Bronsted-Lowry, Lewis theory, Strong acids and strong bases, conjugate acid-base pair, classification of salts, hydrolysis of salts and its effect.

Unit – 4: Atomic structure

Atomic structure: Rutherford's Model, Bohr's Model, Atomic spectra, Dual nature of electron, uncertainty principle, Quantum number, Aufbau principle, Hund's rule, Pauli's exclusion principle, electronic configuration.

Unit – 5: Modern Periodic table

Modern Periodic table, Periodic properties, size of atoms (atomic and ionic radii), Ionization energies, electron affinity, electro-negativity, Basic Concepts of s,p,d and f- block Elements.

Unit – 6: Chemical bonding

Chemical bonding: electronic theory of valency, Ionic, covalent and co-ordinate covalent bonds, characteristics of ionic and covalent compounds, Hydrogen bonding.

Unit-7: Chemical equilibrium

Chemical equilibrium: Law of mass action, equilibrium constant, factors effecting equilibrium, Le-Chatellier's principle and its applications, ionic equilibrium, pH value, dissociation of acids and bases, common ion effect, buffer solution, solubility product and its applications.

Unit-8: Electrolysis

Electrolysis: Laws of electrolysis, problems, Industrial application of electrolysis (extraction and purification of metals, electroplating and galvanization).

Unit-9: Catalysis

Catalysis: Definition, type of catalyst, industrial applications of catalysis in manufacture of NH_3 , H_2SO_4 by contact process, cracking.

Unit-10: Water

Water: Causes of hardness of water, removal of hardness by permutite process, de-ionisation of water, effect of water in boiler preparation of boiler-feed water, preparation of Municipal water with block-diagram, Estimation of hardness of water

SUGGESTED READINGS:

TEXTBOOKS:

1. NCERT Text book (Class XI and XII)
2. Engg. Chem, B. K. Sharma
3. A Text Book Of Engineering Chemistry, SashiChawla
4. Engineering Chemistry, Jain and Jain
5. Applied Chemistry, Dr. Raman Rani Mittal

REFERENCE BOOKS:

1. Physical Chemistry: Peter Atkins, Julio De. Paula
2. Concise Inorganic Chemistry: J. D. Lee

Subject Code	Subject Name	Credit Lecture (L-T-P)			Total Credits
IE101	Engineering Thermodynamics	3	1	0	11

Unit-I: Basic concepts and definition

Scope of Thermodynamics, Macroscopic and Microscopic approaches; Definition of Fixed mass (closed systems) and Control volume(open system), Properties (extensive and Intensive), State and its representation on a property diagram, Process and its representation, Cyclic process (or cycle) and its representation, Carnot Cycle, Otto Cycle, Diesel Cycle, Dual Cycle, Rankine Cycle, Brayton Cycle, Characteristics of properties (point and path function);Reversible and Irreversible processes; Thermal, mechanical and Chemical equilibrium, Thermodynamic equilibrium, Zeroth Law of Thermodynamics and temperature, Measurement of temperature and calibration of Thermometers, the ideal gas temperature scale, Measurement of pressure, Bourdon pressure gage and manometers, gage and absolute pressure.

Unit-II: Ideal Gases

Ideal gases and their P-V-T relations, Gas mixtures. Work Transfer (definition and calculation), Different modes of work, Displacement Work for various process, Heat Transfer; Modes of heat transfer, Basic laws in conduction, convection and radiation, combined modes of heat transfer with examples.

Unit-III: First Laws of Thermodynamics

Formal statement (using cyclic processes), First law for processes of fixed masses(closed systems) and introduction of internal energy as a thermodynamics property, Introduction of enthalpy as a thermodynamic property; Definition of specific heats and their use in calculation of internal energy and enthalpy with emphasis on ideal gases.

Application of First Law to control volumes; Nozzle, Diffuser, Compressor, Turbine, Throttling device, Heat Exchanger.(only steady flow need be considered)

Unit- IV: Second Law of Thermodynamics

Kelvin- Planck and Clausius statements of Second Law, Reversible and irreversible engines and their efficiency, Entropy concepts and the principle of entropy increase.

Unit- V: Properties of Pure Substances

P-V, P-T, T-S, H-S diagram for steam, different types of steam, Introduction to steam tables with respect to specific volume, pressure, temperature, enthalpy and entropy.

Unit-VII: Application of thermodynamics

Air compressors, steam power plant, Refrigerators and Heat pump, I.C. Engines (Brief description of different components of above mentioned systems and working principles with Schematic diagram only)

TEXT BOOK(S):

1. Engineering Thermodynamics by P.K.Nag, Publisher:TMH
2. Basic Engineering Thermodynamics by Rayner Joel, Pearson Education

REFERENCE BOOK(S):

1. Engineering Thermodynamics by Van Wylen and Sonntag, John Wiley
2. Engineering Thermodynamics by M.Achuthan, Publisher:PHI
3. Applied Thermodynamics by Eastop and McConkey, Publisher:Pearson
4. Fundamental of Engineering Thermodynamics by E. Rathakrishnan, publisher.PHI
5. Engineering Thermodynamics by Russel and Adebisi, publisher,Oxford
6. Steam Tables in SI Units by Ramalingam, Scitech.

Subject Code	Subject Name	Credit Lecture			Total Credits
		(L-T-P)			
IE102	Fundamentals of Computer Engineering	2	0	2	8

UNIT 1:

Basic Internet skills: Understanding browser, efficient use of search engines, awareness about Digital India portals (state and national portals) and college portals.

General understanding of various computer hardware components – CPU, Memory, Display, Keyboard, Mouse, HDD and other Peripheral Devices.

UNIT 2:

OS Installation (Linux and MS Windows), Unix Shell and Commands, vi editor.

UNIT 3:

HTML4, CSS, making basic personal webpage.

UNIT 4:

Office Tools: OpenOffice Writer, OpenOffice Spreadsheet (Calc), OpenOffice Impress.

UNIT 5: Information security best practices.

Class lectures will only introduce the topic or demonstrate the tool, actual learning will take place in the Lab by practicing regularly.

SUGGESTED LAB WORK:

This is a skill course. Topics/concepts taught in the class should be practiced in the Lab same week and practiced regularly during the semester till student becomes confident about it. This course is all about some theory and a lot of practice.

RECOMMENDED BOOKS:-

- 1) R.S. Salaria, Computer Fundamentals, Khanna Publishing House.
- 2) Ramesh Bangia, PC Software Made Easy – The PC Course Kit, Khanna Publishing House.
- 3) Online Resources, Linux man pages, Wikipedia.
- 4) Mastering Linux Shell Scripting: A practical guide to Linux command-line, Bash scripting, and Shell programming, by MokhtarEbrahim, Andrew Mallett.

Subject Code	Subject Name	Credit Lecture (L-T-P)			Total Credits
		L	T	P	
EP101	Engineering Drawing	0	0	3	3

1. Introduction to Engineering Drawing

1.1 Introduction to drawing instruments, materials, layout and sizes of drawing sheets and drawing boards.

1.2 Different types of lines in Engineering drawing as per BIS specifications

1.3 Practice of vertical, horizontal and inclined lines, geometrical figures such as triangles, rectangles, circles, ellipses and curves, hexagonal, pentagon with the help of drawing instruments.

1.4 Free hand and instrumental lettering (Alphabet and numerals) – upper case (Capital Letter), single stroke, vertical and inclined at 75 degree, series of 5,8,12 mm of free hand and instrumental lettering of height 25 to 35 mm in the ratio of 7:4

2. Dimensioning Technique

2.1 Necessity of dimensioning, method and principles of dimensioning (mainly theoretical instructions)

2.2 Dimensioning of overall sizes, circles, threaded holes, chamfered surfaces, angles, tapered surfaces, holes, equally spaced on P.C.D., counter sunk holes, counter bored holes, cylindrical parts, narrow spaces and gaps, radii, curves and arches

3. Scales

3.1 Scales –their needs and importance (theoretical instructions), type of scales, definition of R.F. and length of scale

3.2 Drawing of plain and diagonal scales

4. Orthographic Projections

4.1 Theory of orthographic projections (Elaborate theoretical instructions)

4.2 Projection of Points in different quadrant

4.3 Projection of Straight Line (1st and 3rd angle)

4.3.1. Line parallel to both the planes

4.3.2. Line perpendicular to any one of the reference plane

4.3.3. Line inclined to any one of the reference plane.

4.4 Projection of Plane – Different lamina like square, rectangular, triangular and circle inclined to one plane, parallel and perpendicular to another plane in 1st angle only

4.5 Three views of orthographic projection of different objects. (At least one sheet in 3rd angle)

4.6 Identification of surfaces

5 Projection of Solid

5.1. Definition and salient features of Solid

5.2. Types of Solid (Polyhedron and Solid of revolution)

5.3 To make projections, sources, Top view, Front view and Side view of various types of Solid.

6. Sections

6.1 Importance and salient features

6.2 Drawing of full section, half section, partial or broken out sections, Offset sections, revolved sections and removed sections.

6.3 Convention sectional representation of various materials, conventional breaks for shafts, pipes, rectangular, square, angle, channel, rolled sections

6.4 Orthographic sectional views of different objects.

7. Isometric Views

7.1 Fundamentals of isometric projections and isometric scale.

7.2 Isometric views of combination of regular solids like cylinder, cone, cube and prism.

RECOMMENDED BOOKS:-

1. A Text Book of Engineering Drawing by Surjit Singh; Dhanpat Rai & Co., Delhi

2. Engineering Drawing by PS Gill; SK Kataria & Sons, New Delhi

3. Elementary Engineering Drawing in First Angle Projection by ND Bhatt; Charotar Publishing House Pvt. Ltd., Anand

4. Engineering Drawing I & II by JS Layall; Eagle Parkashan, Jalandhar

5. Engineering Drawing I by DK Goel, GBD Publication.

Subject Code	Subject Name	Credit Lecture (L-T-P)			Total Credits
		L	T	P	
EP102	Engineering Workshop Practices I	0	0	3	3

Unit 1

Fitting Shop:

Introduction and practice of various fitting processes: Use of hand tools in fitting, preparing a male and female joint of M.S.

Unit 2

Welding Shop:

Introduction and practice of various Welding processes: Electric Arc welding Practice and Gas welding, TIG, MIG, Gas Cutting and application. Joints such as a Lap joint, a T-joint or a Butt joint are to be prepared.

Unit 3

Machine Shop:

Introduction and practice of various Machining processes: Plain and Stepped cylindrical turning, grooving, knurling and Thread-cutting of a job in lathe.

TEXT BOOK(S):

1. Elements of Workshop Technology, Vol. I and II by Hajrachoudhary, Khanna Publishers

REFERENCE(S):

1. Workshop Technology by WAJ Chapman, VivaBooks
2. Workshop Manual by Kannaiah / Narayana, Scitech

Subject Code	Subject Name	Credit Lecture (L-T-P)			Total Credits
		L	T	P	
IS102L	Physics Lab	0	0	2	2

List of Practicals:

(To be performed a minimum of 10 practicals)

1. To measure length, radius of a given cylinder, a test tube and a beaker using a Vernier caliper and find volume of each object.
2. To determine diameter of a wire, a solid ball and thickness of cardboard using a screw gauge.
3. To determine radius of curvature of a convex and a concave mirror/surface using a spherometer.
4. To verify triangle and parallelogram law of forces.
5. To find the co-efficient of friction between wood and glass using a horizontal board.
6. To determine force constant of a spring using Hook's Law.
7. To verify law of conservation of mechanical energy (PE to KE).
8. To find the moment of inertia of a flywheel.
9. To find the viscosity of a given liquid (Glycerin) by Stoke's law.
10. To find the coefficient of linear expansion of the material of a rod.
11. To determine atmospheric pressure at a place using Fortin's barometer.
12. To measure room temperature and temperature of a hot bath using mercury thermometer and convert it into different scales.

TEXT / REFERENCE BOOKS:-

1. Text Book of Physics for Class XI& XII (Part-I, Part-II); N.C.E.R.T., Delhi.
2. Comprehensive Practical Physics, Vol, I & II, JN Jaiswal, Laxmi Publications (P)Ltd.
3. Practical Physics by C. L. Arora, S. Chand Publication.
4. E-books/e-tools/ learning physics software/YouTube videos/websites etc.

Subject Code	Subject Name	Credit Lecture (L-T-P)			Total Credits
HU 101	Universal Human Values	1	1	0	5

Unit I: Motivation and Objectives of Human Values Course

Introduction to the objectives of the course. Content and process of the course including mode of conduct. Daily life as lab for the course. Activities in the course.

