Course Grid for Fire & Safety Engineering Engineering
Assam Energy Institute, Sivasagar
Rajiv Gandhi Institute of Petroleum Technology, Jais, Amethi

Course: Diploma in Fire & Safety Engineering

Total Number of Credits: 366

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	Engineering Thermodynamics	3	1	0	11
EP101	Engineering Drawing	0	0	3	3
EP102	Engineering Workshop Practices-I	0	0	3	3
IE102	Fundamentals of Computer Engineering	2	0	2	8
IS102L	Physics Lab	0	0	2	2
	TOTAL				**57**
HU101	Universal Human Values	1	1	0	5
	Communication Skills*	2	0	1	7
*For selective students with less proficiency in English					

SEMESTER II					
Subject Code	**Subject**	**L**	**T**	**P**	**Credits**
IS104	Mathematics-II	3	1	0	11
IS105	Physics-II	3	1	0	11
IS106	Chemistry-II	3	0	2	11
IE102	Fundamentals of Mechanical Engineering	2	0	0	6
IE103	Fluid Mechanics& Fluid Flow Operations	3	1	0	11
IE104	Computer Programming	2	0	2	8
	TOTAL				**58**
HU102	Community Internship	1	1	0	5

SEMESTER III					
Subject Code	**Subject**	**L**	**T**	**P**	**Credits**
DC201	Fire Codes & Standards	2	0	0	6
DC202	Engineering of Materials	3	0	0	9
IE 201	Fundamentals of Electrical & Electronics Engineering	3	1	2	13
DC203	Thermal Engineering	3	0	0	9
DC204	Heat Transfer Operations	3	0	0	9
DC205	Engineering Mechanics	2	1	0	8
DC206L	Unit Operations Lab-I	0	0	2	2
DC207L	Fire Ground Operations – I	0	0	3	3
	TOTAL				**59**

SEMESTER IV					
Subject Code	Subject	L	T	P	Credits
DC208	Fire Service Hydraulics	3	0	0	9
DC209	Fire Dynamics	3	0	0	9
DC 210	Petroleum Refinery Operations	3	0	0	9
DC 211	Structural Fire Protection	3	0	0	9
DC 212	Fire Suppression Systems	3	0	0	9
DC 213	Explosions and Industrial Fire Safety	2	0	0	6
DC 214L	Fire Ground Operations – II	0	0	3	3
DP201	Project	0	0	5	5
	TOTAL				59
DP 202	Industrial Training	0	0	5	5

	SEMESTER V				
Subject Code	Subject	L	T	P	Credits
DC 301	Design & Installation of Detection and Fire Fighting System	3	1	0	11
DC 302	Fire Risk Analysis	3	0	0	9
DC 303	Health, Safety & Environment	2	0	0	6
DC 304	Smoke Management &Fire Alarm System	2	0	0	6
HU 301	Humanities	2	0	0	6
LM 301	Engineering Economics	2	1	0	8
DC 305L	Fire Ground Operation – III	0	0	3	3
DP 301	Project	0	0	10	10
TOTAL					59

SEMESTER VI					
Subject Code	Subject	L	T	P	Credits
DC306	Fire modeling	3	0	0	9
DC307	Industrial Pollution & Control	2	0	0	6
DC308	Simulation of Fires in Enclosures	3	0	0	9
DE301	Departmental Elective-I	3	0	0	9
DC309	Special Fire Hazards	2	0	0	6
OE301	Open Elective	3	0	0	9
DC307L	Industrial Pollution & Control Lab	0	0	2/2	1
DC308L	Simulation of Fires in Enclosures Lab	0	0	2/2	1
DP302	Project	0	0	10	10
TOTAL					60

Department Electives:

DE 301   Department Elective -I
1. Advanced Fire Dynamics
2. Computational Fluid Dynamics
3. Piping Hydraulics & Machineries
4. Energy Management

Cat.		Diploma in Fire & Safety Engineering		Min
HU		Humanities and Social Science		16
IS		Basic Science		65
IE		Institute Requirement Engineering		57
EP		Engineering Drawing (Manual and Computer Aided), Manufacturing Practices and Practice course of Department		6
LM		Language & Management		8
DC		Department/Programme Core		166
DE		Department/Programme Elective		9
OE		Open Elective		9
DP		Project/ Industrial visit/ Training		30
		Total		**366**

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-Movier'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 conversations; 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 angles, sub-multiple angles (2A,3A, A/2); Graph of sinx, cosx, tanx, cosecx, secx and cotx.

Unit-VI: Differential Calculus

Definition of function; Concept of limits; Four standard limits $\lim_{x \to a} \dfrac{x^n - a^n}{x - a}, \lim_{x \to 0} \dfrac{\sin x}{x}, \lim_{x \to 0} \dfrac{a^x - 1}{x}$ and $\lim_{x \to 0}(1 + x)^{1/x}$. 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. Finey, Calculus and Analytical Geometry, Addision 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
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 Bhhatacharya&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, Grahm'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 conceptsanddefinition

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 absolutepressure.

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 LawofThermodynamics

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 idealgases.

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

Unit- IV: Second LawofThermodynamics

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 ofPureSubstances

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 andentropy.

Unit-VII: Applicationofthermodynamics

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 diagramonly)

TEXT BOOK(S):
1. Engineering Thermodynamics by P.K.Nag, Publisher:TMH
2. Basic Engineering Thermodynamics by Rayner Joel, PearsonEducation

REFERENCE BOOK(S):

1. Engineering Thermodynamics by Van Wylen and Sontang, JohnWiley

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 Adebiyi, publisher,Oxford

6. Steam Tables in SI Units by Ramalingam,Scitech.

Subject Code	Subject Name	Credit Lecture (L-T-P)			Total Credits
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
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 3 rd 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; DhanpatRai& 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
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 inlathe.

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
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 UniversityPress)
2.   English for Polytechnics by DrPapori Rani Barooah (Eastern Book House Publishers)

3.   English Grammar by Annie Brinda (Cambridge UniversityPress)

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; Crammer'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 differentia equations of the forms:

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

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

. 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, Addision 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
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
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 Cp and Cv, 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.

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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
IS106L	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 oxalicacid solution using phenolphthalein indicator.

3. Standardization of $KMnO_4$ solution using standard oxalic acid and determine the percentage ofiron present in given Hematite ore by $KMnO_4$ solution.

4. Estimation oftotal 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): SudarshanBarua

Subject Code	Subject Name	Credit Lecture (L-T-P)			Total Credits
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.

Subject Code	Subject Name	Credit Lecture (L-T-P)			Total Credits
DC 201	Fire Codes & Standards	2	0	0	6

Unit1:

Specification of fire-fighting equipment.

Unit2:

Technical parameter / specification specific reference to appliances.

Unit3:

Code & Standards concerning construction & Design of building.

Unit4:

International code & standard for Hydraulic platform, Turntable ladder and other Rescue and fire-fighting devices and components.

Unit5:

Code and Standard for passive fire protection system and materials.

Unit6:

Code, Standard and specification concerning to safety of fire-fighting personnel i.e., Breathing Apparatus P.P.E., safety gears and other devices.

Unit7:

Code, Standard and byelaws concerning Industrial, Municipal and State life safety & fire protection measures.

Unit 8:

Code and Practice for construction of temporary structures, pandal/ Samiyana and scaffolding.

