MADHAV INSTITUTE OF TECHNOLOGY & SCIENCE, GWALIOR
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170211: Chemical Process Calculations

Category	Title	Code	Credits-4			Theory Paper
			L	T	P	
Departmental Core-DC	Chemical Process Calculation	170211	2	1	2	Max.Marks-60 Min.Marks-19 Duration-2hrs.

Course Objective:
To understand and apply the basics of calculations related to material and energy flow in the processes.

Syllabus:

Unit-I: Mathematical and Engineering Calculations:- Units and dimensions, conversion units, expression and equations, Dimensional groups and constants, stochiometric and composition relationships, conversion of mass, mass and volumetric reactions, basis of compositions, Excess reactants , degree of completion.

Unit-II: Ideal Gases & vapor Pressure: Behavior of ideal gases, Gaseous mixtures, vapor pressure , Clausius Clapeyron equation, Cox chart, Duhring's plot, Raoult's law, Humidity and saturation, relative humidity, humid volume, dew point, humidity chart and its use.

Unit-III: Material Balance: Crystallization, dissolution, solving material balance problems with and without simultaneous equations, Recycle, bypass and purge calculations

Unit-IV: Energy Balance: Heat capacity, calculation of enthalpy changes, Energy balance with chemical reactions,

Unit-V: Heat of vaporization, Heat of formation, Laws of thermo chemistry, Heat of combustion of fuels, Heat and Theoretical flame temperature, Case study of selected problems.

Course Outcomes: After the completion of this course, Students will be able to

CO1 **Recall** different unit system, basic mass volume relationship, conversion of units & change
CO2 **Classify** ideal and non –ideal gases.
CO3 **Solve** energy balance problems.
CO4 **Analyze** the recycle, bypass, and purge calculation.
CO5 **Estimate** the raw material requirement for synthesis of a chemical product based on stoichiometry.
CO6 **Estimate** the performance of chemical equipment using material and energy balance

Text Books

1.O.A. Hougen, K.M. Watson, R.A. Ragatz (CBS publications New Delhi 1995 edition)- Chemical Process Principles, part-I

Reference Books

1. David M. Himmelbau (prentice Hall ,sixth edition Feb. 1999)- BASIC PRINCIPLES AND CALCULATIONS IN CHEMICAL ENGINEERING.
2. B.L.Bhatt, S.M. Vora(Tata Mc-Graw –Hill, 1996) STOCHIOMETRY.

List of Experiments:

1. To determine the boiling point relation with respect to concentration of caustic soda and verify Duhring's rule.
2. Application of dry and wet bulb Thermometer to find out atmospheric humidity.
3. Use of humidity charts to find enthalpy , dew point , humid heat and saturation.
4. Solubility at room temperature and at boiling point of urea in water and verify the material balance.
5. Crystallization of copper sulphate in saturated solution by cooling and finding out of the crystal yield.
6. Combustion of coal and performing the material balance.
7. Proximate analysis of coal sample.
8. Measurement of flame temperature and compare actual & Theoretical temp. (Bunsen-Burner, spirit lamp, Kerosen lamp.)
9. To find the heat of reaction using CaO and water.

Note: Every student should perform at least eight experiments out of the above list.

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Lab Course Outcomes

After the completion of this lab course, Students will be able to

CO1: Determine the proximate analysis for coal samples

CO2: Proficiency to integrate the data and formulate the mass and energy balance problems.

CO3: Use mathematical knowledge for solving mass and energy balance problems with and without chemical reactions

CO4: Use the energy balance to solve particular problems with and without chemical reactions

CO5: Material balance for recycle drying operation for solids

CO6: Easy to do the material balance and energy balance for evaporation unit operation.

170311: Fluid Mechanics

Category	Title	Code	Credits-4			Theory Paper
Departmental Core-DC	Fluid Mechanics	170311	L	T	P	Max.Marks-50 Min.Marks- Duration-2 hrs.
			2	1	1	

Course Objective:

To understand basic concept of fluid flow and its application to chemical process industries including pipe flow, fluid machinery like pumps and various flow meters.

