CMC-401[CHEMICAL PROCESS CONTROL]

Unit I

Construction and characteristics of final control elements such as Proportional, Integral, PD, PID controllers, pneumatic control valve, principles and construction of pneumatic and electronic controllers.

Unit II

Process instrumentation diagrams and symbols, process instrumentation for process equipments such as Distillation column Absorption column, Heat Exchanger, Reactors, Evaporators, fluid storage vessels.

Unit III

Laplace Transform, Linear open loop system, first order system and their transient response. Dynamic response of a pure capacitive process, Transportation lag, Dynamic response of a first order lag system.

Unit IV

Second order system and their transient response. Interacting and non-interacting system. Linear closed loop system, block diagram of closed loop transfer function, controllers, transient response of closed loop system.

Unit V

Stability concept, Routh stability criterion, relative stability, Hurwitz stability criterion, Nyquist's stability criterion. Root locus technique, introduction to frequency response, Bode diagram, Bode stability criterion, gain and phase margins, Ziegler Nichols controller setting.

References:

1. Coughnower & Koppel – Process System Analysis And Control- McGraw Hill, New York.
2. D. P. Eckman – Automatics Process Control – McGraw Hill, New York.
3. Peter Harriot – Process Control – McGraw Hill, New York.
4. J. J. Nagrath & M. Gopal; Control System Engineering.

List of Experiment (Pl. expand it):

1. To study the characteristics of control valves (linear, quick opening, etc)
2. To study the dynamics of liquid level systems of non-interacting and interacting types.
3. To study the response of mercury in glass thermometer with and without a thermowell.
4. To study the characteristics of an electronic PID controller.
5. To study the characteristics of a current to pneumatic converter.
6. To study the effectiveness of computer control of a distillation column.
7. To study the effectiveness of a computer control of a heat exchanger.
8. To study to effectiveness of a computer control of a chemical reactor
9. To study to dynamics of a pressure tanks.
10. To calibrate an air purged liquid level indicator.

CMC-402 [MECHANICAL OPERATIONS]

UNIT I

Particle Technology: Particle shape, particle size, different ways of expression of particle size, shape factor, sphericity, mixed particles size analysis, screens – ideal and actual screens, differential and cumulative size analysis, effectiveness of screen, specific surface of mixture of particles, number of particles in a mixture, standard screens and screen analysis of solids.

UNIT II

Size Reduction: Introduction – types of forces used for communition, criteria for communition, characteristics of communited products, laws of size reduction, crushing, grinding, pulverizing and ultrafining size reduction equipment, power requirement in communication.

UNIT III

Flow of Fluid Past Immersed Bodies: Drag, drag coefficient, pressure drop, fluidization, conditions for fluidization, minimum fluidization velocity, types of fluidization, application of fluidization, slurry transport, pneumatic conveying

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UNIT IV

Sedimentation: Principles of Sedimentation process for system involving solids, liquids & gases, classification, Separation and Filtration batch and continuous process.

UNIT V

Agitation and Mixing: Application of agitation, Agitation equipment, Mixing of solids, Types of mixers- change can mixers, Muller mixers, Mixing index, Ribbon blender, Internal screw mixer, Tumbling mixer.Sampling, Storage and Conveying of Solids: Sampling of solids, storage of solids, Open and closed storage, Bulk and bin storage, Conveyors – Belt conveyors, Chain conveyor, Apron conveyor, Bucket conveyor, Bucket elevators, Screw conveyor.

REFERENCES:

1. Unit Operations of Chemical Engineering: McCabe and Smith,.TMC
2. Chemical Engineering Vol. I: Coulson & Richardson, Pergamon, 1979
3. Perry RH & Don WG; PERRY'S CHEMICAL Engineering HAND BOOK; McGrawHill.
4. Nevers De; Fluid Mechanics for Chemical Engineers; TMH
5. BancheroBadker; Introduction to chemical engg; TMH
6. Narayan CM, Bhattacharya BC; Mechanical operations for chemical eng.; PHI

List of Experiments :

1. To analyses the given sample by differential, cumulative methods using standard screen.
2. Determination of size & surface area of irregular particles using a Measuring gauge.
3. To study Crushing behavior & to determine the Rittinger's& Bond's Constant of the given solid in aJaw crusher.
4. To determine the efficiency of a ball mill for grinding a material of known.
5. To determine the power consumption of the Hammer Mill.
6. To determine the specific cake resistance for the given slurry by Leaf Filter.
7. To determine the efficiency of a given cyclone separator.
8. To determine the efficiency of fluidized characteristic bed.
9. To study the Dorr type of thickener.
10. To study the Plate & Frame filter press.