Reference ofBooks:

1. NBC, B.I.S, DIN, EU, B.S., UL, FM Code & Standards, EN. Standards C.E. Australiancodes.
2. DGMS, Director general ofmines. Safety and minesregulations.
3. All relevant standards specification, codes and practice National & International Standard.

Subject Code	Subject Name	Credit Lecture (L-T-P)			Total Credits
DC 202	Engineering of Materials	3	0	0	9

Unit1: Structure of solids

Classification of engineering materials, Structure-property relationship in engineering materials, Crystalline and noncrystalline materials, Miller Indices, Crystal planes and directions, Determination of crystal structure using X-rays, Inorganic solids, Silicate structures and their applications. Defects; Point, line and surface defects.

Unit2:Mechanical properties of materials

Elastic, Anelastic and Viscoelastic behaviour, Engineering stress and engineering strain relationship, True stress - true strain relationship, review of mechanical properties, Plastic deformation by twinning and slip, Movement of dislocations, Critical shear stress, Strengthening mechanism, and Creep.

Unit3:Equilibrium diagram: Solids solutions and alloys, Gibbs phase rule, Unary and binary eutectic phase diagram, Examples and applications of phase diagrams like Iron - Iron carbide phase diagram.

Unit4:Electrical and magnetic materials: Conducting and resistor materials, and their engineering application; Semiconducting materials, their properties and applications; Magnetic materials, Soft and hard magnetic materials and applications; Superconductors; Dielectric materials, their properties and applications. Smart materials: Sensors and actuators, piezoelectric, magnetostrictive and electrostrictive materials.

Unit5:Corrosion process: Corrosion, Cause of corrosion, Types of corrosion, Protection against corrosion.

Unit6:Materials selection

Overview of properties of engineering materials, Selection of materials for different engineering applications.

Text Books:
1. W.D. Callister ,Materials Science and Engineering; John Wiley & Sons, Singapore, 2002.
2. W.F. Smith, Principles of Materials Science and Engineering: An Introduction; Tata Mc-Graw Hill, 2008.
3. V. Raghavan, Introduction to Materials Science and Engineering; PHI, Delhi, 2005.

Reference Books:
1. S. O. Kasap, Principles of Electronic Engineering Materials; Tata Mc-Graw Hill, 2007.
2. L. H. Van Vlack, Elements of Material Science and Engineering; Thomas Press, India, 1998.
3. K. G. Budinski, Engineering Materials – Properties and selection, Prentince Hall India, 1996

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.

Subject Code	Subject Name	Credit Lecture (L-T-P)			Total Credits
DC 203	Thermal Engineering	3	0	0	9

Unit-I: Analysis of Second LawofThermodynamics

Review of second law of thermodynamics, Concept of entropy, Clausius' Theorem, property of Entropy, Clausius' inequality, entropy change in various processes, Entropy Principle and its application, Entropy generation in a closed system and open system. Entropy and Disorder.

Unit-II: AvailabilityorExergy

Exergy-work potential of energy, exergy associated with K.E and P.E, reversible work and irreversibility, second law efficiency.

Unit-III: Properties of Gases andGasMixture

Avogadro's law, Equations of State , Virial Expressions, Law of corresponding states, Properties of Mixtures of Gases, Internal Energy, enthalpy, specific heats and entropy of Gasmixtures.

Unit-IV: Vapour and VapourPowerCycles

Properties and processes of ideal vapour, Qualities of steam, Simple steam power cycle, Rankine Cycle, Actual Vapour Cycle, Actual Vapour Cycle Processes, Reheat cycle, ideal and Practical Regenerative Cycles, Characteristics of an ideal Working Fluid in Vapour Power Cycles, Binary VapourCycles.

Unit-V: ReciprocatingGasCompressor

Classification of air compressors, Advantages and Disadvantages of Air compressors, Compression Processes, Working of Reciprocating Compression, Analysis of Single Stage Reciprocating Air Compressor, Analysis of Multi-Stage Compressors

Unit-VI: Thermodynamics ofFluidFlow

Velocity of pressure pulse in a fluid, Stagnation Properties, One dimensional Steady Isentropic Flow, Choking in Isentropic Flow, Critical Properties, normal Shocks, Adiabatic Flow with Friction and Diabatic Flow without Friction.

Unit-VII:TermodynamicRelations

Maxwell's Equations, Tds Equations, relationship of heat capacities, Energy Equation, Joule-Kelvin Effect, Clausius-Clapeyron Equation, Evaluation of Thermodynamic Properties from an Equation of State

Text Book(s):

1. P.K. Nag ,Engineering Thermodynamics,TMHPublishers
2. J. SelwinRajadurai ,Thermodynamics & Thermal Engineering ,New Age International Publishers

Reference Book(s):

1. C.P. Arora ,Thermodynamics ,TMHPub.
2. D.S. Kumar ,Thermal Science & Engineering ,S.K. Kataria&Sons
3. S.C. Gupta ,Thermodynamics , PearsonEducation
4. Cengal& Boles ,Thermodynamics- An Engineering Approach ,McGrawHill
5. K. Ramakrishna ,Engineering Thermodynamics, AnuradhaAgencies

Subject Code	Subject Name	Credit Lecture (L-T-P)			Total Credits
DC 204	Heat Transfer Operations	3	0	0	9

Unit 1: Introduction:
Various modes of heat transfer, Fourier's, Newton's and Stefan Boltzmann's Law, Combined modes of heat transfer, Thermal transfer, Thermal diffusivity, Overall heat transfercoefficient.

Unit 2: Conduction:
The thermal conductivity of solids, Liquids and gases, Factors influencing conductivity measurement. The general differential equation of conduction, One dimensional steady state conduction, Linear heat flow through a plane and composite wall, Tube and sphere, Critical thickness of insulation, Effect of variable thermal conductivity, Conduction with heat generation in slab andcylinders,Spheres.

Unit 3: Fins:
Conduction convection system, Extended surfaces rectangular, Triangular, Circumferential and pin fins, General conduction analysis, Fins of uniform and non-uniform cross sectional area. Heat dissipated by a fin. Effectiveness and efficiency offins.

Unit 4: Transient/Unsteady State Heat Conduction:
System with negligible internal resistance, Lumped capacity method and its Validity. Unsteady state conduction through finite and semi- infinite slab without surface resistance, convection boundary conditions. Solution throughHeisler`schart.

Unit 5: Forced Convection:
Physical Mechanism of Forced Convection, Dimensional analysis for forced convection, velocity and Thermal Boundary layer, Flow over plates, Flow across cylinders and spheres, Flow in tubes,Reynolds'sanalogy

Unit 6: Natural Convection:
Physical Mechanism of Natural Convection, Dimensional analysis of natural convection; Empirical relationship fornaturalconvection.

Unit 7: Boiling and condensation:
Condensation and boiling heat transfer – film and drop wise condensation – film boiling and pool boiling – boiling curve – empirical relations for heat transfer with change of face.Boiling heat transfer,Poolboiling.

