Faculty of Engineering and Technology
P.K.University
Shivpuri (MP)

Evaluation Scheme & Syllabus
Diploma in Chemical Engineering

(I& VI Semester)

(Effective from session 2019-20)

EVALUATION SCHEME

SEMESTER I

SUBJECT CODE	SUBJECT NAME	THEORY		PRACTICAL		TOTAL
		SESS.(30)	EXT.(70)	SESS.(25)	EXT.(25)	
DCH-101	Professional Communication	30	70	25	25	150
DCH-102	Applied Mathematics-I	30	70	NA	NA	100
DCH-103	Applied Physics-I	30	70	25	25	150
DCH-104	Applied Chemistry	30	70	25	25	150
DCH-105	Engineering Drawing	30	70	NA	NA	100
DCH-106	Measuring Instrument and Measurements	30	70	NA	NA	100

SEMESTER II

SUBJECT CODE	SUBJECT NAME	THEORY		PRACTICAL		TOTAL
		SESS.(30)	EXT.(70)	SESS.(25)	EXT.(25)	
DCH-201	Applied Mathematics-II	30	70	NA	NA	100
DCH-202	Applied Physics-II	30	70	25	25	150
DCH-203	Applied Mechanics	30	70	25	25	150
DCH-204	Mechanical Operation and Solid Handling	30	70	25	25	150
DCH-205	Workshop practice	NA	NA	25	25	50

SEMESTER III

SUBJECT CODE	SUBJECT NAME	THEORY		PRACTICAL		TOTAL
		SESS.(30)	EXT.(70)	SESS.(25)	EXT.(25)	
DCH-301	Applied Mathematics-III	30	70	NA	NA	100
DCH-302	Chemical Engineering Thermodynamics	30	70	NA	NA	100
DCH-303	Material Energy Balance	30	70	NA	NA	100
DCH-304	Elect. Tech. & Electronics	30	70	25	25	150
DCH-305	Computer Application	30	70	25	25	50

SEMESTER IV

SUBJECT CODE	SUBJECT NAME	THEORY		PRACTICAL		TOTAL
		SESS.(30)	EXT.(70)	SESS.(25)	EXT.(25)	
DCH-401	Chemical Technology	30	70	25	25	150
DCH-402	Conventional & Non-Conventional Source of energy	30	70	NA	NA	100
DCH-403	Fluid Mechanics	30	70	25	25	150
DCH-404	Process Plant Utilities	30	70	NA	NA	100

SEMESTER V

SUBJECT CODE	SUBJECT NAME	THEORY		PRACTICAL		TOTAL
		SESS.(30)	EXT.(70)	SESS.(25)	EXT.(25)	
DCH-501	Industrial Management and Entrepreneurship Development	30	70	NA	NA	100
DCH-502	Heat Transfer Operations	30	70	25	25	150
DCH-503	Mass Transfer Operations	30	70	NA	NA	100
DCH-504	Pollution Control & Indusial Safety	30	70	NA	NA	100
DCH-505	Fertilizer Technology	30	70	25	25	150

SEMESTER VI

SUBJECT CODE	SUBJECT NAME	THEORY		PRACTICAL		TOTAL
		SESS.(30)	EXT.(70)	SESS.(25)	EXT.(25)	
DCH-601	Chemical Reaction Engineering	30	70	NA	NA	100
DCH-602	Automatic Process Control	30	70	25	25	150
DCH-603	Process Equipment Design	30	70	NA	NA	100
DCH-604	Project	NA	NA	25	25	50

Department of Chemical Engineering
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I Year I Semester
DCH-101: PROFESSIONAL COMMUNICATION

PART I : COMMUNICATION IN ENGLISH (50 Marks)

1.1 Concept of communication, importance of effective communication, types of communucation, formal, informal,verbal and nonverbal, spoken and written. Techniques ofcommunication, Listening, reading, writting and speaking,Barriers in communication, Modern tools of communication-Fax, e-mail, Telephone, telegram, etc.

1.2 Technical communication Vs. General Communication :Development of comprehension and knowledge of English through the study of text material and language exercises based on the prescribed text book of English.

1.3 Development of expression through:

1.3.1 Paragraph writing, Essay writing, Proposal writing.

1.3.2 Business and personal correspondence (Letters) :

Kinds of letters:-

Official, demi-offical, unofficial , for reply or in reply, quotation, tender and order giving letters.

Application for a job, Resume.

1.3.3 Report writing and Note making and minutes writing.

1.4 Functional Grammer : Study of sentences and parts of speech

(word class), Preposition, Verb, Articles, Abbreviations.

1.5 Vocabulary Building : Homophones, One word substitution,

Idioms and Phrases.

1.6 Composition on narrative, descriptive, imaginative, argumentative, discussion and factual topics.

2. PART II : COMMUNICATION IN HINDI (20 Marks)

2.1 Development of comprehension and knowledge of Hindi usage through rapid reading and language exercises based on prescribed text material developed by IRDT.

2.2 Development of expression through ;Letter writing in Hindi:

Kinds of letters:-Official, demi-offical, unofficial , for reply or in reply, quotation, tender and order giving letters,

Application for a job, Press release in Hindi, Report writing.

Note: Paper should be in two parts,

part I - English and part II Hindi.

REFERENCE BOOKS

1.   Bookshelf worksheet of Professional Communication, New Delhi: Bookshelf 2008

2. Functional Skills in language and literature by R. P. Singh,New Delhi : Oxford University Press.

3. Oxford Engilsh Hindi English Dictionary, New Delhi : Oxford 2008

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DCH-101: **PROFESSIONAL COMMUNICATION LAB**

LANGUAGE LAB PRACTICE

   For the practice/exercise the following is suggested :-

1. A. Phonetic transcription
    B. Stress and intonation :
     (At least 10 word for writting and 10 word for pronunciation)
2. **ASSIGNMENT**: (Written Communication)
    Two assignment of approximately 400 word each decided by the teacher concerned.

THE FOLLOWING MODEL IS PROPOSED :

1. a picture/photograph
2. an opening sentence or phrase
3. a newspaper/magzine clipping or report
4. factual writting which should be informative or argumentative.
  (The students may refer to "Bookshelf worksheet" for technical communication)

3. Oral Conversation:

1. Short speeches/declamation : Bid farewell, Felicitatesomebody, Celebrate a public event,
   Offer condolences
2. Debate on current problems/topics
3. MockInterview : Preparation, Unfolding of personality and Expressing ideas effectively
4. Group discussion on current topics/problems
5. Role Play/ general conversation : Making polite enquiries at Railway Station, Post Office, Banks
   and other Public places, Replying to such enquiries, enquiring about various goods sold in the
   market and discussing their prices. Complaining about service at Hotel, restaurant, Offering
   apologies in reply to such complaints, complain to a company about a defective product you have
   brought, reply to such complaints.
6. Presentation skill, Use of OHP and LCD.
7. Through drilling of model words involving different phonetic symbols
   (Vowels, Consonants, Difthongs).

4. Aural :

Listening to conversation/talk/reading of short passage and then writing down the relevant or main points in the specified number of words and answering the given questions The assignments/project work are to be evaluated by the internal/ external examiner. The distribution of 30 marks
e.g.10 marks for assignment (Given by subject teacher as sessional marks)
10 marks for conversation and viva-voce
   10 arks for phonetic transcription

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DCH-102: APPLIED MATHEMATICS -I

1. ALGEBRA-I :

1.1 Series : AP and GP; Sum, nth term, Mean

1.2 Binomial theorem for positive, negative and fractional index (without proof). Application of Binomial theorem.

1.3 Determinants : Elementary properties of determinant of order 2 and 3, Multiplication system of algebraic equation, Consistency of equation, Crammer's rule

2. ALGEBRA-II:

2.1 Vector algebra : Dot and Cross product, Scaler and vector   triple product.

2.2 Complex number : Complex numbers, Representation, Modulus and amplitudDemoivre theorem, its application in solving algebraic   equations, Mod. function and its properties..

3. TRIGONOMETRY :

3.1 Relation between sides and angles of a triangle : Statement   of various formulae showing relationship between sides and angle of a triangle.

3.2 Inverse circular functions : Simple case only

4. DIFFERENTIAL CALCULUS - I :

4.1 Functions, limits, continuity, - functions and their graphs, range and domain, elementary methods of finding limits (right and left), elementary test for continuity and differentiability.

4.2 Methods of finding derivative, - Function of a function, Logaritimic differentiation, Differentiation of implicit functions.

5. DIFFERENTIAL CALCULUS -II :

5.1 Higher order derivatives, Leibnitz theorem.

5.2 Special functions (Exponential, Logarithmic, Inverse circular and function), Definition, Graphs, range and Domain and Derivations of each of these functions.
5.3 Application - Finding Tangants, Normal, Points of Maxima/Minima, Increasing/Decreasing functions,   Rate, Measure, velocity, Acceleration, Errors and approximation.

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I Year I Semester
DCH-103: APPLIED PHYSICS-I

1. UNITS AND DIMENSIONS (4 MARKS)

S.I. Units & Dimensions of physical quantities, Dimensional formula and dimensional equation. Principle of homogeneity of dimensions and applications of homogeneity principle to: (i) Checking the correctness of physical equations, (ii) Deriving relations among various physical quantities,(iii) Conversion of numerical values of physical quantitiesFrom one system of units into another. Limitations ofdimensional analysis.

2. ERRORS AND MEASUREMENT (4 Marks)

Errors in measurements, accuracy and precision, random and systematic errors, estimation of probable errors in the results of measurement(Combination of errors in addition, subtraction, multiplication and powers). Significant figures, and order of accuracy in respect to instruments,

3. CIRCULAR MOTION (5 MARKS)

Central forces. Uniform Circular motion (Horizontal and Vertical cases),angular velocity, angular acceleration and centripetal acceleration. Relationship between linear and angular velocity and acceleration. Centripetal and centrifugal forces. Practical applications of centripetal forces. Principle of centrifuge.

4. MOTION OF PLANETS AND SATELLITES :(5 Marks)

Gravitational force, Acceleration due to gravity and its variation w..r. to height and depth from earth, Kapler's Law, Escape and orbital velocity, Time period of satellite, Geo- stationary, Polar satellites.

5.DYNAMICS OF RIGID BODY (ROTATIONAL MOTION) (6 MARKS)

Rigid body, Rotational motion, Moment ofinertia, Theorems(Perpendicular and Parallel axis) of moment of inertia (Statement). Expression of M.I. of regular bodies (Lamina, Sphere, Disc, Cylindercal),Concept of Radius of gyration, angular momentum, Conservation of angular momentum, Torque, Rotational kinetic energy. Rolling of sphere on the slant plane .Concept of Fly wheel.

6. FLUID MECHANICS :(5 MARKS)

Surface tension, Capillary action and determination of surface tension from capilary rise method, Equation of continuity (A1V1=A2V2), Bernoulli's theorem, and its application stream line and Turbulent flow, Reynold's number.

