



GAYATRI VIDYA PARISHAD COLLEGE OF ENGINEERING

(AUTONOMOUS)

**COLLEGE OF ENGINEERING
(AUTONOMOUS)**

**MADHURAWADA, VISAKHAPATNAM-530048
AFFILIATED TO JNTU KAKINADA**

CHEMICAL ENGINEERING

**SYLLABI FOR B.TECH. (III, IV SEMESTERS)
UNDER AUTONOMOUS STATUS**

FOR 2009 ADMITTED, 2010 LATERAL ENTRY BATCHES



**ALL BRANCHES ARE ACCREDITED BY NBA OF AICTE
ACCREDITED BY NAAC WITH 'A' GRADE WITH A CGPA OF 3.47/4.00**



*Meeting of the Joint Board of Studies held
on 11th April 2010*

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Vision

*To evolve into and sustain as a Centre of
Excellence in Technological Education
and Research with a holistic approach.*

Mission

To produce high quality engineering graduates with the requisite theoretical and practical knowledge and social awareness to be able to contribute effectively to the progress of the society through their chosen field of endeavour.

To undertake Research & Development, and extension activities in the fields of Science and Engineering in areas of relevance for immediate application as well as for strengthening or establishing fundamental knowledge.

F O R E W A R D

The G.V.P. College of Engineering has started its new life as an autonomous College with great responsibility and confidence one year ago. It has become now a torch bearer for other sister institutions because of its success story in running an autonomous system for the last one year. People are inquisitive to know what has happened and how it has happened.

The functional mechanism has been explained to the faculty and students before the start. A mid-term review and an end-term review are conducted with students as well as faculty for their feed-back and corrective measures in both the semesters of first year. This helped us in eliminating some of the hitches and improving the rate of progression.

The course structure and syllabi for 1st and 2nd semesters have been reviewed for fine tuning in the second BOS meeting alongwith the syllabi for the 3rd and 4th semesters. The College expresses its thanks to all the members for their cooperation.

It must be said that the success is because of the acceptance of the main stakeholders, the students and their parents. The enthusiasm of the faculty cannot be understressed. Various learned academicians from outside, as paper setters and valuers have extended timely support through their positive response to become a part of the mechanism in the conduct of exams and bringing out the results quickly at the end of each semester. The college acknowledges their association and wishes to share its happiness with them.

Principal

***AMENDMENTS TO B.TECH. REGULATIONS,
REGULATIONS FOR
LATERAL ENTRY STUDENTS***

AMENDMENTS TO ACADEMIC REGULATIONS FOR EIGHT SEMESTER (4 YEAR) B.TECH. - 2009-10 ADMITTED BATCH

EXTERNAL EVALUATION:

If the difference between the first and second valuations is less than or equal to 15% of the maximum of the paper the better of the two valuations shall be awarded and if the difference between the first and second valuation is more than 15%, the chief examiner appointed has to discuss with the two valuers and have his own assessment of the script. The marks given by the chief examiner shall be final for award.

R.2.0 CLAUSE d (i):

EXISTING:

A student has to record a participation of minimum of 32 hours **per semester** in his/her chosen activity during the first year.

MODIFICATION:

A student has to record a participation of minimum of 32 hours in his/her chosen activity **during the first year**.

R.6.0-CLAUSE (iii):

EXISTING:

Incase of practical/drawing/project/seminar, a student shall be deemed to have satisfied the minimum academic requirements and earned the credits allotted to each of them if he or she secures not less than 50% of marks on the aggregate in the internal evaluation and external end-examination taken together.

MODIFICATION:

Incase of practical/drawing/project/seminar, a student shall be deemed to have satisfied the minimum academic requirements and earned the credits allotted to each of them **if the student secures a minimum of 50% in the end examination** and not less than 50% of marks

on the aggregate in the internal evaluation and external end-examination taken together.

R.9.0 CLASS/DIVISION:

EXISTING:

70% and above : First class with distinction.

60% and above, but less than 70% : First class.

50% and above, but less than 60% : Second class.

Less than 50% : Fail.

A candidate shall get an aggregate of 50% overall at the end of VIII semester while fulfilling a minimum of 216 credits for the award of B.Tech. degree. The best 216 out of 224 credits shall be considered for the award of class/division.

