CHHATRAPATI SHAHU JI MAHARAJ UNIVERSITY

KANPUR

SYLLABUS

(Diploma in Chemical Engineering)

CHEMICAL ENGINEERING

UNIVERSITY INSTITUTE OF ENGINEERING & TECHNOLOGY

SCHOOL OF ENGINEERING & TECHNOLOGY

Semester I
(Common to all Branches)

Sl. No	Category of Course	Code No.	Course Title	Hours per week			Total contact hrs/ week	Cred-its
				L	T	P		
1.	Basic Science	BS101	Mathematics-I	2	1	0	3	3
2.	Basic Science	BS103	Applied Physics-I	2	1	0	3	3
3.	Basic Science	BS105	Applied Chemistry	2	1	0	3	3
4.	Humanities & Social Science	HS101	Communication Skills in English	2	0	0	2	2
5.	Engineering Science	ES101	Engineering Graphics	0	0	3	3	1.5
6.	Engineering Science	ES103	Engineering Workshop Practice	0	0	3	3	1.5
7.	Basic Science	BS107	Applied Physics-I Lab	0	0	2	2	1
8.	Basic Science	BS109	Applied Chemistry Lab	0	0	2	2	1
9.	Humanities & Social Science	HS103	Sports and Yoga	0	0	2	2	1
10.	Humanities & Social Science	HS105	Communication Skills in English Lab	0	0	2	2	1
	Total Credits							**18**

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Semester II
(Common to all Branches)

Sl. No	Category of Course	Code No.	Course Title	Hours per week			Total contact hrs/ week	Cred-its
				L	T	P		
1	Basic Science	BS102	Mathematics-II	3	1	0	4	4
2	Basic Science	BS104	Applied Physics-II	2	1	0	3	3
3	Engineering Science	ES102	Introduction to IT Systems	2	0	0	2	2
4	Engineering Science	ES104	Fundamentals of Electrical & Electronics Engineering	2	1	0	3	3
5	Engineering Science	ES106	Engineering Mechanics	2	1	0	3	3
6	Basic Science	BS106	Applied Physics-II Lab	0	0	2	2	1
7	Engineering Science	ES108	Introduction to IT Systems Lab	0	0	4	4	2
8	Engineering Science	ES110	Fundamentals of Electrical & Electronics Engineering Lab	0	0	2	2	1
9	Engineering Science	ES112	Engineering Mechanics Lab	0	0	2	2	1
10	Audit	AU102	Environmental Science	2	0	0	2	0
Total Credits								**20**

Detailed First Year Curriculum Contents
SEMESTER - I

Course Code	:	BS101
Course Title	:	Mathematics- I
Number of Credits	:	3 (L:2,T:1,P:0)
Prerequisites	;	NIL
Course Category	:	BS

Course Objectives:

This course is designed to give a comprehensive coverage at an introductory level to the subject of Trigonometry, Differential Calculus and Basic elements of algebra.

Course Content:

UNIT - I: Trigonometry

Concept of angles, measurement of angles in degrees, grades and radians and their conversions, T-Ratios of Allied angles (without proof), Sum, difference formulae and their applications (without proof). Product formulae (Transformation of product to sum, difference and vice versa). T- Ratios of multiple angles, sub-multiple angles (2A, 3A, A/2). Graphs of sin x, cos x, tan x and e^x .

Differential Calculus

Definition of function; Concept of limits. Four standard limits $\lim_{x \to a} \frac{x^n - a^n}{x-a}$, $\lim_{x \to 0} \frac{\sin x}{x}$, $\lim_{x \to a} \left(\frac{a^x - 1}{x}\right)$ and $\lim_{x \to a} (1+x)^{\frac{1}{x}}$.

Differentiation by definition of x^n, $\sin x$ $\cos x$, $\tan x$, 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.

UNIT - III: Algebra

Complex Numbers: Definition, real and imaginary parts of a Complex number, polar and Cartesian, representation 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 a complex number. De-movier's theorem, its application.

Partial fractions: Definition of polynomial fraction proper & 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.

Permutations and Combinations: Value of ${}^nP_r$ and ${}^nC_r$.

Binomial theorem: Binomial theorem (without proof) for positive integral index (expansion and general form); binomial theorem for any index (expansion without proof) first and second binomial approximation with applications to engineering problems

References:

1. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, New Delhi, 40th Edition, 2007.
2. G. B. Thomas, R. L. Finney, Calculus and Analytic Geometry, Addison Wesley, 9th Edition, 1995.
3. Reena Garg, Engineering Mathematics, Khanna Publishing House, New Delhi (Revised Ed. 2018)
4. V. Sundaram, R. Balasubramanian, K.A. Lakshminarayanan, Engineering Mathematics, 6/e., Vi-

kas Publishing House.

5. Reena Garg & Chandrika Prasad, Advanced Engineering Mathematics, Khanna Publishing House, New Delhi

Course Outcomes:

By the end of the course, the students are expected to learn

(i) The students are expected to acquire necessary background in Trigonometry to appreciate the importance of the geometric study as well as for the calculation and the mathematical analysis.

(ii) The ability to find the effects of changing conditions on a system.

(iii) Complex numbers enter into studies of physical phenomena in ways that most people cannot imagine.

(iv) The partial fraction decomposition lies in the fact that it provides an algorithm for computing the antiderivative of a rational function.

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Course Code	:	BS103
Course Title	:	Applied Physics –I
Number of Credits	:	3 (L: 2, T: 1, P: 0)
Prerequisites	:	High School Level Physics
Course Category	:	BS

Course Objectives:

Applied Physics includes the study of a large number of diverse topics all related to materials/things that exist in the world around us. It aims to give an understanding of this world both by observation and by prediction of the way in which such objects behave. Concrete use of physical principles and analysis in various fields of engineering and technology are given prominence in the course content. The course will help the diploma engineers to apply the basic concepts and principles to solve broad-based engineering problems and to understand different technology based applications.

Teaching Approach:

- Teachers should give examples from daily routine as well as, engineering/technology applications on various concepts and principles in each topic so that students are able to understand and grasp these concepts and principles. In all contents, SI units should be followed.
- Use of demonstration can make the subject interesting and develop scientific temper in the students. Student activities should be planned on all the topics.
- Activity- Theory - Demonstrate/practice approach may be followed throughout the course so that learning may be outcome and employability based.

Course Content:

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 numericals) 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.

Learning Outcome:

After undergoing this subject, the student will be able to:

- Identify physical quantities, select their units for use in engineering solutions, and make measurements with accuracy by minimizing different types of errors.
- Represent physical quantities as scalar and vectors and solve real life relevant problems.
- Analyse type of motions and apply the formulation to understand banking of roads/railway tracks and conservation of momentum principle to describe rocket propulsion, recoil of gun etc.
- Define scientific work, energy and power and their units. Drive relationships for work, energy and power and solve related problems.
- Describe forms of friction and methods to minimize friction between different surfaces.
- State the principle of conservation of energy. Identify various forms of energy, and energy transformations.
- Compare and relate physical properties associated with linear motion and rotational motion and apply conservation of angular momentum principle to known problems.
- Describe the phenomenon of surface tension, effects of temperature on surface tension and solve statics problems that involve surface tension related forces.
- Describe the viscosity of liquids, coefficient of viscosity and the various factors affecting its value. Determine viscosity of an unknown fluid using Stokes' Law and the terminal velocity.
- Define stress and strain. State Hooke's law and elastic limits, stress–strain diagram, determine; (a) the modulus of elasticity, (b) the yield strength (c) the tensile strength, and (d) estimate the percent elongation.
- Illustrate the terms; heat and temperature, measure temperature in various processes on different scales (Celsius, Fahrenheit, and Kelvin etc.)
- Distinguish between conduction, convection and radiation; identify different methods for reducing heat losses and mode of heat transfer between bodies at different temperatures.
- State specific heats and measure the specific heat capacity of solids and liquids.

References:

1. Text Book of Physics for Class XI& XII (Part-I, Part-II); N.C.E.R.T., Delhi
2. Applied Physics, Vol. I and Vol. II, TTTI Publications, Tata McGraw Hill, Delhi.
3. Concepts in Physics by HC Verma, Vol. I & II, Bharti Bhawan Ltd. New Delhi
4. Engineering Physics by PV Naik, Pearson Education Pvt. Ltd, New Delhi
5. Engineering Physics by DK Bhhatacharya & PoonamTandan; Oxford University Press, New Delhi.
6. Comprehensive Practical Physics, Vol, I & II, JN Jaiswal, Laxmi Publications (P) Ltd., New Delhi
7. Practical Physics by C. L. Arora, S. Chand Publication.
8. e-books/e-tools/ learning physics software/websites etc.

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Course Code	:	BS105
Course Title	:	Applied Chemistry
Number of Credits	:	3 (L: 2, T: 1, P: 0)
Prerequisites	:	High School Level Chemistry
Course Category	:	BS

Course Objectives:

There are numerous number materials are used in fabricating and manufacturing devices for the comfort of life. The selection, characterization and suitability assessment of natural raw materials essentially requires principles and concepts of Applied Chemistry for technicians. On successful completion of this course content will enable technicians to understand, ascertain and analyse and properties of natural raw materials require for producing economical and eco-friendly finished products.

- Solve various engineering problems applying the basic knowledge of atomic structure and chemical bonding.
- Use relevant water treatment method to solve domestic and industrial problems.
- Solve the engineering problems using knowledge of engineering materials and properties.
- Use relevant fuel and lubricants for domestic and industrial applications
- Solve the engineering problems using concept of Electrochemistry and corrosion.

Course Content:

- **Unit 1: Atomic Structure, Chemical Bonding and Solutions**

  Rutherford model of atom, Bohr's theory (expression of energy and radius to be omitted), and hydrogen spectrum explanation based on Bohr's model of atom, Heisenberg uncertainty principle, Quantum numbers – orbital concept. Shapes of s,p and d orbitals, Pauli's exclusion principle, Hund's rule of maximum multiplicity Aufbau rule, electronic configuration.

  Concept of chemical bonding – cause of chemical bonding, types of bonds: ionic bonding (NaCl example), covalent bond (H_2, F_2, HF hybridization in $BeCl_2$, BF_3, CH_4, NH_3, H_2O), coordination bond in NH_4^+, and anomalous properties of NH_3, H_2O due to hydrogen bonding, and metallic bonding.

  Solution – idea of solute, solvent and solution, methods to express the concentration of solution- molarity (*M* = mole per liter), ppm, mass percentage, volume percentage and mole fraction.

- **Unit 2: Water**

  Graphical presentation of water distribution on Earth (pie or bar diagram). Classification of soft and hard water based on soap test, salts causing water hardness, unit of hardness and simple numerical on water hardness.

  Cause of poor lathering of soap in hard water, problems caused by the use of hard water in boiler (scale and sludge, foaming and priming, corrosion etc), and quantitative measurement of water hardness by ETDA method, total dissolved solids (TDS) alkalinity estimation.

  i). Water softening techniques – soda lime process, zeolite process and ion exchange process.

  ii). Municipal water treatment (in brief only) – sedimentation, coagulation, filtration, sterilization.

  Water for human consumption for drinking and cooking purposes from any water sources and enlist Indian standard specification of drinking water (collect data and understand standards).

- **Unit 3: Engineering Materials**

  Natural occurrence of metals – minerals, ores of iron, aluminium and copper, gangue (matrix), flux, slag, metallurgy – brief account of general principles of metallurgy.

  Extraction of - iron from haematite ore using blast furnace, aluminium from bauxite along with reactions. Alloys – definition, purposes of alloying, ferrous alloys and non-ferrous with suitable examples, properties and applications.

  General chemical composition, composition based applications (elementary idea only details omitted):

  Port land cement and hardening, Glasses Refractory and Composite materials.

  Polymers – monomer, homo and co polymers, degree of polymerization, simple reactions involved in preparation and their application of thermoplastics and thermosetting plastics (using PVC, PS, PTFE, nylon – 6, nylon-6,6 and Bakelite), rubber and vulcanization of rubber.

- **Unit 4: Chemistry of Fuels and Lubricants**

  Definition of fuel and combustion of fuel, classification of fuels, calorific values (HCV and LCV), calculation of HCV and LCV using Dulong's formula.

  Proximate analysis of coal solid fuel

  petrol and diesel - fuel rating (octane and cetane numbers),

  Chemical composition, calorific values and applications of LPG, CNG, water gas, coal gas, producer gas and biogas.

  Lubrication – function and characteristic properties of good lubricant, classification with examples, lubrication mechanism – hydrodynamic and boundary lubrication, physical properties (viscosity and viscosity index, oiliness, flash and fire point, could and pour point only) and chemical properties (coke number, total acid number saponification value) of lubricants.

- **Unit 5: Electro Chemistry**

  Electronic concept of oxidation, reduction and redox reactions.
  Definition of terms: electrolytes, non-electrolytes with suitable examples, Faradays laws of electrolysis and simple numerical problems.
  Industrial Application of Electrolysis –
    - Electrometallurgy
    - Electroplating
    - Electrolytic refining.

  Application of redox reactions in electrochemical cells –
    - Primary cells – dry cell,
    - Secondary cell - commercially used lead storage battery, fuel and Solar cells.

  Introduction to Corrosion of metals –
    - definition, types of corrosion (chemical and electrochemical), H_2 liberation and O_2 absorption mechanism of electrochemical corrosion, factors affecting rate of corrosion.

  Internal corrosion preventive measures –
    - Purification, alloying and heat treatment and

  External corrosion preventive measures: a) metal (anodic, cathodic) coatings, b) organic inhibitors.

Suggested Sessional work:

- **Unit 1: Atomic Structure, Chemical Bonding and Solutions**

  Assignments: Writing electronic configuration of elements up to atomic number 30 (Z= 30). Numerical on molarity, ppm, mass percentage, volume percentage and mole fraction of given solution.

  Seminar: 1. Quantum numbers,

  2. Discuss the metallic properties such as malleability, ductility, hardness, high melting point, conductance of heat and electricity, magnetic properties of metals.

  Projects: Model of molecules $BeCl_2$, BF_3, CH_4, NH_3, H_2O.

- **Unit 2: Water**

  Assignments: Simple problems on hardness calculation.

  Seminar: 1. Quality and quantity requirement of water in house and industry.

  2. Quality of control measures of effluents (BOD & COD).

  Projects: Collect water samples from different water sources and measure of hardness of water.

- **Unit 3: Engineering Materials**

  Assignments: Preparation of table showing different ores of iron, copper and aluminium metals along with their chemical compositions and classify in to oxide sulphide halide ores.

  Seminar: Discuss the chemical reactions taking place in blast furnace in extraction of Fe, Cu and Al metals.

  Projects: Make table showing place of availability of different ores in India and show places on India map.

- **Unit 4: Chemistry of Fuels and Lubricants**

  Assignments: Calculation of HCV and LCV of fuel using fuel composition in Dulong's formula.

  Seminar: Chemical structure of fuel components influence on fuel rating.

  Projects: Mapping of energy recourses in India. Collection of data of various lubricants available in the market.

- **Unit 5: Electro Chemistry**

  Assignments: Simple problems on Faradays laws of electrolysis.

  Seminar: 1. Corrosion rate and units.

  2. Corrosion preventions.

  Projects: Mapping of area in India prone to corrosion. Collection of data of various electrochemical cells batteries used in equipment and devices and available in market. Visit to sites such as Railway station to watch corrosion area in railways and research establishment in and around the institution.

Learning Outcomes

At the end of the course student will be able to

1. Understand the classification and general properties of engineering materials such as met-

al, alloys, glasses, cement, refractory and composite materials using knowledge of chemical bonding.

2. Understand and assess the suitability of water source for domestic and industrial application, effluents and minimize water pollution.
3. Qualitatively analyze the engineering materials and understand their properties and applications.
4. Choose fuel and lubricants suitable for economical industrial processing to obtain eco-friendly finished products.
5. a) Ascertain construction, mechanism efficiency of electrochemical cells, solar cell fuel cells

   b) Understand corrosion and develop economical prevention techniques.

References/Suggested Learning Resources:

(a) Books :

1) Text Book of Chemistry for Class XI& XII (Part-I, Part-II); N.C.E.R.T., Delhi, 2017-18.
2) Agarwal, & Shikha, Engineering Chemistry, Cambridge University Press; New Delhi, 2015.
3) C.N. R. Rao, Understanding Chemistry, Universities Press (India) Pvt. Ltd., 2011.
4) Dara, S. S. & Dr.S.S.Umare, Engineering Chemistry, S.Chand. Publication, New Delhi, New Delhi, 2015.
5) Jain & Jain, Engineering Chemistry, Dhanpat Rai and Sons; New Delhi, 2015.
6) Dr. Vairam, S., Engineering Chemistry, Wiley India Pvt.Ltd., New Delhi, 2013.
7) Dr. G. H. Hugar & Prof A. N. Pathak, Applied Chemistry Laboratory Practices, Vol. I and Vol. II, NITTTR, Chandigarh, Publications, 2013-14.
8) Agnihotri, Rajesh, Chemistry for Engineers, Wiley India Pvt.Ltd., 2014.

(b) Open source software and website address:

1 www.chemguide.co.uk/atommenu.html (Atomic structure and chemical bonding)
2 www.visionlearning.com (Atomic structure and chemical bonding)
3 www.chem1.com (Atomic structure and chemical bonding)
4 https://www.wastewaterelearning.com/elearning/ (Water Treatment)
5 www.capital-refractories.com (Metals, Alloys, Cement, and Refractory Materials)
6 www.em-ea.org/guide%20books/book-2/2.1%20fuels%20and%20combustion.pdf (Fuel and Combustion)
7 www.chemcollective.org (Metals, Alloys)
8 www.wqa.org(Water Treatment)

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Course Code	:	HS101
Course Title	:	Communication Skills in English
Number of Credits	:	2(L:2,T:0,P:0)
Prerequisites	:	NIL
Course Category	:	HS

Course Objectives:

Communication skills play an important role in career development. This course aims at introducing basic concepts of communication skills with an emphasis on developing personality of the students. Thus, the main objectives of this course are:

To develop confidence in speaking English with correct pronunciation.
To develop communication skills of the students i.e. listening, speaking, reading and writing skills.
To introduce the need for personality development- Focus will be on developing certain qualities which will aid students in handling personal and career challenges, leadership skills etc.

Course Content

Unit-1 Communication: Theory and Practice

- Basics of communication: Introduction, meaning and definition, process of communication etc.
- Types of communication: formal and informal, verbal, non-verbal and written Barriers to effective communication.
- **7** Cs for effective communication (considerate, concrete, concise, clear, complete, correct, courteous).
- Art of Effective communication,
    - Choosing words
    - Voice
    - Modulation
    - Clarity
    - Time
    - Simplification of words
- Technical Communication.

Unit-2 Soft Skills for Professional Excellence

- Introduction: Soft Skills and Hard Skills.
- Importance of soft skills.
- Life skills: Self-awareness and Self-analysis, adaptability, resilience, emotional intelligence and empathy etc.
- Applying soft skills across cultures.
- Case Studies.

Unit-3: Reading Comprehension

Comprehension, vocabulary enhancement and grammar exercises based on reading of the following texts:

Section-1

Malgudi Days: R.K. Narayan
The Room on Roof: Ruskin Bond
"The Gift of the Magi" by O. Henry
"Uncle Podger Hangs a Picture" Jerome K. Jerome

Section-2

Night of the Scorpion by Nissim Ezekiel,
Stopping by Woods on a Snowy Evening by Robert Frost,
Where the Mind is Without Fear by Rabindranath Tagore,
Ode to Tomatoes by Pablo Neruda,

Unit-4: Professional Writing

The art of précis writing,
Letters: business and personnel,
Drafting e-mail, notices, minutes of a meeting etc.
Filling-up different forms such as banks and on-line forms for placement etc.

Unit-5: Vocabulary and Grammar

Vocabulary of commonly used words
Glossary of administrative terms (English and Hindi)
One-word substitution, Idioms and phrases etc.
Parts of speech, active and passive voice, tenses etc., Punctuation

References:

1. J.D.O'Connor. *Better English Pronunciation.* Cambridge: Cambridge University Press, 1980.
2. Lindley Murray. *An English Grammar: Comprehending Principles and Rules.* London: Wilson and Sons, 1908.
3. Kulbhushan Kumar, Effective Communication Skills, Khanna Publishing House, New Delhi (Revised Edition 2018)
4. Margaret M. Maison. *Examine your English.* Orient Longman: New Delhi, 1964.
5. M. Ashraf Rizvi. *Effective Technical Communication*. Mc-Graw Hill: Delhi, 2002.
6. John Nielson. *Effective Communication Skills.* Xlibris, 2008.
7. *Oxford Dictionary*
8. *Roget's Thesaurus of English Words and Phrases*
9. *Collin's English Dictionary*

Course outcomes:

At the end of this course, the participants will:

- Develop basic speaking and writing skills including proper usage of language and vocabulary so that they can become highly confident and skilled speakers and writers.
- Be informed of the latest trends in basic verbal activities such as presentations, facing interviews and other forms of oral communication.
- Also develop skills of group presentation and communication in team.
- Develop non-verbal communication such as proper use of body language and gestures.

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Course Code	:	ES101
Course Title	:	Engineering Graphics
Number of Credits	:	1.5 (L: 0, T: 0, P: 3)
Prerequisites	:	NIL
Course Category	:	ES

Course Objectives:

- To understand the language of graphics which is used to express ideas, convey instructions while carrying out engineering jobs.
- To develop drafting and sketching skills, to know the applications of drawing equipments, and get familiarize with Indian Standards related to engineering drawings.
- To develop skills to visualize actual object or a part of it, on the basis of drawings.
- To develop skills to translate ideas into sketches and to draw and read various engineering curves, projections and dimensioning styles.
- To understand the basic commands and develop basic skills related to computer aided drafting, of how to draw, modify, and edit basic shapes (2D), using AUTOCAD.

Course Content

Unit – I Basic elements of Drawing

Drawing Instruments and supporting materials: method to use them with applications.

Convention of lines and their applications.

Representative Fractions – reduced, enlarged and full size scales; Engineering Scales such as plain and diagonal scale.

Dimensioning techniques as per SP-46:2003 – types and applications of chain, parallel and coordinate dimensioning.

Geometrical and Tangency constructions. (Redraw the figure)

Unit – II Orthographic projections

Introduction of projections-orthographic, perspective, isometric and oblique: concept and applications. (No question to be asked in examination).

Introduction to orthographic projection, First angle and Third angle method, their symbols.

Conversion of pictorial view into Orthographic Views – object containing plain surfaces, slanting surfaces, slots, ribs, cylindrical surfaces. (use First Angle Projection method only)

Unit – III Isometric Projections

Introduction to isometric projections.

Isometric scale and Natural scale.

Isometric view and isometric projection.

Illustrative problems related to objects containing lines, circles and arcs shape only.

Conversion of orthographic views into isometric view/projection.

Unit – IV Free Hand Sketches of engineering elements

Free hand sketches of machine elements: Thread profiles, nuts, bolts, studs, set screws, washer, Locking arrangements. (For branches other than mechanical Engineering, the teacher should select branch specific elements for free hand sketching)

Free hand sketches of orthographic view (on squared graph paper) and isometric view (on isometric grid paper)

Unit – V Computer aided drafting interface

Computer Aided Drafting: concept.

Hardware and various CAD software available.

System requirements and Understanding the interface.

Components of AutoCAD software window: Title bar, standard tool bar, menu bar, object properties tool bar, draw tool bar, modify tool bar, cursor cross hair. Command window, status bar, drawing area, UCS icon.

File features: New file, Saving the file, Opening an existing drawing file, Creating templates, Quit.

Setting up new drawing: Units, Limits, Grid, Snap.

Undoing and redoing action.