7. FRICTION :(4 MARKS) Introduction, Physical significance of friction, Advantage and disadvantage of friction and its role in everyday life. Co efficients of static and dynamic friction and their measurements. viscosity, coeff. of viscosity, & its determination by stoke's method.

8. HARMONIC MOTION (6 MARKS)

Periodic Motion ,characteristics of simple harmonic motion; equation of S.H.M. anddetermination of velocity and acceleration. Graphical representation. Spring-mass system. Simple pendulum. Derivation of its periodic time. Energy conservation in S.H.M.. Concept of phase, phase difference, Definition of free, forced, undamped and damped vibrations, Resonance and its sharpness, Q-factor.

9. HEAT & THERMODYNAMICS: (6 MARKS)

Modes of heat transfer (Conduction, Convection and Radiation), coefficient of thermal conductivity Isothermal and adiabatic process. Zeroth First, Second Law of Thermodynamics and Carnot cycle, Heat Engine (Concept Only).

10. ACOUSTICS (5 MARKS)

Definition of pitch, loudness, quality and intensity ofsound waves. Echo, reverberation and reverberation time. Sabine's formula without Derivation.Control of reverberation time (problems on reverberation time). Accoustics of building defects and remedy.

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DCH-104: APPLIED CHEMISTRY

1**. ATOMIC STRUCTURE :**
Basic concept of atomic structure, Matter wave concept, Quantum number, Haisenberg's Uncertainty Principle, Shaples of orbitals.

2**. CHEMICAL BONDING :**
Covalent bond, Ionic & Co-ordinate, Hydrogen bonding, Valence bond theory, Hybridisation, VSEPR theory, Molecular orbital theory.

3**. CLASSIFICATION OF ELEMENTS :**
Modern classification of elements (s,p,d and f blcok elements), Periodic properties : Ionisation potential electro negativity, Electron affinity.

4. **ELECTRO CHEMISTRY-I:**
Arrhenius Theory of electrolytic dissociation, Transport number, Electrolytic conductance, Ostwald dilution law. Concept of Acid and bases : Bronsted, Arrhenius and Lewis theory. Concept of pH and numericals. Buffer solutions, Indicators, Solubility product, Common ion effect with their application,

5. **ELECTRO CHEMISTRY-II:**
Redox reactions, Electrode potential(Nernst Equation), Electro-chemical cell (Galvanic and Electrolytic). EMFof a cell and free energy change. Standard electrode potential, Electro chemical series and its application. Chemical and Electrochemical theory of corrosion, Galvenic Series. Prevention of corrosion by various method.

6. **CHEMICAL KINETICS :**
Law of mass action, order and molecularity of reaction. Activation energy, rate constants, Ist order reactions and 2nd order reactions.

7. **CATALYSIS :**
Definition Characteristics of catalytic reactions, Catalytic promoters and poison , Autocatalysis and Negative catalysis, Theory of catalysis, Application.

8. **SOLID STATE :**
Types of solids (Amorphous and Crystalline), Classification (Molecular, Ionic, Covalent, Metallic), Band theory of solids (Conductors, Semiconductors and Insulators), types of Crystals, FCC, BCC, Crystal imperfection.

9. **FUELS :**
Definition, its classification, high& low Calorific value.Determination of calorific value of solid and liquid fuels by Bomb calorimeter. Liquid fuel - Petroleum and its refining, distillate of petroleum (Kerosene oil, Disel and Petrol), Benzol and Power alchol. Knocking, Anti-knocking agents, Octane number and Cetanenumber.Cracking and its type, Gasoling from hydrogenation of coal (Bergius process and Fischer tropsch's process)Gaseous Fuel - Coal gas, Oil gas, Water gas, Producer gas, Bio gas, LPG and CNG.Numerical Problems based on topics.

10. **WATER TREATMENT :**
Hardness of water, Its limits and determination of hardness of water by EDTA method. Softening methods (Only Sods lime, Zeolote and Ion exchange resin process). Disadvantage of hard water in different industries, scale and sludge formation, Corrosion, Caustic embritlement, primming and foarming in biolers. Disinfecting of Water By Chloramine-T, Ozone and Chlorine. Advantage and disadvantage of chlorinational, Industrial waste and sewage, Municipality waste water treatment, Definition of BOD and COD. Numerical Problems based on topics.

11. **COLLOIDAL STATE OF MATTER :**

Concept ofcollidal and its types, Different system of colloids, Dispersed phase and dispersion medium. Methods of preparation of colloidal solutions, Dialysis andelectrodealysis. Properties of colloidal solution with special reference to absorption, Brownian Movement, tyndal effect, Electro phoresis and coagulation. relative stability

ofhydrophillic andhydrophobie colloids. Protection andprotective colloids. Emulsion, Types, preparation,properties and uses. Application of colloids chemistry in different industries.

12. **LUBRICANTS :**

Definition, classification, Necessasity and various kinds of lubricants. Function and mechanism of action of lubricants and examples. Properties of lubricants, Importance of additive compunds in lubricants, Synthetic lubricants and cutting fluids. Industrial application, its function in bearing.

13. **HYDROCARBONS:**

A. Classification andIUPACnomeuclature of organic compounds hamologous series (Functional Group)

B. Preparation, properties and uses of Ethane, Ethene, Ethyne

(Acetylene), Benzene and Toluene.

14. **ORGANIC REACTIONS & MECHANISM:**

1. Fundamental auspects -

   A. Electrophiles and nucleophiles, Reaction Intermediates, Free radical, Carbocation, Carbanion

   B. Inductive effect, Mesomeric effect, Electromeric effect.

2.A. Mechanism of addition reaction (Markonicove's Rule, Cyanohydrin and Peroxide effect),

B. Mechanism of Substitution reactions; (Nucleophillic) hydrolysis of alkyle halide, electrophillic substitution halogenation, Sulphonation, Niration and friedel-Craft reaction.

C. Mechanism of Elimination reaction - Dehydration of primary alcohol, Dehyrohalogenation of primary alkyl halide.

15. **POLYMERS :**

1. Polymers and their classification. Average degree of polymerisation, Average molecular weight, Free radical polymerisation (Mechanisms)

2. Thermosetting and Thermoplastic resen -

   A. Addition polymers and their industrial application- Polystyrene, PVA, PVC, PAN, PMMA, Buna-S, Buna-N, Teflon.

   B. Condensation polymer and their industrial application :

Nylon 6, Nylon 6,6, Bakelite, Melamine formaldehyde, Urea formaldehyde, Terylene or

Decron, Polyurethanes.

3. General concept of Bio polymers, Biodegradable polymers and inorganic polymers(Silicon)

16. **SYNETHETICMATERIALS :**

A. Introduction - Fats and Oils

B. Saponification of fats and oils , Manufacturing of soap.

C. Synthetic detergents, types of detergents and its manufacturing.

3. EXPLOSIVES: TNT, RDX, Dynamite.

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DCH-104: APPLIED CHEMISTRY LAB

LIST OF PRACTICAL'S

1. To analyse inorganic mixture for two acid and basic radicals
from following radicals

A. **Basic Radicals :**
NH_4^+, Pb^{++}, Cu^{++}, Bi^{+++}, Cd^{++}, As^{+++}, Sb^{+++}, Sn^{++}, Al^{+++}, Fe^{+++}, Cr^{+++}, Mn^{++}, Zn^{++}, Co^{++}, Ni^{++}, Ba^{++}, Sr^{++}, Ca^{++}, Mg^{++}

B. **Acid Radicals :**
CO_3^{--}, S^{--}, SO_3^{--}, CH_3COO^-, NO_2^-, No_3^- , Cl^-, Br_- , I^- , So_4^{--}

2. To determine the percentage of available Chlorine in the supplied sample of Bleaching powder.
3. To determine the total hardness of water sample in terms of $CaCo_3$ by EDTA titration method using Eriochroma black-T indicator.
4. To determine the strength of given HCl solution by titration against NaOH solution using Phenolphthalium as indicator.
5. To determine the Chloride content in supplied water sample by using Mohr's methods.
6. Determination of temporary hard ness of water sample by O- Hener'smetho

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DCH-105: MEASURING INSTRUMENT AND MEASUREMENTS

1. ### INTRODUCTION & CLASSIFICATION OF INSTRUMENTS:
   Importance of instruments in chemical process industries. General classification of industrial instruments. Indicating and recording type of instruments. Static &Dynamic characteristics of instruments. Description and constructional details, working principle, ranges and application of following instruments.

2. ### PRESSURE AND VACUUM GAUGES:
   Liquid column gauges, Bourdantubegauge, Melleodgauge, Ionization and thermal conductivity meters.

3. ### THERMO METERS AND PYROMETERS:
   Bimetallic thermometers, liquid expansion thermometers, thermocouples, resistance thermometers, optical and radiation pyro meters.

4. ### MASS & WEIGHT MEASUREMENT:
   Measurement equipment- Two pan balance and single pan mechanical balances, Single pan electronic balance.

5. ### LIQUID LEVEL METERS:
   Visual indicators, Float actuated level meters, static pressure type instruments. The bubbler system, diaphragm box and air trap system. Electrical contact type liquid level indicators. Hydrostatic head density compensator level meter, Hydro step, Radar or microwave level indicator, Ultrasonic or Sonic level indicator.

   ### REFERENCE BOOKS:
   1. Industrial instrumentation by Donald, P. Ekman
   2. Instrumentation by Krik and Ramboi.

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<u>DCH 105: ENGINEERING DRAWING</u>

NOTE: Latest Indian Standards Code of Practice to be   1 Sheet
   Drawing, instrument sand their uses. Introduction to various drawing, instruments.

   1.1   Correct use and care of Instruments.
   1.2   Sizes of drawing sheets and their layouts.
2.   **<u>LETTERING   TECHNIQUES</u>**   2 Sheet
   Printing of vertical and inclined, normal single stroke capital letters.
   Printing of vertical and inclined normal single stroke numbers. Stencils and their use.

(B)   **<u>INTRODUCTION TO SCALES</u>**   2 Sheet
   Necessity and use, RF Types of scales used in general engineering drawing. Plane,
   diagonal and chord scales.

   3.   **<u>CONVENTIONAL PRESENTATION:</u>**   1 Sheet
   Thread (Internal and External), Welded joint, Types of lines, Conventional
   representation of materials, Conventional representation of machine parts.

4.   (a)   **<u>PRINCIPLES OF PROJECTION</u>**   1 Sheet
   Orthographic, Pictorial and perspective. Concept of horizontal and vertical planes.
   Difference between I and III angle projections. Dimensconing techniques. Projections of
   points, lines and planes.

5   (a)   orthographic projections of simple   2 Sheet
6   (a)   **<u>GEOMETRICAL SOLIDS</u>**
   Edge and ax is making given angles with the reference planes. Face making
   given angles with reference planes. Face and its edge making given angles with
   reference planes.

   (b)   Orthographic views of simple composite solids from there isometric views.
   (c) Exercises on missing surfaces and views

   6.   **<u>SECTION OF SOLIDS</u>**   2 Sheet
   Concept of sectioning Cases involving cutting plane parallel to one of the
   reference planes and perpendicular to the others.Cases involving cutting plane
   perpendicular to one of the Reference planes and in clind to the others plane,
   true shape of the section.
(a)   **<u>ISOMETRIC PROJECTION.</u>**   2 Sheet

   Isometric scale Isometric projection of solids.