Unit II: Purpose of Education

How human being has a need for Knowledge, what should be the content of knowledge, how the content should be discussed in education. Complimentarily of skills and values, how the current education system falls short.

Unit III: Peers Pressure, Social Pressure

In various dimensions of life, how do these things work. What is the way out? In the context of education, peer pressure etc.

Unit IV: Concept of Competition and Excellence

How competition leads to degradation of self and relationships. How excellence is the basic need of a human being. What is excellence?

Unit V: Time Management

How does one deal with myriads of activities in college? Focus of the mind.

Unit VI: Concept of Preconditioning

How preconditioning affects our thinking, behavior, work, relationships, society and nature. How do we develop pre-conditioning? What are the various sources of preconditioning? How do we evaluate our Preconditioning? How do we come out of it?

Unit VII: Concept of Natural Acceptance in Human Being

What is natural acceptance? How can the concept of natural acceptance be used to evaluate our preconditioning? Universal nature of natural acceptance. Are anger, jealousy, hatred natural? How do we feel when we experience them? Which feelings are natural for a human being and which are not?

Unit VIII: Understanding Relationships

Are relationships important? What is the role of relationships in our life? If relationships are important then why they are important? If they are important then why it is the case that we are not discussing them? What are the notions/conditions and factors which stop us to explore more into relationships? Relationships in family and extended family. Dealing with anger, Basic expectations in relationships. Seven types of relations, Gratitude as a universal value in relationships, Nine universal values in human relationships, Trust as the founding value, Concept of acceptance, Unconditional acceptance in

relationships, Our preconditioning affecting our relationships, Our relationships with subordinate staff, with people of opposite gender, caste, class, race, How relationships have the power to force a person to change his preconditioning.

Unit IX: Concept of prosperity Material goods

What role others have played in making material goods available to me: Identifying from one's own life.

Unit X: Idea of Society

What is a society? What constitutes a society? What systems are needed for a society to work? What is the purpose of society and various systems which are working in it? How understanding of Human Nature is important in order to understand the purpose of Society and various social systems? And what happens when this understanding is lacking?

Unit XI: Balance in nature

Balance which already exists in nature, How human beings are disturbing the balance. Resource depletion and pollution, our own role in wastage of electricity, water and in use of plastics, Waste management, Issues like global warming, animal extinction

SUGGESTED READINGS:

1. Human Values and Professional Ethics by R R Gaur, R Sangal, G P Bagaria, Excel Books, New Delhi, 2010
2. The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi
3. On Education - J Krishnamurthy
4. Siddhartha - Hermann Hesse
5. Old Path White Clouds -ThichNhatHanh
6. Diaries of Anne Frank - Anne Frank
7. Life and Philosophy of Swami Vivekananda
8. Swami Vivekananda on Himself
9. Small is Beautiful - E. F Schumacher
10. Slow is Beautiful - Cecile Andrews
11. Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi
12. Rediscovering India - by Dharampal
13. Hind Swaraj or Indian Home Rule - by Mohandas K. Gandhi
14. India Wins Freedom -Maulana Abdul Kalam Azad
15. Autobiography of a Yogi – by ParamhansaYogananda
16. Gandhi and Question of Science – Sahasrabudhe

Subject Code	Subject Name	Credit Lecture (L-T-P)			Total Credits
	Communication Skills*	2	0	1	7

Chapter 1: Parts of Speech

Recognition and review of Nouns, Pronouns, Verbs, Adverbs, Adjectives, Prepositions, Conjunctions, Interjections, Knowledge of Subject, Object and Compliment of the Verb ,Verbals – Infinitival, Gerund and Preposition

Chapter 2: Prepositions of time and place

Contextual teaching of prepositions of time - on, in, at, since, for, ago, before, to, past, to, from, till/until, by Prepositions of place: in, at, on, by, next to, beside, near, between, behind, in front of, under, below, over, above, across, through, to, into, towards, onto, from

Chapter 3: Clause, phrases and Relative Clauses

Basic definitions of clauses and phrases, Focus on Relative Pronouns and their use in sentences as relative clauses

Chapter 4: Subject Verb Agreement

Rules that guide the agreement of the subject to its verb

Chapter 5: Sentence types and Transformation of sentences

Assertive sentences, Exclamatory sentences, Interrogative sentences, Negative sentences, Compound sentences, complex sentences, simple sentences, Degrees of Comparison

Chapter 6: Voice

Change from Active Voice to Passive Voice and vice versa

Chapter 7: Punctuation

Use of the comma, semi-colon, colon, apostrophe, exclamation mark, question mark and quotation marks

Chapter 8: Word formation

Change of one part of speech to the other: from Verbs to Nouns, Nouns to Verbs, Adjectives to Nouns, Nouns to Adjectives, Verbs to adverbs, and Adverbs to Verbs

Chapter 9: Affixation

Prefixes and Suffixes and new word formations

Chapter 10: Nominal Compounds

Common nominal compound

Chapter 11: Paragraph Writing

Descriptive Paragraph on various related topics.

SUGGESTED READINGS:

1. Essential English Grammar with Answers by Raymond Murphy (Cambridge University Press)
2. English for Polytechnics by Dr Paporí Rani Barooah (Eastern Book House Publishers)
3. English Grammar by Annie Brinda (Cambridge University Press)

Semester II

Subject Code	Subject Name	Credit Lecture (L-T-P)			Total Credits
IS104	Mathematics-II	3	1	0	11

Unit-I: Determinants and Matrices:

Elementary properties of determinants up to 3rd order; Consistency of equations; Cramer's rule; Algebra of matrices; Inverse of a matrix; Matrix inverse method to solve a system of linear equations in 3 variables.

Unit-II: Integral Calculus:

Integration as inverse operation of differentiation; Simple integration by substitution, by parts and by partial fractions (for linear factors only); Use of formula $\int_0^{\pi/2} \sin^n x dx$, $\int_0^{\pi/2} \cos^n x dx$ & $\int_0^{\pi/2} \sin^m x \cos^n x dx$

for solving problems where m and n are positive integers.

Unit-III: Co-ordinate Geometry:

Equation of straight line in various standard form (Without Proof); Intersection of two straight lines; Angle between two straight lines; Parallel lines and perpendicular lines; Perpendicular distance formula; Sections of a cone: Circle, Parabola, Ellipse and Hyperbola; General equation of a circle and its characteristics. ; Definition of conics (Parabola, Ellipse, Hyperbola) their standard equations (without proof). Problems

Unit-IV: Vector Algebra:

Definition, notation and rectangular resolution of a vector; Addition and subtraction of vectors; Scalar and vector products of 2 vectors; Simple problems related to work; moment and angular velocity.

Unit-V: Differential Equations:

Definition of differential equations; Order and degree of a differential equation; General and particular solution of a differential equation; Formation of differential equation whose general solution is given; Solution of first order and first degree differential equation by variable separation method; Solution of Linear differential equations of the forms:

(i) $\frac{dy}{dx} + Py = Q$; P & Q are functions of x or constants

(ii) $\frac{dx}{dy} + Px = Q$; P & Q are functions of y or constants

. MATLAB – Simple Introductions.

TEXT BOOKS:-

3. B.S. Grewal, Higher Engineering Mathematics, Khana Publishers, New Delhi, 40th Edition, 2007
4. Murray R. Spiegel, Robert E. Moyer, College Algebra, Tata McGraw Hill, New Delhi, 2nd Edition, 2000
5. Frank Ayers, Elliot Mendelson, Calculus, McGraw Hill, New York, 4th Edition

REFERENCE BOOKS:-

3. G. B. Thomas, R.L. Finey, Calculus and Analytical Geometry, Addison Wesley, 9th Edition, 1995
4. Murray R. Spiegel, Vector Analysis, McGraw-Hill Book Company, New York,
5. Richard Bronson, Differential Equations, Tata McGraw-Hill, New Delhi, 2nd Edition, 2004

Subject Code	Subject Name	Credit Lecture (L-T-P)			Total Credits
		L	T	P	
IS105	Physics-II	3	1	0	11

Unit - 1: Wave motion and its applications

Wave motion, transverse and longitudinal waves with examples, definitions of wave velocity, frequency and wave length and their relationship, Sound and light waves and their properties, wave equation ($y = r \sin \omega t$) amplitude, phase, phase difference, principle of superposition of waves and beat formation.

Simple Harmonic Motion (SHM): definition, expression for displacement, velocity, acceleration, time period, frequency etc. Simple harmonic progressive wave and energy transfer, study of vibration of cantilever and determination of its time period, Free, forced and resonant vibrations with examples.

Acoustics of buildings – reverberation, reverberation time, echo, noise, coefficient of absorption of sound, methods to control reverberation time and their applications, Ultrasonic waves – Introduction and properties, engineering and medical applications of ultrasonic.

Unit - 2: Optics

Basic optical laws; reflection and refraction, refractive index, Images and image formation by mirrors, lens and thin lenses, lens formula, power of lens, magnification and defects. Total internal reflection, Critical angle and conditions for total internal reflection, applications of total internal reflection in optical fiber.

Optical Instruments; simple and compound microscope, astronomical telescope in normal adjustment, magnifying power, resolving power, uses of microscope and telescope, optical projection systems.

Unit - 3: Electrostatics

Coulomb's law, unit of charge, Electric field, Electric lines of force and their properties, Electric flux, Electric potential and potential difference, Gauss law: Application of Gauss law to find electric field intensity of straight charged conductor, plane charged sheet and charged sphere.

Capacitor and its working, Types of capacitors, Capacitance and its units. Capacitance of a parallel plate capacitor, Series and parallel combination of capacitors (related numerical), dielectric and its effect on capacitance, dielectric break down.

Unit - 4: Current Electricity

Electric Current and its units, Direct and alternating current, Resistance and its units, Specific resistance, Conductance, Specific conductance, Series and parallel combination of resistances. Factors affecting resistance of a wire, carbon resistances and colour coding.

Ohm's law and its verification, Kirchhoff's laws, Wheatstone bridge and its applications (slide wire bridge only), Concept of terminal potential difference and Electro motive force (EMF)

Heating effect of current, Electric power, Electric energy and its units (related numerical problems), Advantages of Electric Energy over other forms of energy.

Unit - 5: Electromagnetism

Types of magnetic materials; dia, para and ferromagnetic with their properties, Magnetic field and its units, magnetic intensity, magnetic lines of force, magnetic flux and units, magnetization.

Concept of electromagnetic induction, Faraday's Laws, Lorentz force (force on moving charge in magnetic field). Force on current carrying conductor, force on rectangular coil placed in magnetic field.

Moving coil galvanometer; principle, construction and working, Conversion of a galvanometer into ammeter and voltmeter.

Unit - 6: Semiconductor Physics

Energy bands in solids, Types of materials (insulator, semi-conductor, conductor), intrinsic and extrinsic semiconductors, p-n junction, junction diode and V-I characteristics, types of junction diodes. Diode as rectifier – half wave and full wave rectifier (centre taped).

Transistor; description and three terminals, Types- pnp and npn, some electronic applications (list only). Photocells, Solar cells; working principle and engineering applications.

Unit - 7: Modern Physics

Lasers: Energy levels, ionization and excitation potentials; spontaneous and stimulated emission; population inversion, pumping methods, optical feedback, Types of lasers; Ruby, He-Ne and semiconductor, laser characteristics, engineering and medical applications of lasers.

Fiber Optics: Introduction to optical fibers, light propagation, acceptance angle and numerical aperture, fiber types, applications in; telecommunication, medical and sensors.

Nano-science and Nanotechnology: Introduction, nanoparticles and nano-materials, properties at nanoscale, nanotechnology, nanotechnology based devices and applications.

TEXT BOOKS:-

1. Text Book of Physics for Class XI& XII (Part-I, Part-II); N.C.E.R.T., Delhi

REFERENCE BOOKS:-

1. Applied Physics, Vol. I and Vol. II, TTTI Publications, Tata McGraw Hill, Delhi
2. Concepts in Physics by HC Verma, Vol. I & II, BhartiBhawan Ltd. New Delhi
3. Engineering Physics by PV Naik, Pearson Education Pvt. Ltd, New Delhi.
4. Modern approach to Applied Physics-I and II, AS Vasudeva, Modern Publishers.
5. A Textbook of Optics, N Subramanyam, BrijLal, MN Avahanulu, S Chand and Company Ltd.
6. Introduction to Fiber Optics, AjoyGhatak and K Thyagarajan, Cambridge University Press India Pvt. Ltd, New Delhi.
7. Nanoscience and Nanotechnology, KK Choudhary, Narosa Publishing House, Pvt. Ltd. New Delhi.
8. Nanotechnology: Importance and Applications, M.H. Fulekar, IK International Publishing House Pvt. Ltd, New Delhi.
9. e-books/e-tools/ learning physics software/websites etc.