Unit 8: Heat Exchangers:
Different types of heat exchangers; Determination of heat exchanger performance, Heat exchanger transfer units, Analysis restricted to parallel and counter flow heat exchanger (LMTD andNTU method)

Unit 9: Thermal Radiation:
Introduction, absorption and reflection of radiant energy, Emission, Radiosity and irradiation, Black and non black bodies, Kirchhoff's law, intensity of radiation, Radiation exchange between black surface, Geometric Configuration factors. Grey body relation exchange between surface of unit configuration factors, Electrical analogy to simple problems. Non-luminous gas radiation.Errors in temperature measurement due to radiation.

Text Book(s):

1. S.P. Sukhatme, Heat Transfer,4th Ed., Tata McGrawHill,2008
2. J.P. Holman, Heat Transfer, 10th Ed., Tata McGrawHill,2011

Reference Book(s):
1. Yunus A. Cengel, Heat Transfer – A Practical Approach,2nd Ed., McGrawHill,2002
2. P.S. Ghoshdastidar, Heat Transfer,2nd Ed., Oxford UniversityPress,2012
3. D.S. Kumar, Basics Heat & Mass Transfer,8th Ed., S.K. Kataria&Sons,2010

Subject Code	Subject Name	Credit Lecture (L-T-P)			Total Credits
DC 205	Engineering Mechanics	2	1	0	8

Unit I: Review of BasicForceSystems

Dimensions and units of mechanics, idealization of mechanics, laws of mechanics, vector algebra review, moment of a force about a point and axis, the couple and couple moment, addition and subtraction of couples, moment of a couple about a line, translation of a force to a parallel position, resultant of a forcesystem.

Unit II: Resolution of a force and composition of aforcesystem

Parallelogram law of forces; triangle law of forces; polygon law of forces.Resultant and Equilibrant, Varignon's theorem of moments. Basic principles: Equivalent force system; Equations of equilibrium; Free body diagram;Reaction; Staticindeterminacy.

UnitIII:Friction

Coulomb dry friction laws, simple surface contact problems, friction angles, types of problems, wedges. Wheel friction and rolling resistance.
Virtual work and Energy method: Virtual Displacement; Principle of virtual work; Mechanical efficiency;

Unit-IV: Analysisofstructures

Analysis of structures: Assumptions followed in the analysis of truss; Analysis of truss by method of joints and sections. Analysis offrames.

Unit V: Centroid and Momentofinertia

Centroid of plane figures - Locating centroid of basic regular figures from first principles including sector of a circle, parabola, locating centroid of built-up sections. Moment of inertia (Second moment of area)- Perpendicular and parallel axis theorems; radius of gyration; Mass moment of inertia.

Unit VI: Kinematics and kineticsofParticles

Rectilinear motion; Curvilinear motion; Force, mass and acceleration; Work and energy; Impulse andmomentum;

Unit VII: Kinematics and Kinetics ofRigidBodies

Relative velocity, Translation, Pure rotation and plane motion of rigid bodies, D'Alembert's principle, linear momentum, principle of conservation of momentum, Impact of solid bodies, work, energy, power, principle of conservation ofenergy

Text book(s):
1. I.H. Shames, Engineering Mechanics: Statics and Dynamics, 4th Ed., PHI,2012
2. F. P. Beer and E. R. Johnston, Vector Mechanics for Engineers: Statics and Dynamics,Tata McGraw Hill,2003.

ReferenceBook(s):

1. J. L. Meriam and L. G. Kraige, Engineering Mechanics, Vol I – Statics, Vol II –   Dynamics, 5th Ed., John Wiley, 2002.
2.   R. C. Hibbler, Engineering Mechanics, Vols. I and II, Pearson Press,2002.

Subject Code	Subject Name	Credit Lecture (L-T-P)			Total Credits
DC 208	Fire Service Hydraulics	3	0	0	9

Unit1:

Water Supply Analysis Overview - Define "hydraulics" as it applies to fire protection Engineering, types of water supply.

Unit2:

Basic Principles of Hydraulics - Recognize and apply the basic principles of pressure in a non-flowing water system, Recognize and apply the basic principles of water flow in a piping system and through an orifice, Concept of friction loss and determine frictionloss.

Unit3:

Calculating Sprinkler System Demand: Simple Side-Fed Tree, Generally describe the interaction between flow and pressure in an operating sprinkler system and identify mathematical relationships that are the basis of sprinkler system calculations, Demonstrate the relationship between flow and pressure by using pressure balancing in performing head by head calculations for a simple-side-fed tree sprinkler system.

Unit4:

Hydraulics of Water Supplies for Automatic Sprinkler Systems

Unit5:

Concepts - Bernoulli's Theorem and Applications, Hazen-Williams Formula, Pressure Loss at Fittings, Discharge from Nozzles, Discharge Coefficient, Theoretical Discharge.

Reference Books:

1. Loss Prevention Datasheet by FM Global, FMDS3-0.
2. SFPE Hand Book for Fire Protection Engineering,NFPA
3. Fire Service Hydraulics: Questions and Answers by DickSylvia
4. Simplified Fire Department Hydraulics by FrederickShepperd
5. NFPA Codes & Standards

Subject Code	Subject Name	Credit Lecture (L-T-P)			Total Credits
DC 209	Fire Dynamics	3	0	0	9

Unit1: Combustion fundamentals

Chemical Thermodynamics and kinetics, Pyrolysis, ignition and combustion, conservation equations for mass, momentum, energy and species, turbulence, radiation.

Unit2: Survey of applications

Industrial settings, buildings, transport modes, forest, shamiana, jhuggi-jhonpdi, materials and their properties, inventory of combustible materials..

Unit3: Fire dynamics

Flames and fire spread theory, buoyant plumes, interactions with surfaces, smoke spread, turbulent diffusion flames, soot formation and radiation effects, toxic products; feedback to fuel; fire chemistry, nitrogen and halogen thermochemistry, numerical techniques.

Unit4: Compartment zone fires

Flashover, post-flashover, control, applications, numerical techniques, plume and ceiling jet models.

Unit5: Codes, standards and laws

Case studies of real fires – buildings, factories and godowns, automobiles, buses, trains and aircraft, oil spills, forest fires, tents, slums, residential spaces. Engineering evaluation of fire safety.

Reference Books:

1. Drysdale, D.D., An Introduction to Fire Dynamics, Wiley, New York, 1999.

2. Lyons, J.W., Fire, Scientific American Books, New York.

3. Karlsson, B., and Quintiere, J.G., Enclosure Fire Dynamics, CRC Press.

4. Cox, G., Combustion Fundamentals of Fire, Academic Press, London, 1995.

5. Haessler, W.M., Fire: Fundamentals and Control, Marcel Dekker, 1988.

6. SFPE, Handbook of Fire Protection Engineering, NFPA, Quincy, Mass.

7. Quintiere, J.G., Principles of Fire Behavior, Delmar, 1985.

Subject Code	Subject Name	Credit Lecture (L-T-P)			Total Credits
DC 210	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
DC 211	Structural Fire Protection	3	0	0	9

Unit 1: Engineering Approach to industrial fire protection

Fire/explosion scenario identification, Consequence analysis, Alternative protection evaluation; **Statistical overview of industrial fires and explosions** – Industrial occupancies in large loss fires, Types of fires/ explosions in the largest losses, Facilities involved in multiple fatality fires and explosions, Ignition sources, Need for automatic detection and suppression; **Historic industrial fires and explosions** – Fire protection lessons learned, Lessons not learned