Syllabus:

Unit –I Introduction: Properties of fluid, forces on fluid, stresses, the concept of constitution relations, fluid statics, Normal forces in fluid, pressure measurement, forces on submerged bodies, buoyancy, Stability.

Unit-II Classification of Fluids: Newtonian and Non – Newtonian fluid, Viscosity measurement, Equations of changes: Equation of Continuity & Equation of Motion, Navier stokes equation, concept of Reynolds number and friction factor: friction for rough and smooth pipes, loss of head due to friction in pipes and fittings.

Unit-III Boundary layer theory, Bernoulli's equation, fluid machinery, pumps, fans, blowers, compressors and vacuum pumps, Power and head requirement for pumps.

Unit-IV Flow of incompressible fluid in conduits and thin layers, flow past immersed bodies, Dimensional analysis, Buckingham π- Theorem, dimensionless numbers and their significance, similitude criteria.

Unit-V Measurement of Flow: Fluid flow Measurement pitot tube, orifice meter, venture meter, rotameter, weirs and notches.

Course Outcomes: After the completion of this course, Students will be able to:

CO1 **Explain** the basic fundamentals of fluid statics & fluid flow.
CO2 **Estimate** pressure drops, forces acting on bodies & power and head requirements of pumps.
CO3 **Apply** equations of change to various fluid flow systems.
CO4 **Formulate** the inter-dependency of various parameters using dimensional analysis.
CO5 **Determine** the flow rate through different flow measuring devices.
CO6 **Examine** the losses due to friction in pipes and other fluid machinery.

Text Books

W.L. Mc Cabe & I.C. Smith- UNIT OPERATIONS IN CHEMICAL ENGG- 3rd edition MC GRaw Hill & Kogakusha 1976.

Reference Books

J.M. Coulson & J.F. Richardson- CHEMICAL ENGINEERING- Vol I & II.
B.S. Maney, Zel(SI) Van Nostand & Reinhold- MECHANICS OF FLUID-ELBS, 1970.
I. Grannet- FLUID MECHANICS FOR ENGINEERING AND TECHNOLOGY.
S.K. Gupta-MOMENTUM TRANSFER- New Age Publication

List of Experiments

To determine the local point pressure with the help of pitot tube.
To find out the terminal velocity of a spherical body in water.
To determine the viscosity of a spherical body in water.
To find the pressure drop in a packed bed,
To study the flow behavior of a Non-Newtonian fluid and to determine the flow constants.

To determine the power number- Reynolds Number curve.
To differentiate between laminar and turbulent flow using Reynolds experiments.
To study the characteristics of an air compressor.
To study the characteristics of a centrifugal pump.
To study the flow of a fluid in a pipeline and to prepare the friction factor-N_{Re} plot.
To determine the friction losses, expansion losses and reduction losses in bends and pipes and verify the Bernoulli equation.
To prepare the calibration curve for an orifice meter and Rotameter.
To prepare the calibration curve for a Venturimeter.

Note: Every student should perform at least eight experiments out of the above list.

170312: Organic Process Technology

Category	Title	Code	Credits-3			Theory Paper
Departmental Core-DC	Organic Process Technology	170312	L	T	P	Max.Marks-50 Min.Marks- Duration-2 hrs.
			2	1	0	

Course Objective:

The purpose of the organic process technology course is to improve knowledge of the chemical processes along with emphasis on recent technological development.

Syllabus:

Unit-I : Pulp and paper industry-Raw Materials, types of pulp and its preparation, Manufacturing of paper, Agro based industries, Fermentation industry, Alcohol by fermentation, Citric acid and Antibiotic like Penicillin.

Unit-II: Intermediates for petrochemical from petroleum based stocks, phenol, methanol, ethylene propylene , aromatic , toluene and xylene, polymer industries.

Unit-III: Preparation, manufacturing and properties of Fats and oil, manmade fiber; rayon, polyester polyamides and acrylics, cellulose and acetate, Rubber industries, Soap and detergent. Insecticides and pesticides, Dyes and dyes intermediate.