Subject Code	Subject Name	Credit Lecture (L-T-P)			Total Credits
		L	T	P	
IS 106	Chemistry-II	3	0	0	9

Unit-1: Environmental Chemistry

Definition, types of pollution, Pollutants, Water Pollution – Causes, Effect and health hazards, Water quality parameters – D.O, B.O.D, C.O.D, T.D.S, Controlling of water pollution, Air pollution – Sources, Effect and controlling, Green house effect, Acid rain, Ozone layer depletion, photochemical smoke, Soil Pollution – Sources and controlling

Unit-2: Metallurgy

General principles of metallurgy, Explain the terms mineral, ore, gangue, slag, flux, roasting, calcinations etc., Metallurgy of Iron and Aluminum, Manufacture of steel by Bessemer, open heart and L-D process, Introduction to alloys.

Unit-3: Fuel

Definition and classification of fuel, calorific value, Gross and net calorific value, Solid fuel-Origin of coal, classification of coal by rank, pulverized coal, principle of carbonization of coal, distinguish between High temperature carbonization and low temperature carbonization, Liquid fuel-definition of Petroleum or crude oil, Classification of three varieties of crude oil, Fractional distillation of petroleum. Important properties of liquid fuel-flash point, fire point, aniline point, smoke point, knocking and octane number, cetane number, Cracking of petroleum.

Unit-4: Building Materials

Portland Cement : Composition, raw materials, Types of manufacturing, setting and hardening of cement, special cements, Glass : Definition, types, raw materials and manufacturing, Bricks : Classification and preparation

Unit-5: Lubricant

Definition of lubricant and lubrication, Classification of lubricants, Important functions of lubricants, Selection of lubricants

Unit-6: Metallic Corrosion

Definition, causes of Corrosion, Different types of Corrosion and factors affecting corrosion rate, Explanation of rusting of iron, Methods of Corrosion Control

Unit-7: Plastic and Polymer

Definition, types of polymerization, classification of polymers, Thermoplastic and Thermosetting polymers, Important Plastic materials-Monomers, properties and uses of Polythene, Polypropylene, Polystyrene, PVC, Bakelite, Teflon, neoprene, Buna-s, Nylon, Terelene.

Unit-8: Organic Chemistry

Classification and Nomenclature of Organic compounds, Homologous series and functional groups, Isomerism-structural and stereo isomerism, General preparation, properties and uses of alkanes, alkenes and alkynes, Types of organic reactions-addition, substitution, elimination and rearrangement reaction, Aromatic compounds-Benzene and its derivatives (preliminary idea only)

SUGGESTED BOOKS:

1. NCERT Text book (Class XI and XII)
2. Engg. Chem, B. K. Sharma
3. A Text Book of Engineering Chemistry, SashiChawla
4. Engineering Chemistry, Jain and Jain
5. Applied Chemistry, Dr. Raman Rani Mittal
6. Organic Chemistry, Volume I: I. L. Finer
7. Concise Inorganic Chemistry: J. D. Le

Subject Code	Subject Name	Credit Lecture (L-T-P)			Total Credits
IE 103	Fundamentals of Mechanical Engineering	2	0	0	6

Unit 1- Fundamentals of Engineering Mechanics

Fundamentals of Engineering Mechanics, Vector quantity, Scalar Quantity, Resolution of forces, Resultant of concurrent forces, parallel forces, Moment of force about a point, Couples, Centre of gravity, Centroid, C.G of simple plane figures, Moment of Inertia, Theorem of Parallel axis and Perpendicular axis, M.I of simple plane figures

Unit 2- Properties of gases:

Gas laws, Boyle's law, Charle's law, Combined gas law, Gas constant, Relation between C_p and C_v , Various non-flow processes like constant volume process, constant pressure process, Isothermal process, Adiabatic process, Poly-tropic process Properties of Steam: Steam formation, Types of Steam, Enthalpy, Specific volume, Internal energy and dryness fraction of steam, use of Steam tables, steam calorimeters. Steam Boilers: Introduction, Classification, Cochran, Lancashire and Babcock and Wilcox boiler, functioning of different mountings and accessories.

Unit 3- Thermodynamics and Heat Engines:

Energy, Work, Power, System, Heat, Temperature, Specific heat capacity, Change of state, Path, Process, Cycle, Internal energy, Enthalpy, Statements of Zeroth law, First law and Second law of thermodynamics, Classification of heat engines, Description and thermal efficiency of Carnot; Rankine; Otto cycle and Diesel cycles

Unit 4- Pumps and Compressors:

Types and operation of Reciprocating, Rotary and Centrifugal pumps, Priming Air Compressors: Types and operation of Reciprocating and Rotary air compressors, significance of Multistage. Refrigeration & Air Conditioning: Refrigerant, Vapor compression refrigeration system, vapor absorption refrigeration system, Domestic Refrigerator, Window and split air conditioners.

Unit 5- Fundamentals of I.C Engines:

Introduction, Classification of Engines, Parts of a I.C Engine, Engine details, Working of four-stroke and two-stroke cycle, Working of Petrol and Diesel engines, Indicated power, Brake Power, Efficiencies etc.

Unit 6- Couplings, Clutches and Brakes:

Construction and applications of Couplings (Box; Flange; Pin type flexible; Universal and Oldham), Clutches (Disc and Centrifugal), and Brakes (Block; Shoe; Band and Disc). Transmission of Motion and Power: Shaft and axle, Belt drive, Chain drive, Friction drive, Gear drive.

TEXT BOOKS:-

1. Basic Mechanical Engineering / Pravin Kumar/ Pearson.
2. Introduction to Engineering Materials / B.K. Agrawal/ McGraw Hill.
3. Thermodynamics and Heat Engines / R. Yadav / Central Book Depot.
4. Thermal Engineering-R.S Khurmi/JS Gupta/S.Chand.
5. Thermal Engineering-P.L.Bellaney/ Khanna publishers.
6. Elements of Environmental Science and Engineering-Meenakshi/Anjali Bagad.
7. Engineering Mechanics / R.K Bansal
8. Internal Combustion engine / V. Ganesan

REFERENCE BOOKS:-

1. Fundamental of Mechanical Engineering/ G.S. Sawhney/PHI.
2. Thermal Science and Engineering / Dr. D.S. Kumar/ Kataria.
3. Engineering Mechanics /Timoshenko.
- 4.Heat transfer / J. P Holman.

Subject Code	Subject Name	Credit Lecture (L-T-P)			Total Credits
IE104	Fluid Mechanics & Fluid Flow Operations	3	1	0	11

Unit 1: Introduction to Fluid Mechanics

Fluid and fluid characteristics, Dimension and Units, International System (SI), Measures of fluid mass and weight -Density, Specific Weight, Specific Gravity, ideal gas law, Viscosity, Kinematic viscosity, Compressibility, Vapour Pressure, Surface Tension

Unit 2: Fluid Statics

Pressure at a point, Compressible and Incompressible fluid, Measurement of pressure, Manometry, Buoyancy - Archimedes' Principle and stability

Unit 3: Fluid kinematics

Ideal Fluid, Flow Types and comparisons, Reynold's Number, Fluid Flow rate, The Bernoulli's equation and its application

Unit 4: Flow in pipelines

Flow regimes in a pipe, Energy loss in pipes – through Darcy-Weisbach equation and Hagen-Poiseuille Equation, Friction factor, Turbulent flow in pipes, Moody's Diagram

Unit 5: Pipeline systems

Basic of Pipe Network system, Gathering System used in Oil & Gas Industry, Minor losses in pipes, Energy and Hydraulic grade line, valves in pipeline- Flow control valve, Check valve, Pressure relief valve/safety valves

Unit 6: Pumps and Compressors

Pumps: Introduction, PD (Reciprocating) Pump, Rotary Pump, Centrifugal Pump; Compressors: Basics, Centrifugal compressor, Axial flow compressor.

TEXT BOOKS:

- 1) R. W. Fox and A. T. McDonald, Introduction to fluid mechanics, 5th Ed
- 2) Unit Operations of Chemical Engineering, McGraw - Hill, International Edition.

REFERENCE BOOKS:

- 1) K. A. Gavhane, Fluid Flow Operations, NiraliPrakashan.
- 2) R.K. Bansal, A textbook of Fluid Mechanics and Hydraulic Machines, Laxmi Publications.

Subject Code	Subject Name	Credit Lecture (L-T-P)			Total Credits
IE105	Computer Programming	2	0	2	8

Unit 1- Information Storage and Retrieval

- 1.1 Need for information storage and retrieval
- 1.2 Creating data base file
- 1.3 Querying database file on single and multiple keys
- 1.4 Ordering the data on a selected key
- 1.5 Programming a very simple application

Unit 2- Programming in C

- 2.1 Basic structure of C programs
- 2.2 Executing a C program
- 2.3 Constants, variables, and data types
- 2.4 Operators and expressions
- 2.5 Managing input-output operations like reading a character, writing a character, formatted input, formatted output through print, scan, getch, putch statements etc.
- 2.6 Decision making and branching using IF-else, switch, go to statements
- 2.7 Decision making and looping using do-while, and for statements
- 2.8 Arrays – one dimensional and two dimensional
- 2.9 File

Unit 3- Computers Application Overview

- 3.1 Commercial and business data processing application
- 3.2 Engineering computation
- 3.3 CAD, CAM , CAE, CAI

RECOMMENDED BOOKS

1. Programming in C by Sachaum Series, McGraw Hills
2. Programming in C by Kerning Lan and Riechle Prentice Hall of India, New Delhi
3. Programming in C by BalaguruSwamy, Tata McGraw Hill, New Delhi
4. Let us C – YashwantKanetkar, BPB Publications, New Delhi
5. Vijay Mukhi Series for C and C++
6. Programming in C by R Subburaj, Vikas Publishing House Pvt Ltd., Jangpura, New Delhi
7. Programming in C by Kris A Jansa, Galgotia Publications Pvt.Ltd., Daryaganj, New Delhi

8. Programming in C by BP Mahapatra, Khanna Publishers, New Delhi
9. Elements of C by MH Lewin, Khanna Publishers, New Delhi

Subject Code	Subject Name	Credit Lecture (L-T-P)			Total Credits
		0	0	2	
IS 106L	Chemistry Lab	0	0	2	2

LIST OF CHEMISTRY PRACTICALS:

1. Preparation of standard solution of oxalic acid or potassium permanganate.
2. Determination of strength of given sodium hydroxide solution by titrating against standard oxalic acid solution using phenolphthalein indicator.
3. Standardization of KMnO_4 solution using standard oxalic acid and determine the percentage of iron present in given Hematite ore by KMnO_4 solution.
4. Estimation of total hardness of given water sample using standard EDTA solution.
5. Determination of Alkalinity of given water sample using 0.01M sulphuric acid.
6. Determination of the conductivity of given water sample.
7. Determination of pH of given water sample.
8. Determination of the total dissolved solid of a given water sample.
9. Gravimetric estimation moisture in given coal sample.
10. Determination of viscosity of a solution using Ostwald viscometer.