Unit – VI Computer aided drafting

Draw basic entities like Line, Circle, Arc, Polygon, Ellipse, Rectangle, Multiline, PolyLine.

Method of Specifying points: Absolute coordinates, Relative Cartesian and Polar coordinates.

Modify and edit commands like trim, extend, delete, copy, offset, array, block, layers.

Dimensioning: Linear, Horizontal Vertical, Aligned, Rotated, Baseline, Continuous, Diameter, Radius, Angular Dimensions.

Dim scale variable.

Editing dimensions.

Text: Single line Text, Multiline text.

Standard sizes of sheet. Selecting Various plotting parameters such as Paper size, paper units, Drawing orientation, plot scale, plot offset, plot area, print preview.

S. No.	Practical Exercises	Unit No.	Approx. Hrs
1	Draw horizontal, Vertical, 30 degree, 45 degree, 60 and 75 degrees lines, different types of lines, dimensioning styles using Tee and Set squares/ drafter. (do this exercise in sketch book)	I	02
2	Write alphabets and numerical (Vertical only) (do this exercise in sketch book)	I	02
3	Draw regular geometric constructions and redraw the given figure (do this exercise in sketch book) Part I	II	02
4	Draw regular geometric construction and redraw the given figure (do this exercise in sketch book) Part II	II	02
5	Draw a problem on orthographic projections using first angle method of projection having plain surfaces and slanting. Part I	III	02
6	Draw another problem on orthographic projections using first angle method of projection having slanting surfaces with slots. Part II	III	02
7	Draw two problems on orthographic projections using first angle method of projection having cylindrical surfaces, ribs. Part I	III	02
8	Draw two problems on Isometric view of simple objects having plain and slanting surface by using natural scale. Part I	IV	02
9	Draw some problems on Isometric projection of simple objects having cylindrical surface by using isometric scale. Part I	IV	02
10	Draw free hand sketches/ conventional representation of machine elements in sketch book such as thread profiles, nuts, bolts, studs, set screws, washers, Locking arrangements. Part I	V	02
11	Problem based Learning: Given the orthographic views of at least three objects with few missing lines, the student will try to imagine the corresponding objects, complete the views and draw these views in sketch book. Part I	III, II, V	02
12	Draw basic 2D entities like: Rectangle, Rhombus, Polygon using AutoCAD (Print out should be a part of progressive assessment). Part I	V	02
13	Draw basic 2D entities like: Circles, Arcs, circular using AutoCAD (Printout should be a part of progressive assessment). Part II	V	02
14	Draw basic 2D entities like: Circular and rectangular array using AutoCAD (Printout should be a part of progressive assessment). Part III	V	02

15	Draw blocks of 2D entities comprises of Rectangle, Rhombus, Polygon, Circles, Arcs, circular and rectangular array, blocks using AutoCAD (Print out should be a part of progressive assessment). Part IV	V	02
16	Draw basic branch specific components in 2D using AutoCAD (Print out should be a part of term work). Part I	VI	02
17	Draw complex branch specific components in 2D using AutoCAD (Print should be a part of progressive assessment). Part I	VI	02
	Total		**34**

SUGGESTED LEARNING RESOURCES

1. Bureau of Indian Standards. *Engineering Drawing Practice for Schools and Colleges IS: Sp-46.* BIS. Government of India, Third Reprint, October 1998; ISBN: 81-7061-091-2.
2. Bhatt, N. D. *Engineering Drawing*. Charotar Publishing House, Anand, Gujrat 2010; ISBN: 978-93-80358-17-8.
3. Jain & Gautam, Engineering Graphics & Design, Khanna Publishing House, New Delhi (ISBN: 978-93-86173-478)
4. Jolhe, D. A. *Engineering Drawing*. Tata McGraw Hill Edu. New Delhi, 2010; ISBN: 978-0-07-064837-1
5. Dhawan, R. K. *Engineering Drawing*. S. Chand and Company, New Delhi; ISBN: 81-219-1431-0.
6. Shah, P. J. *Engineering Drawing*. S. Chand and Company, New Delhi, 2008, ISBN:81-219-2964-4.
7. Kulkarni, D. M.; Rastogi, A. P.; Sarkar, A. K. *Engineering Graphics with AutoCAD*. PHI Learning Private Limited-New Delhi (2010); ISBN: 978-8120337831.
8. Jeyapoovan, T. *Essentials of Engineering Drawing and Graphics using AutoCAD*. Vikas Publishing HousePvt. Ltd, Noida, 2011; ISBN: 978-8125953005.
9. Autodesk. *AutoCAD User Guide*. Autodesk Press, USA, 2015.
10. Sham, Tickoo. *AutoCAD 2016 for Engineers and Designers*. Dreamtech Press; Galgotia Publication, New Delhi, 2015; ISBN 978-9351199113.

Software/Learning Websites

1. https://www.youtube.com/watch?v=TJ4jGyD-WCw
2. https://www.youtube.com/watch?v=dmt6_n7Sgcg
3. https://www.youtube.com/watch?v=_MQScnLXL0M
4. https://www.youtube.com/watch?v=3WXPanCq9LI
5. https://www.youtube.com/watch?v=fvjk7PlxAuo
6. http://www.me.umn.edu/coursesme2011/handouts/engg%20graphics.pdf
7. https://www.machinedesignonline.com

Course Outcomes

Following outcomes will be achieved:

1) Select and construct appropriate drawing scales, use drawing equipment's, and understand Indian Standards of engineering drawing

2) Draw views of given object and components 3) Sketch orthographic projections into isometric projections and vice versa.

3) Apply computer aided drafting tools to create 2D engineering drawings

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Course Code	:	ES103
Course Title	:	Engineering Workshop Practice
Number of Credits	:	1.5 (L: 0, T: 0, P: 3)
Prerequisites	:	NIL
Course Category	:	ES

Course Objectives:

- To understand basic engineering processes for manufacturing and assembly.
- To understand, identify, select and use various marking, measuring, and holding, striking and cutting tools and equipment's
- To understand and interpret job drawings, produce jobs, and inspect the job for specified dimensions
- To understand the various types of wiring systems and acquire skills in house wiring
- To understand, operate, control different machines and equipment's adopting safety practices

Course Content:

S.No.	Details Of Practical Content
I	**Carpentry:** i) Demonstration of different wood working tools / machines. ii) Demonstration of different wood working processes, like plaining, marking, chiseling, grooving, turning of wood etc. iii) One simple job involving any one joint like mortise and tenon dovetail, bridle, half lap etc.
II	**Fitting:** i) Demonstration of different fitting tools and drilling machines and power tools ii) Demonstration of different operations like chipping, filing, drilling, tapping, sawing, cutting etc. iii) One simple fitting job involving practice of chipping, filing, drilling, tapping, cutting etc
III	**Welding:** i) Demonstration of different welding tools / machines. ii) Demonstration on Arc Welding, Gas Welding, MIG, MAG welding, gas cutting and rebuilding of broken parts with welding. iii) One simple job involving butt and lap joint
IV	**Sheet Metal Working:** i) Demonstration of different sheet metal tools / machines. ii) Demonstration of different sheet metal operations like sheet cutting, bending, edging, end curling, lancing, soldering, brazing, and riveting. iii) One simple job involving sheet metal operations and soldering and riveting.
V	**Electrical House Wiring:** Practice on simple lamp circuits (i) one lamp controlled by one switch by surface conduit wiring, (ii) Lamp circuits- connection of lamp and socket by separate switches, (iii) Connection of Fluorescent lamp/tube light, (iv) simple lamp circuits-install bedroom lighting. And (v) Simple lamp circuits- install stair case wiring.
VI	**Demonstration:** i) Demonstration of measurement of Current, Voltage, Power and Energy. ii) Demonstration of advance power tools, pneumatic tools, electrical wiring tools and accessories. iii) Tools for Cutting and drilling

References:

1. S.K. Hajara Chaudhary, Workshop Technology, Media Promoters and Publishers, New Delhi, 2015
2. B.S. Raghuwanshi, Workshop Technology, Dhanpat Rai and sons, New Delhi 2014
3. K. Venkat Reddy, Workshop Practice Manual, BS Publications, Hyderabad 2014
4. Kents Mechanical Engineering Hand book, John Wiley and Sons, New York

Course outcomes

At the end of the course, the student will be able to:

CO1	Acquire skills in basic engineering practice to identify, select and use various marking, measuring, and holding, striking and cutting tools & equipment's and machines
CO2	Understand job drawing and complete jobs as per specifications in allotted time
CO3	Inspect the job for the desired dimensions and shape
CO4	Operate, control different machines and equipment's adopting safety practices

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Course Code	:	BS107
Course Title	:	Applied Physics-I Labs
Number of Credits	:	1 (L: 0, T: 0, P: 2)
Prerequisites	:	NIL
Course Category	:	BS

Course Objectives

Study of Applied Physics aims to give an understanding of physical world by observations and predictions. Concrete use of physical principles and analysis in various fields of engineering and technology is very prominence. The course aims to supplement the factual knowledge gained in the lecture by first hand manipulation of apparatus. This will develop scientific temper and help to apply the basic concepts and principles in solving engineering and technology based problems. In addition, students get necessary confidence in handling equipment and thus learn various skills in measurement.

List of Practical's/Activities (To perform minimum 10 practical's).

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.

Learning Outcome:

After undergoing this lab work, the student will be able to:

- Select right kind of measuring tools (Meter scale, Vernier caliper, Screw gauge, Spherometer etc.) for determining dimensions of physical quantities and make measurements with accuracy and precision.
- Differentiate various shapes and determine dimensions of plane, curved and regular surfaces/bodies.
- Apply and Verify laws of forces and determine resultant force acting on a body.
- Appreciate role of friction and measure co-efficient of friction between different surfaces.
- Describe and verify Hook's law and determine force constant of spring body.
- Identify various forms of energy, energy transformations and verify law of conservation of energy.
- Understand rotational motion and determine M.I. of a rotating body (flywheel)
- Understand Stoke's law for viscous liquids and determine viscosity of a given liquid.
- Understand how materials expand on heating and determine linear expansion coefficient for a given material rod.
- Understand working and use Fortin's barometers for determining pressure at a place.
- Understand use of thermometers to measure temperature under different conditions and different scales of temperature measurements.

SUGGESTED STUDENT ACTIVITES & STRATEGIES

Apart from classroom and laboratory learning following are the suggested student related activities which can be undertaken to accelerate the attainment of various outcomes of the course

a. Make survey of different physical products and compare the following points
    - Measurements of dimensions
    - Properties
    - Applications
b. Library survey regarding engineering materials/products used in different industries
c. Seminar on any relevant topic.

Teachers should use the following strategies to achieve the various outcomes of the course.

- Different methods of teaching and media to be used to attain classroom attention.
- Massive open online courses (MOOCs) may be used to teach various topics/sub topics.
- 15-20% of the topics which are relatively simpler of descriptive in nature should be given to the students for self-learning and assess the development of competency through classroom presentations.
- Micro-projects may be given to group of students for hand-on experiences.

References:

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.

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Course Code	:	BS109
Course Title	:	Applied Chemistry Lab
Number of Credits	:	1 (L: 0, T: 0, P: 2)
Prerequisites	:	NIL
Course Category	:	BS

Course Objectives:

There are numerous number of materials used in fabricating and manufacturing devices for the comfort of life. The selection, characterization and suitability assessment of natural raw materials essentially requires principles and concepts of Applied Chemistry for technicians. The course aims to supplement the factual knowledge gained in the lectures by first hand manipulation of processes and apparatus. This will develop scientific temper and help to apply the basic concepts and principles in solving engineering problems.

LIST OF PRACTICALS:

Perform any 12 (twelve) Laboratory Practicals.

Volumetric and Gravimetric analysis:

1 Preparation of standard solution of oxalic acid or potassium permanganate.

2 To determine strength of given sodium hydroxide solution by titrating against standard oxalic acid solution using phenolphthalein indicator.

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

4 Iodometric estimation of copper in the copper pyrite ore.

5 Volumetric estimation of total acid number (TAN) of given oil.

6 Volumetric estimation of

a) Total hardness of given water sample using standard EDTA solution.

b) Alkalinity of given water sample using 0.01M sulphuric acid

7 Proximate analysis of coal

a) Gravimetric estimation moisture in given coal sample

b) Gravimetric estimation ash in given coal sample

Instrumental analysis

8. Determine the conductivity of given water sample.
9. Determination of the Iron content in given cement sample using colorimeter.
10. Determination of calorific value of solid or liquid fuel using bomb calorimeter.
11. Determination of viscosity of lubricating oil using Redwood viscometer.
12. Determination of flash and fire point of lubricating oil using Able's flash point apparatus.
13. To verify the first law of electrolysis of copper sulfate using copper electrode.
14. Construction and measurement of emf of elector chemical cell (Daniel cell).
15. To study the effect of dissimilar metal combination.

Teachers should use the following strategies to achieve the various outcomes of the course.

- Different methods of teaching and media to be used to attain classroom attention.
- Massive open online courses (MOOCs) may be used to teach various topics/sub topics.
- 15-20% of the topics which are relatively simpler of descriptive in nature should be given to the students for self-learning and assess the development of competency through classroom presentations.
- Micro-projects may be given to group of students for hand-on experiences
- Encouraging students to visit to sites such as Railway station and research establishment around the institution.

Learning Outcomes:

At the end of the course student will be able to

- To express quantitative measurements accurately.
- To practice and adapt good measuring techniques.
- To use various apparatus for precise measurements.
- To understand and differentiate different methods of quantitative analysis.
- To know and understand principles of quantitative analysis using instruments.
- To construct different electrochemical cells used in developing batteries.
- To understand and appreciate methods of corrosion abetments.

Reference Books:

1. Text Book of Chemistry for Class XI & XII (Part-I, Part-II); N.C.E.R.T., Delhi, 2017-18.
2. Dr. G. H. Hugar and Prof A. N. Pathak, Applied Chemistry Laboratory Practices, Vol. I and Vol. II, NITTTR, Chandigarh, Publications, 2013-14.
3. Agnihotri, Rajesh, Chemistry for Engineers, Wiley India Pvt.Ltd., 2014.
4. Jain & Jain, Engineering Chemistry, Dhanpat Rai and Sons; New Delhi, 2015.

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Course Code	:	HS103
Course Title	:	Sports and Yoga
Number of Credits	:	1(L:0,T:0,P:2)
Prerequisites	:	NIL
Course Category	:	HS

Course Objectives:

- To make the students understand the importance of sound health and fitness principles as they relate to better health.
- To expose the students to a variety of physical and yogic activities aimed at stimulating their continued inquiry about Yoga, physical education, health and fitness.
- To create a safe, progressive, methodical and efficient activity based plan to enhance improvement and minimize risk of injury.
- To develop among students an appreciation of physical activity as a lifetime pursuit and a means to better health.

Course Content:

- **Introduction to Physical Education**
  - Meaning & definition of Physical Education
  - Aims & Objectives of Physical Education
  - Changing trends in Physical Education
- **Olympic Movement**
  - Ancient & Modern Olympics (Summer & Winter)
  - Olympic Symbols, Ideals, Objectives & Values
  - Awards and Honours in the field of Sports in India (Dronacharya Award, Arjuna Award, Dhayanchand Award, Rajiv Gandhi Khel Ratna Award etc.)
- **Physical Fitness, Wellness & Lifestyle**
  - Meaning & Importance of Physical Fitness & Wellness
  - Components of Physical fitness
  - Components of Health related fitness
  - Components of wellness
  - Preventing Health Threats through Lifestyle Change
  - Concept of Positive Lifestyle
- **Fundamentals of Anatomy & Physiology in Physical Education, Sports and Yoga**
  - Define Anatomy, Physiology & Its Importance
  - Effect of exercise on the functioning of Various Body Systems. (Circulatory System, Respiratory System, Neuro-Muscular System etc.)
- **Kinesiology, Biomechanics & Sports**
  - Meaning & Importance of Kinesiology & Biomechanics in Physical Edu. & Sports
  - Newton's Law of Motion & its application in sports.
  - Friction and its effects in Sports.
- **Postures**
  - Meaning and Concept of Postures.
  - Causes of Bad Posture.
  - Advantages & disadvantages of weight training.
  - Concept & advantages of Correct Posture.
  - Common Postural Deformities – Knock Knee; Flat Foot; Round Shoulders; Lordosis, Kyphosis, Bow Legs and Scoliosis.
  - Corrective Measures for Postural Deformities

- **Yoga**
  - Meaning & Importance of Yoga
  - Elements of Yoga
  - Introduction - Asanas, Pranayama, Meditation & Yogic Kriyas
  - Yoga for concentration & related Asanas (Sukhasana; Tadasana; Padmasana & Sha-shankasana)
  - Relaxation Techniques for improving concentration - Yog-nidra
- **Yoga & Lifestyle**
  - Asanas as preventive measures.
  - Hypertension: Tadasana, Vajrasana, Pavan Muktasana, Ardha Chakrasana, Bhujangasana, Sharasana.
  - Obesity: Procedure, Benefits & contraindications for Vajrasana, Hastasana, Trikonasana, Ardh Matsyendrasana.
  - Back Pain: Tadasana, Ardh Matsyendrasana, Vakrasana, Shalabhasana, Bhujangasana.
  - Diabetes: Procedure, Benefits & contraindications for Bhujangasana, Paschimottasana, Pavan Muktasana, Ardh Matsyendrasana.
  - Asthema: Procedure, Benefits & contraindications for Sukhasana, Chakrasana, Gomukhasana, Parvatasana, Bhujangasana, Paschimottasana, Matsyasana.
- **Training and Planning in Sports**
  - Meaning of Training
  - Warming up and limbering down
  - Skill, Technique & Style
  - Meaning and Objectives of Planning.
  - Tournament – Knock-Out, League/Round Robin & Combination.
- **Psychology & Sports**
  - Definition & Importance of Psychology in Physical Edu. & Sports
  - Define & Differentiate Between Growth & Development
  - Adolescent Problems & Their Management
  - Emotion: Concept, Type & Controlling of emotions
  - Meaning, Concept & Types of Aggressions in Sports.
  - Psychological benefits of exercise.
  - Anxiety & Fear and its effects on Sports Performance.
  - Motivation, its type & techniques.
  - Understanding Stress & Coping Strategies.

- **Doping**
  - Meaning and Concept of Doping
  - Prohibited Substances & Methods
  - Side Effects of Prohibited Substances
- **Sports Medicine**
  - First Aid – Definition, Aims & Objectives.
  - Sports injuries: Classification, Causes & Prevention.
  - Management of Injuries: Soft Tissue Injuries and Bone & Joint Injuries
- **Sports / Games**

  Following sub topics related to any one Game/Sport of choice of student out of: Athletics, Badminton, Basketball, Chess, Cricket, Kabaddi, Lawn Tennis, Swimming, Table Tennis, Volleyball, Yoga etc.
  - History of the Game/Sport.
  - Latest General Rules of the Game/Sport.
  - Specifications of Play Fields and Related Sports Equipment.
  - Important Tournaments and Venues.
  - Sports Personalities.
  - Proper Sports Gear and its Importance.

References:

1. Modern Trends and Physical Education by Prof. Ajmer Singh.
2. Light On Yoga By B.K.S. Iyengar.
3. Health and Physical Education – NCERT (11th and 12th Classes)

Course Outcomes:

On successful completion of the course the students will be able to:

(i) Practice Physical activities and Hatha Yoga focusing on yoga for strength, flexibility, and relaxation.

(ii) Learn techniques for increasing concentration and decreasing anxiety which leads to stronger academic performance.

(iii) Learn breathing exercises and healthy fitness activities

(iv) Understand basic skills associated with yoga and physical activities including strength and flexibility, balance and coordination.

(v) Perform yoga movements in various combination and forms.

(vi) Assess current personal fitness levels.

(vii) Identify opportunities for participation in yoga and sports activities.

(viii) Develop understanding of health-related fitness components: cardiorespiratory endurance, flexibility and body composition etc.

(ix) Improve personal fitness through participation in sports and yogic activities.

(x) Develop understanding of psychological problems associated with the age and lifestyle.

(xi) Demonstrate an understanding of sound nutritional practices as related to health and physical performance.

(xii) Assess yoga activities in terms of fitness value.

(xiii) Identify and apply injury prevention principles related to yoga and physical fitness activities.

(xiv) Understand and correctly apply biomechanical and physiological principles elated to exercise and training.

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Course Code	:	HS105
Course Title	:	Communication Skills in English - Lab
Number of Credits	:	1 (L: 0, T: 0, P: 2)
Prerequisites	:	NIL
Course Category	:	HS

Course Objectives:
Communication skills play an important role in career development. This lab course aims at actively involving students in various activities to improve their communication skills with an emphasis on developing personality of the students. Thus, the objectives of this course are:

1. To develop listening skills for enhancing communication.
2. To develop speaking skills with a focus on correct pronunciation and fluency.
3. To introduce the need for Personality development- Focus will be on developing certain qualities which will aid students in handling personal and career challenges, leadership skills etc. for that purpose group discussion, extempore and other activities should be conducted during lab classes.

Course Content:
Unit 1 Listening Skills
Listening Process and Practice: Introduction to recorded lectures, poems, interviews and speeches, listening tests.

Unit II Introduction to Phonetics
Sounds: consonant, vowel, diphthongs, etc. transcription of words (IPA), weak forms, syllable division, word stress, intonation, voice etc.

Unit III Speaking Skills
Standard and formal speech: Group discussion, oral presentations, public speaking, business presentations etc. Conversation practice and role playing, mock interviews etc.

Unit IV Building vocabulary
Etymological study of words and construction of words, phrasal verbs, foreign phrases, idioms and phrases. Jargon/ Register related to organizational set up, word exercises and word games to enhance self-expression and vocabulary of participants.

Recommended Readings:
1. Daniel Jones. *The Pronunciation of English.* Cambridge: Cambridge University Press, 1956.
2. James Hartman& et al. Ed. *English Pronouncing Dictionary.* Cambridge: Cambridge University

Press, 2006.

3. Kulbhushan Kumar, Effective Communication Skills, Khanna Publishing House, New Delhi (Revised Ed. 2018)
4. J.D.O'Connor. *Better English Pronunciation.* Cambridge: Cambridge University Press, 1980.
5. Lindley Murray. *An English Grammar: Comprehending Principles and Rules.* London: Wilson and Sons, 1908.
6. Margaret M. Maison. *Examine your English.* Orient Longman: New Delhi, 1964.
7. J.Sethi & et al. *A Practice Course in English Pronunciation*. New Delhi: Prentice Hall, 2004.
8. Pfeiffer, William Sanborn and T.V.S Padmaja. *Technical Communication: A Practical Approach*. 6th ed. Delhi: Pearson, 2007.

Learning Outcome:

- At the end of this course the students will be able to communicate effectively with an increase in their confidence to read, write and speak English fluently.
- They will also demonstrate a significant increase in word power.
- The variety of exercises and activities that will be conducted in the Language Lab will develop their skills needed to participate in a conversation like listening carefully and respectfully to others' viewpoints; articulating their own ideas and questions clearly and over all students will be able to prepare, organize, and deliver an engaging oral presentation.
- They will also develop non-verbal communication such as proper use of body language and gestures.

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Semester - II

Course Code	:	BS102
Course Title	:	Mathematics - II
Number of Credits	:	4 (L: 3, T: 1, P: 0)
Prerequisites	:	NIL
Course Category	:	BS

Course Objectives:

This course is designed to give a comprehensive coverage at an introductory level to the subject of matrices, Integral Calculus coordinate geometry, Basic elements of vector algebra and First Order Differential Equations.

Course Content:

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 formulas $\int_0^{\frac{\pi}{2}} \sin^n x\, dx$, $\int_0^{\frac{\pi}{2}} \cos^n x\, dx$ and $\int_0^{\frac{\pi}{2}} \sin^m x \cos^n x\, dx$ for solving problems Where m and n are positive integers.