Unit 2: Plant Siting and layout

Fire protection siting considerations – Safe separation distances, Water supplies, Fire fighting organizations, Codes and attitudes, Environmental effects; **Plant layout for fire/explosion protection** – General principles and procedures, Hazard segregation and isolation, Ignition source isolation, Passive barriers, Sprinkler system layout, Accessibility for manual fire fighting, Emergency exits, Computer aided plant layout

Unit 3: Fire Resistant Construction

Construction materials – Steel, Steel Insulation, Concrete**; Fire resistance calculations; Fire resistance tests** – Furnace exposure tests, Empirical correlations, High intensity fire resistance tests**; Fire Walls** – General criteria for fire walls, Fire wall design, Fire wall loss experience; **Fire doors** – Types of fire doors, Fusible links and detectors, Reliability issues; **Insulated metal deck roofing** – Description, Tests and classifications**; Water spray protection of exposed structures**

Unit 4: Smoke Production & Properties

Particle size of smoke from burning wood and plastics, Smoke Aerosol Properties, Visibility, Smoke isolation and venting; **Isolation and suppression within ventilated equipment**; **Isolation within rooms – Building smoke control** – Buoyancy pressure differences, Volumetric expansion pressures, Isolation via ventilation exhaust, Upstream smoke propagation, Door and damper smoke leakage; **Heat and smoke roof venting**; **Heat and smoke venting in sprinklered buildings** – Testing, Loss experience, mathematical modelling

Unit 5: Warehouse Storage

Warehouse fire losses Storage configurations; Effect of storage height, flue space and aisle width; Commodity effects – Generic commodity classification, Laboratory flammability testing, Small array tests, Large array sprinklered fire tests**; Sprinkler flow rate requirements** – Ceiling spray sprinklers, In-rack sprinklers, Early suppression fast response (ESFR) sprinklers; **Sprinklered warehouse fire modeling** – Conceptual model overview, Free burn heat release rates and flame spread rates, Warehouse fire plumes and ceiling jets, Sprinkler actuation model, Spray-plume penetration model, Reduction in heat release due to actual delivered density, Fire control criteria; Fire suppression criteria**; Cold storage warehouse fire protection**

Unit 6: Storage of special commodities and bulk materials:

Roll Paper – Commodity description, Loss experience, Roll paper fire tests, Roll paper protection

requirements; **Nonwoven roll goods –** Commodity description, Loss experience, Fire tests, Sprinkler protection requirements for nonwovens; **Rubber tire storage; Aerosol Products –** Product description, Aerosol warehouse fires, Aerosol product formulation effects, Sprinkler protection guidelines; **Solid oxidizers; Bulk storage –** General Description, Spontaneous ignition testing, Spontaneous ignition theory, Detection and suppression of bulk storagefires

Reference Books:

1. Industrial Fire Protection Engineering – Robert G.Zalosh
2. National Fire Protection AssociationHandbook
3. Hydro Carbon Processing Unit Volume I,II
4. An Introduction to Fire Dynamics - DougalDrysdale
5. Automatic Sprinkler performance table, Fire Journal, NFPA, 1970Edition
6. Evaporation from plain liquid surface into a turbulent boundary layer – By BrightonP.W.N
7. Factory Mutual loss prevention data sheet, 1-20 protection against fire protection
8. Factory Mutual loss prevention data sheet 2-8, Earthquake, Protection for sprinkler system
9. NFPA 13, NFPA 30B, NFPA 49, NFPA 70A, NFPA 101, NFPA325M
10. SPFE Book of Fire ProtectionEngineering.

Subject Code	Subject Name	Credit Lecture (L-T-P)			Total Credits
DC 211	Fire Suppression Systems	3	0	0	9

Unit 1: Suppression Agents and Extinguishing Mechanisms

Life Cycle of Fire/Fire Triangle/Fire Tetrahedron.Theories of suppression and extinguishment.Suppression agents/attributes.

Unit 2: Water-Based Suppression Systems

Basic components of water-based suppression systems.Types of systems / components / applications.Attributes of system components.Hazard classifications/System design criteria.Spacing / location / placement of discharge devices.Methods for sizing piping / piping configurations.Hydraulic calculations.

Unit 3: Foam Suppression Systems

Basic components of foam suppression systems.Types of systems / components / applications.Attributes of system components.System design criteria.Spacing / location / placement of discharge devices.Methods for sizing piping / piping configurations.Hydraulic calculations.

Unit 4: Carbon Dioxide Suppression Systems

Basic components of carbon dioxide suppression systems.Types of systems / components / applications.Attributes of system components.System design criteria.Spacing / location / placement of discharge devices.Methods for sizing piping / piping configurations.Agent supply requirements.Safety considerations.

Unit 5: Halon Suppression Systems

Basic components of water-based suppression systems.Types of systems / components / applications.Attributes of system components.Hazard classifications.System design criteria.Spacing / location / placement of discharge devices.Methods for sizing piping / piping configurations.Agent supply requirements.

Unit 6: Dry and Wet Chemical Suppression Systems

Basic components of dry and wet chemical suppression systems.Types of systems / components / applications.Attributes of system components.System design criteria.Spacing / location / placement of discharge devices.Methods for sizing piping / piping configurations.

Unit 7: Manual Fire Suppression Systems

Portable Fire Extinguishers - Classifications of portable fire extinguishers. Testing of portable fire extinguishers.Spacing / location / placement of discharge devices.

Standpipe and Hose Systems - Basic components of standpipe and hose systems.Types of systems / components / applications.Attributes of system components.System design criteria.Spacing / location / placement of discharge devices.Methods for sizing piping / piping configurations.

Reference Books:

1. Fire Suppression and Detection Systems - Ch. 1-2; Friedman (1991)
2. Automatic Sprinkler Systems Handbook; Automatic Sprinkler and Standpipe Systems; Solomon (1991:1); Fleming (1991:2); Solomon (1991:2); Fleming (1991:1); Cote and Fleming (1991); Hodnett (1991); Fleming (1988)
3. Fire Suppression and Detection Systems - Ch. 3-4; Meldrum (1991); Hickley (1988)
4. Fire Suppression and Detection Systems - Ch. 6; NFPA 12; Wysocki (1991)
5. Fire Suppression and Detection Systems - Ch. 7; NFPA 12A, 12B; Taylor (1991); Grant (1988)
6. Fire Suppression and Detection Systems - Ch. 2; NFPA 10; Demers (1991)
7. Automatic Sprinkler and Standpipe Systems - Ch. 1; NFPA 14; Shapiro (1991)

Subject Code	Subject Name	Credit Lecture (L-T-P)			Total Credits
DC 213	Explosions and Industrial Fire Safety	2	0	0	6

Unit 1: Introduction to Explosion Characteristics:

Background - Burchfield explosion case study. Other similar explosion incidents; Explosion hazards; Stoichiometry for gases- Introduction, Calculation for air, Calculation for O2; Stoichiometry for general hydrocarbons and wood (Air to fuel ratio); Application of stoichiometry- Naphtha storage tank example, Burner startup; Boiler firebox explosion.

Unit 2: Flammability limits and Theories:

1. Lean limit and Rich limit, 2. LEL & UEL measurement techniques and equipment, 3.Minimum ignition energy, 4.Relation between auto-ignition temperature and flash point, 5.Effect of temperature and pressure on flash point, 6.Classification of flammable materials, 7.Vapour tank explosion, a. TWA flight 800 Disaster.