SUGGESTED READING:

1. A text book of quantitative Inorganic analysis: A. I. Vogel
2. Analytical Chemistry: G. D. Christian
3. Advanced Practical Physical Chemistry: J. B. Yadav
4. A textbook of Elementary Practical Chemistry (Part I and II): Sudarshan Barua

Subject Code	Subject Name	Credit Lecture (L-T-P)			Total Credits
		1	1	0	
HU 102	Community Internship	1	1	0	5

Unit-1: Understanding Society

- Social structure and relationships,
- Social institutions and social groups,
- Socialization and social control : development of self

Unit-2: Community Health

- Illness and Disease, Health and public health: Meaning, components, determinants of health,
- Wellbeing and Quality of life, Health as an aspect of social development,
- Nutrition and malnutrition,
- Community Health: relevance, needs assessment, developing mechanisms for people's participation,
- Community Mental Health

Unit-3: Working with Groups

- Social Groups: Definitions, characteristics, functions and group structure,
- Principles of group work and Models of group work practice,
- Leadership - Theories of leadership, roles and responsibilities of group leader, Leadership Power, Leadership Styles, Leadership in Administration,
- Techniques and skills in group work ,Group worker: roles and functions

Unit-4: Work with Communities

- Understanding Community: Definitions, types, approaches and framework,
- Community dynamics: Caste, class, religion and gender , Issues of identity, inclusion and exclusion, Community power structure,
- Community organization- principles, steps and process,
- Community work and community participation - Strategies and principles; Models and processes,
- Professionalism and inculcation of ethics in community practice

Unit-5: Personality Development

- Definition of Personality, Determinants of Personality- biological, psychological and sociocultural factors,Communication, Flow and barriers of Communication, Listening,
- Spirituality and its role in personality development
- Stress: Causes, Management and Impact,
- Groups in organization, Interactions in group, Group Decision Taking, Team Building

Unit-6: Development Communication

- Communication: concept, principles and its significance
- Process of Communication, Forms of communication: Verbal, non-verbal and written.
- Self-awareness in communication
- Barriers to communication

SUGGESTED READINGS:

1. Davis, K. 1969. *Human Society*, New York: The Macmillan.
2. Giddens, A.1999. *Sociology*, Cambridge: The Polity Press.
3. Dasgupta, M. & Lincoln, C.C. 1996, *Health, Poverty and Development in India*. New Delhi: Oxford University Press.
4. Trecker, H.B. 1972, *Social Group Work: Principles and Practices*. New York: Association Press.
5. Weil, M. (ed.) 1996, *Community Practice: Conceptual Models*. New York: The Haworth Press Inc.
6. Hergenhahn, B. R., &Olson., M. H. 2003, *An Introduction to Theories of Personality*, New Jersey: Prentice Hall.

SEMESTER III

Subject Code	Subject Name	Credit Lecture (L-T-P)			Total Credits
DC 201	Material and Energy Balance	3	1	0	11

Unit 1: Fundamental Concepts of Stoichiometry

Units and Dimension : SI Units and its dimensions, Derived units, Conversion of units; Mole concept: Atomic weight, Molecular weight and Equivalent weight, gmol, kmol, gatom, Composition of solids- Mass fraction and Mole fraction, Composition of liquids- concentration, Molarity, Normality and Molality, Specific Gravity, Composition of gas- volume percent, partial pressure, Raoult's law, Dry basis and wet basis; Ideal gas: Boyle's Law, Charles Law, Avogadro Law, Amagat Law, Dalton's Law, Average Molecular weight, Density

Unit 2: Material Balance Without Chemical Reaction

Basic Material balance principles; Total and component balance; Steady state and Unsteady state process; Batch and continuous process; Tie element; Basis for calculation; Steps for solving Material Balance problems; Material Balance in Unit Operations-Evaporation, Crystallization, Leaching, Drying, Liquid-Liquid extraction, Absorption, Distillation; Bypass Operations

Unit 3: Material Balance with Chemical Reaction

Stoichiometry; Limiting Reactant and Excess Reactant; Conversion, Yield and Selectivity; Oxidation of Sulphur Compounds; Carbondioxide from Limestone; Nitrogen, Ammonia and Nitric Acid; Hydrogenation, Hydration and Oxidation; Combustion of Solid, Liquid and Gaseous fuel; Orsat Analysis; Proximate and Ultimate analysis of coal

Unit 4: Recycle Operations

Introduction; Application; Purging Operation; Recycle Ratio, Combined feed ratio; Purge ratio

Unit 5: Energy Balance

Energy and its classification; Heat Capacity; Heat of Reaction; Heat of Formation; Heat of Combustion; Hess Law; Phase Change Operation

TEXT BOOKS:

1. A.Olaf, K.M. Watson and R. A. R. Hougen, Chemical Process Principles, Part 1: Material and Energy Balances, John Wiley & Sons
2. D. M. Himmelblau and J. B. Riggs, Basic Principles and Calculations in Chemical Engineering, Pearson

REFERENCE BOOKS:

1. K. A. Gavhane, Introduction to Process Calculation, NiraliPrakashan
2. K. Narayanan and B Lakshmikutty, Stoichiometry and Process Calculation, Eastern Economy Edition
3. B. I. Bhatt and S M Vora, Stoichiometry, Tata McGraw Hill Edition

Subject Code	Subject Name	Credit Lecture (L-T-P)			Total Credits
		L	T	P	
IE 202	Materials Science	3	0	0	9

Unit 1: Introduction

Scope of Material Science; Classes of engineering material; Engineering requirements of materials; Level of structure; Structure property relationship; Selection of materials

Unit 2: Mechanical Properties

Mechanical Fundamentals- Isotropy and Anisotropy, Stress and Strain, Hooke's Law, Modulus of material, Poisson's Ratio, Stress-Strain Relation; Fundamental Properties-Strength, Elasticity, Stiffness, Resilience, Plasticity, Ductility, Toughness, Hardness; Fatigue-Factors affecting, Design for fatigue; Creep-Factors affecting; Factors affecting Mechanical Properties

Unit 3: Testing of Materials

Tensile Tests-Measure of Elasticity, Strength, Ductility, Stiffness; Compression Tests; Hardness Tests- Brinell Hardness Test, Rockwell Hardness Test, Vickers Hardness Test, Shore or rebound hardness test; Impact Tests; Fatigue Tests; Creep and stress rupture tests

Unit 4: Heat Treatment

Introduction; Purpose and Methods of heat treatment; Annealing; Normalising; Hardening; Tempering; Case Hardening; Nitriding; Furnaces and temperatures

Unit 5: Chemical, Thermal and Technological Properties

Chemical Properties- Oxidation, Reduction; Thermal Properties-Specific heat, Thermal Conductivity, Thermal Expansion, Melting Point; Technological Properties- Weldability, Machinability, Formability, Castability

Unit 6: Engineering Materials

Ferrous Metals- Pig iron, Cast iron, Wrought iron, Steel; Non-ferrous alloys- aluminum and its alloys, copper and its alloys, Lead, Tin, Zinc, Nickel; Alloys for high temperature service; Metals for nuclear energy; Ceramic Materials- Classification, Structure, Properties, Applications; Refractories, Glass, Cement, Abrasives; Organic materials; Composite Materials

TEXT BOOKS:

1. V. Raghavan, V., Material Science & Engineering, Prentice Hall.
2. W. D. Callister (Jr.), Material Science and Engineering - an Introduction, 6th Ed., John Wiley & Sons

REFERENCE BOOKS:

1. K. H. Choudhary, Material Science and Processes, Indian Book Distributing Co.
2. A .K. Bhargava, Engineering Materials, Eastern Economy Edition
3. R. K . Rajput, Engineering Materials, S Chand and Co.

Subject Code	Subject Name	Credit Lecture (L-T-P)			Total Credits
		L	T	P	
DC203	Fluid Particle Mechanics & Mechanical Operations	2	0	0	6

Unit 1: Properties and Storage of Solids

Characteristics of Solid Particles, Particle Shape, Particle Size, Average Particle sizes. Solids in Bulk, Angle of Repose, Angle of Internal Friction, Storage of Bulk Solids, Flow of Bulk Solids

Unit 2: Size Reduction of Solids

Objectives and Methods of size reduction, Impact, Attrition, Compression, Shear Properties of Solids, Energy and Power consumption, Crushing Efficiency, Laws of Communiton, Rittinger's Law, Kick's law, Bond's Law. Size Reduction Equipments, Classification, Coarse Crushers, Intermediate Crushers, Fine Crushers

Unit 3: Separation and Transportation of Solids

Introduction, Screening, Screening Equipments, Transportation Equipment, Belt Conveyors, Screw Conveyors, Bucket Elevators

Unit 4: Filtration

The theory of filtration, relation between thickness of cake and volume of filtrate, flow of liquid through the cloth, flow of filtrate through the cloth and cake combined, compressible filter cakes, Filtration practice, The filter medium, blocking filtration, preliminary treatment of slurries before filtration, washing of filter cake, Filtration equipment, Filtration in a centrifuge.

Unit 5: Mixing and Agitation

Agitation of liquids, Purpose of agitation equipment, Impellers, Flow patterns in agitation vessels, effect of system geometry.

Unit 5: Fluid particle Mechanics

Free settling and Hindered settling, Stock's law & Newton's law regimes of settling, Gravity settling processes, gravity classifiers, sorting classifiers: sink-and-float methods, differential settling methods. Clarifiers and thickeners, flocculation, batch sedimentation, rate of sedimentation. Equipment for sedimentation: thickeners. Clarifier and thickener design, sedimentation zones in continuous thickeners. Cyclones, hydrocyclones, centrifugal decanters.

TEXT BOOKS:

1. W. L. McCabe, J. Smith and P. Harriot, Unit Operations of Chemical Engineering, McGraw - Hill, International Edition.

REFERENCE BOOKS:

1. W.L. Badger and J.T. Banchero, Introduction to Chemical Engineering, Tata McGraw-Hill, International Edition
2. C. J. Geankoplis, Transport Processes and Unit Operations, Prentice Hall, India.
3. B.K. Dutta. Principles of Mass Transfer and Separation Processes Phi Learning Private Ltd

Subject Code	Subject Name	Credit Lecture (L-T-P)			Total Credits
DC204	Heat Transfer Operations	3	0	0	9

Unit -1: Introduction

Heat and Modes of heat transfer, Conduction, Convection, Radiation, concept of steady state and unsteady state heat transfer, analogy between flow of heat and electricity.

Unit - 2: Conduction

Thermal conductivity, Fourier's law of heat conduction, Unsteady state equation, Steady state equation, Heat flow equation for composite walls, Composite cylinders, Spheres, Insulation and insulating materials, Critical insulation thickness.

Unit -3: Convection

The nature of heat convection, dimensional analysis and significance of various dimensional groups Forced convection (No derivation), Free convection (No derivation)

Unit -4: Thermal Radiation

Nature of thermal radiation, Absorption, Transmission, Reflection and Emission of Radiation, Emissive power of black body, Plank's distribution, Total emissive power, Stefan-Boltzman law, Emissivity, Kirchoff's law, Black body, Wien's displacement law.

Unit -5: Heat Exchangers

Introduction, types of heat exchangers, overall heat transfer coefficient, construction and description of various types of heat exchangers, logarithmic mean temperature difference, LMTD for parallel and counter current heat exchangers.

Unit - 6: Boiling and condensation

Interface, bubble and film boiling, boiling regime, Concept of condensation, types of condensation i.e. drop wise and film wise condensation

TEXT BOOK:

1. J. P. Holman, Heat Transfer, McGraw - Hill
2. B. K. Dutta, Heat Transfer, Prentice Hall of India

REFERENCE BOOKS:

1. D.Q. Kern, Process Heat Transfer, Tata McGraw - Hill.
2. W. L. McCabe, J. Smith and P. Harriot, Unit Operations of Chemical Engineering, McGraw-Hill,
3. International Edition

Subject Code	Subject Name	Credit Lecture (L-T-P)			Total Credits
DC205	Chemical Engineering Thermodynamics	2	1	0	8

UNIT 1: Introduction and Basic Concepts

Scope and Limitations of Thermodynamics; Definitions and Fundamental Concepts -Systems and Processes, State and Properties, State and path functions, Force, Pressure and Energy; Steady state, Equilibrium State and Phase Rule; Temperature and Zeroeth Law of Thermodynamics; Heat reservoirs, Heat engine and Heat Pump; Reversible and Irreversible Processes

UNIT 2: First Law of Thermodynamics

General Statements; For Cyclic Processes; Internal energy; For Non-Flow Process; Enthalpy; For Flow Process; Heat Capacity

UNIT 3: P-V-T Behaviour

Pure Fluids; Equation Of State and Concept of Ideal gas; Processes involving Ideal gases-Constant Volume process, Constant Pressure process, Constant Temperature process, Adiabatic process, Equation of state for Real gases, Compressibility Charts

UNIT 4: Second Law of Thermodynamics

Limitations of First Law-Direction of Change, Qualitative difference between heat and work; General Statements- Kelvin Planck Statement, Clausius' Statement; Entropy; The Carnot Principle; Thermodynamic Temperature Scale

UNIT 5: Applications of The Laws of Thermodynamics

Flow Processes- Continuity Equation, Energy equation, Flow in Pipes, Flow through nozzles, ejectors, Throttling process; Refrigeration, Carnot Cycle, Refrigerator, Heat Pump; Steam Power Plant, Rankine Cycle; Internal Combustion Engines- Otto Cycle

TEXT BOOK:

1. J. M. Smith, H C Van Ness, Introduction to Chemical Engineering Thermodynamics, McGraw Hill Edition
2. K. V. Narayanan, Chemical engineering Thermodynamics, Eastern Economy Edition

REFERENCE BOOKS:

1. Y. V. C. Rao, Engineering Thermodynamics, University Press
2. P. K. Nag, Basic and Applied Thermodynamics, Tata McGraw Hill Edition

Subject Code	Subject Name	Credit Lecture (L-T-P)			Total Credits
IE 201	Fundamentals of Electrical & Electronics Engineering	3	1	2	13

UNIT I

Overview of Electronic Components & Signals: Passive Active Components: Resistances, Capacitors, Inductors, Diodes, Transistors, FET, MOS and CMOS and their Applications. Signals: DC/AC, voltage/current, periodic/non-periodic signals, average, rms, peak values, different types of signal waveforms, Ideal/non-ideal voltage/current sources, independent/dependent voltage current sources.