CMC-403 [FLUID MECHANICS]

UNIT I

Properties of fluids, fluid statics, Forces on fluids, pressure depth relationship for compressible and incompressible fluids, Forces on submerged bodies, Rigid body motion, pressure measurements, Euler's equation, Bernoulli's theorem.

UNIT II

Kinematics of flow, Description of velocity field, Stream functions, Angular velocity, Fluids in circulation, Irrotational flow, Dimensional analysis, Buckingham Pi Theorem, Dimensionless numbers and their physical significance, Similitude Criteria.

UNIT III

Fluid flow: Laminar and turbulent flows, Pressure drop in pipes, pipe fittings and pipe network, friction factor, Conservation of mass, momentum and energy, Mechanical engineering Bernoulli's equation.

UNIT IV

Flow measuring devices for chemical plants, venturimeter, orifice meter, nozzle, Rota meter, pitot's tubeand v-notch.

UNIT V

Pumping and compressing of chemicals and gases, reciprocating pumps, rotary pumps, centrifugal pumps and blowers, NPSH and calibrations, mixing and agitation, types of mixers and their selection, power requirement, compressible fluid flow, introductory concepts of two-phase flow.

References: -

1. McCabe Smith;Unit Operation for Chemical Engg. TMH
2. Modi& Seth; Fluid Mechanics; Standard Book House, Delhi
3. Som and Biswas; Fluid Mechnics and machinery; TMH
4. Rajpoot R. K. ;Fluid Mechanics and Hydrolic Machine.
5. Bansal R.K.; Fluid Mechanics and Hydrolic Machine.

List of Experiment:

1. To determine the local point pressure with the help of pitot tube.
2. To find out the terminal velocity of a spherical body in water.
3. Calibration of Venturimeter
4. Determination of Cc, Cv, Cd of Orifices
5. Calibration of Orifice Meter
6. Calibration of Nozzle meter and Mouth Piece
7. Reynolds experiment for demonstration of stream lines & turbulent flow
8. Determination of metacentric height
9. Determination of Friction Factor of a pipe
10. To study the characteristics of a centrifugal pump.

CMC-404 [COMPUTATIONAL METHODS IN CHEMICAL ENGINEERING]

Unit I

Treatment of engineering data – Graphical representation. Empirical equations, Interpolation, Newton's formula, Lagrange's Interpolation formula, extrapolation, Integration, graphical Integration, Graphical Construction of Integral curves, Numerical Integration.

Unit II

Interpretation of Engineering Data- Significant figure, Classification of Measurements, Propagation of Errors, Variation and Distribution of Random Errors, Properties of Variance, Confidence limits for small samples.

Unit III

Ordinary Differential Equations – Formulation, Application of Law of Conservation of Mass– Mixing in flow process. Classification of ordinary Differential Equations and its applications to common Chemical Engineering problem

Unit IV

Numerical Solutions of Ordinary Differential Equations– Linear Second– order Equations with variable coefficients, Numerical solution by Runge Kutta Method. Its application to higher– order equations

Unit V

Formulation of Partial Differential Equations. Finite difference, linear finite difference equations, non-linear difference equations, Optimization, types of methods, its application relating to chemical processes.

References:

1. Mickley HS, Sherwood and Reed; Applied Mathematics In Chemical Engineering;TMH pub.
2. Jenson & Jeffrey's; Mathematical Methods In Chemical Engineering; Mc Graw Hill.
3. Luyben WL; Process modeling, simulation and control for chemical engr; Mc Graw Hill

List of Experiment

1. Data representation and treatment by Graphical methods, Pressure- Volume-Temperature and concentration relationships for gases and their mixtures.
2. Integrated methods of data processing. Integral functions and their graphical representation.
3. Estimation of properties from empirical correlations (Nokay)
4. Estimation of critical properties from group contribution method.
5. Redlich-Kwong equation of state and other Virial equations to estimate thermodynamic properties like compressibility factor, molar volume and P-V-T relationships.
6. To study the effect of liquid viscosity and dissolved gases on pump efficiency, reciprocating pump performance.
7. Measurement errors their propagation and minimization of random errors. Selection of confidence limits.
8. Mass balance problems using continuity equation applied to a dynamic system. Formation of differential equations (component balance) and their solution & examples – CSTR and flow through pipes.
9. Numerical Solutions of batch reactor problems. Euler Algorithm
10. Runge-Kutta algorithm and its application in chemical Engineering. Implicit and explicit calculations. Problems related to effect design, optimum liquid concentration.
11. Transient flow of fluid unsteady temperature and varying concentration problems and use of partial differential equation to solve them.