Unit-IV: Carbon Technology: Introduction, Classification of activated carbons, raw materials and manufacture of activated carbons, classification of carbon fibers, precursors for carbon fibers, manufacture of carbon fibers from polyacrylonitrile, manufacture of carbon black by furnace black process, applications.

Unit-V: Nanotechnology: Introduction, properties of nano particles like optical properties, reactivity, synthesis: Introduction, Structure and properties of carbon nano tubes and fabrication of carbon nanotubes applications.

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

CO1: **Explain** the processing of natural products.
CO2: **Describe** about microbial processes and edible oil refining process.
CO3: **Elaborate** the processes for producing petrochemicals.
CO4: **Characterize** polymers and elaborate its production processes.
CO5: **Describe** the production processes of fibres.
CO6: **Evaluate** the different processes from economical aspects.

Text Books

1. Dryden C.E., Outlines of chemical technology-3rd edition AFFILIATED East – West Press , New Delhi, 1997

Reference Books

1. V.B. Gupta& V.K. Kathari-Manufacturing Fiber Technology-Chapman Hall , Newyork I edition 1997.
2. V.K. Kathari-Process in Textile, science Technology, Vol –I & II –IAFL publication, S-351 Greater Kalaish part-I New Delhi.-48 ed.
3. Austinn, G.T. Shree Chemical Process Industries -5th edition Mc Graw Hill New York 1984.

170313: Chemical Engineering Thermodynamics

Category	Title	Code	Credits-3			Theory Paper
Departmental Core-DC	Chemical Engineering Thermodynamics	170313	L	T	P	Max.Marks-50 Min.Marks- Duration-2 hrs.
			2	1	0	

Course Objective:

To understand the basic concepts and applications of classical thermodynamics, thermodynamic properties, equations of state, methods used to describe and predict phase and chemical equilibria.

Syllabus:

Unit- I The First law of Thermodynamics and Equations of State: Steady and unsteady closed and flow process, Critical properties corresponding state, Compressibility, P-V-T behavior of pure fluids, Virial-equations, Generalized correlations and eccentric factor.

Unit-II The Second and Third Law of Thermodynamics: Entropy of various systems, Thermodynamics equations, Effect of pressure on specific heat, Joule-Thompson effect, Third law of thermodynamics, Compression of ideal gas, Refrigeration capacity, Carnot cycle, Vapor compression cycle, Air refrigeration cycle.

Unit-III Thermodynamic Properties of Fluids: Thermodynamic properties of homogeneous mixtures, Property relations for systems of variable compositions, Partial properties, Fugacity and Fugacity co-efficient in ideal solutions, Properties change of mixing, Activity, Heat effects of mixing process, Excess properties, Activity coefficient of gaseous mixtures.

Unit-IV Phase Equilibria: Criteria of phase equilibrium and stability, Phase equilibrium in single component system, Phase rule, Gibbs-Duhem equation, Vapor-liquid equilibria.

Unit- V Chemical Reaction Equilibria: Chemical potential, Effect of pressure and temperature on heat of reaction and on free energy, Vant Hoff's equation, Clausius - Clapeyron equation, Chemical Reaction Equilibria and its applications

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

CO1: infer the fundamental concepts of thermodynamics to chemical engineering applications.
CO2: explain the first and second laws of thermodynamics with their practical implications.
CO3: analyze the processes involving refrigeration and compression.
CO4: classify the thermodynamic properties of solutions with their relationships.
CO5: infer the detail of vapour liquid equilibria and its use in practical situations.
CO6: analyze the chemical equilibrium with thermodynamics for predicting behavior of reacting systems.