UNIT II

Overview of Analog Circuits: Operational Amplifiers-Ideal Op-Amp, Practical op amp, Open loop and closed loop configurations, Application of Op-Amp as amplifier, adder, differentiator and integrator.

UNIT III

Overview of Digital Electronics: Introduction to Boolean Algebra, Electronic Implementation of Boolean Operations, Gates-Functional Block Approach, Storage elements-Flip Flops-A Functional block approach, Counters: Ripple, Up/down and decade, Introduction to digital IC Gates (of TTL Type).

UNIT IV

Electric and Magnetic Circuits: EMF, Current, Potential Difference, Power and Energy; M.M.F, magnetic force, permeability, hysteresis loop, reluctance, leakage factor and BH curve; Electromagnetic induction, Faraday's laws of electromagnetic induction, Lenz's law; Dynamically induced emf; Statically induced emf; Equations of self and mutual inductance; Analogy between electric and magnetic circuits.

UNIT V

A.C. Circuits: Cycle, Frequency, Periodic time, Amplitude, Angular velocity, RMS value, Average value, Form Factor Peak Factor, impedance, phase angle, and power factor; Mathematical and phasor representation of alternating emf and current; Voltage and Current relationship in Star and Delta connections; A.C in resistors, inductors and capacitors; A.C in R-L series, R-C series, R-L-C series and parallel circuits; Power in A. C. Circuits, power triangle.

UNIT VI

Transformer and Machines: General construction and principle of different type of transformers; Emf equation and transformation ratio of transformers; Auto transformers; Construction and Working principle of motors; Basic equations and characteristic of motors.

RECOMMENDED BOOKS:-

1. RituSahdev, Basic Electrical Engineering, Khanna Publishing House
2. Mittle and Mittal, Basic Electrical Engineering, McGraw Education, New Delhi, 2015, ISBN :978-0-07-0088572-5
3. Saxena, S. B. Lal, Fundamentals of Electrical Engineering, Cambridge University Press, latest edition ISBN : 9781107464353
4. Theraja, B. L., Electrical Technology Vol – I, S. Chand Publications, New Delhi, 2015, ISBN: 9788121924405
5. Theraja, B. L., Electrical Technology Vol – II, S. Chand Publications, New Delhi, 2015, ISBN:9788121924375
6. Jegathesan, V., Basic Electrical and Electronics Engineering, Wiley India, New Delhi, 2015, ISBN : 97881236529513
7. Sedha, R.S., A text book of Applied Electronics, S.Chand, New Delhi, 2008, ISBN-13: 978-8121927833
8. Malvino, Albert Paul, David, Electronics Principles, McGraw Hill Education, New Delhi,2015, ISBN-13: 0070634244-978
9. Mehta, V.K., Mehta, Rohit, Principles of Electronics, S. Chand and Company, New Delhi, 2014, ISBN-13-9788121924504
10. Bell Devid, Fundamental of Electronic Devices and Circuits, Oxford University Press, New Delhi.

SEMESTER IV

Subject Code	Subject Name	Credit Lecture (L-T-P)			Total Credits
DC207	Mass Transfer Operations- I	3	0	0	9

Unit 1: Introduction to mass transfer and diffusion

Types of diffusion, Diffusivity measurement and prediction, multi-component diffusion, molecular diffusion in solids, Fick's Law, Steady state molecular diffusion in fluids under stagnant and laminar flow conditions.

Unit 2: Theories for mass transfer

Film Theory, Penetration theory, Surface renewal theory, Convective mass transfer, Dimensionless groups in mass transfer and their significance, Analogy between Momentum, Heat and Mass transfer

Unit 3: Introduction to absorption

Mechanism of absorption, Diffusion through gas, Description of absorption, Equipment application, Different materials used in absorption column.

Unit 4: Introduction to adsorption

Application of adsorption, Types of adsorbents, Parameters affecting the adsorption rate, Physical adsorption and chemisorptions, Different adsorption materials and their industrial application

Unit 5: Humidification

Humidity, Relative, Percentage, Absolute humidity, Dry bulb, Wet bulb temperature and Dew point, Adiabatic saturation temperature.

Unit 6: Crystallization

Principle, Classification, Solid-liquid phase equilibrium, Nucleation and crystal growth, melt crystallization, Batch crystallization, Crystallization equipment.

TEXT BOOK:

1. R. E. Treybal, Mass Transfer Operations, McGraw -Hill International Edition
2. W. L. McCabe, J. Smith and P. Harriot, Unit Operations of Chemical Engineering, McGraw-Hill, International Edition

REFERENCE BOOKS:

1. C. J. Geankoplis, Transport Processes and Unit Operations, Prentice Hall, India
2. B.K. Dutta, Principles of Mass Transfer and Separation Processes, Prentice Hall of India

Subject Code	Subject Name	Credit Lecture (L-T-P)			Total Credits
		L	T	P	
DC208	Chemical Technology – Inorganic	2	0	0	6

Unit -1: Introduction

Typical chemical processes: unit operations and unit processes, classification of Indian chemical process industry, inorganic chemical industry, study aspects of a CPI- raw materials, process, chemical reactions, process and block flow diagram, major engineering issues and uses.

Unit -2: Sulfur and Sulfuric Acid:

Classification of production process, Sulphur-its forms, properties and sources, sulphur mining by Frasch process, Manufacturing process of Sulphuric Acid by Contact Process, description of economical process and uses of sulfur and sulfuric Acid.

Unit -3: Fertilizer Industry:

Types of chemical fertilizers, Nitrogenous fertilizers, Phosphoric fertilizers, Potassium fertilizers, mixed fertilizers, Manufacture of Ammonia by Habers process, Manufacture of urea, and its major industrial problems.

Unit -4: Chlor-Alkali Industries:

Soda Ash, Properties, uses, classification of processes, manufacturing process of Soda ash by solvay process, Caustic soda and Chlorine, Properties, uses, classification of processes, manufacturing process of Caustic soda and Chlorine.

Unit -5: Cement Industries:

Cement, Methods of Production, Types of Portland cement, manufacture of Portland cement and its major industrial problems.

TEXT BOOK:

1. C. L. Dryden, Outlines of Chemical Technology, Edited and Revised by M. Gopala Rao and S. Marshall, Affiliated East West, New Delhi.
2. T. G. Austin and S. Shreve, Chemical Process Industries., McGraw Hill, New Delhi

REFERENCE BOOKS:

1. R. E. Kirk, and D. F. Othmer, Encyclopaedia of Chemical Technology, Interscience, New York

Subject Code	Subject Name	Credit Lecture (L-T-P)			Total Credits
DC209	Process Instrumentation & Control	3	0	0	9

Unit 1 :Introduction Process Instrumentation and Control

Definition and aim of measurement, Classification of methods of measurement, functions of instruments, Types of instruments, Errors in measuring instrument, Instrument Error Combination, Static and dynamic characteristics of instrument.

Incentive for chemical process control, Process variables, Elements of instruments, Static Characteristics, Dynamic characteristics, Application of Laplace transform in instrumentation, First order process, Significance of First order process, Second order process

Unit 2: Temperature and Pressure measuring Instruments

Thermometers, thermocouples, automatic potential recorders, radiation pyrometers, optical pyrometers, photoelectric pyrometers, thermistors, response of these instruments.

Manometers, pressure Spring, Pirani Gauge, Ionization gauge, Thermocouple gauge, Liquid seals, responses of these instruments

Unit 3:Process Instrumentation diagram

Piping and instrumentation design, Instrumentation symbols, Process flow diagrams, Transmission lines.

Unit 4: Controllers and final control elements

Self-operated, pneumatic, hydraulic, electric power employed, actuators, sensors.

Unit 5:Design of Feedback Control Systems

Review of Feedback control system, its components and basic block diagram, Development and Reduction of Block diagram for a chemical process system, Closed loop transfer functions, overall transfer function for single and multi-loop systems, Transient response for servo and regulatory problems, Basic control modes PI - PD - PID – Integral wind- up and prevention Auto/Manual transfer, Selection of control modes for processes involving temperature -pressure level and flow

TEXT BOOK:

1. G. Stephanopoulos, Chemical Process Control: An Introduction to Theory and Practice, Prentice-Hall, New Jersey
2. D. P. Eckman, Industrial Instrumentation, Wiley Eastern Limited

REFERENCE BOOKS:

1. D.Patranabis, Principles of Industrial Instrumentation, Tata McGraw Hill, Publishing Ltd, New Delhi
2. D. R. Coughanowr, and L. B. Koppel, Process systems Analysis and Control, Mc-Graw-Hill,

Subject Code	Subject Name	Credit Lecture (L-T-P)			Total Credits
DC210	Chemical Reaction Engineering	3	1	0	11

Unit 1: Basics of Chemical Reactions

Scope and importance of Chemical Reaction Engineering; Chemical Kinetics; Classifications of Chemical Reaction; Basics of Reactor design; Rate of Chemical reaction- Reaction rate on various basis, Factors affecting Rate equation

Unit 2: Kinetics of Homogeneous Reactions

Rate Expression; Concentration Dependent term; Rate constant; Reaction Mechanism; Elementary and Non-Elementary Reaction; Molecularity of reaction; Order of reaction; Temperature Dependent term of rate equation-Arrhenius law, Activation Energy

Unit 3: Interpretation of Batch Reactor Data

Introduction; Data Collection; Method for analyzing kinetic data-Integral Method, Differential Method, Constant volume batch reactor, Integrated rate equation for different order reaction, Half-life Method

Unit 4: Ideal Reactors

Features of Ideal reactor; Different types of reactor- Batch reactor, Semi batch reactor, Flow reactors, Multiphase reactor

Unit 5: Design of Single ideal Reactors

Performance design equations of ideal reactors- Batch reactor, CSTR, PFR; Space Time, Space velocity

Unit 6: Design for Single Reactions

Size comparison of single reactors; Comparison of CSTR with PFR for first order reaction; CSTR in series- Unequal size, Equal size, PFR in series, PFR in parallel; Reactors of different types in series.

TEXT BOOK:

1. Y.O. Levenspiel, Chemical reaction engineering, John Wiley and Sons
2. H. S. Fogler, Essentials of Chemical reaction engineering, Prentice Hall International series

REFERENCE BOOKS:

1. L. D. Schmidt, The Engineering of Chemical reactions, Oxford University Press
2. K. A. Gavhane, Chemical Reaction Engineering-I, NiraliPrakashan

Subject Code	Subject Name	Credit Lecture (L-T-P)			Total Credits
DC211	Petroleum Refinery Operations	3	0	0	9

Unit 1: Introduction to Petroleum Industry

Indian Petroleum Industry overview, origin of petroleum, Composition of petroleum, Characteristics of crude, Exploration Methods, Search for oil, Scientific methods for petroleum survey, Rotary drilling Rigs.

Unit 2: Refining

Physical changes or unit operations in Petroleum refining. Fractional distillation of crude oil, Crude Distillation Unit, Atmospheric distillation Unit, Products of fractional distillation of crude oil and their boiling ranges, Refinery product uses and characteristics, Flash point, fire point, Smoke point and pour point, VI, DI, octane number and anti-knocking agent.

Unit 3: Treatment Techniques

Physical & Chemical Impurities, Treatment of gasoline, Kerosene & lubes by various methods, Removal of sulfur and sulfur compound.