   (b**)** **<u>FREE HAND SKETCHING</u>**   1 Sheet
   Use of squared paper orthographic views of simple solids Isometric views of
   simple job like carpentry joints.

7. **DEVELOPMENT OF SURFACES**   2 Sheet

   Parallel line and radial line methods of developments. Development
   Of simple and truncated surfaces (Cube, prism, cylinder, cone and pyramid).

8. **ORTHOGRAPHIC PROJECTION OF MACHINE PARTS:**   2 Sheet

   Nut and Bolt, Locking device, Wall bracket

9. **PRACTICE ON AUTOCAD**:   2 Sheet

   Concept of Auto CAD, Tool bars in AutoCAD, Coordinate System, Snap, Grid and
   Ortho mode. Drawing Command - Point, Line, Arc, Circle, Ellipse. Editing
   Commands-Scale, Erase, Copy, Stretch, Lengthen and Explode. Dimensioning and
   Placing text in drawing area. Sectioning and hatching. Inquiry for different parameters
   of drawing.

   NOTE :

A.   The drawing should include dimension with tolerance where ever necessary, material
     list according to I.S. code. 25% of the drawing sheet should be drawn in first angle
     projection and rest 75% drawing sheet should be in third angle figure

Practice on AutoCAD latest software is to be done in AutoCAD lab of Mechanical Engineering
Department.

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DCH 201: APPLIED MATHEMATICS –II

1. INTEGRAL CALCULUS - I :

   Methods of Indefinite Integration :-
1.1 Integration by substitution.
1.2 Integration by rational function.
1.3 Integration by partial fraction.
1.4 Integration by parts.

2.   INTEGRAL CALCULUS -II :

2.1 Meaning and properties of definite integrals, Evaluation ofdefinite integrals. Integration of special function.
2.2 Application : Finding areas bounded by simple curves, Length   of simple curves, Volume of solids of revolution, centre of   mean of plane areas.
2.3 Simposns 1/3rd and Simposns3/8th rule and Trapezoidal Rule : their application in simple cases.

3. CO-ORDINATE GEOMETRY (2 DIMENSION):

3.1 CIRCLE :   Equation of circle in standard form. Centre - Radius form, Diameter form, Two intercept form.
3.2 Standard form and simple properties
     Parabola $x^2=4ay$, $y^2=4ax$,
     Ellipse $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$
Hyperbola $\frac{x^2}{a^2} - \frac{y^2}{b^2} = 1$

4. CO-ORDINATE GEOMETRY (3 DIMENSION):

4.1 Straight lines and planes in space -Distance between two points in space, direction cosine and direction ratios, Finding equation of a straight line and Plane (Different Forms),
4.2 Sphere $x^2 + y^2 + z^2 + 2gx + 2fy + 2wz = d$ (Radius, Centre and General Equation)

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DCH-202 APPLIED PHYSICS-II

1. **Optics :**
   Nature of light, Laws of Reflection and Refraction, Snell's Law, Interference (Constructive and Destructive), Diffraction and Polarization (Concept Only), Law of Mallus and Polaroid's.

1. **Introduction To Fibre Optics :**
   Critical angle, Total internal reflection, Principle of fiber optics, Optical fiber, Pulse dispersion in step-index fibers, Graded index fiber, Single mode fiber, Optical sensor.

3. **Lasers and its Applications :**
   Absorption and Emission of energy by atom, Spontaneous and Stimulated Emission, Population inversion, Main component of laser and types of laser- Ruby Laser, He-Ne laser and their applications. Introduction to MASER.

   4. **Electrostatics :**
   Coulomb's Law, Electric field, Electric potential, Potential energy, Capacitor, Energy of a charged capacitor, Effect of dielectric on capacitors.

5. **D.C. Circuits :**
   Ohm's Law, Kirchoff's Law and their simple application, Principle of Wheat Stone bridge and application of this principle in measurement of resistance (Meter bridge and Post Office Box); Carey Foster's bridge, potentiometer.

6. **Magnetic Materials and Their Properties:**
   Dia, Para and Ferro-magnetism, Ferrites, Magnetic Hysteresis Curve and its utility. Basic idea of super conductivity, Meissner's effect.

7. **Semiconductor Physics :**
   Concept of Energy bands in solids, classification of solids into conductors, insulators and semiconductors on the basis of energy band structure. Intrinsic and extrinsic semi conductors, Electrons and holes as charge carriers in semiconductors, P-type and N-type semiconductors.

8. **Junction Diode and Transister :**
   Majority and Minority charge carriers P-N junction formation, barrier voltage, Forward and reverse biasing of a junction diode, P-N junction device characteristics, Formation of transistor, transistor-action, Base, emitter and collector currents and their relationship LED's.

9. **Introduction To Digital Electronics :**
   Concept of binary numbers, Inter conversion from binary to decimal and decimal to binary. Concepts of Gates (AND, NOT, OR).

10. **Non-conventional energy sources:**
   (a) Wind energy : Introduction, scope and significance, measurement of wind velocity by anemometer, general principle of wind mill.

   (b) Solar energy: Solar radiation and potentiality of solar radiation in India, uses of solar energy: Solar Cooker, solar water heater, solar photovoltaic cells, solar energy collector.

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<u>PHYSICS LAB</u>

Note: Any 4 experiments are to be performed.

1. Determination of coefficient of friction on a horizontal plane.

 2. Determination of 'g' by plotting a graph T2 verses l and using the formula g=4n2/Slope of the graph line

3. Determine the force constant of combination of springs incase of 1. Series 2. Parallel.

4. To verify the series and parallel combination of   Resistances with the help of meter bridge.

5. To determine the velocity of sound with the help of resonance tube.

6. Determination   of viscosity coefficient of a lubricant by Stoke's law.

7. Determination of E1/E2 of cells by potentiometer.

8. Determination of specific resistance by Carry Foster bridge.

9. Determination of resistivity by P.O.Box.

10. Verification of Kirchhoff's Law.

11. To draw Characteristics of p-n Junction diode.

12. To measure instantaneous and average   wind velocity by indicating cup type anemometer/hand held anemometer.

NOTE :
Students should be asked to plot a graph in experiments (where possible) and graph should be used for calculation of results. Results should be given in significant figures   only.

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DCH-203: APPLIED MECHANICS

1. **Introduction:**
Mechanics and its utility.Concept of scaler and vector quantities.Effect of a force.Tension& compression.Rigid body.Principle of physical independence of force.Principle of transmissibility of a force.

2. **A.   System of Forces:**
Concept of coplanar and non-coplanar forces including parallel forces. Concurrent and non-concurrent forces. Resultant force. Equilibrium of forces. Law of parallelogram of forces. Law of triangle of forces and its converse. Law of polygon of forces. Solution of simple engineering problems by analytical and graphical methods such as simple wall crane, jib crane and other structures. Determination of resultant of any number of forces in one plane acting upon a particle, conditions of equilibrium of coplaner concurrent force system.

   B.   **General Condition of Equilibrium:**
General condition of equilibrium of a rigid body under the action of coplanar forces, statement of force law of equilibrium, moment law of equilibrium, application of above on body.

3. **Moment & couple:**
Concept of Varignon's theorem. Generalised theorem of moments. Application to simple problems on levers-Bell crank lever, compound lever, steel yard, beams and wheels, lever safety valve, wireless mast, moment of a couple; Properties of a couple ; Simple applied problems such as pulley and shaft.

4. **Friction:**
Types of friction: statiscal, limiting and dynamical friction, statement of laws of sliding friction, Coefficient of friction, angle of friction; problems on equilibrium of a body resting on a rough inclined plane, simple problems on friction. Conditions of sliding andtoppling.

5. **Machines:**
Definition of a machine.Mechancial advantage, velocity ratio, input, output, mechanical efficiency and relation between them for ideal and actual machines. Law of a machine Lifting machines such as levers, single pulley, three system of pulleys. Weston differential pulley, simple wheel and axle, differential wheel and axle.Simple screw jack, differential screw jack, simple worm and worm wheel.

6. **Centre of Gravity:**
    Concept, definition of centroid of plain figures and center of gravity of symmetrical solid bodies. Determination of centroid of plain and composite lamina using moment method only, Centroid of bodies with removed portion. Determination of center of 'gravity' of solid bodies - cone, cylinder, hemisphere and sphere, composite bodies and bodies with portion removed.

7. **Moment of Inertia:**
    Concept of moment of inertia and second moment of area and radius of gyration, theorems of parallel and perpendicular axis, second moment of area of common geometrical section : rectangle, triangle, circle (without derivations). Second moment of area for L, T, I and channel section, section of modulus.

8. **Beams &Trusses:**
    Definition of statically determinate and indeterminate trusses.Types of supports. Concept of tie & strut, Bow's notation, space diagram, polar diagram, funicular polygon; calculation of reaction at the support of cantilever and simply supported beams and trusses graphically and analytically; graphical solution of simple determinate trusses with reference to force diagram for determining the magnitude and nature of forces in its various members. Analytical methods: method of joints and method of sections.(simple problems only)

Department of Chemical Engineering
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I Year II Semester

DCH-203: APPLIED MECHANICS LAB

1. To verify the law of Polygon of forces.

2. To verify the law of parallelogram and triangle of forces.

3. To verify the law of principle of moments.

4. To find the coefficient of friction between wood, steel, copper and glass.

5. To find the reaction at supports of a simply supported beam carrying point load sonly.

6. To find the forces in the jib & tie of a jib crane

7. To find the forces in the members of a loaded roof truss. (King / Queen posttruss)

8. To find the mechanical advantage, velocity ratio and efficiency of any three of the

    following machines:

    (i)   Simple wheel &axle

    (ii)   Differential wheel &axle

    (iii)   Differential pulley block

    (iv)   Simple Screw jack

    (v)   Simple Worm & worm wheel

    (vi)   System of Pulleys (any type).

9. To find out center of gravity of regular lamina.
10. To find out center of gravity of irregular lamina

Department of Chemical Engineering
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I Year II Semester

DCH-204: MECHANICAL OPERATION AND SOLID HANDLING

1. **INTRODUCTION:**
   Concept and role of unit operation in Industries.

2. **CHARACTERIZATION OF SOLID PARTICLES:**
   Characterization of solid particles, screening equipment's, standard screens, screen analysis, Grizzles, trammels.

3. **SIZE REDUCTION:**
   Theory of crushing, Rittinger's law, Kick's law, Bonds Law, Crushing and grinding machinery; their classification, general description of jaw crusher, gyratory crusher, role crusher, hammer mills, ball mills, open circuit and closed circuit Systems.

4. **CONVEYING OF SOLID SPARTICLES:**
   Conveying equipment's, 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) Thickener
   (iv) Cyclones.

6. **MIXING EQUIPMENT'S:**
   Details of mixing equipment, Homogeneous mixing equipment, Mixing equipment's used for liquid-liquid, liquid-solid and liquid-gas system.