Text Books

1. Smith J.M. & Van Ness., "Introduction to Chemical Engineering Thermodynamics", McGraw Hill
2. Sandler, S.I., "Chemical Engineering Thermodynamics", John Wiley & Sons
3. Dodge B.F., "Chemical Engineering Thermodynamics", McGraw Hill
4. Narayanan K.V., "Chemical Engineering Thermodynamics", Prentice Hall India Learning Private Limited

Reference Books

1. Balzhiser, Samuels and Eliassen, "Chemical Engineering Thermodynamics", Prentice Hall.
2. Rao Y.V.C, "Chemical Engineering Thermodynamics", University Press (I) Ltd., Hyderabad
3. Kyle B.G., "Chemical Process Thermodynamics", Prentice Hall of India Pvt. Ltd., New Delhi

170314: Fluid Particle Mechanics

Category	Title	Code	Credits-4			Theory Paper
Departmental Core-DC	Fluid Particle Mechanics	170314	L	T	P	Max.Marks-50 Min.Marks- Duration-2 hrs.
			2	1	1	

Course Objective:

To understand the basic principles of various mechanical operations, construction and working of the equipments.

Syllabus:

Unit-I Particulate Solids: Properties of particulate solids, Evaluation of size and shape, surface and population of particles, standard screens and screen analysis of solids. **Size Reduction:** Principles of communication, size reduction, crushing, grinding, pulverizing and ultra fine size reduction equipment, power requirement in communition.

Unit-II Mixing: Mixing of solids, Mixing equipment's design and power requirement of mixers, Mixer Effectiveness and Mixing Index.

Unit-III Separation: Principles of Separation techniques for system involving solids, liquids and gases, Classification, Sedimentation, filtration, separation equipments.

Unit-IV Transportation and Handling of Solids: Selection and conveying devices for solids: Belt, Chain, Screw- conveyors, elevators and pneumatic conveying devices, Elementary design aspects of the devices, Visit to Chemical Engg. Industry engaged mainly with Mechanical Operation.

Unit –V Fluidization & Application: Particulate & aggregative fluidization, Characteristics of fluidized bed due to particle size, size distribution, shape and density, Pressure drop through a fluidized bed, Character of dense phase fluidization as revealed by pressure drop fluctuations, Up flow and down flow fluidization, Fluid Catalytic process, bed drying, Mass transfer in fluidized beds.

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

CO1: Recognize the application of Screen Analysis in Industry.
CO2: Describe the various methods of size reduction along with the various principles.
CO3: Explain the separation techniques and equipments.
CO4: Illustrate the various process like sedimentation, filtration etc.
CO5: Analyze the various conveying devices.
CO6: Illustrate the fluidization and fluid catalytic process.

Text Books

1. McCabe Smith- UNIT OPEARATION OF CHEMICAL ENGG, Mc Graw Hill 2001.

Reference Books

1. Badger Bencharo- INTRODUCTION TO CHEMICAL ENGG- Tata Mc Grawhill 1998.
2. Coulson & Richordson Vol. 2-CHEMICAL ENGG. New Delhi Asian Book Pvt. Ltd.
3. G.G. Brown- UNIT OPERATIONS-CBS Publications New Delhi 1995.

List of Experiments:

To analyze the given sample by differential, cumulative methods using standard screen.
Determination of size and surface area of irregular particles using a measuring gauge.
To study the crushing behavior and to determine the Rittinger's and Bond's constant of the given solid in a jaw crusher.

To study the crushing behavior and to determine the Rittinger's and Bond's constant of the given solid in a ball mill.
To study the crushing behavior and to determine the Rittinger's and Bond's constant of the given solid in a hammer mill.
Determination of mixer effectiveness and mixing index of given slurries.
To study the filtration behavior of a given slurry using a Plate and Frame Filter press.
To study the filtration behavior of a given slurry using a leaf filter press.
To study the filtration behavior of a given slurry using a rotary drum filter press..
To study the performance of a Dorr Thickener.
To study the characteristics of liquid-solid fluidized bed.
To study the characteristics of gas-solid fluidized bed.
Study of gas/liquid solid cyclone separator and to evaluate the separation efficiency.

Note: Each student should perform at least 8 experiments out of the above list.