Unit 4: Unit processes in Refineries

Cracking, Thermal cracking – Coking, visbreaking, Catalytic cracking - Fluidized bed Catalytic Cracking, Comparison between thermal and Catalytic cracking, Hydrocracking, Hydrotreating, Reforming, Isomerization, Alkylation – Hydrofluoric acid process, Sulphuric acid process, Comparison, Polymerization

Unit 5: Introduction of Petrochemical Industry: Definition, History, Major Petrochemical products and their producers in India, Raw materials for Petrochemicals, Characteristics of Petrochemical Industry.

TEXT BOOK:

1. W.L. Nelson, Petroleum Refinery Engineering, McGraw Hill, New York
2. B.K. B Rao, Modern *Petroleum Refining* Processes, Oxford & IBH Publishing

REFERENCE BOOKS:

1. B.K. B Rao, A Text on Petrochemicals, Khanna Publishers
2. S. Maity, Introduction to Petrochemicals, Oxford and IBH Publishing

Subject Code	Subject Name	Credit Lecture (L-T-P)			Total Credits
DC212	Process Plant Utilities	2	0	0	6

Unit 1: Introduction

Importance of process utilities in chemical industries and plants. Introduction to the use of various utilities.

Unit 2: Water and Steam

Sources of water, their characteristics, storage and distribution of water, water for boiler use, cooling purposes, drinking and process water treatment reuse and conservation of water, water resources management. Steam generation and its application in chemical process plants, distribution and utilization, design of efficient steam heating systems, steam economy, condensate utilization, steam traps, their characteristics, selection and application, waste heat utilization.

Unit 3: Compressors and vacuum pumps

Types of compressors and vacuum pumps and their performance characteristics. Methods of vacuum development and their limitations, materials handling under vacuum, piping systems, lubrication and oil removal in compressors in pumps

Unit 4: Refrigeration systems

Refrigeration system and their characteristics, load calculation and load calculation and humidification and de humidification equipments, drying and cooling tower, air blending, exhaust, ventilation, cryogenics, their characteristics and production of liquid N₂ and O₂.

Unit 5: Insulation

Importance of insulation for meeting for the process equipment, insulation material and their effect on various materials of equipment piping, fitting and valves, insulation for high, intermediate, low and sub-zero temperatures including cryogenic insulation, determination of optimum insulation thickness.

Unit 6: Inert gases

Introduction, properties of inert gases & their use, sources and methods of generation, comparison of nitro generation routes, general arrangement for inerting system, operational, maintenance and safety aspects.

TEXT BOOK:

1. J. Broughton, Process utility systems, Institution of Chem. Engineers U.K
2. D. B. Dhone, Plant Utilities, Nirali Prakashan

REFERENCE BOOKS:

1. Reid, Prausnitz poling, The properties of gases & liquids, IV ed. McGraw Hill international ed.
2. S.C.Aroraand S.Domkumdwat, A course in refrigeration and air conditioning, DhanpatRai& Co.(P) ltd.

SEMESTER V

Subject Code	Subject Name	Credit Lecture (L-T-P)			Total Credits
DC301	Mass Transfer Operations- II	2	0	0	6

Unit 1 :

Drying: Principles, equilibrium in drying, types of moisture content, mechanism of batch drying, continuous drying, and time required for drying, mechanism of moisture movement in solid, Classification and selection of industrial dryers

Unit 2:

Evaporation: Introduction, Single & multiple-effect evaporators, Construction (With diagrams) operation and application different evaporators like Horizontal tube, Vertical tube, Film type, Short tube & Long tube, Different feeding techniques-their advantages Capacity and economy of evaporators.

Unit 3:

Leaching and Extraction: Objective of leaching, Different equipments and their application, Comparison of leaching and extraction, Objective of extraction, Different equipments and their description.

Unit 4:

Distillation: Raoult's law, methods of distillation: Flash distillation, differential or simple distillation, steam distillation, multistage continuous rectification, Total reflux, minimum reflux ratio, optimum reflux ratio, Choice and effect of pressure in distillation column, Murphree stage and overall efficiency.

TEXT BOOK:

1. R. E. Treybal, Mass Transfer Operations, McGraw -Hill International Edition
2. W. L. McCabe, J. Smith and P. Harriot, Unit Operations of Chemical Engineering, McGraw-Hill, International Edition

REFERENCE BOOKS:

1. C. J. Geankoplis, Transport Processes and Unit Operations, Prentice Hall, India
2. B.K. Dutta, Principles of Mass Transfer and Separation Processes, Prentice Hall of India

Subject Code	Subject Name	Credit Lecture (L-T-P)			Total Credits
		L	T	P	
DC302	Process Equipment Design	2	0	2	8

UNIT 1: Basic Consideration in Process Equipment Design

Introduction; General Design Procedure; Requirement of Chemical Engineering design; Equipment Classification; Equipment Symbols; Essentials of Drawing; Computer Aided Drafting

UNIT 2: Material of Construction

Mechanical Properties; Engineering Materials; Corrosion-Corrosion Prevention; Coating; Lining; Choice of Material

UNIT 3: Design Considerations

Introduction; Stresses Created due to Static and Dynamic loads; Design Stress- Joint efficiency; Elastic Instability; Fatigue; Brittle Fracture; Creep; Temperature effects; Fabrication- Types, Effects; Economic Considerations

UNIT 4: Design of Machine Elements

Introduction; Shafts; Keys; Bolts; Couplings; Bearings; Joints- Riveted, Welded, flanged; Packing and Gaskets; Mechanical Design of Piping systems- Schedule number,

UNIT 5: Pressure Vessels

Introduction; Pressure Vessel Codes; Selection Of material; Design condition and stresses; Design of shell and its components- Types of head, Nozzles; Flanged joints

UNIT 6: Storage Vessels

Introduction; Storage of Fluids- Volatile and Non-volatile; Fixed Roof storage; Variable roof storage; Types of roof; Storage of gases- Hortonspheres

UNIT 7: Supports for Vessels

Introduction; Bracket or Lug supports; Leg supports; Skirt support; Saddle support

TEXT BOOK

1. S.D Dawande, Process Equipment Design, Dennet& Co

REFERENCE BOOKS

2. V. V. Mahajani and S. B. Umarji, Process Equipment Design, Macmillan Publishers
3. B. Young, Process Equipment Design, Wiley India Pvt. Ltd.

Subject Code	Subject Name	Credit Lecture (L-T-P)			Total Credits
		3	0	0	
DC303	Chemical Technology – Organic	3	0	0	9

Unit-1: Sugar Industry

Manufacturer of cane sugar, various engineering problems encountered in sugar industry, Pollution abatement in sugar industry.

UNIT-2: Fermentation Industry

Introduction of fermentation industry, Types of fermentation processes, Production of ethyl alcohol by fermentation, Industrial alcohol, manufacture of industrial alcohol-beers, wines and liquors, Various engineering problems encountered in fermentation industry, Pollution abatement in fermentation industry.

Unit-3: Pulp and Paper Industries

Methods of pulp production, manufacture of pulp by Kraft process, recovery of chemicals from black liquor, various engineering problems encountered in paper industry & Pollution abatement in pulp and paper industry.

Unit-4: Soaps and Detergent Industry

Manufacturing of soap, glycerin as by products from soap, Manufacturing of detergents (including raw material and manufacturing process), Manufacturing of House disinfectants, Various engineering problems encountered in soaps and detergent industry.

Unit-5: Polymer Industry

Types of polymer, polymerization process, manufacture of polyethylene, styrene nylon 6, nylon 66, rayon. Manufacture of rubber

Unit-6: Petroleum Refining Industry

Constituents of petroleum, crude oil distillation- atmospheric and vacuum distillation. Pollution abatement in petroleum refining plant.

TEXT BOOK:

1. C. L. Dryden, Outlines of Chemical Technology, Edited and Revised by M. Gopala Rao and S. Marshall, Affiliated East West, New Delhi.
2. T. G. Austin and S. Shreve, Chemical Process Industries., McGraw Hill, New Delhi,

REFERENCE BOOKS:

1. R. E. Kirk, and D. F. Othmer, Encyclopaedia of Chemical Technology, Interscience, New York
2. P.H. Groggins, Unit Process in Organic Synthesis, Tata McGraw Hill

Subject Code	Subject Name	Credit Lecture (L-T-P)			Total Credits
		L	T	P	
HU 301	Humanities	2	0	0	6

Unit - 1: Introduction to Sociology

Definition of sociology, some sociological concepts: social structure, status, role, norms, values etc. Socialization, and culture and change.

Social stratification - various approaches and concept of social mobility.

Population and society - Trends of demographic change in India and the world, Human Ecology, Trends of Urbanization in the developing countries and the world.

Major social institutions - Family and marriage, caste and tribe and organizations: (i) formal organization (bureaucracy) (ii) informal organization.

Processes of social change - Modernization (including Sanskritization), industrialization, environmental/ecological changes and development.

Social movements - protest movements, reformist movement and radical movements in India.

Unit - 2: Introduction to Literature

Nature of Literature: Literature as a Humanistic Experience. Definitions: (i) Humanities: concern with culture, values, ideologies; (ii) Literature: concepts of imitation, expression, intuition & imagination. Major Themes of Literature: Nature, Science, Selfhood, Love, Rebellion.

The Language of Literature: Modes of literary and non-literary expression. The concepts of Figurative language, imagery, symbolism, style. The Forms of Literature: Prose Narratives (short stories & novels) Poetry, Drama and Essays (Suitable texts are to be chosen by the instructors), Use of a Learner Dictionary.

Unit - 3: Introduction to Philosophy

Philosophy and History of Science: Growth of scientific knowledge: factors leading to the emergence of modern science. Conceptual evolution: internal and external history. Methodology of science: induction, falsifications, confirmation and probability. Nature of scientific laws and theories: realism, instrumentalism and under-determination. Relationship between scientific observation, experiment and scientific theory. Nature of scientific explanation: teleological explanations and the covering law model. Selected case studies on scientific theories.

Logic and the nature of mathematical reasoning: Inductive and deductive forms of reasoning. Nature of axioms: formal axiomatic systems. Concept of consistency, independence and completeness. Nature of rules of inference and proof. Selected examples of axiomatic systems and proof procedures.

Cognition: Current approaches to the understanding of mind and mental processes: empiricist, rationalist, behaviorist and cognitivist.

Ethics: Impact of science and technology on man and society: elements of environmental and professional ethics.

TEXT / REFERENCE BOOKS:-

(A) Introduction to Sociology:

- (a) L. Broom, P. Selznick and D. Dorrock, Sociology, 11th Edn. 1990 (Harper International).
- (b) M. Haralambos, Sociology: Themes and Perspectives, Oxford University Press, 980.
- (c) M.S.A. Rao (ed) Social movements in India, vols. 1-2, 1984, Manohar.
- (d) David Mandelbaum, Society in India, 1990, Popular.
- (e) M.N. Srinivas, Social change in modern India, 1991, Orient Longman.
- (f) Guy Rocher, A. General Introduction to Sociology, MacMillan, 1982.

(B) Introduction to Literature:

- (a) David Murdoch (ed.). The Siren's Song: An Anthology of British and American Verse, Orient Longman, 1988.
- (b) S. Alter & W. Dissanayake (eds.) The Penguin Book of Modern Indian Short Stories. Penguin Books (India), 1989.
- (c) Bertrand Russell, Impact of Science on Society. Allen & Unwin, 1952.
- (d) Henrik Ibsen, A Doll's House, Macmillan India, 1982.
- (e) George Orwell, Animal Farm, Penguin, 1951.
- (f) J. Bronowski. The Ascent of Man, BBC, 1973.

(C) Introduction to Philosophy:

- (a) A.C. Grayling (ed.) Philosophy: A Guide through the subject, Oxford Univ. Press, London, 1995.
- (b) Marx W. Wartofsky, Conceptual Foundations of Scientific Thought: An Introduction to the Philosophy of Science, Macmillan, London, 1968.
- (c) I.B. Cohen, The Birth of a New Physics, Vakils, Feffer and Simons Pvt. Ltd., Bombay, 1968.
- (d) H. Eves and C.V. Newsom, Foundations and Fundamental Concepts of Mathematics, Boston, PWS-Kart Pub. Co., 1990.
- (e) K.E. Goodpaster and K.M. Sayre (eds.) Ethics and Problems of 21st Century, Univ. of Notre Dame Press, London, 1979.
- (f) S.D. Agashe, A. Gupta & K. Valicha (eds.) Scientific Method, Science, Technology and Society: A Book of Readings, Univ. of Bombay Press, 1963.