Unit 3: Explosion Prevention and Protection

1. Explosion prevention techniques-a. Ventilation. Separation.Physical barriers. Alternative techniques,2. Preventing the formation of explosive atmosphere, 3. Explosion protection systems - a. Protection techniques - Containment, Isolation, Suppression, Venting, b.Ventilation for explosion protection system, c. Explosion protection using inert gases, 4. Flame arrestors and quenching distance

Unit 4: Safety Management

Concept Of Safety, Industrial Accidents, Reasons For Accident Prevention, Function Of Safety Management, Safety Organizations, Objectives Of Safety Organizations, Role Of Industrial Organization (Safety), Essential Requirements Of Safety Programs, Plant Safety Rules And Procedures, Formulation Of Rules, Types Of Rules, Violation Of Rules, Reduction Of Hazards.

Unit 5:Safety In Miscellaneous Industries

Hazards And Safety Measures For Welding Process, Types Of Welding Processes, Precaution And Safety, Fertilizer Industry, Pesticides Industry, Lethal Dosages, Manipulation Process And Their Hazards And Controls, Textile Industry, Steel Industry, Chemical Hazards.

Reference Books:

1. Handbook of fire and Explosion Protection Engineering Principles for Oil, Gas, Chemical and Related Facilities- Dennis. P. Nolan
2. National Fire Protection AssociationHandbook
3. Hazards in Process Industries - HidupSuatuPendakian
4. Industrial Safety Management - N.K. Tara Fdar, K.J Tara Fdar
5. Industrial Safety - National Safety Council of India

Subject Code	Subject Name	Credit Lecture (L-T-P)			Total Credits
DC 301	Design & Installation of Detection and Fire Fighting System	3	1	0	11

Unit 1:
Provisions & applicable standards of detection and alarm system, Introduction of detection devices, alarm and detection system, Type of detectors, Method of selection. Cost analysis, design, installation, testing and commissioning of alarm and detectionsystem.Provisions & applicable standards of foam, gases and dry chemical powder based systems.

Unit 2:
Classification and property of foam, gases and dry chemical powder.

Unit 3:
Identification, Hydraulic Calculation and Design of foam system: Installation identification, Hazard classification, Type of protection, Hazard description, Flammable or combustible liquids area to be protected, Flammable or combustible liquids identification, foam application method, Description, number and placement of foam application devices, Selection of foam agent, Rate of application of foam solution, Rate of foam concentrate, Rate of water application, Duration of discharge, Quantity of foam and water required.

Unit 4:

Identification and Design of clean agent based system: Determine the design concentration, Determine the total agent quantity, Establish the maximum discharge time, Selection of piping material and thickness consistent with pressure rating requirement, Piping design network and selection of nozzle to deliver required concentration at required discharge time to ensure mixing, Evaluation of compartment over / under pressurization and provide venting if required, Establish maximum agent hold requirements and evaluate compartment for leakage.

Unit 5:

Design of dry and wet chemical extinguishing agent based system: Physical property, Extinguishing properties, Method of application, System design, Storage of chemical and expellant, System actuation, distribution system, Quantity and rate of application,Limitations of the system, cost analysis of the system, Inspection, testing and maintenance procedure.

Reference Books & Standards:

1. NFPA 17, 17A
2. UL300
3. NFPA Handbook
4. SFPE Hand book of Fire Protection Engineering

Subject Code	Subject Name	Credit Lecture (L-T-P)			Total Credits
DC 302	Fire Risk Analysis	3	0	0	9

Unit 1: Application of fire risk analysis
Basic field of application, Methods of application; Probability Concept: Basic concept of Probability Theory, Independence and conditionality, Random Variables and Probability Distributions, Key parameters of probability Distributions, Commonly used Probability Distributions.

Unit 2: Statistics
Introduction, Basic concept of statistical analysis, Key parameters of descriptive statistics, Correlation, Regression and Analysis of Variance, Hypothesis Testing in Classical Statistical Inference, Sampling Theory. Extreme Value Theory: Extreme Order Distribution, Behaviour of Large Losses, Average Loss, Economic Value of Fire Protection Measures, Factor Affecting fire damages, Analysis of test results, Fire Severity and fire resistance.

Unit 3: Reliability
Component Life, Failure Rate, Estimating the parameters of a Distribution, System Reliability, Bayesian Methods. Probability Models in Fire Protection Engineering: Decision Trees, Fault Trees, Markov Chains, Queuing Models of Fire Company Availability, Stress-Strength model in Fire Safety, Engineering Economics.

Unit 4: Utility Theory
Utility, Utility Functions, Fire Protection and Insurance, Decision Analysis, Construction of Utility Function, Value of Human Life: Methods of Valuing Human Life, Applications, Cost-Benefit Analysis, General Decisions

Unit 5: Computer Simulation for Fire Protection
Engineering Computer Simulation Methodology, Tools of Simulation, Variance Reduction Techniques, Statistical Termination Tests, Flexibility versus Computation, Simulation Languages

Unit 6: Fire Risk Assessment Schedules
Introduction, Taxonomy of Methods for Fire Risk Assessment, Schedules, Insurance Rating, Dow's Fire and Explosion Index.

Books Recommended:

1) SFPE Handbook of Fire ProtectionEngineering

2) Fire Protection Handbook Vol. I -II
3) NFPA Codes &Standards
4) Insurance Rules AndAssessment
5) Fire ChiefHandbook
6) Fire Insurance – By Lester WilliamZartman
7) The Law of Fire Insurance – By George AnselClement
8) An approach to fire insurance – By Clayton G.Hale

Subject Code	Subject Name	Credit Lecture (L-T-P)			Total Credits
DC 303	Health, Safety & Environment	2	0	0	6

Unit 1: Occupational health and safety management
1. General definitions: Health, safety, environment protection, occupational accident, hazard, risk, near misses, health and safety culture. 2. Key elements for health and safety system 3. Importance of health and safety policy, aim and objective of health and safety policy 4. Health and safety culture, factors influencing health and safety culture 5. Influencing factors for health and safety management

Unit 2:Safety elements
1. Philosophy of safety a. Need of safety philosophy b. Nature and subjects of safety philosophy 2. Safety psychology a. Need of safety psychology b. Meaning and aim of safety psychology c. Factors affecting safety at work: attitude, aptitude, frustration, morale, motivation, individual differences.

Unit 3:Environment
1. Introduction and 5 elements 2. Environmental issues in fire protection a. Halon and the ozone layer b. Other special extinguishing agent c. Water based fire protections d. Fire protection measures 3. Environmental audit a. Need b. procedure c. Benefit 4. Solid waste management a. Definition b. Classification c. Characteristics of solid waste d. Environment impact e. Role of citizen

Unit 4: Various Pollution & its effects on Environment
1. Noise Pollution a) Introduction b) Fundamentals of noise c) Transmission of sound d) The ear and the measurement of hearing e) Noise control 2. Radiation a) Introduction b) The concept of injury by radiation c) Infrared radiation d) Corpuscular radiation e) Poisoning from radioisotopes 3. Water Pollution a) Introduction b) Sources of water pollution c) Water pollution monitoring d) Control of water pollution e) Treatment of domestic waste water f) Treatment of industrial waste water

Reference Books:

1. Safety, health and working condition in the transfer of technology - Inter National Labor Office
2. Industrial Safety, Health and environment Management system - RK Jain and Sunil S Rao
3. Publications from Inter National standard Organizations like ISO, OSHA, IOSH, NEBOSH etc.
4. Encyclopedia of occupational health and safety - Inter National Labor Office

Subject Code	Subject Name	Credit Lecture (L-T-P)			Total Credits
DC 304	Smoke Management & Fire Alarm System	2	0	0	6

Unit 1: Smoke Production in Fires
Smoke measurements. Mass yields/mass fractions/molar yields/molar fractions. Smoke release rate/heat release rate. Entrainment.Optical characteristics/optical density/Bougher's Law.Mass optical density/specific optical density.Visibility through smoke.The influence of ventilation on smoke production.