7. **Fluidization**

REFERENCE BOOKS

1. Unit operation of chemical engineering by Mc Cabe & Smith
2. Mechanical Operation for Chemical Engineers by C.M.Narayan and B. C.Bhattacharya
3. Chemical Engineering Vol. II by Rechardson & Coulson.
4. Momentum Transfer Operation By S. K. Gupta, TMC, 1979

Department of Chemical Engineering
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I Year I Semester

DCH-204: MECHANICAL OPERATION AND SOLID HANDLING LAB

List of experiments

1. To draw a layout of Chemical Engineering lab.

2. To analyses the given sample on a set of screens and report the analysis.

3. To determine the critical speed of a ball mill.

4. To determine the efficiency of disintegrator.

5. To determine filtration constant by a plate and frame filter press.

6. To determine the rate of settling of slurries of various concentration draw a height VS time curve.

7. To determine the efficiency of Jaw crusher.

8. To study and sketch a Rotary filter.

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I Year II Semester

WORKSHOP PRACTICE

1. **Carpentry Shop :**

EX-1   Introduction & demonstration of tools used in carpentry shop and different types of joints, types of wood, seasoning and preservation of wood

EX-2   Planning and sawing practice
EX-3   Making of lap joint
EX-4   Making of mortise and tenon joint
Ex-5   Making of any one utility article such as wooden- picture frame, hanger, peg, name plate, etc.

2. **Painting and Polishing Shop:**

EX-1   Introduction of paints, varnishes, Reason for surface preparation, Advantage of painting, other method of surface coating i.e. electroplating etc.

EX-2   To prepare a wooden surface for painting apply primer on one side and to paint the same side. To prepare

french polish for wooden surface and polish the other side.

Ex-3 To prepare metal surface for painting, apply primer and paint the same.
EX-4 To prepare a metal surface for spray painting, first spray primer and paint the same by spray painting gun and compressor system.

*   The sequence of polishing will be as below:
i)   Abrassive cutting by leather wheel.
ii)   Polishing with hard cotton wheel and with polishing material.
iii)   Buffing with cotton wheel or buff wheel.

3.   **Sheet Metal and Soldering Shop**:
EX-1   Introduction and Types of sheets, measuring of sheets
EX-2   Study and sketch of various types of stakes/anvil.
EX-3   Introduction & demonstration of tools used in Sheet metal working shop.
EX-4   Cutting, shearing and bending of sheet.
EX-5   To prepare a soap case by the metal sheet.
EX-6   To make a funnel withth in sheet and to solder the seam of the same.
EX-7   To make a cylinder and to solder the same.
EX-8   Preparation of different type of joints such as Lap joint-single seam, double seam. Hemp and wired joints.
EX-9   To braze small tube/conduitjoints.

4.   Fitting Shop, Plumbing Shop & Fastening Shop:

EX-1 Study of materials, limits, fits and tolerances.

EX-2 Introduction &demonstration of tools used in Fitting Shop.

EX-3 Hacksawing and chipping of M.S. flat. Filing and squaring of chipped M.S. job.
          Filing on square or rectangular M.S.piece.

EX-4 Making bolt & nut by tap and die set and make its joints

Ex-5 To drill a hole in M.S. Plate and taping the same to create threads as per need.

EX-6 Utility article-to prepare double open mouth spanner for 18" hexagonal head of a
          bolt.

EX-7   Cutting and threading practice for using socket, elbow and tee etc. and to fit it
on wooden practice board.

EX-8   Study of-bib cock, cistern or stop cock, wheel valve and gate valveetc.

  EX-9   Practice of bolted joints

  EX-10   To prepare a rivetted joint

  EX-11   To make a pipe joint

  EX-12   To make a threaded joint

  EX-13   Practice of sleeve joint

 5.   Foundry Work

Ex-1   Study of metal and nonmetals

Ex-2   Study & sketch of the foundry tools.

Ex-3   Study & sketch of cupula & pitfurnace.

Ex-4   To   prepare the green mouldings and and to prepare moulds (single piece
          and double piece pattern sweep mould)

Ex-5   Casting of non ferrous (leadoraluminium) as per exercise 3.

6.   Smithy Shop:

EX-1   Study & Sketch of Tools used in smithy shop.

EX-2   To prepare square or rectangular piece by the M.S. rod.

EX-3   To make a ring with hook for wooden doors.

EX-4   Utility article-to prepare a ceiling fan hook.

7.   Welding Shop:

EX-1   Introduction to welding, classification of welding, types of weld joints.

EX-2   Welding practice-gas and electric.

EX-3   Welding   for lap joint after preparing the edge.

EX-4   Welding of Butt joint after preparation of the edge.

EX-5   'T' joint welding after preparation of edge.

EX-6   Spot welding, by spot welding machine.

8.   Machine Shop

EX-1   Study & sketch of lathe machine.

EX-1   Study & sketch of grinders, milling M/c, Drilling M/c and CNC Machines

Ex-2   Plain and step turning & knurling practice.

Ex-3   Study and sketch of planning/Shaping machine and to plane a Rectangle of
          castiron.

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II Year III Semester
DCH 301: APPLIED MATHEMATICS- III

1. MATRICES

1.1 **Algebra of Matrices, Inverse:** Addition, Multiplication of matrices, Null matrix and a unit matrix, Square matrix, Symmetric, Skew symmetric, Hermitian, Skew hermition, Orthagonal, Unitary, diagonal and Triangular matrix, Determinant of a matrix. Definition and Computation of inverse of a matrix.

1.2 **ElementaryRow/Column Transformation:** Meaning and use in computing inverse and Rank of a matrix.

1.3 **Linear Dependence, Rank of a Matrix:** Linear dependence/independence of vectors, Definition and computation of a rank of matrix. Computing rank through determinants, Elementary row transformation and through the concept of a set of independent vectors, Consistency of equations.

1.4 **Eigen Pairs, Cayley-Hamilton Theorem**: Definition and evaluation of eign values and eign vectors of a matrix of order two and three, Cayley-Hamiltontheorem (without Proof) and its verification, Use in finding inverse and powers of a matrix.

2. DIFFERENTIAL CALCULUS

2.1 Function of two variables, identification of surfaces in space, conicoids

2.2 **Partial Differentiation:** Directional derivative, Gradient, Use of gradient f, Partial Derivatives, chain rule, Higher order derivatives, Eulens theorem for homogeneous functions, Jacobians.

2.3 **Vector Calculus**: Vector function, Introduction to double and triple integral, differentiation and integration of vector functions, gradient, divergence and curl, differential derivatives.

3. DIFFERENTIAL EQUATION

3.1 **Formation, Order, Degree, Types, Solution:** Formation of differential equations through physical, geometrical, mechanical and electrical considerations, Order, Degree of a differential equation, Linear, Nonlinear equation.

3.2 **First Order Equations:** Variablese perable, equations reducible to separable forms, Homogeneous equations, equations reducible to homogeneous forms, Linear and Bernoulli form exact equation and their solutions.

3.3 **Higher Order Linear Equation**: Property of solution, Linear differential equation with constant coefficients (PI for X=eax, Sin ax, Cos ax, Xn, eaxV, XV.

3.4 **Simple Applications**: LCR circuit, Motion under gravity, Newton's law of cooling, radioactive decay, Population growth, Force vibration of a mass point attached to spring with and without damping effect. Equivalence of electrical and mechanical system

4. INTEGRAL CALCULUS - II

4.1 **Beta and Gamma Functions**: Definition, Use, Relation between the two, their using evaluating integrals.

4.2 **Fourier Series:** Fourier series of f(x),-n<x<n, Odd and even function, Half range series.

4.3 **Laplace Transform**: Definition, Basic theorem and properties, Unit step and Periodic functions, inverse Laplace transform, Solution of ordinary differential equations.

5. PROBABILITY AND STATISTICS

5.1 **Probability:** Introduction, Addition and Multiplication theorem and simple problem.

5.2 **Distribution:** Discrete and continuous distribution, Binomial Distribution, Poisson Distribution Normal Distribution.

Department of Chemical Engineering
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II Year III Semester
DCH 302: CHEMICAL ENGINEERING THERMODYNAMICS

1. **INTRODUCTION**

Scope of Thermodynamics, open & closed system, Thermodynamic properties-Temperature, Volume, Pressure, Specific heat atconstant volume, Isothermal &Adiabetic process, irreversible & reversible process, Intensive &Extensive properties.
Thermodynamic system, properties and state of a substance, processes and cycle, equality of temp. the Zeroth law of thermodynamics; the pure substance; phases of a pure substance; Phase Rule Independent properties of a pure substance; eqationof state for vap or phase (Wonder Wall quation).

2.FIRST LAW: Various froms of energy; Heatwork,Internalenergy, Enthalpy comparison of heat and work, calculationof U,KE, PE, Q & W first law of thermodynamicsfor a closed system under going a cycle;forachangein state ofa closed system; Joule Thomson coefficient J; Throttling process. Calculation of U, H, Q &W for Ideal gas under going reversible isometric, Isothermal, Isobar and adiabatic processes.

3. **SECONDLAW:** Kelvin, Planck and Classius statement, the reversible process, Factorsthat renderProcess irreversible: the Carnot cycle, Two propositions regarding the efficiency of a Carnot cycle. Thermodynamic temperature scaleand ideal gas temperature scale. Thermalthermodynamicequation-Maxwell relation.

4. **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 and availability; simple numerical problem for calculation of entropy change; thermodynamic relations.

5. **REFRIGERATIONS & LIQUEFACTION**: The Cornot refrigeration cycle, the air refrigeration cycle, vapor compression cycle, Absorption refrigeration- flow diagram and their descriptions; coefficient of performance (C.O.P).liquefaction process. Latest refrigerant and their qualities and application.

6. **VAPOUR LIQUID EQUALIIBRIA**: Concept of chemical potential, Roult's Law, Henery's Law, Fugacity, Fugacity coefficient activity coefficient.

NOTE:- At least one Question should be asked from each topic (1 To5).

REFERENCE BOOKS
1. Introduction to Chemical Engineering Thermodynamics by J.M. Smith
2. Chemical Engineering Thremodynamics by PandeyandChaudhary
3. Chemical Engineering Thermodynamics by Mishra andRastogi

Department of Chemical Engineering
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II Year III Semester
DCH 303: MATERIAL ENERGY BALANCE

1. **Scope of material & energy balance in process industries.**
2. (a) Dimensions, Units and their conversion factors, S.I units, mole unit, Concept of gm mole, gm atom Use of gravitational conversion factor gc.
   Problems relating conversion of one set of units in a function of equation into another equivalent set for mass, length, time, temperature, area, volume, pressure, energy and force of an expression for heat capacity from one set of units to another.

   (a) Density & specific gravity, mole fraction (or percent) mass fraction (or percent). conversion ofthe composition of a mixture from mole fraction(or percent) to mass(wt.) fraction (or percent)and reverse.