Subject Code	Subject Name	Credit Lecture (L-T-P)			Total Credits
		2	1	0	
LM301	Engineering Economics	2	1	0	8

Unit 1- INTRODUCTION TO ECONOMICS:

Introduction to economics – Flow in an economy – Law of supply and demand – Concept of engineering economics – Engineering efficiency – Economic efficiency – Scope of engineering economics – Element of costs – Marginal cost – Marginal revenue – Sunk cost – Opportunity cost – Break-even analysis – V ratio – Elementary economic analysis – Material selection for product design selection for a product – Process planning.

Unit 2- VALUE ENGINEERING:

Make or buy decision – Value engineering – Function – Aims – Value engineering procedure – Interest formulae and their applications – Time value of money – Single payment compound amount factor – Single payment present worth factor – Equal payment series sinking fund factor – Equal payment series payment Present worth factor – Equal payment series capital recovery factor – Uniform gradient series annual equivalent factor – Effective interest rate – Examples all methods.

Unit 3- CASH FLOW:

Methods of comparison of alternatives – Present worth method (Revenue dominated cash flow diagram) – Future worth method (Revenue dominated cash flow diagram, cost dominated cash flow diagram) – Annual equivalent method (Revenue dominated cash flow diagram, cost dominated cash flow diagram) – Rate of return method – Examples all methods.

TEXT BOOKS:-

1. PanneerSelvam, R., “Engineering Economics”, Prentice Hall of India Ltd, 2001.
2. Smith, G.W., “Engineering Economy”, Iowa State Press, 1973.

REFERENCE BOOKS:-

1. Park, C.S., “Contemporary Engineering Economics”, Prentice Hall of India, 2002.
2. Newman, D.G. and Lavelle, J.P., “Engineering Economics and Analysis”, Engineering Press, 2002.
3. Degarmo, E.P., Sullivan, W.G. and Canada, J.R, “Engineering Economy”, Macmillan, 1984.
4. Grant, E.L., Ireson, W.G. and Leavenworth, R.S., “Principles of Engineering Economy”, Ronald Press, 1976.

Subject Code	Subject Name	Credit Lecture (L-T-P)			Total Credits
		2	0	0	
DC304	Fire, Safety & Hazard	2	0	0	6

Unit 1: Fires

Classification of fires- The fire triangle- Distinction between fires and explosions- Flammability characteristics of liquids and vapour Well blowout fires mid their control- Fire fight equipment- Suppression of hydrocarbons fires.

Unit 2: Occupational Hazards

Toxicity, physiological, asphyxiation, respiratory, skin effect of petroleum hydrocarbons and their mixture- Sour gases with their threshold limits- Guidelines for occupational health monitoring in oil and go industry. Corrosion in petroleum industry- Additives during acidizing, sand control and fracturing.

Unit 3:Hazard Identification

Hazard evaluation- HAZOP and what if reviews- Developing a safe process aid safety management- Personal protection systems and measures.

Guidelines on internal safety audits (procedures and checklist –Inspection and safe practices during electrical installations- Safety instrumentation for process system in hydrocarbon industry- Safety aspects in functional training-Work permit systems.

Unit 4:Safety

Engineering control of chemical plant hazards, ventillation and lighting,maintenance of pressure vessels, storage, handling and transportation of chemicals,electrical systems, instrumentation, personnel protection devices,maintenance procedure, laboratory safety, effluent disposal and checking of spillage.Colour codes forsafety color codes for pipe lines and gas cylinders.

TEXT BOOK:

1. P. C. Nicholas, Safety management practices for hazard waste materials, Dekker
2. D.P. Nolan, Handbook of Fire and Explosion Protection Engineering Principles for the Oil, Gas, Chemical, and Related Facilities, Gulf publishing

REFERENCE BOOKS

1. W. E. Baker, Explosion Hazards and Evaluation, Elsevier, Amsterdam
2. O. P. Kharbanda and E.A. Stallworthy, Management of Disasters and How to Prevent Them, Grower
3. F. P. Lees, Loss Prevention in Process Industries, Vols.1 and 2, Butterworth

Subject Code	Subject Name	Credit Lecture (L-T-P)			Total Credits
DC305	Corrosion & Material Selection	2	0	0	6

Unit-1: Corrosion Basics

Why Metals Corrode, Matter Building Blocks, Acidity and Alkalinity (pH), Corrosion as a Chemical Reaction, Corrosion in Acids, Corrosion in Neutral and Alkaline Solutions.

Unit-2: Corrosion Electrochemistry and Thermodynamics

Electrochemical Reactions, Anodic Processes, Faraday's Law, Cathodic Processes, Surface Area Effect. Corrosion Thermodynamics, Free Energy, Standard Electrode Potentials, Nernst Equation, Thermodynamic Calculations, Reference Half-Cells (Electrodes).

Unit-3: Forms of Corrosion

Recognizing Corrosion, General or Uniform Attack, Galvanic or Two metal Corrosion, Crevice Corrosion, Pitting, Intergranular, Selective Leaching, Erosion Corrosion, Stress Corrosion, Hydrogen Damage.

Unit-4: Corrosion Prevention

Materials Selection, Alteration of Environment, Design, Cathodic and Anodic Protection, Coatings, Prevention of corrosion Corrosion Testing

Unit 5: Properties of Materials:

Mechanical property spectrum, Technological properties such as Weldability machinability etc., Properties related with surface finish, Selection criteria for components and equipments.

Unit 6: Corrosion Considerations in Material Selection

Corrosion in Oil and Gas Products, Effect of CO₂, Effect of Temperature, Effect of Pressure, Prediction of CO₂ Corrosion Rate, Effect of H₂S, Corrosives and Corrosion Problems in Refineries and Petrochemical Plants, Sulfur Content, Erosion.

BOOKS:

1. V. Raghavan, V., Material Science & Engineering, Prentice Hall
2. W. D. Callister (Jr.), Material Science and Engineering - an Introduction, John Wiley & Sons

REFERENCE BOOKS:

1. J.F. Shackelford and W. Alexander, Material Science and Engineering Handbook, CRC
2. V. Saini, Corrosion and Corrosion Control, Scitus Publisher.

Subject Code	Subject Name	Credit Lecture (L-T-P)			Total Credits
		0	0	2	
EP301	AutoCAD	0	0	2	2

Unit-1: Introduction to AutoCAD

1.1 File menu of AutoCAD with New, Open, Save, Save as and Close
 1.2 Basic 2D commands like Line, Circle, Ellipse, Multi Line, Construction Line, Polyline, Point, Donut, Ellipse, Polygon, Rectangle, Arc
 1.3 Erase, Snap, Redraw, Regenerate, Zoom, Pan

Unit-2: Editing of AutoCAD Drawing

2.1 Modify Properties of Drawing Entity
 2.2 Copy, Move, Rotate, Mirror, Offset
 2.3 Array, Scale, Stretch, Lengthen, Trim
 2.4 Extend, Break, Chamfer, Fillet
 2.5 Block, WBlock, Insert and Explode, Area
 2.6 and Volume with Civil Engineering
 2.7 Application

Unit-3: Advanced 2D Commands

3.1 Application of LAYER command in Civil Engineering
 3.2 Layer command with its all sub commands, Line type, Color
 3.3 Dimension command – linear, aligned, arc length, radius, Diameter, Centre, Leader, Baseline and Continuous Dimensioning, tolerance, override and Dimension updates
 Text and DTEXT commands with Text Style Hatch command

Unit-4: 3D Commands of AutoCAD

4.1 Units, Elevation, Thickness, UCS and UCS Icon
 4.2 Viewports, Extrude, 3D Solids – Sphere, Box, Cylinder, Cone, Wedge, Interference
 4.3 3D Surface – Revolved, Tabulated and Ruled Surfaces
 4.4 Hide, Render and Shade of 3D drawings

Unit 5: Plot of 2D & 3D Drawing

5.1 PLAN, ELEVATION and 3D Views of Residential and Commercial Building
 5.2 PLOT and its Sub Command for Plotting Drawing on A1, A2 and A3 Size Paper using Printer and / or Plotter

BOOKS:

1. AutoCAD manual by Autodesk
2. Mastering AutoCAD, George Omura, Wiley India
3. AutoCAD – A problem solving Approach – 2013 & Beyond, Shamitikoo, Autodesk

SEMESTER VI

Subject Code	Subject Name	Credit Lecture (L-T-P)			Total Credits
DC 306	Modeling, Simulation & Optimization	3	0	0	9

Unit 1: Modeling Aspects

Definition of process model, physical and mathematical modeling, deterministic and stochastic process, classification of models, model building, black-box model, white box model, gray model, classification of mathematical methods.

Unit 2: Mathematical Models of Chemical Engineering Systems

Introduction, uses of mathematical models, scope of coverage, principles of formulation, fundamental laws, continuity equations, energy equations, equation of motion, transport equation, equation of state, equilibrium, kinetics. Examples of Mathematical Models- series of isothermal, constant-hold up CSTR, CSTR with variable holds up, two heated tanks, gas-phase, pressurized CSTR, non-isothermal CSTR, single-component vaporizer, batch reactor, reactor with mass transfer, ideal binary distillation column, batch distillation with holdup.

Unit 3: The Nature and Organization of Optimization Problems

Scope and hierarchy of optimization, examples of applications of optimization, the essential features of optimization problems, general procedure for solving optimization problems, obstacles to optimization

Unit 4: Basic Concepts of Optimization

Classification of models, how to build a model, selecting functions to fit empirical data, factorial experimental designs, degrees of freedom, examples of inequality and equality constraints in models, formulation of the objective function, Continuity of function, NLP problem statement, convexity and its applications, interpretation of the objective function in terms of its quadratic approximation, necessary and sufficient conditions for an extremum of an unconstrained function.

Unit 5: Application of Optimizations

Examples of optimization in chemical processes like: optimizing recovery of waste heat, optimal shell and tube heat exchanger design, optimal design and operation of binary distillation column, chemical reactor design and operation.

Unit 6: Simulation

Simulation of the models, Introduction and use of process simulation software to solve fluid mechanics, heat transfer, mass transfer (Ansys Fluent, Aspen Plus/ Aspen Hysys) problem.

BOOKS:

1. W.L. Luyben, Process Modeling, Simulation and Control for Chemical Engineers, McGraw Hill International Editions.
2. R.E.G. Franks, Modeling and Simulation in Chemical Engineering, Wiley Interscience, NY

REFERENCE BOOKS:

1. B.V.Babu, Process Plant Simulation, Oxford University Press
2. B.A.Finlayson, Introduction to Chemical Engineering Computing", John Wiley & Sons, New Jersey

Subject Code	Subject Name	Credit Lecture (L-T-P)			Total Credits
		L	T	P	
DC307	New Separation Techniques	3	0	0	9

Unit 1: Introduction

Review of conventional processes, Recent advances in separation techniques based on size, surface properties, ionic properties and other special characteristics of substances, Process concept, Theory and equipment used in cross flow filtration, cross flow electro filtration, dual functional filter, Surface based solid - liquid separations involving a second liquid, Sirofloc filter.

Unit 2: Membrane Separation

Types and choice of membranes, Plate and frame, tubular, spiral wound and hollow fiber membrane reactors and their relative merits, Commercial, pilot plant and laboratory membranes permeators involving dialysis, reverse osmosis, Nanofiltration, ultrafiltration, Microfiltration and Donnan dialysis, Economics of membrane operations, Ceramic membranes.

Unit 3: Separation by Adsorption Techniques

Mechanism, Types and choice of adsorbents, Normal adsorption techniques, Affinity chromatography and immuno chromatography. Types of equipment and commercial processes, Recent advances and process economics.

Unit 4: Ionic Separation

Controlling factors, Applications, Types of equipment employed for electrophoresis, Di-electrophoresis, Ion exchange chromatography and electro dialysis, Commercial Processes.

Unit 5: Other Techniques

Separations involving Lyophilisation, Pre-vaporization and permeation techniques for solids, liquids and gases. Industrial viability and examples, Zone melting, Adductive crystallization, Other separation process, Supercritical fluid extraction, Oil spill Management, Industrial effluent treatment by modern techniques.