Unit 2: Principles of Smoke Movement
Air flow principles.Gas expansion.Buoyancy/stack effect/local heating.HVAC systems.Wind.

Unit 3: Principles of Smoke Management
Objectives of smoke management.Passive smoke management methods. Active/mechanically-assisted smoke management methods. Opposed air flow Stairwell pressurization Zoned smoke control Smoke exhaust

Unit 4: Smoke Management for Large Spaces
Venting requirements.Natural ventilation through roof and wall openings. Mechanical smoke exhaust systems. Stratification. Activation methods

Unit 5: Fire alarm
Review of current technologies associated with fire detectors Performance characteristics of heat, smoke and flame detection Alarm system classifications, components, design criteria Performance characteristics of alerting devices Fire detection and alarm system evaluation.

Introduction of Electronics and Electricity, Semi-conductor Physics, Circuit Control and Protective Devices, Transistors, Principles of fire detectors, Parts of fire alarm unit, Control panel, Type of detectors, Automatic fire detection, Classification of detector, Control and indicating equipment, Trouble shooting and maintenance, Intruder alarms

Unit 6: Detection & warning systems, emergency lighting
1. Detection and warning systems a. Intro to types of systems b. Automatic fire detection and principles of operation c. Smoke, Radiation and Heat Detectors, Line Detectors, Beam Detectors. d. Detector Positioning e. Control Panel & its Functions 2. Emergency lighting a. Minimum Illuminance level b. Defined escape routes/ undefined routes c. Identification of escape routes and signs d. Emergency lighting design e. Sighting of essential escape lighting and additional escape lighting

Text / Reference books:-

1. John H. Klote; James A Milke; Paul G Turnbull; Ahmed Kashef; Michael J Ferreira, Handbook

of Smoke Control Engineering, ASHRAE, Atlanta, 2012.

2. Klote, J.H. and Nelson, H.E., Smoke Movement in Buildings, Fire Protection Handbook, 17th Edition, ed A.E. Cote (NFPA), 1991Fire Protection Handbook (17th ed), Ch. 6-7.

3. Schifiliti, R.P., Design of Detection Systems, SFPE Handbook, 1st Edition, ed. P.J. Di Nenno (Society of Fire Protection Engineers, Boston), 1988, Ch. 3-1.

4. Shapiro, J., Standpipe and Hose Systems, Fire Protection Handbook, 17th Edition, ed A.E. Cote (NFPA), 1991Fire Protection Handbook (17th ed), Ch. 5-14.

Subject Code	Subject Name	Credit Lecture (L-T-P)			Total Credits
HU301	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.

<u>Ethics</u>:   Impact of science and technology on man and society: elements of environmental and professional ethics.

TEXT / REFERENCE BOOKS:-

(A) <u>Introduction to Sociology:</u>

   (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) <u>Introduction to Literature:</u>

   (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) <u>Introduction to Philosophy:</u>

   (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
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", Lowa 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.

Semester VI

Subject Code	Subject Name	Credit Lecture (L-T-P)			Total Credits
DC 306	Fire modeling	3	0	0	9

Unit 1:

Basic Model Forms, Basic Simulation Approaches, Handling Stepped and Event-based Time in Simulations, Discrete versus Continuous Modelling, Numerical Techniques, Sources and Propagation of Error.
Dynamical, Finite State, and Complex Model Simulations: Graph or Network Transitions Based Simulations, Actor Based Simulations, Mesh Based Simulations, Hybrid Simulations.

Unit 2:

Converting to Parallel and Distributed Simulations: Partitioning the Data, Partitioning the Algorithms, Handling Inter-partition Dependencies.Probability and Statistics for Simulations and Analysis: Introduction to Queues and Random Noise, Random Variates Generation, Sensitivity Analysis.

Unit 3:

Simulations Results Analysis and Viewing Tools: Display Forms: Tables, Graphs, and Multidimensional Visualization, Terminals, X and MS Windows, and Web Interfaces, Validation of Model Results.

Unit 4:

Index notation, matrix operations, Thermodynamics, equation ofstate, chemical and phase equilibrium,Droplet mass, momentum, and energy transfer, Taylor series, order of accuracy, Numerical time integration, explicit and implicit methods, Finite difference methods, stability restrictions, Lax equivalence theorem, Derivation of mass, momentum, and energy equations Pressure Poisson equation, projection methods,Scalar transport schemes, Godunov'stheorem.

Unit 5:

Time-splitting methods for source terms, Non-dimensional forms of the governing equations, Compressible and low-Mach formulations Velocity divergence constraint for low-Mach ows, Thermal radiation, discrete ordinates method, Beer's law, Turbulence theory: vortices dynamics, Kolmogorov, Batchelor, power spectra, 2 DNS, length scale requirements, parallel computing, estimating cost, RANS, turbulence models, statistical correlations, LES, subgrid closures, ltering, energy spectrum, Nyquist limit,aliasing.

Unit 6:

Turbulent boundary layers, grid design, mesh quality metrics Models for the mean chemical source term (turbulent combustion) Extinction, ignition, under-ventilated combustion, toxic products (CO, soot) Pyrolysis, ame spread, Fire suppression, Model validation and uncertainty quantization (model input and output) .

References:

1. Introduction to Mathematical Fire Modeling, Second Edition ByMarc L.Janssens
2. Standard Fire Behavior Fuel Models: A Comprehensive Set for Use withRothermel's Surface Fire Spread Model by Joe H. Scott, Robert E. Burgan

Subject Code	Subject Name	Credit Lecture (L-T-P)			Total Credits
DC 307	Industrial Pollution & Control	2	0	0	6

Unit 1:

Types of emissions from Chemical industries and Effects of environment, Environment legislation, Type of pollution and their sources, Effluent guidelines and standards

Unit 2:

Characterization of effluent streams, Oxygen demands and their determination (BOD, COD, and TOC), Oxygen sag curve, BOD curve mathematical, Controlling of BOD curve, Self-purification of running streams, Sources and characteristics of pollutants in fertilizer, paper and pulp industry, petroleum and petroleum industry.

Unit 3:

Methods of Primary treatments: Screening, Sedimentation, Flotation, Neutralization, and methods of tertiary treatment. Brief studies of Carbon absorption, Ion exchange, Reverse osmosis, Ultra filtration, Chlorination, Ozonation, treatment and disposal.