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

3. **THE CHEMICAL EQUATION AND STRICHEOMETRY:** Definition of excess and limiting reactant, conversion, degree of completion and yield in a reaction. Relating problems. Identification of limiting and excess reactant and calculation of percent excess reactant, the percent conversion, Degree of completion of reaction, Yield fora chemical reaction with reactants being in non stoichlo metric proportion.

4. **BEHAVIOUR OF IDEAL GASES:** P V T relationship, standard conditions, partial pressure and pure component volume. Dolton's and Amaget'slaws, average molecular weights of a gaseous mixture. Problems relating calculation of composition, average molecular weight, density and molar density, concentration of a gasious mixture.

5. **MATERIAL BALANCE**: Tie substance, bye pass streams, recycle and purge, simple problems relating various chemical reactions and without chemical reactions.

6. **COMBUSTIONPROCESS:**
   a. Analysis of products of combustions: - Proximate and ultimate analysis.
   b. Problems of fuel analysis, Air-fuel ratio, Theoretical oxygen/air required.
   c. Problems on flue gas analysis.
   d. Oxidation of sulphur and its compounds.

7. ENERGY BALANCE:

Forms of Energy, Definition of

(i) Exothermic and endothermicreaction.
(ii) Standard heat ofreaction.
(iii) Heat ofcombustion.
(iv) Heat offormation.
(v) Heat capacity &mean heatcapacity.
(vi) Net and gross heating value (LHV &HHV).

Calculation of:

(i) Enthalpy changes (without change ofphases).
(ii) Standard heat of reactionfrom heat offormation and combustiondata.
(iii) Heat of formation and combustion from combination of heat of reactions atreference temperature.(25oc).
(iv) Heat of reaction at constant pressure or constantvolume.
(v) Heat ofreaction at a temperature different from standard conditions i.e. 25oc (when reactant &products are not at 25oc).

REFERENCE BOOKS

1. Stoichiometry by B. L. Bhatt & S. M.Vora
2. Chemical Process Principles Part - I by O. A. Hougen&K.M. Watson
3. Chemical Process Principles Part - I by R. A.Rastogi
4. Solved Example in Chemical Engineering by G. K.Ray

Department of Chemical Engineering
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II Year III Semester
DCH 304: ELECTRICAL TECHNOLOGY & ELECTRONICS

1. ELECTRIC INDUCTION:
Faraday's Laws of electromagnetic induction. Self and mutual induction. Statically and Dynamically induced e.m.f., Lenz's law. Fleming's left hand and right hand rule.

2. A. C. THEORY:
Production of alternating e.m.f. Definition of cycle, Frequency, Amplitude, Time period, Instantaneous, Average, R.M.S. maximum values of sinusoidal wave. Form factor, peak factor.

Representation of a sinosoidal quantity by a mathematical expression and phas or, phase and phase difference, Relationship of voltage and current for pure resistance, pure inductance and pure capacitive reactance, impedance. Solution and phasor diagrams of simple R.L.C. series and parallel circuits. Active and reactive power. Significance of P.F.

3. THREE PHASE CIRCUITS:
Production of Three phase voltage, advantages of three phase supply. Concept of star and delta connections. Relationship between phase and line values of currents and voltages, Power in three phase circuits, simple numerical problems.

4. MEASUREMENT& MEASURING INSTRUMENTS:

I. Primary and secondary instruments-Indicating, Recording and Integrated instruments.
II. Working principle and construction of the following instruments.
  a. Ammeter & Voltmeter (Moving coil& Moving Iron).Extension of their ranges.

  b. Dynamometer type watt meter.

  c. Single Phase A. C. Energy Meter.

III. Measurement of power in a single phase and three phase circuits by wattmeter, Use of digital multimeter for measurement of voltage, Current and testing of devices.

5. ELECTRONICS:
Basic idea of semiconductors P & N type. Semiconductor diodes, Zener diodes and their applications inrectifiers. Transistors-PNP and NPN-their characteristics and uses at an amplifier (Brief description only). Prniciple characteristics and application of SCR. Devices like UJT, FET, DIAC, TRIAC (Brief introduction, Introduction to operational amplifier, Introduction to basic logic gates and microprocessors.

6.D. C. MACHINES:

D. C. Generator: Working principle, Constructional details, e.m.f. equation, Types of generators and their applications.
D. C. Motor: Working principle, Back e.m.f., Types of D. C. motor and elementary idea of their characteristics. Torque equation, Methods of speed control (Description Only).

7. TRANSFORMERS:
Working principle and constructional details of a single phase and 3 phase transformers, e.m.f. equation, Losses and efficiency, Cooling of transformers, Elementary idea of auto transformers and welding transformers.

8. SYNCHRONOUS MACHINES:
a) Alternators: Working principle, Types of alternators, Constructional details, E.M.F. equation, Condition for parallel operation.
b) Synchronous Motors: Working principle, Constructional details, Vector diagram, Effect of excitation on armature current and power factor, Synchronous condenser.

9. INDUCTION MOTORS:
a) Three Phase Induction Motors: Working principle and constructional details-Types of induction motors-Slipring and Squirrel cage. Slip in induction motors. Speed torque characteristic, Starting and speed control. Application of induction motors in industry. General faults and their remedies.
b) Single Phase Induction Motors: Working principle and constructional details and application of single phase motors (Split phase, Capacitor start and Run Motor). A. C. series motors, General faults and their remedies.

10. ELECTRO HEATING:
Types of electro heating. Brief description of resistance ovens and induction furnace and core furnaces.

11. ELECTROPLATING:
Importance of electroplating, Principle of electroplating and equipment used. Processes used in electroplating, Anodizing.

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II Year III Semester
DCH 304: ELECTRICAL TECHNOLOGY & ELECTRONICS LAB

1. To change the speed and direction of rotation of d.c. shunt motor by
(a) Armature control method.
(b) Field control method.

2. To change the speed and direction of rotation of d.c.compound motor by
(a) Armature control method.
(b) Field control method.

3. To measure the terminal voltage with variation of load current of
(a) D.C. shunt generator.
(b) D.C. compound generator.

4. To perform load test on a single phase transformer and determine its efficiency.

5. To start and run a induction motor by
(a) Star Delta Starter.
(b) Auto Transformer Starter.

6. To measure slip of an induction motor by direct loading.
7. To start and change the direction of rotation of an induction motor.
8. To measure transformation ratio of a single-phase transformer.
9. To measure power and P.F. ina single phase circuit by Ammeter, Voltmeter and Wattmeter.
10. To measure power and P.F. in a 3 phase/A.C.circuit by two watt meter method.
11. To calibrate a single phase energy meter at different P.F.'s and different loads.
12. To locate the faults in an electrical machine by am egger.
13. To connect a fluorescent tube and note it's starting and running current.
14. To draw characteristics on Silicon Controlled Rectifier(SCR).
15. Testing of electrical devices-Zenor, Diode,Transistor, FET, UJT,SCR.
    Use of operational amplifier as adder, substractor, comparator, differentiator and integrators.

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II Year III Semester
DCH 305 COMPUTER APPLICATIONS

1. INTRODUCTION TO COMPUTER:
A. Block Diagram of Computer.
B. Types Of Computer
C. Types of Input and Output devices
D. Memories Devices (Its Types and Basic).

2. INTRODUCTION TO OPERATING SYSTEMS (MS-DOS/MS-WINDOWS:)
What is operating system, its significance, Commands of DOS, Features/Application of window.
3. WORD PROCESSING:
File : Open, Close, Save, Save as, Search, Send to, Print Preview, Print and Page Setup
Edit : Cut, Copy,Paste, Office Clipboard, Select All, Find, replace, Goto, etc.
View : Normal/Web Layout/Print Layout;
Tool Bars; Header/Footer; Zoom, etc.
Insert: Break, Page Number, Date & Time, Symbol, Comment, Reference, etc.
Format: Font, Paragraph, Bullets & Numbering, Borders & Shading, Column, Change case,
Back ground, etc.
Tools : Spelling & Grammer, Language, Word Count, Letters & Mailing, Options, Customize, etc.
Table : Draw, Insert, Delete, Select, Auto Format, AutoFit, Convert, Sort, Formula, etc.
Mail Merge

4. WORKSHEET:
Introduction, Use of Tools/Icons for preparing simple Mini Project.

5. PRESENTATION :
Introduction, Use of Tools/Icons for preparing simple presentation on Power Point.

6. DATABASE OPERATION :
Create database using MS Access, Create Table and Creating Reports.

7. INTRODUCTION TO INTERNET:
What is Network, How to send & receive messages, Use of Search Engines, Surfing different web sites. Creating Mail ID, Use of Briefcase, Sending./replying emails.

8. INTRODUCTION TO ADVANCE TOOLS :
I. Steps requires to solving problems.
A. Flow Chart
B. Algroithm
C. Programming
II. Use of advance Tools such as Skype, Teamviewer, Installation of Modem, use of WiFi, Etc

DCH 305 COMPUTER APPLICATION LAB

List of Practicals

1. Practice on utility commands inDOS.

2. Composing, Correcting, Formatting and Article (Letter/Essay/ Report) on Word Processing tool Word andtaking its print out.

3. Creating, editing, and modifying tables in Databasetool.

4. Creating labels, report, and generation of simple formsin Databasetool.

5. Creating simple spread sheet, usingin built functionsin Worksheet tool.

6. Creating simplepresentation.

7. Creating mail ID, Checking mailbox, sending/replyinge- mails.

8. Surfing web sites, using searchengines.

Note : In the final year, related students have to use the concept of MS Word/MS Excel/MS Access/ MS Power Point in their respective branch's project work such as creating project report through MS Word/Creation of statistical data in MS Excel/Creation of database in MS Excel/ Demonstration of project through Power Point Presentation.

Department of Chemical Engineering
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II Year IV Semester

DCH 401: CHEMICAL TECHNOLOGY

1. **INDUSTRIAL GASES:**
   Manufacture and uses of Oxygen,Hydrogen,Nitrogen,CarbonDioxide.

2. **FERTILIZER INDUSTRIES:**
    Ammonia, Nitric acid,AmmoniumSulphate,Urea,Ammonium Nitrate, Phosphorus, Phosphoric Acid, CalciumPhosphates- Super Phosphates, Triple SuperPhosphate,Nitro Phosphate, N-P-Kfertilizer.

3. **CHLOR-ALKALI INDUSTRIES:**
   Common Salt, Caustic Soda, Chlorine, HydrochloricAcid, Soda-Ash, BleachingPowder.

4. **SULPHURINDUSTRIES:**Manufacture of Sulphuric acid, Oleum.

5. **CEMENT INDUSTRIES**: Manufacture of PortlandCement.

6. **INSECTISIDES, PESTICIDES & HERBICIDES:**
   Definition, types of insecticides, pesticides and herbicides, Uses and Quantity and variety, benefits.

7. **PROCESSINDUSTRIES:**
   A. **Petroleum Refining**:Constituent of petroleum including petroleum gases, products of refining, distillation- atmospheric distillation unit and vacuum distillation unit.
   B. **Sugar Industry**: Manufacture of canesugar.