Applications of integration for i. Simple problem on evaluation of area bounded by a curve and axes. ii. Calculation of Volume of a solid formed by revolution of an area about axes. (Simple problems).

UNIT - III: Co-Ordinate Geometry

Equation of straight line in various standard forms (without proof), inter section of two straight lines, angle between two lines. Parallel and perpendicular lines, perpendicular distance formula.

General equation of a circle and its characteristics. To find the equation of a circle, given:

i. Centre and radius,

ii. Three points lying on it and

iii. Coordinates of end points of a diameter;

Definition of conics (Parabola, Ellipse, Hyperbola) their standard equations without proof. Problems on conics when their foci, directories or vertices are given.

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

Solution of first order and first degree differential equation by variable separation method (simple problems). MATLAB – Simple Introduction.

References:

1. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, New Delhi, 40th Edition, 2007.
2. G. B. Thomas, R. L. Finney, Calculus and Analytic Geometry, Addison Wesley, 9th Edition, 1995.
3. S.S. Sabharwal, Sunita Jain, Eagle Parkashan, Applied Mathematics, Vol. I & II, Jalandhar.
4. Comprehensive Mathematics, Vol. I & II by Laxmi Publications, Delhi.
5. Reena Garg & Chandrika Prasad, Advanced Engineering Mathematics, Khanna Publishing House, New Delhi

Course Outcomes:

By the end of the course the students are expected to learn

(i) the students are expected to acquire necessary background in Determinants and Matrices so as to appreciate the importance of the Determinants are the factors that scale different parameterizations so that they all produce same overall integrals, i.e. they are capable of encoding the inherent geometry of the original shape.

(ii) the cumulative effect of the original quantity or equation is the Integration

(iii) the coordinate geometry provides a connection between algebra and geometry through graphs of lines and curves.

(iv) Tell the difference between a resultant and a concurrent force to model simple physical problems in the form of a differential equation, analyze and interpret the solutions.

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Course Code	:	BS104
Course Title	:	Applied Physics -II
Number of Credits	:	3 (L: 2, T: 1, P: 0)
Prerequisites	:	High School Level Physics
Course Category	:	BS

Course Objectives

Applied Physics aims to give an understanding of this world both by observation and by prediction of the way in which objects behave. Concrete use of physical principles and analysis in various fields of engineering and technology are given prominence in the course content. The course will help the diploma engineers to apply the basic concepts and principles to solve broad-based engineering problems and to understand different technology based applications.

Teaching Approach

Teachers should give examples from daily routine as well as, engineering/technology applications on various concepts and principles in each topic so that students are able to understand and grasp these concepts and principles. In all contents, SI units should be followed.

Use of demonstration can make the subject interesting and develop scientific temper in the students. Student activities should be planned on all the topics.

Activity- Theory - Demonstrate/practice approach may be followed throughout the course so that learning may be outcome and employability based.

Course Content

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

Coulombs 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 mag-

netic 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.

Nanoscience and Nanotechnology: Introduction, nanoparticles and nanomaterials, properties at nanoscale, nanotechnology, nanotechnology based devices and applications.

Learning Outcome:

After undergoing this subject, the student will be able to;

a) Describe waves and wave motion, periodic and simple harmonic motions and solve simple problems. Establish wave parameters: frequency, amplitude, wavelength, and velocity and able to explain diffraction, interference, polarization of waves.

b) Explain ultrasonic waves and engineering, medical and industrial applications of Ultrasonics. Apply acoustics principles to various types of buildings for best sound effect.

c) State basic optical laws, establish the location of the images formed by mirrors and thin converging lens**,** design and assemble microscope using lenses combination.

d) Describe refractive index of a liquid or a solid and will be able to explain conditions for total internal reflection.

e) Define capacitance and its unit, explain the function of capacitors in simple circuits, and solve simple problems.

f) Differentiate between insulators, conductors and semiconductors, and define the terms: potential, potential difference, electromotive force.

g) Express electric current as flow of charge, concept of resistance, measure of the parameters: electric current, potential difference, resistance.

h) List the effects of an electric current and its common applications, State Ohm's law, calculate the equivalent resistance of a variety of resistor combinations, distinguish between AC and DC currents, determine the energy consumed by an appliance,

i) State the laws of electromagnetic induction, describe the effect on a current-carrying conductor when placed in a magnetic field.

j) Explain the operation of appliances like moving coil galvanometer, simple DC motors.

k) Apply the knowledge of diodes in rectifiers, power adapters and various electronic circuits. Use the knowledge of semiconductors in various technical gadgets like mobile phones, com-

puters, LED, photocells, solar lights etc.

l) Illustrate the conditions for light amplification in various LASER and laser based instruments and optical devices.

m) Appreciate the potential of optical fiber in fields of medicine and communication.

n) Express importance of nanoscience and nanotechnology and impact of nanotechnology to the society.

References:

1. Text Book of Physics for Class XI& XII (Part-I, Part-II); N.C.E.R.T., Delhi
2. Applied Physics, Vol. I and Vol. II, TTTI Publications, Tata McGraw Hill, Delhi
3. Concepts in Physics by HC Verma, Vol. I & II, Bharti Bhawan Ltd. New Delhi
4. Engineering Physics by PV Naik, Pearson Education Pvt. Ltd, New Delhi.
5. Modern approach to Applied Physics-I and II, AS Vasudeva, Modern Publishers.
6. A Textbook of Optics, N Subramanyam, Brij Lal, MN Avahanulu, S Chand and Company Ltd.
7. Introduction to Fiber Optics, Ajoy Ghatak and K Thyagarajan, Cambridge University Press India Pvt. Ltd, New Delhi.
8. Nanoscience and Nanotechnology, KK Choudhary, Narosa Publishing House, Pvt. Ltd. New Delhi.
9. Nanotechnology: Importance and Applications, M.H. Fulekar, IK International Publishing House Pvt. Ltd, New Delhi.
10. e-books/e-tools/ learning physics software/websites etc.

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Course Code	:	ES 102
Course Title	:	Introduction to IT Systems
Number of Credits	:	2 (L: 2, T: 0, P: 0)
Prerequisites (Course code)	:	NIL
Course Category	:	ES

Course Objectives::

This course is intended to make new students comfortable with computing environment - Learning basic computer skills, Learning basic application software tools, Understanding Computer Hardware, Cyber security awareness

Course Content:

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.

References:

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

Course outcomes:

At the end of the course student will be able to comfortably work on computer, install and configure OS, assemble a PC and connect it to external devices, write documents, create worksheets, prepare presentations, protect information and computers from basic abuses/ attacks.

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Course Code	:	ES104
Course Title	:	Fundamentals of Electrical and Electronics Engineering
Number of Credits	:	3 (L: 2, T: 1, P: 0)
Prerequisites	:	NIL
Course Category	:	ES

Course Objectives:

To provide basic knowledge of the different elements and concepts of electrical engineering field and to learn basic concepts of various active and passive electronic components, Signals, Op-Amp and their applications, Digital Electronics and their applications to help students deal with electrical and electronics engineering principles and applications in industrial processes of different fields.

Course Content:

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.

References:

1. Ritu Sahdev, 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: ٠٠٧٠٦٣٤٢٤٤-٩٧٨
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 2015 ISBN : 9780195425239

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Course Code	:	ES 106
Course Title	:	Engineering Mechanics
Number of Credits	:	3 (L: 2, T: 1, P: 0)
Prerequisites	:	NIL
Course Category	:	ES

Course Objectives:

Following are the objectives of this course:

1) To obtain resultant of various forces
2) To calculate support reactions through conditions of equilibrium for various structures
3) To understand role of friction in equilibrium problems
4) To know fundamental laws of machines and their applications to various engineering problems

Course Contents:

Unit – I Basics of mechanics and force system

Significance and relevance of Mechanics, Applied mechanics, Statics, Dynamics.

Space, time, mass, particle, flexible body and rigid body.

Scalar and vector quantity, Units of measurement (SI units) - Fundamental units and derived units.

Force – unit, representation as a vector and by Bow's notation, characteristics and effects of a force, Principle of transmissibility of force, Force system and its classification.

Resolution of a force - Orthogonal components of a force, moment of a force, Varignon's Theorem.

Composition of forces – Resultant, analytical method for determination of resultant for concurrent, non-concurrent and parallel co-planar force systems – Law of triangle, parallelogram and polygon of forces.

Unit– II Equilibrium

Equilibrium and Equilibrant, Free body and Free body diagram, Analytical and graphical methods of analysing equilibrium

Lami's Theorem – statement and explanation, Application for various engineering problems.

Types of beam, supports (simple, hinged, roller and fixed) and loads acting on beam (vertical and inclined point load, uniformly distributed load, couple),

Beam reaction for cantilever, simply supported beam with or without overhang – subjected to combination of Point load and uniformly distributed load.

Beam reaction graphically for simply supported beam subjected to vertical point loads only.

Unit– III Friction

Friction and its relevance in engineering, types and laws of friction, limiting equilibrium, limiting friction, co-efficient of friction, angle of friction, angle of repose, relation between co-efficient of friction and angle of friction.

Equilibrium of bodies on level surface subjected to force parallel and inclined to plane.

Equilibrium of bodies on inclined plane subjected to force parallel to the plane only.

Unit– IV Centroid and centre of gravity

Centroid of geometrical plane figures (square, rectangle, triangle, circle, semi-circle, quarter circle)

Centroid of composite figures composed of not more than three geometrical figures

Centre of Gravity of simple solids (Cube, cuboid, cone, cylinder, sphere, hemisphere) Centre of Gravity of composite solids composed of not more than two simple solids.

Unit – V Simple lifting machine

Simple lifting machine, load, effort, mechanical advantage, applications and advantages. Velocity ratio, efficiency of machines, law of machine.

Ideal machine, friction in machine, maximum Mechanical advantage and efficiency, reversible and non-reversible machines, conditions for reversibility

Velocity ratios of Simple axle and wheel, Differential axle and wheel, Worm and worm wheel, Single purchase and double purchase crab winch, Simple screw jack, Weston's differential pulley block, geared pulley block.

Suggested Learning Resources:

1. D.S. Bedi, Engineering Mechanics, Khanna Publications, New Delhi (2008)
2. Khurmi, R.S., Applied Mechanics, S. Chand & Co. New Delhi.
3. Bansal R K, A text book of Engineering Mechanics, Laxmi Publications.
4. Ramamrutham, Engineering Mechanics, S. Chand & Co. New Delhi.
5. Dhade, Jamadar & Walawelkar, Fundamental of Applied Mechanics, Pune Vidhyarthi Gruh.
6. Ram, H. D.; Chauhan, A. K., Foundations and Applications of Applied Mechanics, Cambridge University Press.
7. Meriam, J. L., Kraige, L.G., Engineering Mechanics- Statics, Vol. I, Wiley Publication, New Delhi.

Course outcomes:

After completing this course, student will be able to:

1. Identify the force systems for given conditions by applying the basics of mechanics.
2. Determine unknown force(s) of different engineering systems.
3. Apply the principles of friction in various conditions for useful purposes.
4. Find the centroid and centre of gravity of various components in engineering systems.
5. Select the relevant simple lifting machine(s) for given purposes.

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Course Code	:	BS 106
Course Title	:	Applied Physics II Lab
Number of Credits	:	1 (L: 0, T: 0, P: 2)
Prerequisites	:	NIL
Course Category	:	BS

Course Objectives:

Concrete use of physical principles and analysis in various fields of engineering and technology is very prominence. The course aims to supplement the factual knowledge gained in the lecture by first hand manipulation of apparatus. This will develop scientific temper and help to apply the basic concepts and principles in solving engineering and technology based problems. In addition, students get

necessary confidence in handling equipment and thus learn various skills in measurement.

List of Practicals/Activities: (To perform minimum 12 Practicals)

1. To determine and verify the time period of a cantilever.
2. To determine velocity of ultrasonic in different liquids using ultrasonic interferometer.
3. To verify laws of reflection from a plane mirror/ interface.
4. To verify laws of refraction (Snell's law) using a glass slab.
5. To determine focal length and magnifying power of a convex lens.
6. To verify Ohm's law by plotting graph between current and potential difference.
7. To verify laws of resistances in series and parallel combination.
8. To find the frequency of AC main using electrical vibrator.
9. To verify Kirchhoff's law using electric circuits.
10. To study the dependence of capacitance of a parallel plate capacitor on various factors and determines permittivity of air at a place.
11. To find resistance of a galvanometer by half deflection method.
12. To convert a galvanometer into an ammeter.
13. To convert a galvanometer into a voltmeter.
14. To draw V-I characteristics of a semiconductor diode (Ge, Si) and determine its knee voltage.
15. To verify inverse square law of radiations using a photo-electric cell.
16. To measure wavelength of a He-Ne/diode laser using a diffraction grating.
17. To measure numerical aperture (NA) of an optical fiber.
18. Study of an optical projection system (OHP/LCD) - project report.

Suggested Student Activities & Strategies

Apart from classroom and laboratory learning following are the suggested student related activities which can be undertaken to accelerate the attainment of various outcomes of the course.

a. Make survey of different physical products and compare the following points
   - Measurements of dimensions
   - Properties
   - Applications

b. Library survey regarding engineering materials/products used in different industries

c. Seminar on any relevant topic.

Teachers should use the following strategies to achieve the various outcomes of the course.

- Different methods of teaching and media to be used to attain classroom attention.
- Massive open online courses (MOOCs) may be used to teach various topics/sub topics.
- 15-20% of the topics which are relatively simpler or descriptive in nature should be given to the students for self-learning and assess the development of competency through classroom presentations/projects.
- Micro-projects on relevant may be given to group of students for hand-on experiences.

Learning Outcome:

After undergoing this subject, the student will be able to;

a) Apply concept of vibrations and determine the time period of vibrating objects.

b) Use of equipment for determining velocity of ultrasonics in different liquids.

c) Verify optical laws; reflection, refraction from plane interfaces and surfaces.

d) Apply knowledge of optics to determine focal length and magnifying power of optical lenses.

e) Understand uses of electrical components and meters and verify Ohm's law for flow of current.

f) Quantify resistances and verify laws of series and parallel combination of resistances.

g) Apply concept of electrical vibrations in determine frequency of AC main.

h) Analyse electrical circuits and verify Kirchhoff's law governing electrical circuits.

i) Measure resistance of a galvanometer and how it is converted into an ammeter and voltmeter.

j) Investigate characteristics of semiconductor diodes, photoelectric cells and determine operational parameters associated with their performance.

k) Work with laboratory lasers and understand method to measure the wavelength of the light emitted from a laser.

l) Handle optical fibers and determine numerical aperture of given optical fiber.

m) Understand construction and working of an optical projection system.

Recommended 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., New Delhi
3. Practical Physics by C. L. Arora, S. Chand & Company Ltd.
4. e-books/e-tools/ learning physics software/you Tube videos/ websites etc.

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Course Code	:	ES 108
Course Title	:	Introduction to IT Systems Lab
Number of Credits	:	2 (L: 0, T: 0, P: 4)
Prerequisites (Course code)	:	NIL, should be doing ES102 in parallel
Course Category	:	ES

Course Objectives:

This Lab course is intended to practice whatever is taught in theory class of 'Introduction of IT Systems' and become proficient in using computing environment - basic computer skills, basic application software tools, Computer Hardware, cyber security features, etc.

Course Content:

S.No.	Topics for Practice
1	Browser features, browsing, using various search engines, writing search queries
2	Visit various e-governance/Digital India portals, understand their features, services offered
3	Read Wikipedia pages on computer hardware components, look at those components in lab, identify them, recognise various ports/interfaces and related cables, etc.
4	Install Linux and Windows operating system on identified lab machines, explore various options, do it multiple times

5	Connect various peripherals (printer, scanner, etc.) to computer, explore various features of peripheral and their device driver software.
6	Practice HTML commands, try them with various values, make your own Webpage
7	Explore features of Open Office tools, create documents using these features, do it multiple times
8	Explore security features of Operating Systems and Tools, try using them and see what happens.

This is a skill course. More you practice, better it will be.

References:

1. Online resources, Linux man pages, Wikipedia.
2. R.S. Salaria, Computer Fundamentals, Khanna Publishing House.
3. Ramesh Bangia, PC Software Made Easy – The PC Course Kit, Khanna Publishing House.
4. Mastering Linux Shell Scripting: A practical guide to Linux command-line, Bash scripting, and Shell programming, by Mokhtar Ebrahim, Andrew Mallett.
5. IT Essentials PC Hardware and Software Companion Guide, Davis Anfinson and Ken Quamme, CISC Press, Pearson Education.
6. PC Hardware and A+ Handbook, Kate J. Chase PHI (Microsoft).

Course outcomes:

At the end of the course student will be able to comfortably work on computer, install and configure OS, assemble a PC and connect it to external devices, write documents, create worksheets, prepare presentations, protect information and computers from basic abuses/attacks.

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Course Code	:	ES110
Course Title	:	Fundamentals of Electrical and Electronics Engineering Lab
Number of Credits	:	1 (L: 0, T: 0, P: 2)
Prerequisites	:	NIL
Course Category	:	ES

Suggested Practicals/Exercises:

The practical in this section are PrOs (i.e. sub-components of the COs) to be developed and assessed in the student for the attainment of the competency.

S. No.	Practical Outcomes (PrOs)	Approx. Hrs.
1.	Determine the permeability of magnetic material by plotting its B-H curve.	02*
2.	Measure voltage, current and power in 1-phase circuit with resistive load.	02*
3.	Measure voltage, current and power in R-L series circuit.	02*
4.	Determine the transformation ratio (K) of 1-phase transformer.	02
5.	Connect single phase transformer and measure input and output quantities.	02
6.	Make Star and Delta connection in induction motor starters and measure the line and phase values.	02
7.	Identify various passive electronic components in the given circuit	02
8.	Connect resistors in series and parallel combination on bread board and measure its value using digital multimeter.	02
9.	Connect capacitors in series and parallel combination on bread board and measure its value using multimeter.	02*

S. No.	Practical Outcomes (PrOs)	Approx. Hrs.
10.	Identify various active electronic components in the given circuit.	02
11.	Use multimeter to measure the value of given resistor.	02
12.	Use LCR-Q tester to measure the value of given capacitor and inductor.	02
13.	Determine the value of given resistor using digital multimeter to confirm with colour code.	02*
14.	Test the PN-junction diodes using digital multimeter.	02*
15.	Test the performance of PN-junction diode.	02
16.	Test the performance of Zener diode.	02
17.	Test the performance of LED.	02
18.	Identify three terminals of a transistor using digital multimeter.	02
19.	Test the performance of NPN transistor.	02*
20.	Determine the current gain of CE transistor configuration.	02
21.	Test the performance of transistor switch circuit.	02
22.	Test the performance of transistor amplifier circuit.	02
23.	Test Op-Amp as amplifier and Integrator	02
	Total	**46**

References:

1. Ritu Sahdev, Basic Electrical Engineering, Khanna Publishing House, 2018
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 Eduction, New Delhi,2015, ISBN-13: ٠٠٧٠٦٣٤٢٤٤-٩٧٨
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 2015 ISBN : 9780195425239

Suggested Softwares/Learning Websites:

a. en.wikipedia.org/wiki/Transformer
b. www.animations.physics.unsw.edu.au//jw/AC.html
c. www.alpharubicon.com/altenergy/understandingAC.htm
d. www.electronics-tutorials
e. learn.sparkfun.com/tutorials/transistors
f. www.pitt.edu/~qiw4/Academic/ME2082/Transistor%20Basics.pdf

g. www.technologystudent.com/elec1/transis1.htm
h. www.learningaboutelectronics.com
i. www.electrical4u.com

Course Outcomes:

At the end of the course student will be able to:

1. Understand basic principle and operation of electric circuits and machines.
2. Solve basic problems related to electrical circuits and machines. Explain the operation of different electrical technologies.
3. Demonstrate an understanding of the control systems.
4. Understand the basic circuit elements
5. Understand different types of signal waveforms.
6. Understand logic gates and apply them in various electronic circuits.
7. Understand the basic concepts of op-amps, and their applications.
8. Use relevant electric/electronic protective devices safely.

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Course Code	:	ES 112
Course Title	:	Engineering Mechanics Lab.
Number of Credits	:	1 (L: 0, T: 0, P: 2)
Prerequisites	:	NIL
Course Category	:	ES

Course Objectives::

Following are the objectives of this course:

1) To obtain resultant of various forces
2) To calculate support reactions through conditions of equilibrium for various structures
3) To understand role of friction in equilibrium problems
4) To know fundamental laws of machines and their applications to various engineering problems

List of Practical to be performed:

1. To study various equipments related to Engineering Mechanics.
2. To find the M.A., V.R., Efficiency and law of machine for Differential Axle and Wheel.
3. To find the M.A., V.R., Efficiency and law of machine for Simple Screw Jack.
4. Derive Law of machine using Worm and worm wheel.
5. Derive Law of machine using Single purchase crab.
6. Derive Law of machine using double purchase crab.
7. Derive Law of machine using Weston's differential or wormed geared pulley block.
8. Determine resultant of concurrent force system applying Law of Polygon of forces using force table.
9. Determine resultant of concurrent force system graphically.
10. Determine resultant of parallel force system graphically.
11. Verify Lami's theorem.
12. Study forces in various members of Jib crane.
13. Determine support reactions for simply supported beam.
14. Obtain support reactions of beam using graphical method.
15. Determine coefficient of friction for motion on horizontal and inclined plane.
16. Determine centroid of geometrical plane figures.

Suggested Learning Resources:

1. Bedi D.S., Engineering Mechanics, Khanna Publishing House
2. Khurmi, R.S., Applied Mechanics, S.Chand & Co. New Delhi.
3. Bansal R K, A text book of Engineering Mechanics, Laxmi Publications.
4. Ramamrutham, Engineering Mechanics, S.,S Chand & Co. New Delhi.
5. Dhade, Jamadar & Walawelkar, Fundamental of Applied Mechanics, Pune Vidhyarthi Gruh.
6. Ram, H. D.; Chauhan, A. K. Foundations and Applications of Applied Mechanics, Cambridge University Press.
7. Meriam, J. L., Kraige, L.G. , Engineering Mechanics- Statics, Vol. I, Wiley Publication, New Delhi.

Course outcomes:

After completing this course, student will be able to

1. Identify the force systems for given conditions by applying the basics of mechanics.
2. Determine unknown force(s) of different engineering systems.
3. Apply the principles of friction in various conditions for useful purposes.
4. Find the centroid and centre of gravity of various components in engineering systems.
5. Select the relevant simple lifting machine(s) for given purposes.

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Course Code	:	AU102
Course Title	:	Environmental Science
Number of Credits	:	0 (non-credit) (L:2, T:0, P:0)
Prerequisites	:	High School Science
Course Category	:	AU

Course Objectives:

Technicians working in industries or elsewhere essentially require the knowledge of environmental science so as to enable them to work and produce most efficient, economical and eco-friendly finished products.

- Solve various engineering problems applying ecosystem to produce eco – friendly products.
- Use relevant air and noise control method to solve domestic and industrial problems.
- Use relevant water and soil control method to solve domestic and industrial problems.
- To recognize relevant energy sources required for domestic and industrial applications.
- Solve local solid and e-waste problems.

Course Content:

Pre requisite: - High School Chemistry

Unit-1 Ecosystem

Structure of ecosystem, Biotic & Abiotic components

Food chain and food web

Aquatic (Lentic and Lotic) and terrestrial ecosystem

Carbon, Nitrogen, Sulphur, Phosphorus cycle.