Unit 4:

Introduction to waste water treatment, Biological treatment of wastewater, Bacterial and bacterial growth curve, Aerobic processes, Suspended growth processes, Activated aerated lagoons and stabilization ponds, Attached growth processes, Trickling filters, Rotary drum filters, and Anaerobic processes

Unit 5:

Air pollution sampling and measurement: Types of pollutant and sampling and measurement, ambient air sampling: Collection of gaseous air pollutants, Collection of particulate air pollutants. Stack sampling: Sampling system, Particulate sampling, and gaseous sampling.

Unit 6:

Air pollution control methods and equipment: Source collection methods: raw material changes, process changes, and equipment modification. Cleaning of gaseous equipment particulate emission control: Collection efficiency, Control equipment like gravitational settling chambers, Cyclone separators, fabric filters, ESP. Scrubbers and absorption equipment

Text Book:

- Environmental Pollution and Control Engineering, Rao C. S., Wiley Eastern Limited, India, 1993.

Reference Books:

- Pollution Control in Process Industries, S.P. Mahajan, TMH., 1985.
- Waste Water Treatment, M.NarayanaRao and A.K.Datta, 3rd Edition, Oxford and IHB, 2008.
- Industrial Pollution Control and Engineering, Swamy AVN, Galgotia publications, 2005.

Subject Code	Subject Name	Credit Lecture (L-T-P)			Total Credits
DC 308	Simulation of Fires in Enclosures	3	0	0	9

Unit 1: Material flammability characteristics
Ignitability, solid materials -Understand the concept of thermal ignition by convective and radiative heating. The concept of critical surface temperature.Relation to fire point theory. Write equations for radiative heating, determination of material flammability parameters such as $k\rho c$, minimum flux for ignition.;**Flame spread** - Various factors influencing flamespread. Various spread modes. Generalized equation for flame spread.Solutions for rapid, concurrent mode. Solutions for lateral flame spread. Determination of flame spread coefficient. **Burning rates** - Fire growth and burning rates of various fuel packages or fuel assemblies. Various factors influencing burning and guidelines for estimating or measuring burning rate.

Unit 2: Chemistry of room fire combustion
Thermal decomposition of polymers, generation of heat and chemical compounds, equilibrium and non-equilibrium calculation of composition of products, Stoichiometry, combustion efficiency,Fuel lean and fuel rich regions. Equivalence ratio.Composition of upper gas layer of a non-vented room fire as a function of combustion efficiency.Adiabatic flame temperature of upper gas layer.Potential for layer ignition. For vented room fires: Flashover and the concepts of critical equivalence ratio and critical energy density.

Unit 3: Vent Flows
General equations for flow through openings   - Calculation methods for flow in openings. Flow coefficients. Hydrostatic pressure differences - Hydrostatic pressure differences for one- and two-zone room fire idealizations. Concept of neutral layer, mass balance equations. Pressure differences calculated for general room temperature distributions.

Unit 4: Heat flow calculations
Heat flow calculations upper gas layer - walls and ceilings in contact upper gas layer - floor and lower part of walls radiation from flames

Unit 5: Ceiling flames and ceiling jet
Ceiling flame geometry and length. Non-dimensional correlations, ceiling jet flow characteristics. Steady fires. Transient fires.

References:

1. Delichatsios, M.A., Air Entrainment Into Buoyant Jet Flames and Pool Fires, SFPE Handbook, 1st Edition, ed. P.J. Di Nenno (Society of Fire Protection Engineers, Boston), 1988, Ch. 1-19.

2. Emmons, D.D., Ceiling Jet Flows, SFPE Handbook, 1st Edition, ed. P.J. Di Nenno (Society of Fire Protection Engineers, Boston), 1988, Ch. 1-8

3. Evans, D.D., Ceiling jet flows, SFPE Handbook, 1st Edition, ed. P.J. Di Nenno (Society of Fire Protection Engineers, Boston), 1988, Ch. 1-9.

4. Heskestad, G., Fire Plumes, SFPE Handbook, 1st Edition, ed. P.J. Di Nenno (Society of Fire Protection Engineers, Boston), 1988, Ch. 1-6.

5. McCaffrey, B.J., Flame Height, SFPE Handbook, 1st Edition, ed. P.J. Di Nenno (Society of Fire Protection Engineers, Boston), 1988, Ch. 1-18.

Department Electives

Subject Code	Subject Name	Credit Lecture (L-T-P)			Total Credits
DE 301	Advanced Fire Dynamics	3	0	0	9

Unit 1:
Basics of conservation equations, turbulence, radiation and thermochemistry.

Unit 2:
Ignition of solids– burning and heat release rates. Properties of fire plumes–buoyant plumes and interactions with surfaces.

Unit 3:
Turbulent diffusion flames–structure, modeling, soot formation and radiation effects.Toxic products.

Unit 4:
Fire chemistry, thermal decomposition of bulk fuel, pyrolysis, nitrogen and halogen chemistry. Fire growth– ignition, initial conditions, flame and fire spread theory, feedback to fuel. Compartment zone models.

Unit 5:
Flashover, post-flashover and control.Fire detection, suppression methods, codes, standards and laws.

Unit 6:
Case studies of real fires–buildings, transport, industries, forests, shamiana, jhuggi-jhonpdi.

Texts:

1. Quintiere J. G., Fundamentals of Fire Phenomena, John Wiley & Sons, Chichester, UK, 2011.

2. Drysdale D., An Introduction to Fire Dynamics, John Wiley & Sons, UK, 2011. 3. Karlsson B. and Quintiere J. G., Enclosure Fire, CRC Press, 2000.

References:

1. Turns S. R., An Introduction to Combustion, McGraw-Hill, New York, USA, 2012.

2. The SFPE Handbook of Fire Protection Engineering, 2nd Ed., 1995.

Subject Code	Subject Name	Credit Lecture (L-T-P)			Total Credits
DE 301	Computational Fluid Dynamics	3	0	0	9

Unit 1: Introduction
Illustration of the CFD approach, CFD as an engineering analysis tool, Review of governing equations, Modeling in engineering, Partial differential equations- Parabolic, Hyperbolic and Elliptic equation, CFD application in Chemical Engineering, CFD software packages and tools.

Unit 2: Principles of Solution of the Governing Equations
Finite difference and Finite volume Methods, Convergence, Consistency, Error and Stability, Accuracy, Boundary conditions, CFD model formulation.

Unit 3: Mesh generation
Overview of mesh generation, Structured and Unstructured mesh, Guideline on mesh quality and design, Mesh refinement and adaptation.

Unit 4: Solution Algorithms
Discretization schemes for pressure, momentum and energy equations - Explicit and implicit Schemes, First order upwind scheme, second order upwind scheme, QUICK scheme, SIMPLE, SIMPLER and MAC algorithm, pressure-velocity coupling algorithms, velocity-stream function approach, solution of Navier-Stokes equations.

Unit 5: CFD Solution Procedure
Problem setup – creation of geometry, mesh generation, selection of physics and fluid properties, initialization, solution control and convergence monitoring, results reports and visualization

Unit 6: Case Studies
Benchmarking, validation, Simulation of CFD problems by use of general CFD software, Simulation of coupled heat, mass and momentum transfer problem.