170315 **Chemical Synthesis Lab**

List of Experiments:

To determine BOD & COD for given waste water sample.
Preparation of acetic acid from ethyl accohol.
To find out the sucrose content in aqueous solution by polarimeter.
To evaluate the viscosity of molasses.
To determine the percentage of formaldehyde in the formalene.
To determined iodine value of the given oil sample.
To determine the acetic acid , ethanol concentration in aqueous solutions.
To prepare azodye and finding the yield.
Prepare a standard phenol solution and estimate the % of phenol in the given unknown sample of phenol.
To prepare urea formaldehyde resin and report % conversion.
To determine total dissolved and suspended solids in water and waste water
To determine turbidity in water and waste water
To determine hardness of water

Note:- Each student should perform at least eight experiments out of the above list.

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Course Code: MAC ******

(For batches admitted in 2021-2022 & onwards)

Course Name: Project Management and Financing

L	T	P	Credit
2	0	0	GRADE

Course Objectives:

1) To know about project, its attributes and essentials of project planning
2) To develop the project network
3) To take rational decisions using project networks for successful completion of the projects
4) To decide about about rational utilization of resources in project.
5) To have an elementary idea of finances involved in a project and managing it

Unit I:

Project Planning:

Introduction to Project Management, Difference between Project and Production, Attributes of a Project: Time, Cost, Quality and Safety. Stakeholders of a Project, Project life cycle. Project Planning: Types of Project Plans and feasibility.

Unit-II:

Project Network logic: Project Networking and work flows, Activity duration and methods of estimating activity duration – One time estimate three time estimates, Duration estimation procedure. Use of Bar Charts, Mile stone charts and networks, Network representation schemes: Activity on Arrow and Activity on Node Networks (**A-o-A** & **A-o-N**), Logic behind developing project network and simple network calculations, Critical paths and floats.

Unit-III:

Decision making through networks: CPM, PERT & PDM:

Use of network in Decision Making: Importance of critical path, Monitoring the progress and updating the project plan. Use of floats in Resource smoothening, Introduction to Precedence Diagramming Method (PDM), Different lag and lead relations in terms of SS(Start to Start), SF(Start to Finish), Finish to Start(FS), and Finish to Finish(FF) and composite relations.

Unit-IV:

Project Cost Control: Breakeven analysis in planning stage, Direct and indirect cost, slope of direct cost curve, Total project cost and optimum duration, contracting the network for cost optimization. Escalation & Variation in prices.

Unit-V:

Projects Financing:

Introduction to project financing; Role of governments in financing projects, Funder and Concessionaire: Economic multiplier effects of Projects; Means of financing-public finance and private finance, Granting authority: **World Bank** Group, **IMF, ADB,** Micro and Small Enterprises Funding Scheme (**MSME**), Elementary understanding of Procurement of infrastructure projects through Public Private Partnership (**PPP**) route, Build Operate Transfer (**BOT**), Build Operate Own & Transfer (**BOOT**); Stakeholders' perspectives, Lifecycle of PPP projects, Micro & Macro economics concepts and its application in Project Financing.

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Course Outcomes

Upon completion of the course, the students will be able to:

CO 1: Know the attributes of project and its different phases.

CO 2: Develop the project network based on work breakdown structure and esimation of activity durations

CO 3: Analyze the project network and make **decide** the various alternates.

CO 4: Evaluate the optimum cost of project for assigned deadlines.

CO 5: Understand the different options to arrange the finances to complete it within stipulated time

Recommended Text-Books:

1. Project Management Scheduling PERT and CPM by Dr. B.C. Punmia, K.K. Khandelawal
2. PERT & CPM Principles and Applications by L.S. Srinath, Affiliated EWP Pvt. Ltd.
3. Project Planning and Control by Albert Lester, Fourth Edition Elsevier Butterworth-Heinemann.

Recommended Reference Books:

1. A Management Guide to PERT/CPM With GERT/PDM/DCPM and Other networks by Jerome D. Wiest, Ferdinand K. Levy, Prentice Hall.
2. Project Management with CPM and PERT by Joseph J. Moder, Cecil R. Phillips, Van Nostrand Reinhold Company

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