   C. **Fermentation Industry**:Introduction, Types of fermentation processes, Production of ethyl alcohol by fermentation, Industrialalcohol, manufacture of industrial alcohol-, Beers, Wines & Liquors.
   D. **Soap & Detergents Industry:**
      Manufacturing of soap, glycerin as by products from soap manufacturing Detergents, Detergents raw material and manufacturing of detergents. House disinfect (Phynyle).
   E. **Pulp and Paper industry:**Sulfite & ground wood pulp for paper manufacture ofpaper, especially paper.
   F. **Polymer Industry:**Types of polymer, Polymerization Process, Manufactureof Polyethylene, Styrene Nylon 6, Nylon 66

   REFERENCE BOOKS
   1. Outline of Chemicals Technology by M. GopalaRao.
   2. Chemical Process Industry by Shreve andAustin
   3. Chemical Technology Vol I & II by G. N.Pandey
   4. Industrial chemicals by Faith, Keyes andClark
   5. Industrial Chemistry by Dr. B. K.Sharma

Department of Chemical Engineering
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P.K. University, Shivpuri (MP)
II Year IV Semester

DCH 401: <u>CHEMICAL TECHNOLOGY LAB</u>

1. Preparation of Phenyl (domestic disinfectant).

2. Preparation ofSoap.

3. Preparation of Detergent/liquiddetergent.

4. Atmospheric distillation of Petroleum Fractional analysisof petroleum.

5. Determination of fife and flash point :Open Cup &Closed Cup

   a) Cleav land open cup(COC)
   b) Penskgymartin closed cup(PMC)

6. Preparation of Polymer by BulkPolymerization.

7. Preparation of Thermo PlasticsPMMA.

8. To find out the viscosity and viscosity index ofgiven sample by red wood no-1 and red wood no-2viscometer.

9. To findout viscosity of and viscosity indexgivensamplebySayboltviscometer.

Department of Chemical Engineering
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P.K. University, Shivpuri (MP)
II Year IV Semester

DCH 402: CONVENTIONAL AND NON CONVENTIONAL SOURCE OF ENERGY

PART-A: CONVENTIONAL ENERGYSOURCE

1. **INTRODUCTION:**Introduction of various Solid, Liquid and Gaseous fuels.
2. **SOLIDFUELS:**Wood, Charcoal, Coal (Peat, Lignite, Bituminous and Anthracite)and Coke .Calorific value Definition and experimental determination by bomb calorimeter and calculations. Washing of coal, Purpose of washing,Principle description and operation of Jigs and washers,Carbonization (Low temperature and High temperature).
3. **LIQUIDFUELS:**
a) Fuel Oil, Gasoline,DeselFules, Kerosine,Biogas, Biomass, GNG,PNG.
b) Properties (Sp. gravity, Viscosity, Flash &firePoint, Octane no, Cetane no. & ignition delay).
c) Advantages and disadvantages of liquid fuels.

4. **GASEOUSFUELS:**Natural Gas, LPG -Advantages and disadvantages of gaseous fuels.
5. **COMBUSTION CALCULATION**:Calculation of percentage of products of combustion, numerical Questions.

PART-B : NON CONVENTIONAL ENERGY SOURCE

SOLARENERGY: Energy from the Sun, Application of solar technology: Solar thermal, Electricity production, Fuel production, Energy storage methods.

1. **WIND ENERGY**:Source of wind energy, Wind power: Types of wind power, Wind power industry : Wind forms, wind turbine.

2. **BIOENERGY:** Resource of Bio energy, Solid biobass,Electricity generation from biomass, Bio energy product.

3. **HYDROENERGY**: Types of Hydropower, Advantage and disadvantages ofhydro energy

4. **GEOTHERMAL ENERGY:** Types of Geothermal energy, Resources,Production, Renewability and sustainability.

5. **WAVE AND TIDALENERGY:** Generation of Tidal energy and wave energy.Generating methods, Difference between wave and tidal energy.

REFERENCE BOOKS
1. Nonconventional Energy Resources by D. S.Chauhan
2. Thermal Engineering by R. K.Rajpoot
3. Fundamental of Renewable Energy System by D.Muknergy

Department of Chemical Engineering
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II Year IV Semester
DCH 403: FLUID MECHANICS

PART - A

1. FLUIDS
- i. Properties
- ii. Classification ofFluids.
- iii. Fluid mano meters, description and simple numericalproblems.

2. FLOW OF INCOMPRESSIBLEFLUIDS:
- i. Shear stress distribution   in a cylindricaltube, velocity distribution for Newtonianfluid.
- ii. ReynoldNo.Elementry knowledge of laminar andturbulent flow, Reynoldexperiment.
- iii. Continuity equations, Bernaulli's theorem, fluidheads and power requirementcalculation.
- iv. Friction factor, Fanning equation and Hagen Poiseuille equation friction losses in pipes, calculationof friction loss due to enlargement, contraction,fittings andvalves.
- v. N.P.S.H., cavitation, pipes, tubing, fittings &(Valves numericalproblems)

3. MEASUREMENT OF FLOWINGFLUIDS:

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

4. PIPE AND PIPE FITTINGS:
Tupes. Pipes, Schedule Number, Difference between tubeand pipes, Various type of valves (Gate, Close, Check,Pressure Reducing valve, Steam Traps, etc). Pipe fittings(Flange, Socket, Albow, Tees, Star, etc.).

5. TRANSPORTATION OFFLUIDS:
- a. Classification of pumps, construction and operation of Air lift, reciprocating, rotary, centrifugal andgear pumps.
- b. NPHS, Cavitations, Simples numericalproblems.

6. FLOWMETERS: Orifice, venturi and nozzle type flow meters, pitottube, rotameters positive displacement type flow meters.

REFERENCE BOOKS

1. Unit operation of chemical engineering by McCabeandSmith
2. Chemical Engineering Vol I & II by Coulson &Richardson.
3. Hydraulics, Hydraulic Machine and Fluid MechanicsbyR.S. Khurmi.

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DCH 403: FLUID MECHANICS LAB

1. To determine the co-efficient of discharge of orifice-meter by Flow measurement

2. To determine the co-efficient of discharge of venturimeter.

3. To determine the co-efficient of discharge of V-Notches.

4. To determine the co-efficient of discharge of Rectangular Notches.

5. To determine coefficient of velocity (Cv), coefficient of discharge (Cd), coefficient of contraction (Cc) and verify the relation between them.

6. To determine friction losses in pipes and fittings.

7. To verify loss of head dueto
a. Sudden Enlargement.
b. Sudden Contraction.

8. To verify Bernoullie's Theorem.

9. To perform Reynold'sexperiments.

10. To determine the efficiency of a centrifugal pump.

11. Study the following.
a. Reciprocating Pump.
b. Pressure Gauge/WaterMeter/MechanicalFlowMeter/PitotTube.
c. Valves (Gate, Gloves,Cock,Check, Butterfly, Steam trap, Safety valve, Ballvalve.
d. Fittings (Flange, Socket, Union, Nipple, Elbow, Reducer, T,Plug)

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II Year IV Semester

DCH 404: PROCESS PLANT UTILITIES

1. **GENERATION, PROCESS & STEAM PROPERTIES:**
   Generations of steam at constant pressure, phases of transformation. Pressure-temperature, curve for steam. Latent Heat-external work of evaporation, Sensible heat of water, dry& saturated steam. Dryness fraction, Latent heat of wet steam, detail of wet steam, total heat of super-heated steam, specific volume of wet & super-heated steam. Simple problems using steam-table,

2. **TYPES OF FUELS USED IN BOILERS:**
   Types of fuels used in boilers, Coal, Fuel Oil, Rice husk, Natural gas, etc. produced/forced draught concept.

3. **STEAM GENERATOR:**
   Type of steam generators (boilers)-Fire tube & water tube and their principles. Elementary concept and principles of modern water tube boilers. Boiler mountings and accessories. Quantity of heat spent in generation. Ideal cycle of a steam plant. Ways of increasing the efficiency to steam power plant (No numerical question).

4. **STEAM DISTRIBUTION:**

   Pipe quality, layout of piping, steam trap, pressure reducing station: Steam ejectors.

5. **PRESSURE & VACUUM SYSTEM:**
   Construction and working of Blowers, Fan, Compressures, Vacuum Pump, Steam Ejectors.

6. **WATER:**
   Different water resources, storage, quality parameters like hardness, suspended solids, turbidity, etc.

7. **WATER TREATMENT TECHNIQUES:**
   Water treatments techniques, Flow diagram, Coagulation by Iron compounds like Alum, sedimentation, filtration, Softened by Sodium Carbonate and Bi-carbonate.

8. **DEMINERALIZATION:**
   Demoralization flow diagram, Cation and Anionexchangersmilded bed, Regeneration of action and anion exchangers and degasor.

9. **COOLING WATER:**
   Recycling of water, Cooling towers, Principals, details and problems like sealing use of inhibitors, like sodium and chromates.

REFERENCE BOOKS
1. Engineering Chemistry by P. C.Jain
2. Unit Operation of Chemical Engg. by MacabeandSmith
3. Thermal Environmental Engineering by J .K.Thiked

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III Year V Semester
DCH-501: INDUSTRIAL MANAGEMENT AND ENTREPRENEURSHIP DEVELOPMENT

1. **Principles of Management**
   1.1 Management, Different Functions: Planning, Organizing, Leading, Controlling.
   1.2 Organizational Structure, Types, Functions of different departments.
   1.3 Motivation: Factors, characteristics, methods of improving motivation, incentives, pay, promotion, rewards, job satisfaction, job enrichment.
   1.4 Need for leadership, Functions of a leader, Factors for accomplishing effective leadership, Manager as a leader, promoting teamwork.

2. **Human Resource Development**
   2.1 Introduction, objectives and functions of human resource development (HRD) department.
   2.2 Recruitment, methods of selection, training strategies and career development.
   2.3 Responsibilities of human resource management – policies and functions, selection–Mode of selection–Procedure– training of workers, Job evaluation and Merit rating.

3. **Wages and Incentives**
   3.1 Definition and factors affecting wages, methods of wage payment.
   3.2 Wage incentive – type of incentive, difference in wage, incentive and bonus; incentives of supervisor.
   3.3 Job evaluation and merit rating.

4. **Human and Industrial Relations**
   4.1 Industrial relations and disputes.
   4.2 Relations with subordinates, peers and superiors.
   4.3 Characteristics of group behavior and trade unionism.
   4.4 Mob psychology.
   4.5 Grievance, Handling of grievances.
   4.6 Agitations, strikes, Lockouts, Picketing and Gherao.
   4.7 Labour welfare schemes.
   4.8 Workers' participation in management.

5. **Professional Ethics**
   5.1 Concept of professional ethics.
   5.2 Need for code of professional ethics.
   5.3 Professional bodies and their role.

6. **Sales and Marketing management**
   6.1 Functions and duties of sales department.
   6.2 Sales forecasting, sales promotion, advertisement and after sale services.
   6.3 Concept of marketing.
   6.4 Problems of marketing.
   6.5 Pricing policy, break even analysis.
   6.6 Distribution channels and methods of marketing.