Note: Each student should perform at least eight experiments from the above list

CMC-405 [MATERIAL SCIENCE & TECHNOLOGY]

UNIT I

Introduction: Introduction to material science, Properties and behavior of materials useful in structure, machines and equipment, Structure- Property relationship in materials. Crystal Geometry and Structure Determination: Geometry of crystals- the Bravais lattices, Structure determination X – ray diffraction, Braggs Law, the power method.

UNIT II

Atomic Structure, Chemical Bonding & Structure of Solids: Atomic arrangements in material and imperfections. Crystal Imperfections: Point Imperfections, Line imperfections- edge and screw dislocations, Surface imperfections.

UNIT III

Phase Diagram And Phase Transformations: Phase rule, Single component systems, Binary Phase Diagrams, Lever rule, Typical Phase diagrams for Magnesia-Alumina, Copper-Zinc, Iron-carbon system, Nucleation and growth, Solidification, Allotropic transformation, Cooling curves for pure iron, Iron-carbon equilibrium diagram, Isothermal transformations (TTT curves). Deformation of Materials-Fracture: Elastic deformation, Plastic deformation, Creep, Visco-elastic deformation, Different types of fracture.

UNIT IV

Heat Treatment: Annealing, Normalizing, Hardening, Martempering, Austempering, Hardenability, Quenching, Tempering, Carburising, Cyaniding, Nitriding, Flame hardening, Cathodic protection, protective coatings. Corrosion charts.

UNIT V

Typical Engineering Materials: Nonferrous metals – Copper, Aluminum, Lead, Chromium, Tin, Brass, and Zinc and its alloy, Non-metals – Glass, Enamels, Chemical stone wares, Graphite, Wood, Plastics, Rubber, Polymers and Ceramics.

REFERENCES:

1. Van Vlack; MATERIAL SCIENCE
2. WOOLEF; <Title>; VOL. 1,2,3,4.
3. Perry RH & Don WG; PERRYS CHEMICAL Engineering HAND BOOK; McGraw Hill.
4. Murthy; Structures and properties of Engg Materials; TMH
5. Narula; Material science; TMH
6. Vijaya; Material Science; TMH
7. O.P. Khanna; MATERIAL SCIENCE & METALLURGY; DhanpatRai Publication.
8. S.K. Hajra Choudhry; MATERIALS SCIENCE & PROCESSES; Indian Book DistribCo.

CMC-406 [ORGANIC CHEMICAL PROCESS INDUSTRY]

Unit I

Soaps and detergents: Difference between soaps and detergents, Classification of cleansing compounds, process of soap manufacture, Glycerol recovery, Manufacture of detergents: sulphated fatty alcohols and alkyl – aryl sulphonates.

Unit II

Important features of Indian sugar industry, Major unit operation of sugar industry, Alcohol fermentation, Production of 95% alcohol and anhydrous or absolute alcohol from fermentation broth, Pollution problems. Raw materials for pulp making, Kraft and Sulphite pulping methods, Semi-chemical pulping, Pulp and paper, pulping process, chemical recovery, stock preparation and paper making,

Unit III

Important petrochemicals, Feed stock, Common unit processes: cracking, alkylation-dealkylation and hydroalkylation, halogenation, oxidation, hydrogenation-dehydrogenation; hydration-dehydration, nitration, amination, esterification, hydrolysis, hydroformylation process.

Unit IV

Basic principles of polymerization reactions: bulk, solution, suspension and emulsion polymerisation, Synthesis of phenol formaldehyde, polyethylene, polystyrene and PVC, Rubbers, their classification and processing, Dyes and Dye intermediates, insecticides and pesticides, nitration and nitrating agents.

Unit V

Natural and synthetic fibres, Fibre properties important in textile production, Fibre spinning processes: melt, dry and wet spinning, Manufacture of nylon 6,6 and nylon 6 fibres, viscose rayon and polyester fibres, polyamides, acrylics, cellulose and acetate,

References:

1. Dryden C.E; Outlines Of Chemical Technology; Affilicted. East West press, New Delhi, 1997
2. G.T. Austin, Shreve's Chemical Process Industries, Mc Graw Hill.
3. Gupta VB & Kathari VK; Manufacturing Fibre Technology; Chapman Hall, Newyork I Edition
4. Kathari V.K.; Progress In Textile, Sciences Technology, Vol I & II; IAFL Publications, S-351 Greater Kailash part I New Delhi – 48 I Ed.
5. Austin, G.T; Shreeves Chemical Progress Industries; . Mc. Graw Hill New York

LIST OF EXPERIMENTS:

1. To prepare soap from the given oil and alkali.
2. To prepare soap in the laboratory and carry out its cost analysis.
3. To determine saponification value of oil sample.
4. To prepare detergent in the laboratory and to carry out its cost analysis.
5. To determine the acid value of the given sample of oil.
6. To separate Fe(II) ion from the given sample by hydrolysis method.