Text Books:

1. P.S. Ghosdastidar, Computer Simulation of Flow and Heat Transfer, Tata McGraw-Hill (1998).

2. Muralidhar, K.,andSundararajan,T. Computational Fluid Flow and Heat Transfer, Narosa Publishing. House (1995).

Reference Books:

1. Niyogi, P. Chakrabarty, S.K. and Laha, M.K., Introduction to computational fluid dynamics, Pearson education (2006).

2. LI J., G. H. Yeoh, C Liu. A Computational Fluid Dynamics, ELSEVER (2008)

3. Suhas V. Patankar. Numerical Heat Transfer and Fluid Flow, Taylor and Francis (1978).

4. S K Gupta. Numerical Methods for Engineers, New Age Publishers, 2nd Edition (1995).

5. Anderson J.D. Computational Fluid Dynamics, Mc-Graw Hills (1995).

6. Ranade, V.V., Computational flow modeling for chemical reactor engineering, Academic Press (2002).

7. J H Ferziger and M Peric, Computational Methods for Fluid Dynamics, Springer (2002).

Subject Code	Subject Name	Credit Lecture (L-T-P)			Total Credits
DE 301	Piping Hydraulics & Machineries	3	0	0	9

Unit 1: Hydraulic machinery
Principles, Dynamic Section of Fluid, Dynamic force and torqueexecuted by fluid jet on plain, curved stationary and moving vanes-, Velocity Diagrams, work done by impact, pressure due to deviated flow; Pumps (Positive Displacement Pumps), Reciprocating pumps; Basic theory, types, construction, installation characteristics and operation and accessories.

Unit 2: Centrifugal pumps and its characteristics
Other water lifting devices, Ejector pumps, Air-lift pump installation operation.-Parallel —Series, Centrifugal pumps. Pump Section, Maintenance and application.

Unit 3: Hydraulics
Flow of water through open channels, pipe hose and nozzles. Measures of flow, pressure and pressure drop. KINEMATICS OF FLUIDS; FLOW: Type of flow, path lines and stream lines, equation of continuity, one dimensional method of flow analysis.

Unit 4: Dynamics of fluid flow
Energies-potential, pressure and kinetic, Momentum and energy equations for steady flow, Bernoulli's theorem and its applications.

Unit 5: Fluid measurement
Pressure measurements, use ofpiezo-meters and static tubes, velocity measurements, use of pitch-tubes, current meters. Discharge measurement, use of venturi-meter. Orifice -meter.

TEXT AND REFERENCE BOOKS:
1. Pump Selection and application: Tyler C. Riches.
2. Pump Operators, Handbook: I.S. University of Science and Technology.
3. Fire Pumps and Hydraulics: I.E. Ditts and T.M. Harris.
4. Hydraulic Mechanics: Dr. J.Lal
5. Pumps and Blowers : Church and Lal
6. Manual of Fireman ship Book No.4
7. Hydraulics Machines :J.Lal
8. Fire-fighting Hydraulics :Purington
9. Hydraulics and Fluid Mechanics :P.N.Modi, Dr. S.M. Seth
10. A text-book of Hydraulics, Fluid Mechanics & Hydraulic Machines: R.S. Khurmi
11. Fluid Mechanics and Systems : S. Nagarathnam
12. Engineering Fluid Mechanics : K.L. Kumar
13. A Text Book on Hydraulics and Fluid Mechanics (Vol. 1): Dr. V.G. Garde, R.M. Advani.

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

Unit 1:
Energy resources, Energy conversion processes and devices – Energy conversion plants – Conventional - Thermal, Hydro, Nuclear fission , and Non – conventional – Solar, Wind Biomass, Fuel cells, Magneto Hydrodynamics and Nuclear fusion. Energy from waste, Energy plantation.

Unit 2:
Energy storage and Distribution – Electrical energy route – Load curves – Energy conversion plants for Base load , Intermediate load, Peak load and Energy displacement – Energy storage plants. Energy Scenario – Global and Indian –Impact of Energy on economy, development and environment, Energy policies, Energy strategy for future.

Unit 3:
Energy Management – Definitions and significance – objectives –Characterising of energy usage – Energy Management program – Energy strategies and energy planning Energy Audit – Types and Procedure – Optimum performance of existing facilities – Energy management control systems – Computer applications in Energy management.

Unit 4:
Energy conservation – Principles – Energy economics – Energy conservation technologies – cogeneration – Waste heat recovery – Combined cycle power generation – Heat Recuperators – Heat regenerators – Heat pipes – Heat pumps – Pinch Technology Energy Conservation Opportunities – Electrical ECOs – Thermodynamic ECOs in chemical process industry – ECOs in residential and commercial buildings – Energy Conservation Measures.

References:

1. AmlanChakrabarti, Energy Engineering and Management, Prentice Hall India, 2011.

2. Eastop T. D. and D. R. Croft, Energy Efficiency for Engineers & Technologists, Longman, 1990.

3. Albert Thumann P. E. and W. J. Younger, Handbook of Energy Audits, Fairmont Press, 2008.

4. Doty S. and W. C. Turner, Energy Management Hand book, 7/e, Fairmont Press, 2009.

5. Rao S. and B. B. Parulekar, Energy Technology, Khanna Publishers, 2005. 6. Rai G. D., Non-conventional Energy Sources, Khanna Publishers, 2011

Subject Code	Subject Name	Credit Lecture (L-T-P)			Total Credits
DC 309	Special Fire Hazards	2	0	0	6

Unit 1: Introduction to concept of Special Fire Hazard

Concept of SFH- Areas under special fire hazard; Principles of life safety and objectives.SEVESO Directive, COMAH, DSEAR regulations ATEX Directives; Basic fire safety strategy in high rise building.Categories of special structures.

Unit 2: Aviation Fire Operations

Introduction to aircraft and parts -Materials of construction, Details of construction, Fuel tanks, construction of tanks and different aviation fuels, Different engines and APU; Aircraft fires - Engine fire, Wheel fire, Cabin fire, Vapour cloud explosion in fuel tanks; Rescue from civil aircrafts - Approach to aircraft with engines running, Main passenger doors, Emergency stairs and escape slide, Break-in points, Safety straps; Categorisation of airports; Airport fire hazards - Introduction to airport fire hazards: landside and airside, Terminal buildings, Aircraft hangars, Fuel storage farms and associated facilities, Engine test facilities, General industrial and commercial facilities, Electrical plant facilities, Communication equipment facilities, Aircraft fuel servicing; Hazards in airport terminal building; Airport emergency planning and procedure - Pre-planning before an emergency: onsite and offsite emergency planning, Operation during an emergency, Support and documentation after emergency; Types of emergencies- Local standby, Low visibility standby, Full emergency; Triage and medical care - Triage principles and categories

Unit 3: Gas Plants, Refineries, Chemical and Petro Chemical industry hazards

Fire Fighting, Fire Prevention and protection and safety measurements for the above mentioned industries; Salvage and protection from disaster fallout for these industries

Unit 4: Onshore, Offshore, Power Plant, fuel storage and LNG fire hazards

LNG introduction & MSDS of LNG; Fire fighting and control; Types of offshore platforms, Fire hazards in offshore platforms, Safety measure in offshore platforms; Power plant and energy generation hazards and fire prevention and fire fighting in these industries.

References:

1. Aircraft incidents – HM Fire Services Publication
2. Petrochemical incidents - HM Fire Services Publication
3. DSEAR Regulations
4. COMAH Regulations
5. SEVESO Directives I. II. III
6. ATEX Directives