7. **Labour Legislation Act (as amended ondate)**
    7.1 Factory Act 1948.
    7.2 Workmen's Compensation Act 1923.
    7.3 Apprentices Act 1961.
    7.4 PF Act, ESI Act.
    7.5 Industrial Dispute Act 1947.
    7.6 Employers State Insurance Act 1948.
    7.7 Payment of Wages Act, 1936.
    7.8 Intellectual Property Rights Act

8. **Material Management**
    8.1 Inventory control models.
    8.2 ABC Analysis, Safety stock, Economic ordering quantity.
    8.3 Stores equipment, Stores records, purchasing procedures, Bin card, Cardex.
    8.4 Material handling techniques.

9. **Financial Management**
    9.1 Importance of ledger and cashbook.
    9.2 Profit and loss Account, Balance sheet.
    9.3 Interpretation of Statements, Project financing, Project appraisal, return on investments.

10. **Entrepreneurship Development**
    10.1 Concept of entrepreneur and need of entrepreneurship in the context of prevailing employment conditions.
    10.2 Distinction between an entrepreneur and a manager.
    10.3 Project identification and selection.
    10.4 Project formulation.
    10.5 Project appraisal.
    10.6 Facilities and incentives to an entrepreneur.

11. **Fundamental of Economics**
    11.1 Microeconomics.
    11.2 Macroeconomics.

12. **Accidents and Safety**
    12.1 Classification of accidents based on nature of injuries, event and place.
    12.2 Causes and effects of accidents.
    12.3 Accident-prone workers.
    12.4 Action to be taken in case of accidents with machines, electric shock, fires and erection and construction accidents.
    12.5 Safety consciousness and publicity.
    12.6 Safety procedures.
    12.7 Safety measures – Do's and Don'ts and god housing keep in

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DCH-502: HEAT TRANSFER OPERATION

1. **MODES OF HEAT TRANSFER:** Conduction, convection & radiation.
2. **CONDUCTION:** Fourier's law, Thermal conductivity, Conductance, flat Wall, Multilayer flat wall, Hollow cylinder, Multilayer cylinder log mean area, geometric mean area & Arthmatic mean area, Simple numerical problems in S.I. Units.
3. **CONVECTION:**
   Natural and forced convection, Physical significance of dimension less number. Reynold No, Prandle No., Nusselt No., Stanton No., Peclet No., Grash off No., Dittus Boelter's equation-simple numerical problems using Dittus Boelter equation. Fouling factor. Individual heat transfer coefficient and over all heat transfer coefficient.
4. **RADIATION:**
   Reflection, absorption and transmission of radiation, Kirch off law, Emissive power, Wein's displacement law, the stefen Boltman law, Heat transferred by radiation exchange of energy between two parallel planes of difference emissivity,
   Radiant Heattransfer coefficient, Solar radiation, gray surfaces or gray body.
5. **CONDENSER:**
   Film-wise and Drop-wise condensation. Construction & description of contact condenser and surface condenser.
6. **EVAPORATORS:**
   Construction and description of
1. Horizontal tube types.
2. Standard vertical type or calendric type.
(a) Natural and forced circulation type.
(b) Entrainment and foam formation.
(c) Method of feeding evaporators- Forward, Backward & cross, mixed multi effect evaporation.
(d) **BOILING**: Nuclear boiling, film boiling, Transition boiling, Maximum flux and critical temperature drop, construction & description of Kettle type boilers. Boiling point rise (B.P.R) and effect, steam economy for single effective evaporator (Simple Numerical Problem).
7. **CRYSTALLIZERS:** Classification of crystallizers; construction and description
1. Swensen walker.
2. Vacuum crystalizer.
P. **INSULATION:**
   Purpose of insulation common insulators, critical thickness of insulation for cylinder and spheres, optimum thickness of insulation, Heat loss from a pipe.

   REFERENCE BOOKS
1. Heat Transfer by D. Q.Kern
2. Unit Operating in Chemical Engineering by McCabe & Smith

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DCH-502: HEAT TRANSFER OPERATION LAB

LIST OF EXPERIMENT

 (At Least 7 experiment to be Performed)

1. To determine overall heat transfer coefficient for an open pan evaporator in steady state conditions.

2. To determine over all heat transfer coefficient for an open pan evaporator in unsteady state conditions.

3. To determine 'U' for a double pipe heat exchanger in steady state conditions and also to determine efficiency of heat utilization.

4. To determine 'U' for a shell and tube heat exchanger in steady state conditions and also to determine efficiency of heat utilization.

5. To study a shieve plate distillation operation and to calculate over-all efficiency of the distillation column.

6. To determine steam economy of a single and double effect evaporator.

7. To study the rate of drying in a vacuum dryer.

8. To determine the pounds of volatile compounds distilled per unit pounds of steam distilled in a steam distillation operation.

9. To determine rate of setting of crystals in acry staliser.

10. To study the rate of drying in Rotary dryer.

11. To determine drying rate for a wet material in a Tray Dryer.

12. To study packed tower in various industries.

13. To study various extractors in solvent extraction plant.

14. To study a spray pond in sugar and other industries for cooling system.

15. Determination of Thermal conductivity of Asbestus Powder.

16. Study of Insulating Material (Glass wool, Mineral wool, Ceramic blanket, Fire brik, Fire cement, Fire clay, Asbestus power, Firecrete)

DCH-503: MASS TRANSFER OPERATIONS

1. DIFFUCION:

Definition of diffusion, Rate of diffusion in Mass Transfer, Fick's law, diffusion in the gas phase-Equimolecular counter diffusion, diffusion through a stationary gas (Stefan's Law), Mass. Transfer Coefficient. Film theory and penetration theory of Mass Transfer, Diffusion in solids. Derivation of the following relations.

$$I. \quad \frac{1}{K_G.a} = \frac{1}{k_G.a} + \frac{m}{k_L.a}$$

$$II. \quad \frac{1}{K_L.a} = \frac{1}{k_L.a} + \frac{1}{m.k_G.a}$$

2. ABSORPTION:

Introduction, importance, absorption with chemical reaction, Mechanism of absorption - two film theory, Diffusion of gases through a stagnant gas, Diffusion in liquid phase, Rate of absorption, Relation between film and overall coefficient, Factors influencing the transfer coefficient. Gas absorption equipments - Plate and packed calumn, Spray towers, Choice of solvent for absorption, Height of Transfer Unit (HTU), Number of Transfer Unit (NTU), Meaning and their relationship (Simple NumericalProblems).

3. DISTILLATION:

Various distillation methods:-

1. Equilibrium or flash distillation.
2. Differentialdistillation
3. Batchdistillation.
4. Vacuum and Steamdistillation.
5. Azeotropic and Extractivedistillation.

Types of distillation columns:-

1. Perforated plate or sieve platecolumn
2. Bubble cap platecolumn

Vapor liquid equilibrium diagram, Raoult's law; Relative volatility, constant boiling mixtures, equilibirium diagram and construction of equilibrium diagram, Fractionating column calculation- Heat & material balance, Reflux ratio, equilibrium plate, Location of feed plate. Sub cooled reflux; effect of reflux ratio, Total reflux, Minimum reflux ratio Entrainment; Mc-Cable Thiele diagram-section above and below feed plate; Intersection of operating line. Location of q-line, optimum reflux ratio, calculation of no. of equilibrium plate by Mc-Cable Thiele diagram. Overall plate efficiency.

4. EXTRACTION:
1. Applications of this operation.
2. Choice of solvent.
3. Steps of extraction operation
4. Solid Liquid extraction, construction and description of

   A. Moving Bed-Basket type oil seed extract or OR Boll man extractor.
   B. Rotocel extractor.

Liquid extractor; description and construction of

   A. Mixer settler extraction system.
   B. Perforated plate and baffletowers.

5. HUMIDIFICATION:
Definition and calculation of
1. Humidity
2. Percentagehumidity
3. Relativehumidity
4. Humidvolume.
5. Humidheat.
6. Enthalpy and itscalculation.
7. Dry bulb and wetbulb-temp.
8. Adiabatic saturationtemperature.
9. Use of humidity chart. Dew point, simple numerical problem using humidity chart, construction and description of cooling towers. (Natural and induceddraft)

6. DRYING
General drying behavior-Critical moisture content, equilibrium moisture content:Descriptionand construction ofdryer.
1. Traydryer.
2. Screen conveyordryer.
3. Rotarydryer.

NOTE:-Atleast One Question From Each Topic.

REFERENCE BOOKS
1. Mass Transfer Operation by R.Treybal
2. Chemical Engineering Vol. II by Richardson &Coulson
3. Unit Operation of Chemical Engineering by McCabe&Smith

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III Year V Semester
DCH-504: POLLUTION CONTROL & INDUSTRIAL SAFETY

1. **INTRODUCTION:**

   What is environment? What is Pollution? Classification of pollution e.g. Land, Water, Air, Noise. Impact assessment of development projects. 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, NH3,F,Cl, CFC,Co2 etc.
   - (ii) Air pollution control equipment inindustries.
     - (a) Settling chambers
     - (b) Cyclones
     - (c) Scrubbers (dry &wet)
     - (d) Multiclones
     - (e) Electro Static Precipitations(ESPS)
     - (f) Bug Filters
   - (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 hazard sand 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.

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, Noise Pollution Act.

8. **SAFETY IN CHEMICAL INDUSTRY:**

Receiving and storing chemicals-Transporting and moving chemicals- Safety in chemical reactions, Pipe-lines in chemical factories. Precautions in the case of processes in operations involving explosive or inflammable dusts, gases, vapor's 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).

9. **DISASTER MANAGEMENT:**

Definition of disaster - Natural and Manmade, Type of disaster management, How disaster forms, Destructive power, Causes and Hazards, Case study of Tsunami Disaster, National policy- Its objective and main features, National Environment Policy, Need for central intervention, State Disaster Authority- Duties and powers, Case studies of various Disaster in the country, Meaning and benefit of vulnerability reduction, Factor promoting vulnerability reduction and mitigation, Emergency support function plan.

Main feature and function of National Disaster Management Frame Work, Disaster mitigation and prevention, Legal Policy Frame Work, Early warning system, Human Resource Development and Function, Information dissemination and communication.

REFERENCE BOOKS

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

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III Year V Semester

DCH-505: FERTILIZER TECHNOLOGY

1. INTRODUCTION:

Origin and development of commercial fertilizer under Indian conditions. Role of fertilizer in plant growth and their application to soil.

2. CATALYST:

Catalyst used in fertilizer industry-reforming catalyst (Primary & Secondary), High & low temperature shift reaction catalyst, ammonia synthesis catalyst, machination catalyst etc.

3. NITROGENOUS FERTILIZERS:

Feed stock for production of Ammonia-Natural gas, associated gas, Coke oven gas, Naphtha fuel oil, coal etc. Process for gasification and methods of production of ammonia. Ammonium- sulphate, Ammonium Nitrate, calcium ammonium nitrate and urea their methods of production, characteristics and specifications. Operation problems of the urea plants.