Global warming -Causes, effects, process, Green House Effect, Ozone depletion

Unit– 2 Air and, Noise Pollution

Definition of pollution and pollutant, Natural and manmade sources of air pollution (Refrigerants, I.C., Boiler)

Air Pollutants: Types, Particulate Pollutants: Effects and control (Bag filter, Cyclone separator, Electrostatic Precipitator)

Gaseous Pollution Control: Absorber, Catalytic Converter, Effects of air pollution due to Refrigerants, I.C., Boiler

Noise pollution: sources of pollution, measurement of pollution level, Effects of Noise pollution, Noise pollution (Regulation and Control) Rules, 2000

Unit- 3 Water and Soil Pollution

Sources of water pollution, Types of water pollutants, Characteristics of water pollutants Turbidity, pH, total suspended solids, total solids BOD and COD: Definition, calculation

Waste Water Treatment: Primary methods: sedimentation, froth floatation, Secondary methods: Activated sludge treatment, Trickling filter, Bioreactor, Tertiary Method: Membrane separation technology, RO (reverse osmosis).

Causes, Effects and Preventive measures of Soil Pollution: Causes-Excessive use of Fertilizers, Pesticides and Insecticides, Irrigation, E-Waste.

Unit– 4 Renewable sources of Energy

Solar Energy: Basics of Solar energy. Flat plate collector (Liquid & Air). Theory of flat plate collector. Importance of coating. Advanced collector. Solar pond. Solar water heater, solar dryer. Solar stills.

Biomass: Overview of biomass as energy source. Thermal characteristics of biomass as fuel. Anaerobic digestion. Biogas production mechanism. Utilization and storage of biogas.

Wind energy: Current status and future prospects of wind energy. Wind energy in India. Environmental benefits and problem of wind energy.

New Energy Sources: Need of new sources. Different types new energy sources. Applications of (Hydrogen energy, Ocean energy resources, Tidal energy conversion.) Concept, origin and power plants of geothermal energy

Unit-5 Solid Waste Management, ISO 14000 & Environmental Management 06 hours

Solid waste generation- Sources and characteristics of : Municipal solid waste, E- waste, biomedical waste.

Metallic wastes and Non-Metallic wastes (lubricants, plastics, rubber) from industries.

Collection and disposal: MSW (3R, principles, energy recovery, sanitary landfill), Hazardous waste

Air quality act 2004, air pollution control act 1981 and water pollution and control act1996.

Structure and role of Central and state pollution control board.

Concept of Carbon Credit, Carbon Footprint.

Environmental management in fabrication industry.

ISO14000: Implementation in industries, Benefits.

References:

(a) Suggested Learning Resources:

Books:

1. S.C. Sharma & M.P. Poonia, Environmental Studies,Khanna Publishing House,NewDelhi
2. C.N. R. Rao, Understanding Chemistry, Universities Press (India) Pvt. Ltd., 2011.

3. Arceivala, Soli Asolekar, Shyam, Waste Water Treatment for Pollution Control and
4. Reuse, Mc-Graw Hill Education India Pvt. Ltd., New York, 2007, ISBN:978-07-062099-
5. Nazaroff, William, Cohen, Lisa, Environmental Engineering Science, Willy, New York, 2000, ISBN 10: 0471144940.
6. O.P. Gupta, Elements of Environmental Pollution Control, Khanna Publishing House, New Delhi
7. Rao, C. S., Environmental Pollution Control and Engineering, New Age International Publication, 2007, ISBN: 81-224-1835-X.
8. Rao, M. N.Rao, H.V.N, Air Pollution, Tata Mc-Graw Hill Publication, New delhi, 1988, ISBN: 0-07-451871-8.
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12. Metcalf & Eddy, Waste Water Engineering, Mc-Graw Hill, New York, 2013, ISBN: 077441206.
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(b) Open source software and website address:

1) www.eco-prayer.org
2) www.teriin.org
3) www.cpcp.nic.in
4) www.cpcp.gov.in
5) www.indiaenvironmentportal.org.in
6) www.whatis.techtarget.com
7) www.sustainabledevelopment.un.org
8) www.conserve-energy-future.com)

Teachers should use the following strategies to achieve the various outcomes of the course.

- Different methods of teaching and media to be used to attain classroom attention.
- Massive open online courses (MOOCs) may be used to teach various topics/sub topics.
- 15-20% of the topics which are relatively simpler of descriptive in nature should be given to the students for self-learning and assess the development of competency through classroom presentations.
- Micro-projects may be given to group of students for hand-on experiences
- Encouraging students to visit to sites such as Railway station and research establishment around the institution.

Course outcomes

At the end of the course student will be able to

1. Understand the ecosystem and terminology and solve various engineering problems applying ecosystem knowledge to produce eco – friendly products.
2. Understand the suitable air, extent of noise pollution, and control measures and acts.
3. Understand the water and soil pollution, and control measures and acts.
4. Understand different renewable energy resources and efficient process of harvesting.
5. Understand solid Waste Management, ISO 14000 & Environmental Management.

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DTCA-122 Workshop practice –II

L	T	P
3	1	0

RATIONALE

In order to have a balanced overall development of diploma engineers, it is necessary to integrate theory with practice. General workshop practices are included in the curriculum in order to provide hands-on experience about use of different tools and basic manufacturing practices. This subject aims at developing general manual and machining skills in the students. In addition, the development of dignity of labour, safety at work place, team working and development of right attitude are the other objectives.

LEARNING OUTCOMES

After completing the course, the students will be able to:

- Identify tools and equipment used and their respective functions.
- Identify different types of materials and their basic properties.
- Use and take measurements with the help of basic measuring tools/equipment.
- Select proper tools for a particular operation.
- Select materials, tools, and sequence of operations to make a job as per given specification/drawing.
- Prepare simple jobs independently and inspect the same.
- Follow safety procedures and precautionary measures.
- Use safety equipment and Personal Protection Equipment.

DETAILED CONTENTS (PRACTICAL EXERCISES)

The following shops are included in the syllabus:

1 Fitting Shop
2 Sheet Metal Shop
3 Mason Shop
4 Machine Shop

1. FITTING SHOP

1.1 Use of personal protective equipment and safety precautions while working.

1.2 Basic deburring processes.

1.3 Introduction to fitting shop tools, marking and measuring devices/equipment.

1.4 Identification of materials. (Iron, Copper, Stainless Steel, Aluminium etc.)

1.5 Identification of various steel sections (flat, angle, channel, bar etc.).

1.6 Introduction to various fitting shop operations/processes (Hacksawing, Drilling, Chipping and Filing).

1.7 Job Practice

Job I Marking of job, use of marking tools, filing and use of measuring instruments. (Vernier caliper, Micrometer and Vernier height gauge).

Job II Filing a rectangular/square piece to maintain dimensions within an accuracy of 0.25 mm.

Job IIIMaking a cut-out from a square piece of MS flat using hand hacksaw and chipping

Job IV Drilling and tapping practice on MS Flat.

2. SHEET METAL SHOP

2.1. Introduction to sheet metal shop, use of hand tools and accessories e.g. different types of hammers, hard and soft mallet, sheet and wire gauge, necessary allowance required during job fabrication, selection of material.

2.2 Introduction and demonstration of hand tools used in sheet metal shop.

2.3 Introduction and demonstration of various machines and equipment used in sheet metal shop e.g. Shearing Machine, Bar Folder, Burring Machine,

2.4 Introduction and demonstration of various raw materials used in sheet metal shop

e.g. black-plain sheet, galvanized-iron plain sheet, galvanised corrugated sheet, aluminium sheet etc.

2.5 Study of various types of nuts, bolts, rivets, screws etc.

2.6 Job Practice

Job I: Shearing practice on a sheet using hand shears.

Job II: Practice on making Single riveted lap joint/Double riveted lap Joint.

Job III :Practice on making Single cover plate chain type, zig-zag type and single rivetted Butt Joint.

3 MASON SHOP

3.1. Introduction and importance of Mason shop

3.2. Introduction of tools, equipment and machines used in Mason shop

3.3. Job Practice

Job I : Preparation of simple bond Job II : Preparation of Arched bond

Job III: Preparation of RCC structure (column and beam)

4 MACHINE SHOP

4.1 Study and sketch of lathe machine

4.2 Study and Sketch of grinders, milling machine, drilling machine and CNC machine.

4.3 Plain and step turning and knurling practice.

4.4 Study and sketch of planning/shaping machine and to plane a rectangle of cast iron.

MEANS OF ASSESSMENT

- Workshop jobs
- Report writing, presentation and viva voce

RECOMMENDED BOOKS

1. Workshop Technology I,II,III, by SK Hajra, Choudhary and AK Choudhary; Media Promoters and Publishers Pvt. Ltd. Mumbai.
2. Workshop Technology Vol. I, II, III by Manchanda; India Publishing House, Jalandhar.
3. Workshop Training Manual Vol. I, II by S.S. Ubhi; Katson Publishers, Ludhiana.
4. Manual on Workshop Practice by K Venkata Reddy; MacMillan India Ltd., New Delhi
5. Basic Workshop Practice Manual by T Jeyapoovan; Vikas Publishing House (P) Ltd., New Delhi
6. Workshop Technology by B.S. Raghuwanshi; Dhanpat Rai and Co., New Delhi
7. Workshop Technology by HS Bawa; Tata McGraw Hill Publishers, New Delhi.

DCT-231 Fluid Mechanics & Solid Handling

L	T	P
2	1	0

RATIONALE

The subject will enhance the knowledge of students about fluids and their properties like shear, laminar, turbulent, continuity equation, friction losses and other properties of incompressible fluids. Time of emptying a tank, transportation of fluids and measurement of flowing liquids. Solid handling is the fundamental of different machine and equipment's used in the chemical industries such as grinding, crushing, ball mills etc. chain belts and screw conveyor, filtration & mixing equipment's. Theoretical and experimental work will inculcate their interest in learning and teaching among the students and teachers.

LEARNING OUTCOMES

After studying this subject, the students will be able to:

1. Understand Fluid properties and their flow behavior.
2. Understand Fluid Transportation Techniques and flow measurement.
3. Understand Size Reduction principle and related machinery.
4. Understand Working of Mixing Equipment's and conveyors.

DETAILED CONTENTS

PART - A

1. FLUIDS

(i) Properties

(ii) Classification of Fluids.

(iii) Fluid manometers, description and simple numerical problems.

2. FLOW OF INCOMPRESSIBLE FLUIDS:

(i) Shear stress distribution in a cylindrical tube, velocity distribution for Newtonion fluid.

(ii) Reynold No.Elementry knowledge of laminar and turbulent flow, Reynold experiment.

(iii) Continuity equations, Bernaulli's theorem, fluid heads and power requirement calculation.

(iv) Friction factor, Fanning equation and Hagen Poiseuille equation friction losses in pipes, calculation of friction loss due to enlargement, contraction, fittings and valves.

(v) N.P.S.H., cavitation, pipes, tubing, fittings & (Valves numerical problems)

3. MEASUREMENT OF FLOWING FLUIDS:

Orifice meter, venturimeter, pitot tube, rotameter, weirs and notches (Their construction and derivation of formulae simple numerical problems, Definition:- Cofficient of contraction, Coefficient of velocity, coefficient of discharge (Simple numerical problems).

4. TRANSPORTATION OF FLUIDS: (08 Periods) Classification of pumps, construction and operation of Air lift, reciprocating, rotary, centrifugal and gear pumps.

PART - B

1. INTRODUCTION:

Concept and role of unit operation in Industries.

2. CHARACTERISATION OF SOLID PARTICLES:

Characterisation of solid particles, screening equipments, standard screens, screen analysis, Grizzles, trommels.

3. SIZE REDUCTION:

Theory of crushing, Rittinger's law, Kick's law, Bond's Law Crushing and grinding machinery; their classification, general description of jaw crusher, gyratory crusher, rol crusher, hammer mills, ball mills, open circuit and closed circuit Systems.

4. HANDLING OF SOLIDS:

Conveying equipment, their classification general construction and industrial application, Belt conveyors, chain conveyors and screw conveyors.

5. MECHANICAL SEPARATIONS:

(i) Types of filtration equipment, their application and operation, sand filters, filter press, leaf filters, rotary filters, filter aids. Centrifugal filtration.

(ii) Classifiers

(iii) Thickeners

(iv) Cyclones

6. MIXING EQUIPMENTS:

Mixing equipment's used for liquid-liquid, liquid-solid and liquid-gas system.

INSTRUCTIONAL STRATEGY

Teacher should give small assignments to the student. Give industrial based practical problems for material and energy calculations.

MEANS OF ASSESSMENT

- Assignments and quiz/class tests
- Mid-term and end-term written tests

RECOMMENDED BOOKS

1. Unit Operations of Chemical Engineering by McCabe, Smith; McGraw Hill
2. Introduction to Chemical Engineering by Badger &Banchero; McGraw Hill
3. Chemical Engineering Volume-1 by Richardson & Coulson; Pergamon Press

Websites for Reference:

http://swayam.gov.in

MEANS OF ASSESSMENT

1. Assignments
2. Class Tests
3. Practical Work
4. End Semester Exam
5. Viva-Voce

RECOMMENDED BOOKS

1 Mechanical Operations by Swain Palra, G.K. Roy, Tata McGraw Hill Publication

2 Mechanical Operations by Kiran D. Patil, Nirali Publication

3 Chemical Engineering, Vol. I and II by Coulson and Richardson, Pergamon Press Publication

4 Unit Operation of Chemical Engineering by McCabe and Smith; McGraw Hill Publication

5 Introduction to Chemical Technology by Badger and Banchero, McGraw Hill Publication

DCT-232 Material and Energy Balance

L	T	P
2	1	0

RATIONALE

This subject equips the students with basic chemical engineering calculations. It is one of the core subjects. In this subject, students learn the fundamental concepts on which chemical engineering design is based. This subject helps the student to prepare the material and enthalpy balance of a process. It also helps them to calculate the quantity of material input and output of a process plant.

LEARNING OUTCOMES

After studying this course, the students will be able to:

- Have understanding of scope of material and balance in chemical industries.
- Carry out conversions of units and equations.
- Have knowledge of the solution concentrations, specific gravity, density, molarity, normality, molality in the chemical industries.
- Find the contents and properties of given analyzed gas.
- Find out quantity of material input and outputs of various unit operations.
- Calculate material input and outputs of chemical reactions to identify excess and limiting reactants.
- Calculate the enthalpy associated with a reaction.
- Calculate the quantities of utility required.
- Carry out combustion calculations, proximate analysis and ultimate analysis

DETAILED CONTENTS

1. Scope
2. Scope of material and energy balance in chemical industries.
3. Unit conversion Unit conversion of units, conversions of equations, S.I. system, M.K.S. system, C.G.S. system.

4. Gases and Gas Mixture

4.1 Ideal gas law, Boyle's law, Charle's law, value of universal gas constant, Amagats Law, partial pressure

4.2 Vander Waal's equation.

4.3 Average molecular weight, density and composition (by weight and by mole) of gas mixture.

4.4 Transform of material from one measure of concentration to another, including mass/volume, PPM, molality, normality and molarity.

5. Material Balance without Chemical Reaction

5.1 Steps for solving material balance problems.

5.2 Solving problems on various unit operations like drying, evaporation, crystallization, distillation, mixing, blending, absorption, extraction.

5.3 By pass, streams, recycle and purge simple problems.

6. Material Balance with Chemical reaction

6.1 Limiting component, excess component, percent conversion, percent yield, percent excess

6.2 By pass, recycle and purge stream related simple problems.

7. Energy Balance

7.1 Units of heat, sensible heat, latent heat calculations.

7.2 Heat of formation by Hess's law, problems on the same.

7.3 Heat of reaction from specific heat data, heat of combustion, heat of formation data problems.

7.4 Adiabatic reaction and adiabatic reaction temperature

7.5 Net and gross heating value and its problems.

8. Combustion Process

8.1 Analysis of products of combustion: proximate and ultimate analysis.

8.2 Problems of fuel analysis, air fuel ratio, theoretical oxygen/air required.

8.3 Problems of fuel analysis

8.4 Oxidation of sulphur and its compounds

INSTRUCTIONAL STRATEGY

Teacher should give small assignments to the student. Give industrial based practical problems for material and energy calculations.

MEANS OF ASSESSMENT

- Assignments and quiz/class tests
- Mid-term and end-term written tests

RECOMMENDED BOOKS

1. Stoichiometry by B. I. Bhatt &S. M. Vora; McGraw Hill Publication
2. Chemical Process Principles Part-1 by O.A. Hougen and K.M. Watson.
3. Chemical Process Principles Part-1 by R.A. Rastogi
4. Solved Examples in Chemical Engineering by G.K. Ray

DCT-233 Chemical Engineering Thermodynamics

L	T	P
2	1	0

RATIONALE

It is a core subject of Chemical Engineering and is essential for understanding basic concepts, thermodynamic properties of fluid and performance of thermal systems used in industry.

LEARNING OUTCOMES

After the completion of this course, the students will be able to:

- Know about basic concepts of thermodynamics.
- Understands laws of thermodynamics.
- Understand the application of laws of thermodynamics
- Know about the phase equilibrium

DETAILED CONTENTS

1. Introduction and Basic Concepts

Systems, processes and surroundings, homogenous and heterogeneous systems, closed, open and isolated, intensive and extensive properties, state and path functions. Concept of internal energy, enthalpy, entropy, free energy and equilibrium equation of state, ideal gas law, Vander Waals equation. Amagat's law, Dalton's law, Henry's law, Zeroth law of thermodynamics.

2. First Law of Thermodynamics for Open and Closed System

Statement of first law of thermodynamics, use of steam tables, calculation of internal energy, enthalpy, heat and work for ideal gas undergoing reversible, isothermal, Isobaric, adiabatic and polytrophic process. T-V, P-V and P-T diagrams.

3. Second Law of Thermodynamics

Statement of second law of thermodynamics: Kelvin Plank statement and

Classius statement, Carnot cycle and its efficiency, concept of entropy and entropy change for closed and open system.

Heat pump and heat engine (coefficient of performance and efficiency). Reversible and irreversible process. Thermodynamic temperature scale. Thermal thermodynamic equation, Maxwell relation

4. Third Law of Thermodynamics (Statement only)

5. Entropy

Inequality of Classius, entropy-a property of a system entropy change in reversible process, entropy change for an open system, principle of increase of entropy, efficiency, irreversibility.

6. Applications of Second law of Thermodynamics

Refrigeration, vapor compression and absorption refrigeration cycle, air refrigeration cycle, types of compressors, reciprocating air compressor, single stage compressor, and isentropic efficiency of compressor, coefficient of performance(COP), liquefaction process, latest refrigerants- their qualities and applications

7. Chemical Reaction Equilibrium and Vapor Liquid Equilibrium

Concept of chemical potential, Gibb's Duhen Equation, Raoul's law, Gibb's phase rule, vapor liquid equilibrium, dew point and bubble point, calculations for two component systems, fugacity, fugacity, fugacity coefficient, activity and activity coefficient.

INSTRUCTIONAL STRATEGY

Lot of emphasis on use of model as well as audio-video presentation should be given. Lot of stress should be given to numerical aspect to give in-depth knowledge of the subject. This will make the subject interesting and improve students' involvement in the subject.

MEANS OF ASSESSMENT

- Assignments and quiz/class tests
- Mid-term and end-term written tests

LIST OF RECOMMENDED BOOKS

1. Introduction to Chemical Engineering Thermodynamics by Smith and Vanness; McGraw Hill.
2. Chemical Engineering Thermodynamics by K.V. Narayanan; Prentice Hall India.
3. Chemical Engineering Thermodynamics by Dodge; McGraw Hill.
4. Chemical Engineering Thermodynamics by YVC Rao
5. Engineering Thermodynamics by PK Nag
6. Thermal Engineering by Ballaney
7. Chemical Engineering Thermodynamics by K.A. Gavhane, Nirali Publication.

DCT-234 Heat Transfer Operations

L	T	P
2	1	0

RATIONALE

Most of the Chemical Engineering operations will involve either heat addition or heat removal in one way or the other. It is, therefore, extremely necessary to have good understanding about the heat transfer mechanisms. This subject enables the students to apply this knowledge for understanding the performances of various heat transfer equipment such as heat exchangers, condensers, evaporators etc. used in almost all chemical and related industries

LEARNING OUTCOMES

After the completion of this course, the students will be able to:

- Understand basic laws of heat transfer
- Analyze problems involving steady heat conduction in simple geometries.
- Understand the concept of convective heat transfer and to analyze the problems involving heat transfer coefficients for natural and forced convection
- Analyze heat exchanger performance using LMTD and use it for parallel or counter flow
- Recognizer various type of heat exchanger working principle, and basic geometries of heat exchanger.
- Determine the overall heat transfer coefficient for a heat exchanger.
- Understand the concept of boiling and condenser
- Analyze the performance of evaporator

DETAILED CONTENTS

1. Modes of Heat Transfer

Conduction, Convection, Radiation, concept of steady state and unsteady state heat transfer

2. Conduction

Fourier's law of heat conduction, thermal conductivity of materials – solids, liquids and gases and effect of temperature on thermal conductivity, one dimensional steady state heat conduction through a plane wall, composite wall and cylinder, multi-layer cylinder. Steady state heat conduction through a variable area in solid cylinder and

sphere.

Insulation and insulating materials, critical thickness of insulation, physical properties of insulating materials

3. Convection

Natural and forced convection, dimensional analysis and significance of various dimensional groups such as Reynolds number, Prandtl number, Nusselt number, Grasshof number., Stanton number. Peclet number, empirical correlations for free and forced convection.

Dittus Boelter's equation,Sieder Tate Equation, simple numerical problems using Dittus Boelter equation,Sieder Tate equation and convective heat coefficient. Convective heat transfer and concept of heat transfer coefficient

4. Radiation

Reflection, absorption and transmission of thermal radiation, Emmisive power, Wein's displacement law, Stefan Boltzmann Law, Planck's law, Kirchhoff's law,Concept of black body, Grey body. Heat transfer by radiation exchange of energy between two parallel planes of different emissivity, view factor, radiation shield, solar radiation.

5 Heat Exchanger

Introduction, classification, individual and overall heat transfer coefficient, fouling factor, roughness of surfaces and their effect, LMTD for parallel and counter current heat exchangers, construction and description of:- Concentric double pipe, Shell and tube (1-1 heat exchanger and 1-2 heat exchanger), Plate type heat exchanger, Efficiency of extended surface equipment, compact heat exchanger, finned tube heat exchanger.

6. Boiling and condensation

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

7. Evaporators

Evaporation Capacity, Evaporation Economy, construction and description of open pan, long type vertical evaporator, falling film evaporator and agitated thin film evaporator, multiple effect evaporator, feeding arrangements- forward, backward, mixed and parallel feed.

INSTRUCTIONAL STRATEGY

A field visit may be conducted to expose the students to various types of heat transfer equipment. Practical should be conducted to give an idea about modes of heat transfer, effect of insulation on heat transfer.

MEANS OF ASSESSMENT

- Assignments and quiz/class tests, mid-semester and end-semester written tests
- Actual practical work, exercises and viva-voce
- Presentation and viva-voce

RECOMMENDED BOOKS

1. Heat Transfer by Chapman, MacMillan Publication.
2. Principles of Heat Transfer by Kreith, Harper and Row Publication.
3. Process Heat Transfer by Kern, McGraw Hill Publication.
4. Heat Transfer by McAdams, McGraw Hill Publication.
5. Heat Transfer by KA Gavahane, NiraliPublications.
6. Process Heat Transfer by Kern DQ, McGraw Hill Book, New York
7. Heat Transfer 7th Ed. By Holman JP; McGraw Hill, New York
8. Applied Process Design for Chemical and Petrochemical Plants, Volume III by Ludwig, E; Gulf Publishing Co., Houston, Texas
9. Heat Transfer Principles and Applications by K Dutta; Prentice Hall, India.
10. Unit Operation of Chemical Engineering by McCabe and Smith.