BOOKS:

1. H..M. Schoew, New Chemical Engineering Separation Techniques, Interscience Publishers
2. C.J. King, Separation Processes, Tata McGraw - Hill Publishing Co. Ltd

REFERENCE BOOKS:

1. R.E. Lacey, and S. Loeb , Industrial Processing with Membranes, Wiley-Inter Science
2. R. W. Roussel, Handbook of Separation Process Technology, John Wiley

Subject Code	Subject Name	Credit Lecture (L-T-P)			Total Credits
		2	0	0	
DC 308	Industrial Pollution & control	2	0	0	6

Unit 1: Types of environments and their pollutants

Classification of pollutants. Legislative aspects including water act. 1974, Air Act 1981 and effluent standards. EPA Air pollution: Sources and effects of different air pollutants, Sampling and analysis of air pollutants, Air pollution control methods and equipment, Cyclone Separator, Baghouse, ESP, Venturi Scrubber

Unit 2:Water pollution

Sources, sampling and classification of water pollutants, determination of basic parameters and computations associated with: BOD, COD, TS, TDS, SS; Waste water treatment: primary, secondary, tertiary and advanced; aerobic treatment with special reference to activated sludge, trickling filter, RBDC and RBRC, EA; non-conventional: WSP, anaerobic treatment with special reference to AFFR, UASB

Unit 3:Solid waste management

Sources and classification, public health aspects, Methods of collection and disposal methods: open dumping, landfill, incineration, composting, vermiculture; Solid waste management using bioremediation for specific pollutants like chromium. Mercury, ammonia / urea, phenolic sludges. Management and handling of Bio-medical waste; E-waste-classification and re-use and disposal; Hazardous waste management- Electro-chemical and photo-chemical oxidation - dye waste, chrome slag – case studies.

Unit 4:Pollution control in selected process industries

fertilizer industries, petroleum refineries and petrochemical units, pulp and paper industries, Tanning industries, Sugar industries, Dairy, Alcohol industries, Electroplating and metal finishing industries, Radioactive wastes, ranking of wastewater treatment alternatives. Case Studies.

BOOKS:

1. C. S. Rao Environmental Pollution Control Engineering , New age
2. Connwell and Devis, Introduction to Environmental Engineering, Tata McGraw - Hill Publishing Co. Ltd

REFERENCE BOOKS:

1. Metcalf and Eddy, Wastewater Engg, Tata McGraw - Hill Publishing Co Ltd
2. S.P. Mahajon Pollution Control in process industries, Tata McGraw - Hill Publishing Co Ltd
3. S.J. Arceivala , Wastewater treatment for pollution control, Tata McGraw - Hill Publishing Co Ltd

Subject Code	Subject Name	Credit Lecture (L-T-P)			Total Credits
DC309	Plant Design	2	0	0	6

Unit 1: Introduction:

Basic consideration in chemical Engg. plant design, project identification, preliminary techno-economic feasibility.

Unit 2: Process Design Aspects:

Selection of process, factors affecting process selection, types of flow diagrams.

Unit 3: Selection of Process Equipment :

Standard versus special equipment, materials of construction, selection criteria etc.

Unit 4: Process Auxiliaries:

Piping design, layout, support for piping insulation, types of valves, process control & instrumentation control system design.

Unit 5: Process Utilities:

Process water, boiler feed water, water treatment & disposal, steam, oil heating system, chilling plant, compressed air and vacuum system.

Unit 6: Plant Location and Layout :

Factors affecting plant location, use of scale models

BOOKS:

1. M.S.Peters and K.D.Timmerhaus, Plant design & Economics for Chemical Engineers, McGraw-Hill Education
2. F.C. Vilbrandt and C.E.Dryden, Chemical Engineering Plant Design, McGraw-Hill Education

REFERENCE BOOKS:

1. Rase and Barrow, Project Engineering of Process Plants, John Wiley

Department Electives:

Subject Code	Subject Name	Credit Lecture (L-T-P)			Total Credits
DE 301	Fluidization Engineering	3	0	0	9

Unit-1: Introduction

The phenomenon of fluidization; liquid like behaviour of a fluidized bed; Comparison with other contacting methods; Advantages and disadvantages of fluidized beds.

Unit-2: Fluidization

Types of fluidization, batch, continuous and semi fluidizations, pressure drop flow diagrams, slugging, channeling, effect of L/D, fluid distributors, mode of fluidization, power consumption and pumping requirements.

Unit-3: Minimum fluidization

Derivation for minimum fluidization mass velocity, pressure drop equation for minimum fluidization.

Unit-4: Bubble phenomena

Single rising bubble, two-dimensional Davidson model, maximum stable bubble size, criteria for the stability of the bubble, rise velocity of a gas bubble, bubbling bed model for the bubble phase.

Unit-5: Entrainment and Elutriation

Transport disengaging height (TDH), entrainment at or above TDH, single size of solids, entrainment below TDH, elutriation rate equation, elutriation of fines, entrainment for an infinite Free Board and small Free Board.

TEXT BOOKS:

1. K. Kunii and Octave Levenspiel, Fluidization Engineering, Butterworth-Heinemann Publisher
2. M. Lava ,Fluidization, McGraw Hill

REFERENCE BOOKS:

1. D. Green and R. Perry, Perry's Chemical Engineers Hand Book, McGraw Hill

Subject Code	Subject Name	Credit Lecture (L-T-P)			Total Credits
		3	0	0	
DE 301	Polymer & Petrochemicals	3	0	0	9

Unit 1: Introduction to Polymers

Monomer and polymerisation, degree of polymerization, Classification of polymers natural, synthetic, organic, inorganic polymers, Plastics, elastomers, fibres& resins. Thermoplastic and Thermosetting resins, commodity, Engineering & speciality plastics, homopolymer, copolymers.

Unit 2: Mechanism of Polymerization:

Addition polymerization, Free radical polymerization (Initiation, propagation, termination), Ionic polymerization, Co-ordination polymerization such as polymerization with Ziegler-Natta catalyst, chain transfer Reaction, Concept of functionality & its importance, condensation polymerisation-polycondensation, ring opening polymerisation, co poly condensation.

Unit 3: Chemistry of polymerization:

Introduction, Chain polymerisation – Free radical polymerisation, Ionic polymerisation, Introduction to catalytic polymerisation, Step polymerization, Kinetics of Polymerization

Unit 4: Polymerization Techniques :

Bulk polymerisation, Solution polymerisation, Suspension polymerisation, Emulsion polymerisation, Melt polycondensation, Solution Polycondensation, Interfacial polymerization

Unit 5: Polymer processing

Extrusion, injection molding, compression molding, blow molding, film extrusion, spinning, extrusion film blowing, etc.

TEXT BOOKS:

1. J. R. Fried, Polymer Science & Technology, Prentice Hall of India.
2. P. Bahadur and N. V. Sastry, Principles of Polymer Science, Narosa Publishing House.

REFERENCE BOOKS:

1. V. R. Gowariker, N. V. Viswanathan and J. Sreedhar, Polymer science, New Age

Subject Code	Subject Name	Credit Lecture (L-T-P)			Total Credits
		3	0	0	
DE301	Electrochemical Engineering	3	0	0	9

Unit-1: Basics Principles of Electrochemistry

Review basics of electrochemistry, Characteristics of Electrochemical Reactions Faraday's law, Nernst potential galvanic cells, polarography. The electrical double layer, it's role in electrochemical processes.

Unit-2: Electrochemical Kinetics

Double Layer, Impact of Potential on Reaction Rate, Use of the Butler–Volmer, Kinetic Expression, Reaction Fundamentals, Mass transfer in electrochemical systems: diffusion controlled electrochemical reaction, the importance of convention and the concept of limiting current, over potential, primary-secondary current distribution, rotating disc electrode.

Unit-3: Corrosion

Introduction to corrosion, series, corrosion theories derivation of potential-current relations of activities controlled and diffusion-controlled corrosion process. Potential-pH diagram, Forms of corrosion-definition, factors and control methods of various forms of corrosion-corrosion control measures-industrial boiler water corrosion control – protective coatings -Vapor phase inhibitors -cathodic protection, sacrificial anodes – Paint removers.

Unit 4: Transport

Fick's Law, Nernst–Planck Equation, Conservation of Material, Transference Numbers, Mobilities, and Migration , Convective Mass Transfer, Concentration Overpotential, Current Distribution, Membrane Transport.

Unit 5: Electrodes Structures and configurations

Electrodes used in different electrochemical industries: Metals-Graphite – Lead dioxide – Titanium substrate insoluble electrodes – Iron oxide – semi conducting type etc. Metal finishing-cell design.types of electrochemical reactors, batch cell, fluidized bed electrochemical reactor, filter press cell, Swiss roll cell, plug flow cell, design equation, figures of merits of different type of electrochemical reactors.

TEXT BOOK:

1. Picket, Electrochemical engineering, Prentice Hall
2. J.S.Newman, Electrochemical systems, Prentice Hall

REFERENCE BOOKS:

1. C.Mantell, Electrochemical Engineering, McGraw Hill.

Subject Code	Subject Name	Credit Lecture (L-T-P)			Total Credits
		3	0	0	
DC301	Management for Engineers	3	0	0	9

Unit 1: Introduction to management theory:

Characteristics of management, Management as an art/profession, Systems approach to management, Task and responsibilities of a professional manager, Levels of managers and skill required. Management process, planning, mission, objectives – goals – strategy – policies – programmes – procedures.

Unit 2: Organizing:

Principles of organizing, organization structures, Directing, delegation, span of control, leadership – motivation, communication, Controlling.

Unit 3: Leading:

Introduction, styles of leadership, leading activities, deciding, communicating, motivating, selecting engineering employees, developing people, special topics on leading

Unit 4: Decision making process :

Decision making under certainty, risk, uncertainty, models of decision making, Project management – critical path method, Programme evaluation and review technique, crashing.

Unit 5: Industrial Management & Systems:

Introduction to industrial management and administration, system concept, function of management; managerial decision making, models as decision aids.

Unit 6: Production Planning and Control:

Product design, pre-production planning, production control for intermittent and continuous process, production control charts machine arrangements problems, control for maximum profit, scheduling techniques.

Unit 7: Marketing Facilities and Management:

Supply of product to state govt, to defence, to railways, to CSPO, to CSD, Participation in international exhibition and fairs, trade centres, state emporium and departmental stores, Quality consciousness and its effect on product sales Concept of Marketing, Problems of Marketing, Pricing policy, Distribution channels and methods of marketing.

TEXT BOOKS:

1. D.J. Paulo, Management and Industrial Engineering, Springer

2. D.L. Babcock Managing Engineering Technology, Prentice Hall

REFERENCE BOOKS:

1. H. Koontz, C. O'Donnell, H. Wehrich, Essentials of Managemnt, McGraw Hill
2. O.P. Khanna Industrial Engineering and Management, Dhanpat Rai Publishing

Subject Code	Subject Name	Credit Lecture (L-T-P)			Total Credits
		3	0	0	
DE301	Entrepreneurship	3	0	0	9

Unit 1: Overview of Entrepreneurship:

Definitions, Roles and Functions/Values of Entrepreneurship, History of Entrepreneurship Development, Role of Entrepreneurship in the National Economy, Functions of an Entrepreneur, Entrepreneurship and Forms of Business Ownership Role of Money and Capital Markets in Entrepreneurial Development: Contribution of Government Agencies in Sourcing information for Entrepreneurship

Unit 2: Business Plans and Importance Of Capital To Entrepreneurship:

Preliminary and Marketing Plans, Management and Personnel, Start-up Costs and Financing as well as Projected Financial Statements, Legal Section, Insurance, Suppliers and Risks, Assumptions and Conclusion, Capital and its Importance to the Entrepreneur

Unit 3: Entrepreneurship and Business Development:

Starting a New Business, Buying an Existing Business, New Product Development, Business Growth and the Entrepreneur Law and its Relevance to Business Operations

Unit 4: Indian Environment for Entrepreneurship:

Key regulations and legal aspects , MSMED Act 2006 and its implications, schemes and policies of the Ministry of MSME, role and responsibilities of various government organisations, departments, banks etc., Role of State governments in terms of infrastructure developments and support etc., Public private partnerships, National Skill development Mission, Credit Guarantee Fund, PMEGP, discussions, group exercises etc

Unit 4: Effective Management of Business:

Issues and problems faced by micro and small enterprises and effective management of M and S enterprises (risk management, credit availability, technology innovation, supply chain management, linkage with large industries), exercises, e-Marketing

TEXT BOOK:

1. M.J. Dollinger, Entrepreneurship: Strategies and Resources, Irwin, Illionis
2. B.S. Rathore and J.S. Saini A Handbook of Entrepreneurship, Aapga Publications

REFERENCE BOOKS:

1. Hisrich R.D. and Peters M.P., Entrepreneurship: Strategy, Developing, and Managing a New Enterprise, Irwin
2. CB Gupta and P Srinivasan, Entrepreneurship Development, S. Chand and Sons, New Delhi