4. PHOSPHATIC FERTILIZERS:

Raw materials-Phosphaticrock, sulfur, superphosphates of all grades by different process, operational details of the plants.

5. MIXED & COMPOUND FERTILIZERS:

Their advantage and disadvantage. Materials used in mixed fertilizers. Manufacture of various grades of NPK fertilizer. Granulation technique of fertilizers mixture.

6. BIO-FERTILIZER(NITROGEN FIXING):

Introduction to bio-fertilizer (nitrogen fixing).

7. POTASIC FERTILIZER:

Manufacture of Potassium Chloride and Potassium Sulphate

REFERENCE BOOKS
1. Shreve's Chemical Process Industries by George T. Austin, Randolph NorrisShreve.
2. Outline of Chemical Technology by Charles E. Dryden, M. Gopala Rao, MarshallSittig

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DCH-505: FERTILIZER TECHNOLOGY LAB
LIST OF EXPERIMENTS

(At Least 6 Experiments To Be Performed)

1. Analysis of Fertilizers.

2. Analysis of flue gases by CNH analyzer

3. Determination of pH-value.

4. Determination of Turbidity.

5. Determination of Total Dissolved Solid (TDS).

6. Determination of Dissolved Oxygen (DO).

7. Determination of Chemical Oxygen Demand (COD).

8. Determination of Biochemical Oxygen Demand (BOD).

9. Softening of water by Ion-exchange method.

10. Demineralization of water by Ion exchange method.

11. Removal of dissolved solid by Membrane method.

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III Year VI Semester

DCH-601: CHEMICAL REACTION ENGINEERING

1. **INTRODUCTION:**
Chemical kinetics, classification of reactions variables affecting the rate of reaction;

2. **HOMOGENEOUS REACTIONS:**
Concentration dependent term of a rate equation, single and multiple reaction, series and parallel reactions. Elementary and Non-elementary reactions, Kinetic view for elementary reactions molecularity and order of reaction, Rate constant K. Representation of a reaction rate, Temperature dependent term of a rate equation, Temperature dependency from - (Arrhenius law, Thermodynamics and collision theory).Activation energy and Temperature dependency. Simple numerical problems.

3. **INTERPRETATION OF CONSTANT VOLUME BATCH REACTOR DATA:**
Constant volume batch reactor-Integral method of Analysis of data, Differential method of analysis of data temperature and Reaction rate. The search for a rate equation. Simple Numerical problems.

4. **IDEAL REACTORS:**
Classification of reactors and application & their comparison, Ideal batch reactor, space time and space velocity, steady-state mixed flow reactor, steady state plug flow reactor. Holding time and space time for flow systems. Simple numerical problems.

5. **INTRODUCTION TO HETEROGENEOUS REACTING SYSTEMS:**
Rate Equation for Heterogeneous Reactions. Contacting pattern for two phase system Simple Numerical problems.

6. **INTRODUCTION OF VARIOUS TYPES OF INDUSTRIAL REACTORS :**CSTR, Tricle, Sheray, Packed bed, Fludizerbed.

REFERENCE BOOKS
1. Chemical Engineering Kinetics by J. M.Smith
2. Chemical Reaction Engineering by Octave Levenspal
3. Reaction Engineering by Walas
4. Chemical Reaction Engineering I & II by K. A.Gawhane

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III Year VI Semester
DCH-602: AUTOMATIC PROCESS CONTROL

1. **INTRODUCTION:**
   What is Automatic control, Advantage of Automatic control, manual and automatic control, physical and block diagram.

2. **ELEMENTS OF CONTROL SYSTEM:**
   Definition-Input means, controlling means, actuating means, measuring means, final control elements.

3. **PROCESS CHARACTERISTICS:**
   Process variables, process degree of freedom, forcing function, step fn., ramp, impulse, sinusoidal function, Laplace transformation.
   Elements of process dynamics:- Proportional, Capacitance.
   Time constant and oscillatory element, determination of system function or transfer function of the following:- (Sketch physical diagram and block diagram)

(a) **Ist order system or time constant element:-**
   (i) Naked bulb thermometer.
   (ii) Stirred tank heater.
   (iii) Mixing process.
   (iv) R.C.Circuit.
   (v) Liquid levels.
   (vi) Two time constant type liquid vessel cascaded i.e. Non interacting and non-cascaded, i.e. Interacting
   (vii) Continuous stirred tank chemical reactor with Ist order chemical reaction.

(b) **IInd order system or oscillatory type element.**
   (i) Bulb in thermo well.
   (ii) Mechanical damper.
   (iii) Fluid manometer or U tubes.
   Response of Ist order system to step, ramp, impulse and sinusoidal inputs, Response of IInd order system to step change (Transient response).

4. **CONTROLLER CHARACTERISTIC OR MODES OF CONTROL ACTION:**
   Elements of controller, proportional control, Integral control, proportional-integral control, proportional derivative control, proportional-integral-derivative control, Two positions control.

5. CLOSED LOOP IN AUTOMATIC CONTROL:

Standard block diagram symbol, overall transfer fn. for a single loop system, overall transfer function for change in set point and for change in load, overall transfer fn. multi loop control system, unit step response of the following.

(i) Proportional control at stirred tank heater for set point change and for load change.

(ii) P.I control of stirred tank heater for set point change and load change.

6. PROGRAMMABLE LOGIC CONTROLLER (PLC):

Introduction, Principle of operation, Architecture of programmable controller, Programming the programmable controller, Application of programmable control.

7. DISTRIBUTED CONTROL SYSTEM (DCS):

Real time computer control system - concept, functional requirements of distributed process control system, configuration some popular DCS.

REFERENCE BOOKS

1. Process System Analysis and Control by Coughnowr and Koppel
2. Chemical Process Control by George Stephanopalous
3. Computer Control of Industrial Process by S. Savas, Emenule
4. Industrial Instrumentation by D. P. Eckman

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P.K. University, Shivpuri (MP)
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DCH-602 AUTOMATIC PROCESS CONTROL LAB

LAB LIST OF EXPERIMENT

(At Least 8 experiment to be performed)

1. To measure time constant of a single capacity thermal process (water bath &heater).

2. Calibration of thermocouple.

3. To study the transient response of first order system (thermo couple) and find out time constant.

4. To study the transient response of a simple R-C network and plot Bodey's diagram.

5. To study on of type water level control and to find out steady state voltage.

6. To study the frequency response of a second order electrical circuit equipment to a physical system (R-L-C network).

7. Calibration of pressure Gauge by Dead Weight tester.

8. To study, sketch and operation of strip chart recorder and directing pen recorder.

9. Calibration of bimetallic thermo meter.

10. To study the response of bimetallic thermo meter for a step input and find its time constant.

11. To calibrate the pneumatic control valve (Diaphragm type).

12. To calibrate the given manometer for level measurement.

13. To study the response of two tank non interacting liquid level system and two tanks interacting liquid level system.

A study of automatic ON and cut of A.C. supply by a solid state (Built in relay and transformer) Voltage stabilizer.

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III Year VI Semester
DCH-603: PROCESS EQUIPMENT DESIGN

1. **BASIC ENGINEERING MATERIALS:**
   Ferrous Materials, Non Ferrous materials, Synthetic Materials, Natural materials.
2. **BASIC CONSIDERATIONS IN PROCESS EQUIPMENT DESIGN:**
   Introduction, General Design Procedures, Fabrication Techniques, Equipment Classification, Power for rotational motion.
3. **DESIGN CONSIDERATIONS**
   Introduction ,Materials Selections, Corrosion Prevention, Stresses Created due to Static & Dynamic Loads, Elastic Instability, Combined Stresses and Theories of Failure, Fatigue, Brittle, Fracture, Creep, Temperature Effect, Radiation Effects, Effects of Fabrication Methods, Economic Consideration.
4. **POWER REQUIREMENT OF PUMPS:**
   Problems relating calculations of horse power(H.P.), N.P.S.H., for flow of incompressible fluid.
5. **PRESSURE VESSELS:**
   Selection of type of vessels and storage tank, criteria of selection, Fixed head and floating head type storage tanks, causes of failure of vessels, methods of fabrication, types of formed heads, stress in thin shells subjected to internal pressure, Longitudinal and circumferential stress, joint efficiency and corrosion allowance, Crown and Knuckle radius, Problems relating calculation of shell thickness of cylindrical and spherical shells, Thickness of Tori spherical heads subjected to internal pressure as per I.S. code. Problems associated with tank and vessels.
6. **DISTILLATION COLUMN:**
   Preparation of equilibrium diagram, Problems relating calculation of theoretical plates at a given reflux ratio and total reflux, minimum reflux ratio, Feed plate location, by McCabe-thiele methods for separation of ideal binary mixtures, Derivation of q-line equation.
7. **HEAT EXCHANGER AND CONDENSERS:**
   Problems relating calculation of L.M.T.D., individual and overall heat-transfer coefficients, Number of tubes, Number of passes, Heat-transfer coefficient for condensing vapors by Wilson's plot.
8. **EVAPORATORS:**
   Problems relating calculation of heating area, Steam requirement, Steam economy for single and double effect evaporators. Methods of feeding evaporators and effect of Boiling Point Rise (B.P.R) and Hydrostatic Head.

REFERENCE BOOKS
1. Process Equipment Design by B. E. Brownell & E. M.Young
2. Process Heat Transfer by D. Q.Kern
3. Mass Transfer Operation by R. E.Treybal
4. I.S. Code for Unfire Pressure : ISNo.2825-1969 PressoreVessel

PROJECT

NOTE-

Every diploma holder have to do a project work before going into the world of work so that he may have sufficient knowledge to face the various problems involved in solving the project. Chemical engineering technician must be well aware of these too. So the project on the design of pressure vessel, storage tanks, heat exchanger, distillation column and evaporator are included in the subject.

Every Student is supposed to design one of the following problems allotted by Head of Deptt. And prepare the complete Project Report. The Students should be acquainted With the various codes and standards and the requirements of inspection and safety.

Problem -I

Design of Pressure Vessel

(a) Shell

(b) Head or Cover

(c) Nozzle

(d) Flanged Joint

(e) Support

Problem-II

Design of Storage Tanks

(a) Material

(b) Bottom Design

(c) Shell Design

(d) Wind graders for open - Top Tanks

(e) Roof - Curb Angles

(f) Self - Supporting Roof Design

(g) Column Supported Roofs

(h) Nozzles and Mountings

Problem - III

Design of Heat Exchanger (Shell & Tube)

(a) Shell Design

(b) Shell Cover

(c) Tubes

(d) Tube Sheet

(f) Tie Rods and Spacers

(g) Baffles

(h) Channel

(i) Channel Cover

Problem - IV

Design of Distillation Column

(a) Shell Thickness

(b) Stresses in Column Shell

(c) Column Internal Details

(d) Head

(e) Support

(f) Tray

Problem - v

Design of Evaporator

(a) Shell design

(b) Shell cover

(c) Tubes

(d) Steam Economy & Heating area

(e) Vacuum creating device

(f) Impingement Baffles