DCT-235 Chemical Technology I

L	T	P
2	1	0

RATIONALE

A comprehensive knowledge of various chemical industries involving process technology, availability of raw materials, production trend, preparation of flow sheet, engineering problems involving material of construction and uses, is required for diploma holders in Chemical Engineering. Hence this subject.

LEARNING OUTCOMES

After studying this course, the students will be able to:

- State basic principles of chemical process industry.
- Understand various processes used for manufacturing different compounds.
- Draw different types of flow sheet used in process industry.
- Describe engineering problems of various chemical industries.
- Understand use of various equipment/instruments used in process industry.

DETAILED CONTENTS

1. Introduction
   - 1.1 Introduction of Chemical process industries with reference to Indian resources, trade and export potential.
   - 1.2 Process symbols used for various equipment
   - 1.3 Uses of different process equipment
   - 1.4 Introduction to Good Manufacturing practices (GMP) and Good Laboratory Practices (GLP)

2. Sugar Industry
   - 2.1 Manufacturer of cane sugar
   - 2.2 Various engineering problems encountered in sugar industry
   - 2.3 Pollution abatement in sugar industry.

3. Fermentation Industry
   - 3.1 Introduction of fermentation industry
   - 3.2 Types of fermentation processes
   - 3.3 Production of ethyl alcohol by fermentation

3.4 Industrial alcohol, manufacture of industrial alcohol-beers, wines and liquors,

3.5 Various engineering problems encountered in fermentation industry

3.6 Pollution abatement in fermentation industry.

4. Soaps and Detergent Industry

4.1 Manufacturing of soap, glycerin as by products from soap

4.2 Manufacturing of detergents (including raw material and manufacturing process)

4.3 Manufacturing of House disinfectants

4.4 Various engineering problems encountered in soaps and detergent industry.

5. Pulp and Paper Industry

5.1 Different pulping process

5.2 Manufacturing of paper

5.3 Role of additives

5.4 Various engineering problems encountered in paper industry.

5.5 Pollution abatement in pulp and paper industry.

6. Polymer Industry

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

7. Petroleum Refining Industry

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

INSTRUCTIONAL STRATEGY

Teacher should explain each process industry and use of each and every equipment used. An industrial visit can be organized in various chemical and process industries. Audio-visuals should be used to teach.

MEANS OF ASSESSMENT

- Assignments and quiz/class tests
- Mid-term and end-term written tests

DEVS-231 Environmental Studies

L	T	P
3	0	0

RATIONALE

A diploma holder must have knowledge of different types of pollution caused due to industries and constructional activities so that he may help in balancing the ecosystem and controlling pollution by various control measures. He should also be aware of environmental laws related to the control of pollution. He should know how to manage the waste. Energy conservation is the need of hour. He should know the concept of energy management and its conservation.

LEARNING OUTCOMES

After undergoing the subject, the student will be able to:

- Comprehend the importance of ecosystem and sustainable
- Demonstrate interdisciplinary nature of environmental issues
- Identify different types of environmental pollution and control measures.
- Take corrective measures for the abatement of pollution.
- Explain environmental legislation acts.
- Define energy management, energy conservation and energy efficiency
- Demonstrate positive attitude towards judicious use of energy and environmental protection
- Practice energy efficient techniques in day-to-day life and industrial processes.
- Adopt cleaner productive technologies
- Identify the role of non-conventional energy resources in environmental protection.
- Analyze the impact of human activities on the environment

DETAILED CONTENTS

1. Introduction

1.1 Basics of ecology, eco system- concept, and sustainable development, Resources renewable and non renewable.

2. Air Pollution

2.1 Source of air pollution. Effect of air pollution on human health, economy, plant, animals. Air pollution control methods.

3. Water Pollution

3.1 Impurities in water, Cause of water pollution, Source of water pollution. Effect of water pollution on human health, Concept of dissolved O_2, BOD, COD.

Prevention of water pollution- Water treatment processes, Sewage treatment. Water quality standard.

4. Soil Pollution

4.1 Sources of soil pollution

4.2 Types of Solid waste- House hold, Hospital, From Agriculture, Biomedical, Animal and human, excreta, sediments and E-waste

4.3 Effect of Solid waste

4.4 Disposal of Solid Waste- Solid Waste Management

5. Noise pollution

Source of noise pollution, Unit of noise, Effect of noise pollution, Acceptable noise level, Different method of minimize noise pollution.

6. Environmental Legislation

Introduction to Water (Prevention and Control of Pollution) Act 1974, Introduction to Air (Prevention and Control of Pollution) Act 1981 and Environmental Protection Act 1986, Role and Function of State Pollution Control Board and National Green Tribunal (NGT), Environmental Impact Assessment (EIA).

7. Impact of Energy Usage on Environment

Global Warming, Green House Effect, Depletion of Ozone Layer, Acid Rain. Eco-friendly Material, Recycling of Material, Concept of Green Buildings.

INSTRUCTIONAL STRATEGY

In addition to theoretical instructions, different activities pertaining to Environmental Studies like expert lectures, seminars, visits to green house, effluent treatment plant of any industry,rain water harvesting plant etc. may also be organized.

MEANS OF ASSESSMENT

– Assignments and quiz/class tests,

– Mid-term and end-term written tests

RECOMMENDED BOOKS

1. Environmental and Pollution Awareness by Sharma BR; Satya Prakashan, New Delhi.

2. Environmental Protection Law and Policy in India by Thakur Kailash; Deep and Deep Publications, New Delhi.

3. Environmental Pollution by Dr. RK Khitoliya; S Chand Publishing, New Delhi

4. Environmental Science by Deswal and Deswal; Dhanpat Rai and Co. (P) Ltd. Delhi.
5. Engineering Chemistry by Jain and Jain; Dhanpat Rai and Co. (P) Ltd. Delhi.
6. Environmental Studies by ErachBharucha; University Press (India) Private Ltd., Hyderabad.
7. Environmental Engineering and Management by Suresh K Dhamija; S K Katariaand Sons, New Delhi.
8. E-books/e-tools/relevant software to be used as recommended by AICTE/ NITTTR, Chandigarh.

Websites for Reference:

http://swayam.gov.in

DCT-241 Mass Transfer Operations

L	T	P
2	1	0

RATIONALE

In this subject the basic concepts of mass transfer are covered to enable the students to understand working of various mass transfer equipment like distillation column, gas absorption columns, dryers, cooling towers and extraction columns etc. which are used in industries for purification of products

LEARNING OUTCOMES

After completion of this course, the students will be able to:

- Understand the fundamentals of mass transfer operations
- Estimate the diffusivity for molecular diffusion in gases and liquids.
- Find out local and overall mass transfer coefficient for interphase mass transfer.
- Understand various mass transfer processes like diffusion, adsorption, stripping, humidification and drying.

DETAILED CONTENTS

1. Introduction to Mass Transfer Operations and Classification

2. Diffusion

Definition of diffusion and its classification viz diffusion under concentration, pressure and thermal gradient, forced diffusion and eddy diffusion.
Role of diffusion in mass transfer, Fick's law, diffusion in the gas phase equimolecular counter diffusion, diffusion through stationary gas. Mass transfer coefficient, film theory and penetration theory, surface renewal theory of mass transfer, diffusion in solids, interface mass transfer, relation between film and overall mass transfer coefficient, Knudsen diffusion. Simple numerical problems based on Fick's law

3. Gas Absorption and Desorption

Condition of equilibrium between gas and liquid, mechanism of absorption, material balance and design equation of operating line. Absorption factor, concept of transfer unit (HTU and NTU) height of column based on condition-gas film, based on condition-liquid film, height of column based on overall coefficient, HETP for packed column of distillation, types of tower packing, properties of tower packing, problems encountered like flooding, channeling, and weeping, loading, choice of solvent, Raoult's law and Henry's law.

4. Humidification and Dehumidification

Definition of humidity, saturated gas, relative humidity, percentage humidity, humid

heat, humid volume, dew point, total enthalpy, phase equilibria – relation between equilibrium, mole fraction and saturation humidity, use of humidity chart.

Dry bulb and wet bulb temperature, Adiabatic saturation temperature.
Gas liquid contact operation: names of adiabatic and non-adiabatic equipment – natural draft cooling tower, humidifier and dehumidifier, different cooling tower arrangements, spray chambers, spray ponds.

5. Drying

General Definition – moisture content (wet and dry basis), equilibrium moisture content, bound moisture content, unbound moisture content, free and critical moisture content, rate of drying curve, time of drying, constant and falling rate periods,drying equipment – tray dryer, rotary dryer, spray dryer, fluidized bed dryer and application.

6. Distillation

- Concept of Distillation, Vapour Liquid Eqilibria, Roault's Law, Dalton's Law Volatility: Relative Volatility, Derivation to calculate Vapour composition and liquid composition.
- Methods of Distillation: Differential or simple Distillation, Rayleigh's equation. Flash or Equilibrium Distillation. Material Balance over stripping and enriching section, McCabe Theile Method (only procedure) Feed plate, feed line, q-line, effect of feed condition, reflux ratio, total reflux ratio, Minimum reflux ratio, optimum reflux ratio.
- Batch Distillation, Azeotropic Distillation, Extractive Distillation, steam Distillation.
- Equipment for distillation – plate column, packed column. Concept of flooding, foaming, dumping/Weeping, Entrainment in distillation columns.

7. Extraction
Definition and application of extraction, (final expression and physical meaning of terms therein, no derivation) equipment: mixer settler, spray and packed extraction towers, perforated plate extraction tower, agitated tower extractor.

8. Leaching
Definition and application of leaching, equipment: leaching through stationary solid beds, moving beds, ideal stages in counter current leaching.

9. Adsorption
Concept of Adsorption operation, types of adsorption and nature of adsorbent, effect of temperature on adsorption and industrial application, adsorption isotherms, Freundlich absorption isotherm

INSTRUCTIONAL STRATEGY

Field visit will make the students familiar with different types of column

(packed/tray) and different types of packings/trays used in the column. This will also make the students aware of auxiliary equipment/models/supports used for the columns. Along with the theoretical part, emphasis should be given to problem solving and practices especially for distillation column, absorption and humidification.

MEANS OF ASSESSMENT

- Assignments and quiz/class tests, mid-semester and end-semester written tests
- Presentation and viva-voce

RECOMMENDED BOOKS

1. Mass Transfer Operations by Treybal, Kogakusha Publication
2. Introduction to Chemical Engineering by Badger and Banchero, McGraw Hill Publication
3. Unit Operation of Chemical Engineering by McCabe and Smith; McGraw Hill Publication
4. Mass Transfer by Sherwood Pigford and Wilke, McGraw Hill Publication
5. Chemical Engineers Handbook by Perry and Chilton, McGraw Hill Publication
6. Mass Transfer Operations by Kiran D. Patil, Nirali Publication

DCT-242 Pollution Control and Industrial Safety

L	T	P
3	0	0

RATIONALE

A Chemical Engineering technician must have the knowledge of different types of pollution caused due to industrialization so that he may help in balancing the eco-system and control the pollution by means of control devices. The technician must know various types of accidents which occur in chemical plants and how to safeguard them to avoid injury to men and material. Hence this subject.

LEARNING OUTCOMES

After completion of this course, the students will be able to:

- Understand different types of pollution caused due to industrialization.
- Balance pollutants to save the ecosystem
- Control pollution by means of control devices
- Have knowledge of different Acts and rules about the environmental protection.
- Manage solid wastes to reduce the pollution.
- Have Knowledge of various types of accidents which occur in chemical plants

DETAILED CONTENTS

1 Introduction

Environment and Pollution, Classification of pollution e.g. Land, Water, Air, Noise.Environment Impact assessment Studies, Character and origin of industrial wastes.

2. Air Pollution

i) Definition of air pollution, Types of Air pollutants and their sources like SPM, SOX, NOX, NH_3, F, C1, CFC, CO_2 etc.

ii) Air Pollution control equipment in industries.

a) Settling chamber

b) Cyclone

c) Scrubber (dry & wet)

d) Multicyclone

e) Electrostatic precipitator

f) Bag Filter

iii) Ambient air quality measurement & their standards

iv) Vehicular Pollution and its control

v) Noise Pollution and its control mechanism

3. Water Pollution

Water pollution, standards for drinking water, domestic waste water and industrial waste water. Methods of measurement of various parameter like BOD, SS, pH, COD, TDS etc.

Methods of treatment of industrial waste water like

a) Chemical treatment

b) Physio-Chemical treatment

c) Bio-chemical treatment

d) Any other advance treatment

4. Environment Protection

Environmental protection from hazardous chemicals waste:

Terminology relating to chemical hazards and air pollution, classification of chemical hazards and hazardous chemicals, codes of safety for operational hazards in laboratories, industries etc. (Reference should be made of I.S. Codes)

5. Radio Active Pollution

Sources and effect on human, animal, plant and material. Measurement, means to control, preventive measures.

6. Solid Waste Management

Municipal solid waste, biomedical waste, Plastic waste and its management, solid waste disposal methods such as open dumping, sanitary landfilling composting, incineration.

Importance of development of green area

7. Pollution Acts

A water pollution prevention control Act 1974, Air Pollution Act 1981, Environment protection Act 1986, Hazardous chemical manufacturing, storage and impact rules 1989 and

hazardous waste and management and handling rules 1989, Regulation and control Rules 2000.

8. Safety in Chemical Industry

Receiving and storing chemicals- transporting and moving chemicals- Safety in chemical reactions, pipe-lines with color coding in chemical factories. Precautions in the case of

processes in operations involving explosive or inflammable dusts, gases, vapours etc. Maintenance of chemical plants-corrosion health hazards in common chemical processes, Fire hazards and their prevention. Codes of practice and specification for safety equipment (Reference should be made from I.S. Codes), case study of major chemical process industries disasters/accidents.

INSTRUCTIONAL STRATEGY

Case Study of any disaster should be undertaken. Study should be data based. Field visit to the industries should be planned.

Student should encouraged to undertake project work related to environmental problems.

MEANS OF ASSESSMENT

- Class Test
- Home Assignment
- Attendance
- Sessional Test

RECOMMENDED BOOKS

1. Safety in Process Plant Design by Wells
2. Safety and Accident Prevention in Chemical Operation by H. H, Tanacatte and W. S. Wood
3. Engineering Chemistry by P.C. Jain

DCT-243 Chemical Technology II

L	T	P
3	0	0

RATIONALE

This subject will cover essential features of Chemical process industries regarding manufacture of various types of chemicals. The subject gives ideas to about various parameters like temperature, pressure, concentration and catalyst which affect the yield of the product.

LEARNING OUTCOMES

After studying this course, the students will be able to:

- State basic principles of chemical industry.
- Understand various processes used for manufacturing different chemicals
- Draw different types of flow sheet used in process industry.
- Describe engineering problems of various chemical industries
- Describe pollution abatement methods in various chemical industries.

DETAILED CONTENTS

1. Sulphuric Acid Industry
   - 1.1 Manufacturing process of Sulphuric Acid by Contact Process
   - 1.2 Manufacturing of oleum
2. Technology and processes involved in the commercial manufacture of the following chemicals
   - 2.1 Ammonia
   - 2.2 Nitric acid
   - 2.3 Urea
   - 2.4 Ammonium Nitrate
   - 2.5 Ammonium Sulphate
   - 2.6 Ammonium Phosphate
   - 2.7 Mixed Fertilizer
   - 2.8 Pollution abatement in fertilizer industry
3. Phosphorus Industry
   - 3.1 Phosphorus
   - 3.2 Phosphoric acid (Sulphuric and Hydrochloric acid Leaching)
   - 3.3 Single Super Phosphate
   - 3.4 Triple Super Phosphate

3.5 Phosphorus Tri Chloride
3.6 Phosphorus Penta Chloride
3.7 Sodium Phosphate

4. Chlor-alkali Industry

4.1 Manufacturing process of Chlorine.
4.2 Manufacturing process of Caustic Soda
4.3 Manufacturing process of Hydrochloric acid.
4.4 Manufacturing process of Soda ash.

5. Flue and Industrial Gases

5.1 Manufacturing process of Oxygen
5.2 Manufacturing process of Nitrogen
5.3 Manufacturing process of Hydrogen
5.4 Manufacturing process of Water Gas
5.5 Manufacturing process of Producer Gas
5.6 Manufacturing process of Carbon di oxide
5.7 Manufacturing process of Acetylene

6. Cement Industry

6.1 Classification of cement based on application
6.2 Constituents of cement
6.3 Gypsum
6.4 Manufacturing of Plaster of Paris
6.5 Manufacturing of Cement
6.6 Manufacturing of Portland cement
6.7 Pollution abatement in cement industry

7. Introduction and uses of Insecticides, Pesticides and Herbicides.

8. Introduction to Paint, Varnishes and dyes.

INSTRUCTIONAL STRATEGY

Teacher should explain each process industry and use of each and every equipment used. An industrial visit can be organized in various chemical and process industries.

Audio-visuals should be used to teach.

MEANS OF ASSESSMENT

– Assignments and quiz/class tests

– Mid-term and end-term written tests

RECOMMENDED BOOKS

2. Dryden's Outlines of Chemical Technology by M. Gopal Rao and Marshal Sitting; Affliated Press Pvt. Ltd.
3. Shreve's Chemical Process Industries by Jorge Austin; Tata McGraw Hill
4. Unit Process in Organic Synthesis by P.H. Groggins; Tata McGraw Hill
5. Chemical Technology Vol I and II by G. N. Pandey

DCT-244 Process Plant Utilities

L	T	P
3	0	0

RATIONALE

The objective of this subject is to teach the students about requirement of different utilities for the process plant and effective utilization. Main utilities required for process plants are water, steam, air and refrigerants. Steam and non-steam heating media is used for conversion of raw material to products in reactors and to elevate the temperature in the chemical processes. Similarly, refrigeration is important to maintain the temperature in the process plant. Compressed air and process air is used in processes and instrument air is used in pneumatic devices and controls.

LEARNING OUTCOMES

After studying this course, the students will be able to:

- Acquire the knowledge for selection of different utilities.
- Understand basic calculations involved in steam generation, psychometric operation and refrigeration.
- Describe the different equipment used to run the process plant with different utilities.
- State the principles involved during water treatment
- Know different fuels used in boilers

DETAILED CONTENTS

1. Importance of Water

1.1 Sources of water, storage, quality parameters like hardness, suspended solids (SS), turbidity and alkalinity etc., hard and soft water.

1.2 Requisites of industrial water and its uses.

1.3 Methods of water treatment –flow diagram, coagulation by iron compounds like alum, sedimentation, filtration, chemical softening and demineralization (Ion Exchange Process)

1.4 Resins used for water softening

1.5 Reverse osmosis and membrane separation

1.6 Effects of impure boiler feed water - scale and sludge formation, corrosion, priming and foaming, caustic embrittlement

2. Fuels used in boilers

Types of fuels used in boilers, coal, fuel oil, rice husk, natural and biogas etc.

3. Steam and Steam Generation:

3.1 Properties of steam

3.2 Problems based on enthalpy calculation for wet steam, dry saturated steam, superheated steam

3.3 Types of steam generators/boilers: water tube & fire tube, Solid fuel fired boiler, waste gas fired boiler, Waste heat boiler, Fluidized bed boiler.

3.4 Scaling, trouble shooting, blow down preparing boiler for inspection

3.5 Steam traps, pressure reducing valves (PRV), steam ejectors, boiler mountings and accessories: feed water pump, injector, economizer, air preheater, super heater, pressure gauge, water level indicator, safety valve etc.

3.6 Boiler Act

4. Humidification and Cooling Towers

Equipment used for humidification, dehumidification evaporative cooling, spray ponds, cooling towers- principle, details and problems like scaling, use of inhibitors like sodium and chromates etc.

5. Refrigeration:

5.1 Refrigeration cycles

5.2 Different methods of refrigeration used in industry – Vapour compression, Vaporabsorption: Lithium bromide (Eco-Friendly)

5.3 Different refrigerants – Monochlorodifluoro methane (R-22), Chlorofluorocarbons (CFC), Secondary refrigerants: Brines

5.4 Simple calculation of C.O.P., Refrigerating effects.

6. Air Supply and Drying Unit

6.1 Use of compressed air, process air and instrument air

6.2 Process of getting instrument air and process air

6.3 Drying unit and regeneration of drying unit

7. Non steam heating system

8. Principle, construction and workingof Thermic fluid heater

9. Inert gases Nitrogen generation, nitrogen drying and supply.

INSTRUCTIONAL STRATEGY

Teacher should focus on conceptual clarity.

An industrial visit can be organized in relevant industries. Audio-visuals aids should be used to teach.

MEANS OF ASSESSMENT

- Assignments and quiz/class tests
- Mid-term and end-term written tests

RECOMMENDED BOOKS

1. Thermal Engineering by P.L. Ballaney; Khanna Publisher New Delhi
2. Industrial water treatment by S.T. Powel; McGraw Hill New York
3. Boiler Operations by Chattopadhyay; Tata McGraw Hill, New Delhi
4. Perry's chemical Engineer's Handbook by Perry R.H. Green D.W; McGraw Hill, New York
5. Elements of Heat Engines Vol. II,III by R.C. Patel C.J.Karmchandani; Acharya Book Depot Vadodara
6. Refrigeration & Air conditioning by P.N. Ananthanarayan; Tata McGraw Hill
7. Industrial chemistry by Jain & Jain; Tata McGraw Hill

DCT-245 Renewable Energy Resources

L	T	P
3	0	0

RATIONALE

Energy is an important input in all sectors of country's economy. Standard of living of a country can be directly judged by per capita consumption of energy. In light of energy crises and environmental concerns, renewable energy is the only solution to save our planet. Hence this subject.

LEARNING OUTCOMES

After completion of this course, the students will be able to:

- Understand the importance and applications of various renewable sources of energy
- Understand the types of biogas plants and electricity generation from biomass
- Identify usage of different types of wind turbines
- Understand the working of various types of collectors and applications of solar energy
- Understand different geothermal power plants
- Understand the usage of tidal and wave energy
- Understand the importance of hydrogen energy

DETAILED CONTENTS

1. Renewable and Non-Renewable Sources of Energy
   - 1.1. Introduction
   - 1.2. Need of renewable sources of energy
   - 1.3. Renewable sources of energy such as biomass, wind, solar, geothermal, tidal and wave, hydrogen energy.
2. Biomass Energy
   - 2.1. Introduction to biomass energy
   - 2.2. Resources of biomass energy
   - 2.3. Types of biogas plants-fixed dome and floating type
   - 2.4. Electricity generation from biomass
   - 2.5. Other useful products from biomass
3. Wind Energy
   - 3.1. Introduction to wind energy
   - 3.2. Site selection of wind mill

3.3. Types of Wind Turbines-Horizontal axis wind turbine (HWAT) and vertical axis wind turbine (VAWT), their construction, working, advantages and disadvantages

4. Solar Energy

4.1. Introduction to solar energy, solar spectral and greenhouse effect

4.2. Classification of solar thermal collectors- flat type, focusing type and central tower receivers, their construction and working

4.3. Application of solar energy like solar cooker, solar water heater, solar crop dryers and solar pond

4.4. Solar photo voltaic- construction and working principle

4.5. Solar energy storage methods

5. Geothermal Energy

5.1. Introduction and its significance

5.2. Geothermal Power Plants-dry stream, flash steam and binary cycle

6. Tidal and Wave Energy

6.1. Generation of Tidal and Wave Energy

6.2. Tidal Power Plant

6.3. Wave Power Plant

7. Hydrogen Energy

7.1. Methods for hydrogen production

7.2. Storage of Hydrogen

7.3. Transportation of Hydrogen-through pipelines and containers

INSTRUCTION STRATEGY

This subject is of great importance, therefore the teachers are expected to lay considerable stress on renewable sources, their importance, production, utilization and storage system. As far as possible, the teaching of the subject must be supplemented by showing the videos on working principle of various renewable energy equipment and also visits to nearby places where such equipmentis installed.

MEANS OF ASSESSMENT

– Assignments and quiz/class tests

– Mid-term and end-term written tests

LIST OF REFERENCE BOOKS

1. Non Conventional Energy Sources by G.D. Rai; Khanna Publishers, New Delhi.

2. Renewable and Conventional Energy by S. Rao; Khanna Publisher, New Delhi

3. Non-Conventional Sources of Energy by Umesh Chandra Sharma; Studium Press, Texas, USA

4. Solar Energy by S.P. Sukhatme; Tata McGrawHill Publishing Co. Ltd., New Delhi

DCT-246 Unit Operation Lab

L	T	P
0	0	4

Fluid Flow and Solid Handling

Screen Analysis; Crushing efficiency for jaw crusher; Crusher rolls; Disintegrater; etc.; Sedimentation and Thickners; Viscosity measurement; Flow through pipes (Reynold'S experiment); Flow-Through Open Channels; Flow Through fitting and Joints; Orifice meter; Venturi meter; Rotameter; Verification of Bernoulli's Theorem; Characteristics of Centrifugal pumps; Fluidized bed; Spouted bed; Plate and Frame filter press; Rotary drum; Vacuum filter; Agitator and mixing.

Heat Transfer

Heat conduction through rods of different materials; Thermal conductivity of insulating materials; Boiling and Condensation; Double pipe Heat Exchanger; Shell & Tube Heat Exchanger; Long tube evaporator.

Mass Transfer

Distillation; Batch &Continuous column; Absorption with and without chemical reaction; Liquid-liquid extraction/leaching; Adiabatic humidifier, Water cooler; Driers; Tray, Rotary, Spray; Ion exchange, Reverse osmosis.

DCT-351 Process Control and Instrumentation

L	T	P
3	1	0

RATIONALE

The subject Automatic Process Control deals with the different types of controls in processes in chemical industries including automatic control systems. Process characteristics is of first order (i.e. time constant element) and second order (i.e. oscillatory type element). Different modes of control action and closed loop in automatic control are well known. The student will be well conversant with these process control systems.

LEARNING OUTCOMES

After completion of this course, the students will be able to:

1. Explain the importance of automation and its applications in chemical industries.
2. Explain the basic principles of process control in industrial processes.
3. Determine the time and response of first order and second order systems for step, ramp, impulse and sinusoidal inputs.
4. Handle chemical processes by framing it in block diagrams.
5. Identify open and closed loop systems.
6. Implement different controllers to various industrial processes.

DETAILED CONTENTS

1. Introduction
   Concept of automatic control, Advantages of automatic control, manual and automatic control, physical and block diagrams.
2. Elements of control System
   Definition- input means, controlling means, actuating means, measuring means, final control elements.
3. Process Characteristics
4. Process variables, process degree of freedom, forcing function, step function, ramp, impulse, sinusoidal function and Laplace transformation.
5. Elements of process dynamics
   Time constant and oscillatory element, determination of system function or transfer function of the following- sketch physical diagram and block diagram

5.1 Ist order system or time constant element- Naked bulb thermometer, Stirred tank heater, Mixing process, R.C. Circuit, Liquid levels, Two time constant type liquid vessel cascaded i.e. non interacting and non-cascaded, i.e. interacting.

5.2 IInd order system or oscillatory type element- Bulb in themowell, Mechanical damper.

Response of Ist order system to step, ramp, impulse and sinusoidal inputs. Response of IInd order system to step change (transient response).

6. Controller Characteristic or Modes of Control Action

7. Block diagram of a control system, negative and positive feedback system, servo and regulatory problem, control valve mechanism and its transfer function, elements of
controller, proportional control, integral control, proportional-integral control, proportional derivative control proportional-integral-derivative control, two positions control.

8. Closed Loop in Automation Control
9. Standard block diagram symbol, overall transfer function for a single loop system, overall transfer function for change in set point and for change in load, overall transfer function in multi loop control system, unit step response of the following:
   9.1 Proportional control at stirred tank heater for set point change and for load change.
   9.2 Proportional integral control of stirred tank heater for set point change and load change
   9.3 Introduction to Programmable Logic Controller (PLC) and Distributed Control System (DCS)

MEANS OF ASSESSMENT

- Class Test
- Home Assignment
- Sessional Test
- Practical work

RECOMMENDED BOOKS

1. Industrial Instrumentation by Donald P. Eckman, Wiley Eastern Publications.
2. Process System Analysis and Control by Coughanowr and Steven LeBlanc, McGraw Hill publications.
3. Industrial Instrumentation by SK Singh, Tata McGraw Hill Publications.
4. Principles of Industrial Instrumentation by D. Patranabis; Tata McGraw Hill Company

DCT-352 Chemical Reaction Engineering

L	T	P
2	0	2

RATIONALE

This subject outline the basic principles of Kinetics. These principles which are useful in developing new concept and operating the plant. It enables the students to have an idea about the different types of rectors and it's design also gives knowledge about the importance of catalyst in various chemical processes in the industries.

LEARNING OUTCOMES

After completion this course, the students will be able to:

- Know about rate of chemical reaction.
- Understand various types of reactors.
- Know the fundamentals of reactor design.
- Know the fundamentals of heterogeneous reacting system
- Understand the concept of catalysis

DETAILED CONTENTS

1. Introduction to Chemical Kinetics
   - 1.1 Concept of rate of reaction, rate equation, rate constant, order of reaction, Molecularity of reaction, Chain reaction, Non chain reaction.
   - 1.2 Type of intermediate form in non-chain reaction.
   - 1.3 Single reaction multiple reaction, non-elementary reaction.
   - 1.4 Theories of reaction rates constant- Arrhenius law and problems based on it, from Thermodynamic, from Collision theory, from Transition state theory.
   - 1.5 Activation Energy.

2. Interpretation of batch reactor data.
   - 2.1 Concept of batch reactor, semi Batch reactor, constant and variable volume reactions. Type of intermediate form in non-chain reaction.
   - 2.2 Integral and Differential method of analysis of batch reactor data.
   - 2.3 Integral method of analysis of irreversible unimolecular first order reaction, bimolecular second order reaction, n^{th} order, zero order and auto catalytic reaction. Problem based on zero order,

first order and second order reactions.

2.4 Half-life concept for the overall order of irreversible reactions and problem based on that.

3. Introduction to Reactor Design
   3.1. Type of reactor (Batch reactor, Continuous reactor, Plug flow reactor, Mixed flow reactor, Biological reactor, Fixed (packed) bed reactor, fluidized bed reactor.
   3.2. Concept of space-time, space velocity and holding time.
   3.3. Performance equation for ideal batch reactor, mixed flow reactor and plug flow reactor for constant volume and variable volume irreversible first order reaction. Problems based on the above topic.
   3.4. Size comparison of the reactor-Batch reactors vs PFR (For first order reactions), PFR vs MFR (For first order irreversible reactions) and problems based on the above topics.

4. Introduction to Heterogeneous Reacting System
   4.1. Rate Equation for Heterogeneous Reaction
   4.2. Contacting pattern for two phase system
   4.3. Factor affecting heterogeneous reaction

5. Catalysis
   5.1. Definition, types and classification of catalyst
   5.2. Preparation of catalyst, ingredients (Promoter, inhibitor, accelerator)
   5.3. Catalyst Poisoning, regenerator.
   5.4. Theories of catalysis-Adsorption, Intermediate compound formation theory.
   5.5. Desired properties of catalyst.

LIST OF PRACTICALS

1. Study and operation of batch reactor
2. Saponification reaction through batch reactor
3. Study the kinetics of reaction for all the combination for given PFR and CSTR in series
4. To find the Arrhenius equation from isothermal batch reactor.
5. To study the performance of a fluidized bed reactor
6. Study the performance of mixed flow reactor
7. Study the performance of plug flow reactor
8. Find out rate constant and in a CSTR

INSTRUCTIONAL STRATEGY

Stress should be given on interpretation and designing of the different reactors.
Industrial visit during the semester should be planned and audio-visual aids

should be used for making student understand. This will make subject interesting and improve student's performance in the subject.

Reaction Engineering Lab

1. Estimation of activation energy of saponification reaction in a batch reactor

2. Estimation of reaction rate constant in a semi-batch reactor

3. Estimation of reaction rate constant in a plug flow reactor

4. Estimation of reaction rate constant in a continuously stirred tank reactor

5. Residence Time Distribution in a plug flow reactor

6. Residence Time Distribution in a continuously stirred tank reactor

MEANS OF ASSESSMENT

- Assignments and quiz/class tests
- Mid semester and end semester written tests

RECOMMENDED BOOKS

1. Chemical Reaction Engineering by Octave Levenspiel; Wiley Eastern Ltd.
2. Chemical Engineering Kinetics by J.M Smith; McGraw Hill Publication
3. Chemical Engineering Thermodynamics by J.M Smith, H.C. Vanness; McGraw Hill
4. Thermodynamics for Chemists by Samuel Glasstone; Krieger Publication Company.

		L	T	P
DCT-353	Process simulation and Control Lab	0	0	4

List of Practicals

1. Comparing different models for computing thermodynamic and transport properties such as K-values, Enthalpy, VLE data etc. for pure substances and mixtures; Flash calculations and VLE of azeotropic mixtures 2. Design of flow network consisting of fittings, pumps and piping (horizontal, vertical & inclined); single and multiple branches

3. Calculations for performances of pumps, compressors, expanders, valves etc.

4. Preparing steady state process flow sheets (equipment selection, numbering, stream designation) and carrying out mass and energy balances with and without recycle for chemical processes

5. Design and rating of heat exchangers (with and without phase changes); double pipe, shell and tube, plate and frame heat exchangers

6. Design and rating of separation processes – simple distillation column with different reflux ratios (short cut design), rigorous column design; multi-component distillation column design, sequencing of distillation columns, absorption and stripping, liquid-liquid extraction

7. Simulating performance of different reactor models for reversible and irreversible reactions

8. Batch reactor rate regression from process of lab data

List of Experiments in process control lab

9. Study of Flow Control Trainer

10. Study of Level Control Trainer

11. Study of Temperature Control Trainer

12. Study of Pressure Control Trainer

13. To study the dynamics of two thank interacting and non-interacting system

14. Study of open loop dynamics of first and second order system using MATLABSIMULINK

		L	T	P
DHSS-352	Industrial Management and Entrepreneurship Development	3	0	0

RATIONALE

In the present day scenario, it has become imperative to impart entrepreneurship and management concepts to students so that a significant percentage of them can be directed towards setting up and managing their own small enterprises. It may be further added that an entrepreneurial mind set with managerial skills helps the student in the job market. This subject focuses on imparting the necessary competencies and skills of enterprise set up and its management.

LEARNING OUTCOMES

After undergoing this course, the students will be able to :

- Know about various schemes of assistance by entrepreneurial support agencies
- Conduct market survey
- Prepare project report
- Explain the principles of management including its functions in an organisation.
- Have insight into different types of organizations and their structures.
- Inculcate leadership qualities to motivate self and others.
- Manage human resources at the shop-floor
- Maintain and be a part of healthy work culture in an organisation.
- Use marketing skills for the benefit of the organization.
- Maintain books of accounts and take financial decisions.
- Undertake store management.
- Use modern concepts like TQM, JIT and CRM.

DETAILED CONTENTS

SECTION – A

ENTREPRENEURSHIP

1. Introduction
   - 1.1 Concept /Meaning and its need
   - 1.2 Qualities and functions of entrepreneur and barriers in entrepreneurship
   - 1.3 Sole proprietorship and partnership forms and other forms of business organisations
   - 1.4 Schemes of assistance by entrepreneurial support agencies at

National, State, District –level, organisation: NSIC, NRDC, DC, MSME, SIDBI, NABARD, NIESBUD, HARDICON Ltd., Commercial Banks, SFC's TCO, KVIB, DIC, Technology Business Incubators (TBI) and Science and Technology Entrepreneur Parks

2. Market Survey and Opportunity Identification/Ideation
   - 2.1 Scanning of the business environment
   - 2.2 Salient features of National and Haryana State industrial policies and resultant business opportunities
   - 2.3 Types and conduct of market survey
   - 2.4 Assessment of demand and supply in potential areas of growth
   - 2.5 Identifying business opportunity
   - 2.6 Considerations in product selection
   - 2.7 Converting an idea into a business opportunity

3. Project report Preparation
   - 3.1 Preliminary project report
   - 3.2 Detailed project report including technical, economic and market feasibility
   - 3.3 Common errors in project report preparations
   - 3.4 Exercises on preparation of project report
   - 3.5 Sample project report

SECTION –B

MANAGEMENT

4. Introduction to Management

   - 4.2 Definitions and importance of management
   - 4.3 Functions of management: Importance and process of planning, organising, staffing, directing and controlling
   - 4.4 Principles of management (Henri Fayol, F.W. Taylor)
   - 4.5 Concept and structure of an organisation
   - 4.6 Types of industrial organisations and their advantages
   - 4.7 Line organisation, staff organisation
   - 4.8 Line and staff organisation
   - 4.9 Functional Organisation

5. Leadership and Motivation

   - 5.2 Leadership: Definition and Need, Qualities and functions of a leader, Manager Vs leader, Types of leadership, Case studies of great leaders
   - 5.3 Motivation: Definition and characteristics, Importance of self motivation, Factors affecting motivation, Theories of motivation (Maslow, Herzberg, Douglas, McGregor)

6. Management Scope in Different Areas

6.1 Human Resource Management: Introduction and objective, Introduction to Man power planning, recruitment and selection, Introduction to performance appraisal methods

6.2 Material and Store Management: Introduction functions, and objectives, ABC Analysis and EOQ

6.3 Marketing and sales: Introduction, importance, and its functions, Physical distribution, Introduction to promotion mix, Sales promotion

6.4 Financial Management: Introductions, importance and its functions, knowledge of income tax, sales tax, excise duty, custom duty, VAT, GST

7. Work Culture

7.1 Introduction and importance of Healthy Work Culture in organization

7.2 Components of Culture

7.3 Importance of attitude, values and behavior

7.4 Behavioural Science – Individual and group behavior.

7.5 Professional ethics – Concept and need of Professional Ethics and human values.

8. Basic of Accounting and Finance

8.1 Basic of Accounting: Meaning and definition of accounting, Double entry system of book keeping, Trading account, PLA account and balance sheet of a company

8.2 Objectives of Financial Management: Profit Maximization v/s Wealth Maximization

9. Miscellaneous Topics

9.1 Total Quality Management (TQM): Statistical process control, Total employees Involvement, Just in time (JIT)

9.2 Intellectual Property Right (IPR) : Introduction, definition and its importance, Infringement related to patents, copy right, trade mark

INSTRUCTIONAL STRATEGY

Some of the topics may be taught using question/answer, assignment, seminar or case study method. The teacher will discuss stories and case studies with students, which in turn will develop appropriate managerial and entrepreneurial qualities in the students. In addition, expert lecturers may also be arranged from outside experts and students may be taken to nearby industrial organisations on

visit. Approach extracted reading and handouts may be provided.

MEANS OF ASSESSMENT

- Assignments and quiz/class tests
- Mid-term and end-term written tests
- Model/Prototype making.

RECOMMENDED BOOKS

1. A Handbook of Entrepreneurship, Edited by BS Rathore and Dr JS Saini; Aapga Publications, Panchkula (Haryana)
2. Entrepreneurship Development and Management by J.S.Narang; Dhanpat Rai & Sons, Delhi.
3. Entrepreneurship Development by CB Gupta and P Srinivasan, Sultan Chand and Sons, New Delhi
4. Handbook of Small Scale Industry by PM Bhandari
5. Entrepreneurship Development and Management by MK Garg
6. E-books/e-tools/relevant software to be used as recommended by AICTE/ NITTTR, Chandigarh.

DST-354 Industrial Training

L	T	P
3	0	0

It is needless to emphasize further the importance of Industrial Training of students during their 3 years of studies at Polytechnics. It is industrial training, which provides an opportunity to students to experience the environment and culture of industrial production units and commercial activities undertaken in field organizations. It prepares student for their future role as diploma engineers in the world of work and enables them to integrate theory with practice. Polytechnics have been arranging industrial training of students of various durations to meet the above objectives.

This document includes guided and supervised industrial training of 4 weeks duration to be organized during the semester break starting after second year i.e. after 4th semester examinations. The concerned HODs along with other teachers will guide and help students in arranging appropriate training places relevant to their specific branch. It is suggested that a training schedule may be drawn for each student before starting of the training in consultation with the training providers. Students should also be briefed in advance about the organizational setup, product range, manufacturing process, important machines and materials used in the training organization.

Equally important with the guidance is supervision of students training in the industry/organization by the teachers. Students should be encouraged to write daily report in their diary to enable them to write final report and its presentation later on.

An external assessment of 50 marks has been provided in the study and evaluation scheme of 5th Semester. Evaluation of professional industrial training report through viva- voce/presentation aims at assessing students understanding of materials, industrial process, practices in industry/field organization and their ability to engage in activities related to problem solving in industrial setup as well as understanding of application of knowledge and skills learnt in real life situations.

Teachers and students are requested to see the footnote below the study and evaluation scheme of 5th semester for further details.

The teacher along with field supervisors will conduct performance assessment

of students.

The components of evaluation will include the following:

List of Electives

Course	Specialization	Subject code	Subject name
Elective I	Paint	DPT-351	Introduction To Paint & Polymer Technology
	Petrochemical	DPC-351	Introduction to Natural and Biogas Engineering
	Plastic	DPL-351	Principles of Polymer Science
	Fertilizer	DFT-351	Introduction to Fertilizers Technology
Elective II	Paint	DPT-352	Drying Oil, Driers, Solvent & Additives
	Petrochemical	DPC-352	Petroleum Exploration and Drilling Technology
	Plastic	DPL-352	Plastic Materials
	Fertilizer	DFT-352	Nitrogenous Fertilizers
Elective III	Paint	DPT-361	Pigments And Extenders
	Petrochemical	DPC-361	Petroleum Refining
	Plastic	DPL-361	Plastic Testing
	Fertilizer	DFT-361	Phosphatic Fertilisers
Elective IV	Paint	DPT-362	Resins & Paint Media
	Petrochemical	DPC-362	Petrochemical Processing-I
	Plastic	DPL-362	Plastic Processing Techniques
	Fertilizer	DFT-362	Potassic Fertilizers
Elective V	Paint	DPT-363	Surface Preparation And Paint Application
	Petrochemical	DPC-363	Petrochemical Processing-II
	Plastic	DPL-363	Design Of Dies And Moulds
	Fertilizer	DFT-363	Complex Fertilizer and Bio Fertilizer

Elective 1

		L	T	P
DPT-351	**Introduction To Paint & Polymer Technology**	3	0	0

RATIONALE

In this subject Students will get to know the basic knowledge of Paint as material , and different types of polymers and polymerization techniques to get the film formers.

LEARNING OUTCOMES

After undergoing this Subject, the students will be able to:

- Understand the Fundamentals of Paints
- Understand the Fundamentals of Polymers.
- Understand the Polymerization techniques
- Understand the Fundamentals of Synthetic Film Formers.

DETAILED CONTENTS

1. BASICS OF PAINT: General Introduction of Paint Industry, definition of Paints, Varnishes and Lacquers, their
constituents and functions. General classification of surface coatings, mechanism of film formation, sources and composition of oils, non–glyceride, components of oils, classification, extraction and refining of oils.

2. FUNDAMENTAL OF POLYMERS:
Introduction & historical background of polymers, macro-molecular concept, monomers & polymers nomenclature of polymers, features ,characteristics and applications of a polymer, definition of polymerization, rate of polymerization, average degree of polymerization, functionality and polymerization. oligomers and high polymers, scope of elastomeric, fiber forming and plastic materials.

3. CLASSIFICATION OF POLYMERIZATION:
Types of polymerization, addition (chain) polymerization, condensation polymerization, Comparison between addition and condensation polymerization. Bulk, suspension, solution & emulsion polymerization.

4. FUNDAMENTAL OF SYNTHETIC FILM FORMERS:
Fundamental of film formers, chemical structure of monomers, functionality and its determination, polymerization and molecular weight, convertible, non- convertible film formers, linear, branched and cross-linked film formers and co polymers.

INSTRUCTIONAL STRATEGY

As the subject involves synthesis of various resin used in paint industry. It can be made more interacting by showing various paint samples (automotive, wall coatings, high duty coatings etc.)so that students can appreciate different types of resin and their properties.

RECOMMENDED BOOKS

1 Basics of Paint Technology- Part- 1 By V.C.Maliha, Meenal. A.Sikchi
2 Organic Coating Technology vol-1 By Henry Fleming, Payne Publisher John Wiley & Sons.
3 Surface Coatings : Raw materials & their usage Volume-1 By OCCA-Australia Publisher Champas & Hall
4 Outlines of Paint Technology By W.M.Margans Publisher Edward Arnold.
5 Introduction To Paint Chemistry By G.P.A.Turner Publisher champan & Hall
6 Polymer Science By V.R.Gowariker Publisher New Age International

DPC-351 Introduction to Natural and Biogas Engineering	L	T	P
	3	0	0

RATIONALE

The field of Natural and Biogas Engineering is very much important for Petrochemical Students this subject outline the basic and essential concepts of Natural and Biogas Industries. The subject gives ideas about Natural Gas Production Processing and Transportation. This course will also provide the knowledge to students to understand the basic concepts and principles of biogas including its applications and utilization in various fields.

LEARNING OUTCOMES

After completion this course, the students will be able to:

- Learning New Systems that are used to create bio-energy which can greatly contribute to reducing green house effect.
- Finding a new non-polluting energy resource which is also renewable.
- Finding different alternative application and uses of natural and bio-fuels.

DETAILED CONTENTS

1. INTRODUCTION AND BASIC CONCEPTS

Introduction to Natural Gas, properties of Natural Gas, Gas Production, Phase Behavior. Introduction to Biogas, Characteristics of Biogas and necessary condition for its formation. Benefits of Biogas, Biogas potential.

NATURAL GAS

2. PROPERTIES OF NATURAL GAS

Formation volume factor, Gas Reservoir, Deliverability, Skin Factor, Productivity Index.

3. NATURAL GAS PRODUCTION

Gas Production, Upstream, Downstream, Surface Facilities, Principle of Separator, Design of Separator : Vertical, Horizontal, Two Phase Separation and Three Phase Separation.

4. DEHYDRATION OF NATURAL GAS

Basic Concept of dehydration, Design of dehydration, Sweeting Process, Compressor Design and Energy Calculation, Transportation and Measurement.

BIO GAS

5. BIOGAS AND BIOGAS SYSTEM

Production of Biogas : Composition, application, Anaerobic Digestion, Applications, Power Generation, Grid Injection,

Aerobic Digestion, Comparison of Anaerobic and Aerobic Digestion, Components of Biogas.

6. APPLICATION AND UTILIZATION OF BIOGAS

Biogas as Transportation fuel, Biogas Vehicles, Biogas Problems and Safety Measures, Benefits of Biogas, Utilization in Social Research, Future Research and Development of Biogas field.

RECOMMENDED BOOKS

1. Natural Gas Engineering Handbook by Ali Ghalambor and Boyun Guo
2. Natural Gas Production Engineering by Mohan Kelkar
3. The Biogas Handbook By Wellinger Jerry Murphy David Baxter
4. Biogas from Waste and Renewable Resources: An Introduction Hardcover – Illustrated By Dieter Deublein, Angelika Steinhauser

REFERENCE WEBSITES

1. https://bue.libguides.com
2. https://www.oilandgaseng.com
3. https://biogaseng.com
4. https://biogasengineering.it/en/

DPL-351 Principles of Polymer Science

L	T	P
3	0	0

RATIONALE

"THE LIFE WITHOUT POLYMER IS VERY DIFFICULT. IT MAKES OUR LIVES VERY EASY." The Purpose of this Paper is to acquaint the students with primary knowledge of polymers i.e. different Polymers, their properties, Reactions, Polymerization Techniques, Classification, Molecular weight, Distribution of Molecular weight and their applications in different era of life.

LEARNING OUTCOMES

After undergoing this course, the students will be able to:

1. Understand the fundamentals of polymers.
2. Understand the classification of polymers.
3. Understand the polymerization mechanism.
4. Understand the polymerization reactions.
5. Understand the polymerization techniques.
6. Understand Kinetics of chain growth polymerization/step growth polymerization.
7. Analyse polymerization components for determination of molecular weight and molecular weight distribution of polymers, copolymers,etc.
8. Understand the different properties of polymer.
9. Understand the Identification and characterization of polymer.

DETAILED CONTENTS

Unit – I Introduction to Polymer Science

The science of large molecules – Definitions – Monomers & its requirement- Broad Classifications of Polymers - Types based on Structure- Processing and Applications - Molecular Force and Chemical Bonding in Polymers –Polymer structure – Homo Polymers and Copolymers – Geometric Isomerism – Tacticity – Nomenclature – Molecular Weight and Distribution and its effect on Properties and Processing of Polymers- Thermal Transition – Tg and Tm.

Unit – II Polymerization

Chain growth Polymerization – Addition Polymerisation – Reaction Mechanism - Free

Radical Reaction – Ionic Reaction – Coordination Polymerization – Ring Opening Polymerization - Condensation Polymerization – Degree of Polymerisation – Polymerization Techniques – Bulk, Solution, Suspension and Emulsion Polymerization - Co-polymerization.

Unit – III Polymer Structure and Properties
Structure – Property Relationship – Molecular Weight and Poly Dispersity Index (PDI) - Effect of Polymerization on PDI – Polymer solutions and solubility – General Rules

for Polymer solubility – solubility Parameters, Properties of Dilute solutions - Solid state properties – State of Polymer – Crystalline, Amorphous, Semi-crystalline, Liquid crystalline
– Requirement of Crystallinity – factors affecting crystallinity. Deformations in Polymer – Mechanical properties - Stress – Strain behavior – Polymer Fracture and Toughness – Cracking & Crazing – Thermal & Electrical properties.

Unit – IV Polymer Characterization
Identification of Polymers – Simple Spectroscopic Methods – Molecular Weight Determination – Measuring Dilute Solution Viscosity – Gas Chromatography – Gel Permeation Chromatography – Melt Flow Characteristics - Thermal Analysis DSC and TGA
– Dynamic Mechanical Analysis.

INSTRUCTIONAL STRATEGY

Fundamentals of Polymer Science being a basic subject, the teacher is expected to emphasize on the basics of chemistry and then polymer chemistry. As this subject is a part of chemistry, teachers are expected to cover different aspects of chemical bonding, reactions, reaction mechanism etc. For identification Purposes students should also be made aware of different plastic identification techniques.

MEANS OF ASSESSMENT

- Assignments and quiz/class tests
- Mid and end-term written tests

RECOMMENDED BOOKS

1. Polymer Science – Gowariker V.R. & others.
2. Text book of Polymer Science – Billmeyer F.W.

	L	T	P
DFT-351 Introduction to Fertilizers Technology	3	0	0

Justify the need for synthetic fertilizer : Categorize fertilizers, Explain role of essential elements for plant growth

Select the relevant fertilizers for the different types of crops

Course content:

Synthetic fertilizers, Classification of fertilizers, Role of essential Elements in plant Growth, Macro elements and Micro elements. Select the relevant fertilizers for the different types of crops Application of fertilizers considering Nutrient Balance and types of crop

References:

1. Handbook on fertilizer technology", fertilizer association of india, near jnu, new Delhi 1992.
2. L. J. Carpentire, "new developments in phosphate fertilizer technology", elsevier, 1971.

3. “Fertilizer technology and management” by Mishra Brahma

4. Microbes as bio-fertilizers and their production technology (woodhead publishing india in agriculture)” by s g borkar

5. “Soil fertility and fertilizers” by havlin/ tisdale/ nelson/ beaton

6. “Manures and fertilizers” by a k kolay

7. “Improving efficiency of urea fertilizers by inhibition of soil urease activity” by s kiss and m simihaian

8. “Production of bio-fertilizers from vermicomposting of waste corn pulp blended with cow dung as a solid waste management approach” by Musaida Mercy Manyuchi

Elective II

DPT-352 Drying Oil, Driers, Solvent & Additives	L	T	P
	3	0	0

RATIONALE

This Subject equips the students with the knowledge of the oils used in surface Coating as film formers. It also gives the basic knowledge about dries , solvents and additives.

LEARNING OUTCOMES

After undergoing this subject, the students will be able to:

- Have understanding of the oils used in Paint.
- Understand about the of Solvents used in Paint.
- Understand about the driers and other additives.

DETAILED CONTENTS

1. INTRODUCTION TO DRYING AND NON DRYING OILS:
2. Properties and uses of some commonly used drying, semi drying & non drying oils,

yellowing of oils, Chemical reactions of oils, like oxidation, hydrolysis, glyceralysis, saponification etc, Evaluation & characterization of oils, modified oils like heat treated oils, maleinised oils, co polymerized oils, dehydrated castor oils, isomerized oils, reconstituted oils etc.

3. DRIERS:

Definition of driers, types of driers like primary, secondary and auxiliary. Function of metals as well as, acid part of driers, driers mechanisms, manufacture of driers, their evaluation and recommendation for water based and solvent based coatings, combination and dosage of driers, properties of different metal as well as organic radical of driers.

4. SOLVENTS:

Types of volatile solvents, general properties of solvents like solvent power, toxicity rate of evaporation, boiling point & aromatic content, etc classification like true solvents, latent solvents and diluents, effect of solvent on film properties, classes of solvents with their sources, properties, evaluation of solvents, solubility parameters.

5. PLASTICIZERS & ADDITIVES:

Definition, importance, mechanism of plasticization, types of plasticizers with their properties, evaluation of plasticizers. Function of additives, additives for solvent-thinned coating like wetting, and dispersing agents, anti settling and bodying agents,

anti skinning agents, anti flooding agents etc, additives for latex paints like surface – active agents, antifoam agents, emulsifier, thickening agents, preservatives & coalescing agents etc.

INSTRUCTIONAL STRATEGY

Mechanical operations has significant importance in the area of chemical engineering. Adequate competency needs to be developed by giving sufficient practical knowledge to mechanical operation (characterization of solid particles, size reduction, energy requirement and mechanical separation). A field visit may be conducted to expose the working of various conveyers and filtration equipment in industries.

MEANS OF ASSESSMENT

1. Assignments
2. Class Tests
3. Practical Work
4. End Semester Exam
5. Viva-Voce

RECOMMENDED BOOKS

1 Basics of Paint Technology- Part- 1 By V.C.Maliha, Meenal. A.Sikchi

2 Organic Coating Technology vol-1 By Henry Fleming, Payne Publisher John Wiley & Sons.

3 Surface Coatings : Raw materials & their usage Volume-1 By OCCA-Australia Publisher Champas & Hall

4 Outlines of Paint Technology By W M Margans Publisher Edward Arnold., London

5 The Chemistry of Organic film formers By D.H.Solomon , R.E.Kriegar

6 Surface Coatings: Science & Technology By Swaraj Paul Publisher John wiley & Sons.

DPC-352	Petroleum Exploration and Drilling Technology	L	T	P
		3	0	0

Objective: This course is offered to build foundations of the geological and geophysical methods used in hydrocarbon exploration and prospecting. In the previous geology courses, students have been taught about rocks, sedimentary processes, structural geology and petroleum geology. In this course, the students will learn about the geophysical techniques and data interpretation involved in finding oil and gas, how to select an exploration area and generate prospects for drilling. Various geophysical methods (with emphasis on the seismic methods) will be covered in this course and the students will learn how to integrate geological and geophysical information for oil and gas exploration. There will be several class projects in this course. Groups of students will be working in different teams for various sedimentary basins. Students are required to submit their progress reports every two weeks and the final report will be due towards the end of the semester.

Course Content:

Unit-wise distribution of content and number of lectures

Fundamentals of Seismic Method:
Foundation of seismic waves propagation and signal processing Seismic Waves, Snell's Law, Seismic wave velocities and rock densities, Impedance, Reflection Coefficient, Synthetic Seismogram, Signal and noise, Fourier analysis of a signal

Seismic Data Acquisition and Processing:
Seismic sources and receivers, 2D and 3D seismic, Land and Marine seismic, Borehole seismic Seismic processingsteps (static corrections, NMO correction, Velocity Analysis, Stack, Migration) 4D seismic

Seismic Data analysis:
Seismic Attributes, AVO and other direct hydrocarbon indicators

Potential Field Methods:
Gravity and Magnetic methods: Principles of gravity and magnetic methods
Acquisition and processing of gravity and magnetic data, Applications of gravity and magnetic data in basin analysis
Basin Analysis:

Tectonics and basin formation, Subsidence and compaction, sequence stratigraphy

Directional Drilling: Types of deflection tools, tool orientation, Directional well

profiles, Well path deflection & correction.

Down Hole Motors : Positive displacement motors and Turbo-drills – motor description, Power calculation and applications

Horizontal Well Drilling: Horizontal well objectives and selection, Different profiles, Drilling techniques.

Down the Hole Well Surveying: Well surveying objectives, Surveying methods, Surveying Analysis.

Measurements While Drilling: Objectives of MWD/ LWD, MWD tools, Telemetry system and data interpretation.

Special Methods of Drilling : Aerated drilling, Under-Balanced drilling, Overbalanced drilling, HPHT Drilling, Plasma drilling, Top drive drilling, Re-entry drilling, Jet Drilling, Extended reach drilling, Multilateral drilling, Slim hole drilling, coil tubing drilling.

Text Books:

1. Fred Aminzadeh Shivaji Dasgupta, "Geophysics for Petroleum Engineers", Elsevier
2. W. M. Telford, L. P. Geldart and, R. E. Sheriff "Applied Geophysics", Cambridge University Press
3. Allen, P. A and Allen, J. R., Basin Analysis: Principles and Applications, Blackwell Publishing
4. Petroleum Engineering: Drilling and Well Completion, Carl Gatlin, Prentice-Hall, Inc., 1960.
5. Drilling Engineering, J.J. Azar and G. Robello Samuel, Pennwell Books, 2007.
6. Working Guide to Drilling Equipment and Operations, William Lyons, Gulf Publishing, 2009.

Reference books:

1. R. E. Sheriff and L. P. Geldart, "Exploration Seismology", Cambridge University Press
2. Oz Yilmaz, "Seismic Data Analysis (Vol I and II)", SEG Publication
3. G. Mavko, T. Mukerji and J. Dvorkin, "The Rock Physics Handbook", Cambridge University Press
4. P. Kearey, M. Brooks and I. Hill, "An Introduction to Geophysical Exploration", Wiley-Blackwell
5. Journals from the American Association of Petroleum Geologists
6. Journals from the Society of Exploration Geophysicists
7. Journals from the Society of Petroleum Engineers

Outcome of the Course:

- Know the process of imaging subsurface with reflection and refraction seismic
- Understanding of various geophysical data and its role in petroleum exploration
- Hands-on experience in interpreting seismic data with industry standard software
- Creating structure map for drilling location

DPL-352 Plastic Materials

L	T	P
3	0	0

RATIONALE

Plastic components are integral part of various engineering industries . Polymers blends and alloys are also incorporated. To understand various polymerization techniques and catalysts used to produce addition polymers. To understand the copolymerization technique to produce important co-polymers. To learn the manufacturing of thermosetting molding powders from phenol formaldehyde and melamine.

LEARNING OUTCOMES

After undergoing this course, the students will be able to:

1. Gain knowledge of Engineering Plastics & their methods of manufacturing
2. Gain knowledge of Special usage plastics & their methods of manufacturing
3. Understand polymer blends and alloys
4. Explain bio-plastics and biodegradable plastics & The Importance of Bio Polymer.

DETAILED CONTENTS

Unit – I Engineering Plastics

Sources of Raw Materials – Method of Manufacture – General Characteristics & Properties – Processing Behaviour and applications of Engineering Plastics -Polyoxymethylene, Polyamide (PA6, PA66, PA610, PA11, PA12 and PA46), Polyesters (PET, PBT), Poly Carbonate , Polyphenylene Oxide, UHMWHDPE, Polytetrafluoroethylene, Polyvinyl fluoride, Polyvinylidene fluoride, Thermoplastics Polyurethane

Unit – II Speciality Plastics

Sources of Raw Materials – Method of Manufacture – General Characteristics & Properties – Processing Behaviour and applications of Polysulphone,, Polyphenylene sulphide, Polyarylsulphone, Polyether Ketone, Polyether Ether Ketone, Polyimide, Polyamideimide, Liquid CrystalPolymers.

Unit – III Polymer Blends&Alloys

Introduction to polymer blends & alloys - Definitions and nomenclature - reasons for making polymer blend - how to select blend components - preparation of alloys & blends - economy of blending.

Unit – IV Bio-degradable Plastics & Bioplastics

Overview of Plastics degradation - Natural Bio-degradable Polymers - Synthetic Bio-degradable Polymers - Water soluble Polymers.

INSTRUCTONAL STRATEGY

The teacher is expected to emphasize on the basics of chemistry and then production process using flow chart and flow diagram. Emphasis should be given on different processes used for production of polymers.

MEANS OF ASSESSMENT

- Assignments and Quiz/Class Tests
- Mid-term and End-term Written Tests

RECOMMENDED BOOKS

1 Plastic Materials Hand Book – A.S. Athalye.
2 J. A. Brydson, " Polymer Materials ", Butterworth-Heinemann, 1990.
3 Mark &Overberger, " Encyclopedia of Polymer Science & Tech. " Wiley-Interscience, 1986.
4 J. Scheries& W. Kaminsky, " Metallocene based Polymers ", Wiley, 2000.
5 Vasant R. Gowariker, "Polymer Science ", New Age International, 1986.
6 Christopher C. Ibeh, " Thermoplastic Materials: Properties, Manufacturing Methods, and Applications ", Taylor and Francis Group, 2011.
7 E-books/e-tools/relevant software to be used as recommended by AICTE/ BTE/ NITTTR, Chandigarh.

DFT-352 Nitrogenous Fertilizers

L	T	P
3	0	0

RATIONALE

Major Learning Outcomes (In Cognitive Domain)

Describe different properties of Ammonia 2b. Prepare synthesis path for manufacturing synthesis gas 2c. Differentiate various Ammonia converter 2d. Differentiate various Ammonia manufacturing process 2e. Describe the engineering problems of ammonia manufacturing

Describe various properties of Nitric Acid, Estimate concentration of Nitric acid, Describe the problems in manufacturing of Nitric Acid

Course content:

Ammonia: Physical, chemical properties and applications, Synthesis gas by Catalytic partial oxidation Steam Hydrocarbon reforming, Ammonia converters: Single bed and multi-bed converter, Manufacturing of ammonia by Linde Ammonia concept process, M. W. Kellogg process and Haldor Topsoe process, Storage and Transportation of Ammonia

Nitric acid: Chemical, physical properties and applications, Manufacturing of Nitric Acid by Pressure ammonia oxidation process and Intermediate pressure ammonia oxidation process, Concentration of Nitric acid by $Mg(NO_3)_2$

Urea : Physical, chemical properties 2.11 Manufacturing of Urea by Stamicarbon's CO2 stripping process, Montecatini Solution recycle process Toyo-Koatsu total recycle process

Manufacturing of Ammonium nitrate by Prilling process, Ammonium sulphate from Ammonium carbonate and gypsum Ammonium chloride from Ammonium sulphate and sodium chloride

References:

1. Handbook on fertilizer technology", fertilizer association of india, near jnu, new Delhi 1992.
2. L. J. Carpentire, "new developments in phosphate fertilizer technology", elsevier, 1971.

3. “Fertilizer technology and management” by Mishra Brahma

4. Microbes as bio-fertilizers and their production technology (woodhead publishing india in agriculture)” by s g borkar

5. “Soil fertility and fertilizers” by havlin/ tisdale/ nelson/ beaton

6. “Manures and fertilizers” by a k kolay

7. “Improving efficiency of urea fertilizers by inhibition of soil urease activity” by s kiss and m simihaian

8. “Production of bio-fertilizers from vermicomposting of waste corn pulp blended with cow dung as a solid waste management approach” by Musaida Mercy Manyuchi

DCT-361 Process Equipment Design

L	T	P
3	0	0

RATIONALE

A diploma holder in Chemical Engineering is expected to have knowledge of design procedure of pressure vessels, heat exchangers and distillation column. He should also be conversant with various fabrication and testing methods. Hence this subject.

LEARNING OUTCOMES

After the completion of this course, the students will be able to:

- Understand the general design method of process equipment.
- Design pressure vessels, heat exchangers and distillation column.
- Design various parts of vessels like head, support etc.
- Understand fabrication and testing methods.

DETAILED CONTENTS

1. Basic Considerations in Process Equipment Design
- 1.1 Introduction
- 1.2 The general design procedure
- 1.3 Fabrication Techniques
- 1.4 Equipment classification

2. Stress and Stress Analysis
- 2.1 Introduction
- 2.2 Definition & types of stresses
- 2.3 Stresses due to static loads
- 2.4 Strains
- 2.5 Elastic constants
- 2.6 Thermal stresses
- 2.7 Stresses caused by bending
- 2.8 Deflection
- 2.9 Stresses caused by torsion
- 2.10 Stresses in flat plates
- 2.11 Stresses in cylinders and spheres
- 2.12 Stress concentration
- 2.13 Dynamic stresses

2.14 Impact stresses
2.15 Compound stresses
2.16 Stresses created due to static and dynamic loads
2.17 Combined stresses and theories of failure
2.18 Effects of fabrication methods Economic considerations

3. Pressure Vessels

3.1 Introduction
3.2 Operating conditions -Normal conditions, Transient conditions
3.3 Pressure vessel code
3.4 Design stress and design criteria
3.5 Corrosion allowance
3.6 Joint efficiency
3.7 Shell thickness for spherical and cylindrical vessels
3.8 Head or covers- crown and knuckle radius
3.9 Thickness of head subjected to internal pressure

4. Heat Exchanger

4.1 Introduction
4.2 Codes and standards for heat exchangers
4.3 Overall heat transfer co efficient
4.4 Shell and tube heat exchangers:Tubes, Shell, Tube sheet layout. (Tube count), Shell types (Passes), Baffles, tie rods , tube joining methods
4.5 Flow patterns
4.6 Kern's Methods
4.7 U tube and floating and heat exchanger

5. Supports for Vessels

5.1 Introduction
5.2 Bracket or lug supports
5.3 Leg supports
5.4 Skirt supports
5.5 Saddle supports
5.6 Flanges
5.7 Nozzles
5.8 Design of Jackets (IS 2825)
5.9 Coils for pressure vessels

6. Distillation Column

6.1 Introduction

6.2 Columns internals
6.3 Selection of Key component for multicomponent distillation
6.4 Advantages and limitation of vacuum distillation
6.5 Determination of number of theoretical stages of binary distillation
6.6 Using McCabe Thiele Method
6.7 Selection of trays
6.8 Checking of conditions for weeping, down comer flooding and liquid entrainment

INSTRUCTION STRATEGY

As far as possible, the teaching of the subject must be supplemented by showing the videos on designing of various parts.

MEANS OF ASSESSMENT

– Assignments and quiz/class tests
– Mid-term and end-term written tests

LIST OF RECOMMENDED BOOKS

1. Process equipment design by M.V. Joshi and V.V.Mahajan; McMillan India
2. Chemical Engineering by J.M. Coulson and J.F. Richardson; Pergamon Press, New York
3. Engineering Mechanics by R.S.Khurmi, S. Chand and Company Ltd., New Delhi
4. Process Equipment Design by B.E. Brownell and E.M. Young; John Wiley & Sons

Elective III

DPT-361 Pigments And Extenders

L	T	P
3	0	0

RATIONALE

In this subject, the concept of colours is discussed Various types of Pigments and Extenders are discussed in this paper which are responsible for colours and others properties in Paints and Coatings.

LEARNING OUTCOMES

After the completion of this course, the students will be able to:

- Understand the color phenomena.
  - Understand the Difference B/W Pigments & Dyes.
  - Understand the Extenders and Pigments, and their manufacturing Processes.
  - Learn about Inorganic and organic & Special effect Pigments.

DETAILED CONTENTS

1. INTRODUCTION:

Concept of color phenomena, classification of pigments, testing of pigments,oil absorption value, bulking value, sp. Gravity, refractive index, mass tone, reducing power, tinting strength, resistance to heat. Definition of pigment Dyes, dyes stuffs, toners and lake pigment etc.

2. INORGANIC PIGMENTS:

3. (A)- White pigment such as titanium di-oxides, zinc oxide, Zinc Sulphate, Lithopone etc.

(B)- Color pigments natural and synthetic iron oxide, lead chromate , silico chromates and molybdates, chromegreen, chromium oxide, cadmium pigments, Prussian and ultramarine blue,black, mercuric sulphide, synthetic inorganic complexes etc.
(C)- Metallic pigments such as aluminium, Zinc, copper alloys, stainless steel etc., anti corrosive pigments such red lead, silicon chromate, zinc and strontium chromate white molybdates, calcium plumbate etc. Functional and miscellaneous pigments such as cuprous and mercuric oxides, barium meta borate, nacreous luminescent, etc.

4. EXTENDERS:

Sources, manufacture, properties and uses of extenders pigments such as carbonates, silicates, sulphates, oxides, aluminates etc. Lead carbonate, sulphate, silicate etc, antimony oxides, zirconium oxide and silicate, potassium titanate etc.

5.ORGANIC PIGMENTS:

Natural organic pigments, comparison of organic pigments and inorganic pigments General method of preparation and classification of synthetic organic pigment. Basic and acid dye pigment.

6.MISCELLANEOUS PIGMENTS:

Phthalocyanine blue and green, honsa yellows rubine, toners, para reds.toludine, metallic, phosphorocent, flouroescent pearl pigments, treated pigments.Testing and identification of organic pigments.

INSTRUCTIONAL STRATEGY

Lot of emphasis on use of model as well as audio-video presentation should be given. Lot of stress should be given to numerical aspect to give in-depth knowledge of the subject. This will make the subject interesting and improve students' involvement in the subject.

MEANS OF ASSESSMENT

-Assignments and quiz/class tests

- Mid-term and end-term written tests

LIST OF RECOMMENDED BOOKS

1. Organic Coating Technology vol-2 By Henry Fleming, Payne Publisher John Wiley & Sons.
2. Surface Coatings : Raw materials & their usage Volume-1 By OCCA-Australia Publisher Champas & Hall
3. Outlines of Paint Technology By W M Morgans Publisher Edward Arnold.
4. Pigment Handbook vol-1 By T.C.Patton
5. Surface Coatings: Science & Technology By Swaraj Paul Publisher John wiley & Sons.

DPC-361 Petroleum Refining

L	T	P
3	0	0

RATIONALE:

Crude oil is the raw material for a refinery. Various processes are envolved in the production of petroleum products. A student having knowledge of Distillation, thermal Carcking, Catalytic Cracking for producing Lubeoil, Bitumen and many other products will be useful for petroleum refining industry.

LEARNING OUTCOMES

After completion of this course, the students will be able to:

- have introductory information about petroleum and refinery.
- learn the refinery products, test methods and petroleum properties.
- recognize the characteristics of petroleum refinery process.
- recognize the distillation processes.
- learn solvent treating and extraction processes.
- learn Thermal cracking.

DETAILED CONTENTS

1. INTRODUCTION:
Origin of petroleum and theories.India and global status of petroleum and natural gas, future prospects and availability of processing technology.

2. CRUDE OIL :
Bench mark of crude oil ,cruide oil hash point, fire point, cloud point, aniline point, freeze point, refractive index . sweet and sour crude oil.Chemistry and Composition, crude oil evaluation, Laboratory distillation (ASTM,TBP, EFV).

3. PETROLEUM PRODUCT :
Composition, uses and Indian specification of LPG, Naptha, MS, Kerosine, ATF, HSD, LDO,Bitumen, Waxes, Petroleum Cokes, Lubricating oil.
4. DISTILLATION :
Distillation of crude oil, Atmospheric distillation,Vacuum distillation.

5. THERMAL CRACKING :
Coking process, Fluid coking, Delayed coking, Visbreaking.

6. CATALYTIC CRACKING PROCESS :

Catalytic reforming, Hydrocracking, Alkalization, isomerisation, Polymerization.

7. MANUFACTURE OF LUBE OIL BASE STOCK :

Solvent Deashphalting, Solvent extraction, Solvent dewaxing, Hydrofinishing, Manufacture of waxes (Paraffin and Microcrystalline).

8. BITUMENT : Manufacturing of Bitumen.

LIST OF REFERENCE BOOKS

1. Petroleum Refining by William L. Leffler
2. Handbook of Petroleum Refining by James Speight
3. Modern Petroleum Refining Processes by Rao
4. Refining Processes Handbook by Surinder Parkash

DPL-361 Plastic Testing

L	T	P
3	0	0

RATIONALE

This subjects provides an idea about the properties evaluation of plastics. The different class of properties are estimated using different standard techniques for finding the suitability and importance of plastic in general and specific use.

Learning Outcome

After undergoing this course, the students will be able to:

1. Understand electrical, optical, chemical properties of plastics
2. Explain test methods for bio- degradability
3. Explain process of testing of plastic products

DETAILED CONTENTS

Unit – I Electrical & Optical Properties

Dielectric strength - Dielectric constant and Dissipation factor – Insulationresistance - Volume and Surface resistivity - Arc resistance - Antistatic tests.Refractive index - Luminous transmittance - Clarity and Haze - Photo-elasticproperties - Colour measurements and Gloss.

Unit – II Chemical Properties

Introduction – Immersion test – Stain Resistance of Plastics – Environmental Stress Cracking Resistance (ESCR).

Flammability

Introduction – Flammability Test – Ignition Properties – Oxygen Index Test – Flammability of Cellular Plastics – Smoke Density Test – UL90 Flammability Test.

Unit – III Weathering Properties

Introduction – environmental factors affecting plastics – Acceleratedweathering tests – outdoor weathering of plastics – Resistance of plastics to biological systems.

Bio-degradability Testing

Test methods and standards for bio-degradable plastics - Criteria used in evaluation of bio- degradable plastics - Description of current test methods.

Unit – IV Product Testing

Plastics Pipes – Films – Woven sacks – Water Tanks – Containers & Plastic Foams.

INSTRUCTONAL STRATEGY

Instructor should focus on different engineering properties and to perform their testing for comparison with true values. The virtual laboratory help should be taken to make aware the students for different testing features.

MEANS OF ASSESSMENT

- Assignments and Quiz/Class Tests
- Mid-term and End-term Written Tests

RECOMMENDED BOOKS

1 Text Book on Fundamentals of Plastics Testing - Prof. (Dr.) S.K. Nayak
2 Plastics Testing Technology Hand Book – Shah Vishu
3 Simple Methods for Identification of Plastics – DietrichBraun
4 E-books/e-tools/relevant software to be used as recommended by AICTE/ BTE/ NITTTR, Chandigarh.

DFT-361 Phosphatic Fertilisers

L	T	P
3	0	0

Major Learning Outcomes (In Cognitive Domain)

Describe various physical and chemical properties Phosphorus and Phosphoric acid

Describe the manufacturing process of Phosphorus by Electric furnace method

Describe the manufacturing process of phosphoric acid by Wet Process

Describe the manufacturing Strong Sulphuric Acid Leaching Hydrochloric Acid Leaching Electric Furnace Process

Course content

Physical, chemical properties and applications of Phosphorus and Phosphoric acid , Manufacturing of elemental phosphorous by Electric furnace method , Manufacturing phosphoric acid by Wet Process , Strong Sulphuric Acid Leaching Hydrochloric Acid Leaching Electric Furnace Process

References:

1. Handbook on fertilizer technology", fertilizer association of india, near jnu, new Delhi 1992.
2. L. J. Carpentire, "new developments in phosphate fertilizer technology", elsevier, 1971.

3. “Fertilizer technology and management” by Mishra Brahma

4. Microbes as bio-fertilizers and their production technology (woodhead publishing india in agriculture)” by s g borkar

5. “Soil fertility and fertilizers” by havlin/ tisdale/ nelson/ beaton

6. “Manures and fertilizers” by a k kolay

7. “Improving efficiency of urea fertilizers by inhibition of soil urease activity” by s kiss and m simihaian

8. “Production of bio-fertilizers from vermicomposting of waste corn pulp blended with cow dung as a solid waste management approach” by Musaida Mercy Manyuchi

Elective IV

DPT-362 Resins & Paint Media

L	T	P
3	0	0

RATIONALE

In This subject, Various Types of Resins are discussed which are used as Film former or binder in the Paints & Coating Synthetic Resins for different application area are discussed along with properties and manufacturing of each.

LEARNING OUTCOMES

After studying this course, the students will be able to:

- Understand about Natural and Synthetic Resins
- Understand the Manufacturing Process of Resins
- Understand the Structure-Property Relationship of each Resin.

DETAILED CONTENTS

1. INTRODUCTION TO NATURAL RESINS :

Classification and properties of natural resins etc, Resins sources, oleoresin and its composition, properties and deficiencies of rosin film, modification of rosin, calcium rosinate and maleoprimaric acid from rosin etc, Identification of rosin.

Shellac: orgin, extraction of lac, different kinds of lac and their properties, composition of lac, chemical modification of shellac for use in coatings , French polish, leather finishes, Oleoresinous varnishes etc, from shellac.

Cellulose source, properties, modification of cellulose for use in surface coatings like cellulose esters, ethers. Bitumen, pitches, gums and glues, natural bitumens like gilosonite and petroleum pitches general properties and uses of gums and glues.

2. ALKYD RESIN AND PHENOLIC RESINS:

Alkyd resin, raw material, chemistry and formulation of various alkyds, manufacturing process classification, properties and application of various types alkyds, water soluble alkyds, polyester Saturated & Unsaturated resins,

Phenolic resins, classification, types of phenols used, reaction of phenol and formaldehyde, novolac and resoles, resin production, properties and application of various phenolics, water souble phenolics.

3. AMINO RESINS AND EPOXY RESINS:

Amino resin: urea formaldehyde and melamine formaldehyde resins, formulation of methylol products, alkylation and curing reaction, properties and application in surface coatings & water soluble and other amino resins. epoxy resin manufacture, formulation of two pack system like solvent based coatings solvent less, high solids coating, single pack epoxies like epoxy ester, thermoplastic epoxy etc., polyamide resins, poly amines and acids used, dimerised fatty acids, properties and application of various polyamides.

4. POLYURETHANE AND SILICONE RESINS:

Poly urethanes: various isocynates used, reaction of the isocynate group and their hazards, classification of poly urethanes, properties and application of various single and two pack systems; silicone resin; synthesis of silicone resin's, structure and properties relationship, properties and application of silicone resins.

5. VINYL AND ACRYLIC RESINS:

A. Vinyl and acrylic : vinyl and acrylic monomers type of vinyl resin used in surface coating . Vinyl co polymer and their properties, thermo plastic and thermo settling acrylics, water soluble acrylics.
B. Other Resins - Hydro carbon resin , coumarone and indene resins, resins from petroleum products, terpene resins, miscellaneous resins : fluoro polymers, ketone resins, poly carbonate etc.

INSTRUCTIONAL STRATEGY

Teacher should explain each process industry and use of each and every equipment used. An industrial visit can be organized in various chemical and process industries. Audio-visuals should be used to teach.

MEANS OF ASSESSMENT

- Assignments and quiz/class tests
- Mid-term and end-term written tests

LIST OF RECOMMENDED BOOKS

1. Basics of Paint Technology- Part- 1 By V.C.Maliha, Meenal. A.Sikchi
2. Organic Coating Technology vol-1 By Henry Fleming, Payne Publisher John Wiley & Sons.
3. Surface Coatings : Raw materials & their usage Volume-1 By OCCA-Australia Publisher Champas & Hall
4. Outlines of Paint Technology By W.M.Morgans Publisher Edward Arnold.
5. The Chemistry of Organic film formers By D.H.Solomon , R.E.Kriegar

6. A manual for Resin for surface coatings By P.K.Oldring Publisher SITA Technology
7. Polymer Science By V.R.Gowariker Publisher New Age International

DPC-362 Petrochemical Processing-I

L	T	P
3	0	0

RATIONALE

Petroleum industry is one among core chemical industries and it has large employment potential. In this subject, the students will be imparted detailed knowledge of petroleum refining and petroleum products along with major petrochemicals.

LEARNING OUTCOMES

After completion of this course, the students will be able to:

- Get familiar with different petroleum refining processes.
- Test petroleum product

DETAILED CONTENTS

1. INTRODUCTION:

Growth and prospects of petrochemcal industry in India. Introduction to technology of Dehydrogenation, Oxidation, Hydration, Sulphonation, Alkylation, etc.

2. SYNTHESIS OF GENERATION :

Synthesis gas generation through steam reforming andpartial oxidation of liquid and gaseous feedstock. Manufacture of Menthol, Oxoalcohol.

3. MANUFACTURE OF OLEFINES :

Naptha pyrolysis and Gas cracking, Manufacture of Acetylene, Ethylene, Propylene, Butanes and their derivatives such as vinyls,Ethylene oxide, Propylene oxide, Isopropyl Alcohol and Acetone, Acrylonitrile and Butadiene.

4. MANUFACTURE OF ARMOMATICS :

Products of benzene, Toluene and xylenes from liquid and Gaseous feed stock.

RECOMMENDED BOOKS

1. Handbook Of Petroleum Petroleum Refining Processes by Naitik Verma, Scitus
2. SPRINGER HANDBOOK OF PETROLEUM TECHNOLOGY 2ED (HB 2017) by HSU C S, SPRINGER
3. Handbook of Petroleum Refining Processes By Meyers Robert
4. Modern Petroleum Refining Processes by Bhaskara Rao B, Oxford & Ibh Publishing

REFERENCE WEBSITES

1. https://www.hydrocarbonprocessing.com/
2. https://chemicals.nic.in/petrochemicals
3. https://www.digitalrefining.com/
4. https://en.wikipedia.org/wiki/Petrochemical

DPL-362 Plastic Processing Techniques

L	T	P
3	0	0

RATIONALE

The purpose of this subject is to equip the students with the knowledge of processes utilized in Injection molding, extrusion and blow moulding. This subject develops the competence of the students in major industrially practiced processing techniques.

Learning Outcome

After undergoing this course, the students will be able to:

1. Explain injection moulding process
2. Understand process of extrusion, classifications, & the performance of extruder.
3. Understand the Knowledge of printing techniques.
4. Understand process of blow moulding and the associated products

DETAILED CONTENTS

a) INJECTION

Basic concept of injection moulding: Hand injection, Semiautomatic injection (vertical and horizontal) and features of machine. Automatic injection moulding machine: Various machine parts like; hopper, screw, barrel, heating devices, clamping unit etc. Injection moulding process and process control, machine parameter, shot capacity, injection pressure, injection speed, day light, limit switch etc., Basic concept of injection cycle, machine control, microprocessor controlled injection moulding, open loop and close loop control, multi colour injection moulding, gas assisted injection moulding, isotactic moulding, faults and remedies in injection moulding process like: Shrinkage, shrink mark, weld line parting line, flash etc.

b) EXTRUSION

1. Introduction

Introduction to extrusion process, different types of extruders:- single screw and twin screw extruder, vented barrel extruder, general principles of operation, die swell, function of various parts i.e. barrel, screw, screenpack, die, breaker plate, adaptor.

2. Types of screws in use for processing different plastics, Feed, Compression and

Metering zone, Die zone, L/D ratio and its significance.

3. Nip rolls, bubble casing, winding equipment, cutting devices, stretching and orientation.

4. Extruder performance and their curves, faults & remedies.

5. Blown film extrusion, extrusion of pipes, wires and cables, sheets and Filaments.
6. Co extrusion of films and sheets.

7. Printing techniques , flexographic printing, gravure printing, pad printing, screen printing, hot stamping.

8. Conversion of plastic films into laminate e.g. metal plastic laminates, paper- plastic laminates, plastic - plastic laminates. Advantages of multi- layer packaging, disadvantages of multi-layer packaging.

c) BLOW MOULDING

1. Basic principles of blow moulding, Types of blow moulding :- Extrusion blow moulding, injection blow moulding. Blow molding irregular containers.

2. Materials for blow moulding.

3. Production of parison, a). by extrusion b). by injection. Parison wall thickness control, Parison blowing systems, air requirement for blowing, effect of process variables on product design and properties. Parison programming, mould venting.

4. Newer concepts including extrusion- stretch blow moulding, injection stretch blow moulding, multi layer moulding etc.

INSTRUCTONAL STRATEGY

This subjects should be taught with the aids available. The students should be visited a unit having Injection molding, extrusion & Blow molding operations of various injection moulding machine, extrusion machine and blow moulding machine.

MEANS OF ASSESSMENT

- Assignments and Quiz/Class Tests
- Mid-term and End-term Written Tests

RECOMMENDED BOOKS

1 Injection Moulding theory & practice-Rubin, Irvin
2 Plastics Processing Technology by Edward A. Muccio.
3 Plastic Materials & Processing , Brent Strong
4 Plastic Engineering Hand Book- Society of Plastic Industry Inc.
5 Plastic Processing data Hand Book- D.V. Rasato
6 E-books/e-tools/relevant software to be used as recommended by AICTE/ BTE/ NITTTR, Chandigarh.

DFT-362 Potassic Fertilizers

L	T	P
3	0	0

Learning objectives

Describe physical and chemical properties

Explain manufacturing of Potassium Chloride from sylvinite

Describe the of Preparation of Potassium nitrate, Potassium sulphate

Course content

Physical, chemical properties and uses of Potassium Chloride, Potassium nitrate, Potassium sulphate,

Manufacturing of potassium chloride from sylvinite,

Preparation of Potassium nitrate, Potassium sulphate

References:

1. Handbook on fertilizer technology", fertilizer association of india, near jnu, new Delhi 1992.
2. L. J. Carpentire, "new developments in phosphate fertilizer technology", elsevier, 1971.

3. “Fertilizer technology and management” by Mishra Brahma

4. Microbes as bio-fertilizers and their production technology (woodhead publishing india in agriculture)” by s g borkar

5. “Soil fertility and fertilizers” by havlin/ tisdale/ nelson/ beaton

6. “Manures and fertilizers” by a k kolay

7. “Improving efficiency of urea fertilizers by inhibition of soil urease activity” by s kiss and m simihaian

8. “Production of bio-fertilizers from vermicomposting of waste corn pulp blended with cow dung as a solid waste management approach” by Musaida Mercy Manyuchi

Elective V

DPT-363 Surface Preparation And Paint Application	L	T	P
	3	0	0

RATIONALE

In this Subject Students will know the importance of surface preparation. Different techniques of surface preparation along with various application techniques are also discussed. The curing mechanism and different types of defects in coating is discussed here.

LEARNING OUTCOMES

After completion of this course, the students will be able to:

- Understand the importance of surface preparation.
- Understand different methods and types of surface preparation.
- Understand Different methods of application.
- Understand Types, Causes & Remedies of defects in Coatings.

DETAILED CONTENTS

1. SURFACE PREPARATION:

Importance of surface preparation, types of substrate : Substrate, Degreasing, rust & oxide removal, blast cleaning, degreasing mild steel and preparation of samples of wood by a sequence of staining, filling and sealing.

2. PRE-TREATMENT:

Steps of surface pre treatment process – activation, phosphating, passivation, zinc, iron and tricationic system, coating weight.

3. PAINT APPLICATION INVOLVING ATOMIZATION:

Selection criteria for application techniques, Paint application involving atomization air assisted spraying, airless spraying, electro state spraying, compare hot and cold sprarying. Disc and bell application and robotics in spraying

4. PAINT APPLICATION NOT INVOLVING ATOMIZATION:

Paint application not involving atomization: Dipping, roller coating, coil & curtaing coating , other application methods- brushing, hand rolling trowelling , silk screeing tumbling
, flow coating, electro deposition, anodic vs cathodic electro deposition – merit and demerits, throwing powder, CED plate.

5. DRYING, CURING AND PAINT DEFECTS:

Drying and curing process: air drying, forced drying and stoving, radiation curing (ultraviolet and electron beam), hybrid curing, selection of curing techniques, ovens. Defects : settling, skinning, orange peels, pin holes, crater, etc.

INSTRUCTION STRATEGY

This subject is of great importance, therefore the teachers are expected to lay considerable stress on renewable sources, their importance, production, utilization and storage system. As far as possible, the teaching of the subject must be supplemented by showing the videos on working principle of various renewable energy equipment and also visits to nearby places where such equipment is installed.

MEANS OF ASSESSMENT

- Assignments and quiz/class tests
- Mid-term and end-term written tests

LIST OF REFERENCE BOOKS

1. Basics of Paint Technology- Part- 2 By V.C.Maliha, Meenal. A.Sikchi
2. Organic Coating Technology vol-2 By Henry Fleming, Payne Publisher John Wiley & Sons.
3. Surface Coatings : Raw materials & their usage Volume-2 By OCCA-Australia Publisher Champas & Hall
4. Outlines of Paint Technology By W.M.Margans Publisher Edward Arnold.
5. Failure Analysis of Paints & Coatings By D wight G. Weldon Publisher John Wiley & Sons

DPC-363 Petrochemical Processing-II

L	T	P
3	0	0

RATIONALE

Petroleum industry is one among core chemical industries and it has large employment potential. In this subject, the students will be imparted detailed knowledge of petroleum refining and petroleum products along with major petrochemicals.

LEARNING OUTCOMES

After completion of this course, the students will be able to:

- Get familiar with different petroleum refining processes.
- Test petroleum product

DETAILED CONTENTS

1. CHEMICALS USED IN DETERGENT INDUSTRY : Manufacture of Linear Alkyl Benzene.

2. MANUFACTURE OF CHEMICALS FOR USE IN FIBRE MAKING : Caprolactum, dimethyl pathalate, polyester, phthalic anhydride.

3. MANUFACTURE OF POLYMERS :
   Polyethylene (Low and High density), Polypropylene, Polymethyl Methacrylate, Polystyrene, teflon, etc.
4. MANUFACTURE OF CHEMICALS :
   Dyes, Pharmaceutical, Intermediates and Textile auxiliaries.

RECOMMENDED BOOKS

5. Handbook Of Petroleum Petroleum Refining Processes by Naitik Verma, Scitus
6. SPRINGER HANDBOOK OF PETROLEUM TECHNOLOGY 2ED (HB 2017) by HSU C S, SPRINGER
7. Handbook of Petroleum Refining Processes By Meyers Robert
8. Modern Petroleum Refining Processes by Bhaskara Rao B, Oxford & Ibh Publishing

REFERENCE WEBSITES

5. https://www.hydrocarbonprocessing.com/
6. https://chemicals.nic.in/petrochemicals
7. https://www.digitalrefining.com/
8. https://en.wikipedia.org/wiki/Petrochemical

DPL-363 Design Of Dies And Moulds

L	T	P
3	0	0

RATIONALE

A diploma holder in plastic technology is engaged in manufacturing plastic components for which design of moulds and dies is essential. This subject will impart them requisite knowledge and skill in design of moulds and dies.

Learning Outcome

After undergoing this course, the students will be able to:

1. Explain basic concepts of mould design
2. Explain various types of die and mould materials
3. Explain machining methods, feed systems, ejection system, cooling systems
4. Gain Knowledge of different parts of moulds

DETAILED CONTENTS

1. Basic concept of mould designing, shrinkage, flash line, taper and draft

2. Materials used for dies and moulds and their characteristics

3. General design considerations for various types of moulds

4. Machining methods - general introduction to lathe machine, grinder, shaper, milling, spark erosion, CNC wire cut

5. Impressions – Core and cavity. Types of cavity and core, their advantages and disadvantages. Bolster plate and its types, guide piller, guide bush, register ring and their types. Mould clamping
– direct,indirect

6. Parting surface – Types of parting surface, selection of parting surface

7. Feed system - Runners – Sprue, runners and its types, balancing of runners, size of runners

- Gates – Types of gates, size of gates

8. Ejection system – Ejector grid, ejector plate assembly

9. Cooling system – Cooling methods, cooling circuits for an integer and insert core cavity moulds e.g. U-type, rectangular and Z-type

10. Injection mould – Types of moulds; 2-plate mould, 3-plate mould, split mould, runnerless mould

INSTRUCTONAL STRATEGY

Students should be encouraged to go through at least one mould design software comprising of analysis of moulds. The Teacher should visit a mold unit manufacturing the product with injection molding for physical/Practical observation of the mold students.

MEANS OF ASSESSMENT

- Assignments and Quiz/Class Tests
- Mid-term and End-term Written Tests

RECOMMENDED BOOKS

1 Handbook of Mould, tool & Die repairing, S. Thompson
2 S.P. S Handbook of plastics by J. Frados
3 Plastic Engineering by RJ Crawford, Maxwell Macmillan International Editions Publications
4 Injection Moulding Handbook by Dominiok V. Rosato and Donald V Rosato
5 Plastic mould Engineering Handbook by J. Harry Don Boss and Mayne & Pribble, Van Nostrand Reinhold Company Publication
6 Mould Making Hand Book,Stoeckert.
7 Plastics Moulds and Dies,Sors.
8 Injection Moulds, V.D.I.
9 Injection Mould Design –PyeR.G.W.
10 Production Technology - Er.R.K.Jain.
11 Production Technology - P.C. Sharma Pub: S. Chand andCo.
12 Workshop Technology, Volume I & II – W.A.JChapman.
13 Elements of Workshop Technology-S.K.Hajra Choudhury & A.K HajraChoudhury.
14 E-books/e-tools/relevant software to be used as recommended by AICTE/ BTE/ NITTTR, Chandigarh.

DFT-363 Complex Fertilizer and Bio Fertilizer

L	T	P
3	0	0

Explain the manufacturing of complex fertilizers with sketches ,

Justify the need for biofertilizers and its benefits ,

Describe the Nitrogen fixing and Phosphate solubilising biofertilizers ,

Explain preparation a biofertilizers

Manufacturing of NPK,

Ammonium Sulphate Phosphate (ASP),

Calcium Ammonium Nitrate(CAN),Types of Biofertilizers, Biofertilizers Nitrogen-fixing biofertilizers Phosphatesolubilizing biofertilizers, Preparation of a biofertilizers

References:

1. Handbook on fertilizer technology", fertilizer association of india, near jnu, new Delhi 1992.
2. L. J. Carpentire, "new developments in phosphate fertilizer technology", elsevier, 1971.

3. “Fertilizer technology and management” by Mishra Brahma

4. Microbes as bio-fertilizers and their production technology (woodhead publishing india in agriculture)” by s g borkar

5. “Soil fertility and fertilizers” by havlin/ tisdale/ nelson/ beaton

6. “Manures and fertilizers” by a k kolay

7. “Improving efficiency of urea fertilizers by inhibition of soil urease activity” by s kiss and m simihaian

8. “Production of bio-fertilizers from vermicomposting of waste corn pulp blended with cow dung as a solid waste management approach” by Musaida Mercy Manyuchi.