MODIFICATION:

70% and above : First class with distinction.

60% and above, but less than 70% : First class.

50% and above, but less than 60% : Second class.

40% and above, but less than 50% : Pass class.

Less than 40% : Fail

A candidate shall get an aggregate of 40% overall at the end of VIII semester while

Fulfilling a minimum of 216 credits for the award of B.Tech. degree. The best 216 out of 224 credits shall be considered for the award of class/division.



REGULATIONS FOR B.TECH. (LATERAL ENTRY) STUDENTS ADMITTED INTO III SEMESTER (II YEAR) (UNDER AUTONOMOUS STREAM)

RL 1.0

- 1.1 The selection and admission process shall be as per Government of Andhra Pradesh rules through ECET.
- 1.2 A student admitted to B.Tech. through lateral entry scheme joins the College in the III Semester of the respective 8-Semester program. The duration of the programme is 3 years / 6 semesters. However, if a student can not complete within 3 years, he can do so by taking more time but not more than consecutive 6 years / 12 semesters.

RL 2.0 These students are exempted from social work.

RL 3.0 The attendance requirements shall be same as those admitted into four year B.Tech programme, I- Semester (Autonomous stream).

RL 4.0 Minimum Academic Requirements :

- i) A student shall be promoted to the VII Semester only after securing 56 credits in III and IV semester courses from the examinations including supplementary examinations in these subjects held till the end of VI semester of study.
- ii) A student shall register and put up minimum required attendance in all the 172 credits counted from the regular course structure of VIII semester B.Tech programme and earn at least 164 credits prescribed as compulsory to be qualified for the award of B.Tech. degree. Marks out of the best 164 credits shall be considered for the award of class /division.

RL 5.0 All other regulations are same as those applicable to the students admitted into B.Tech I-Semester under Autonomous stream.

RL 6.0 Subjects are identified as exempted / mandatory / pre-requisites. A student has to attend classes in subjects prescribed as mandatory/ pre-requisites and has to earn the credits in the examinations as and when conducted. The evaluation for the above courses may be totally internal.



TRANSITORY REGULATIONS FOR STUDENTS RE-ADMITTED INTO II - YEAR OF AUTONOMOUS STREAM FROM PREVIOUS REGULATIONS

1. The student has to attend classes in the subjects declared as prerequisites before joining into II year (III or IV semester) under autonomous stream offered in the preceding summer and has to earn the credits in the examinations as and when conducted.
2. For subjects which are not prerequisites but declared as compulsory, the instruction may be taken during the following summer programmes or as and when they are offered and shall earn the credits in the examinations as and when conducted.
3. The re-admitted students have to appear and pass the I year / II Year I semester (in case of readmission into II semester) subjects by appearing for the examinations as and when conducted by JNT University Kakinada in the failed subjects.

4. Promotion to V semester:

For a readmitted student to get promoted to V semester (III year) he has to earn 52 credits out of 56 credits in the I year courses from both regular and supplementary examinations, conducted by JNT University-Kakinada.

5. Promotion to VII semester:

For a re-admitted student to get promoted to VII semester (IV year) the following criteria must be satisfied

- I. He shall acquire all the 56 credits of the I year courses.
- II. He shall acquire at least 104 credits from the courses up to the end of II year excluding prerequisites (Including the supplementary examinations) and secure

a pass in prerequisite courses offered during the transition from previous regulations to autonomous regulations.

6. The student seeking readmission into II year shall abide by all other relevant regulations in force under the autonomous stream in addition to the above and shall secure a pass in prerequisite and compulsory courses.
7. For the award of the degree, the student shall acquire 216 credits excluding prerequisite and compulsory subjects.



REGULATIONS FOR THE SUMMER PROGRAMME

In addition to the rules and regulations given in R 7.0 of the B.Tech regulations and syllabus book the following rules are to be followed.

1. It is desirable for a candidate to put up 100% attendance in all the subjects registered for the summer course. However 25% concession in attendance may be permitted at the discretion of the principal based on the merits of the individual case under extraneous conditions with proper evidence. No further condonation of attendance on par with the regular semester shall be permitted.
2. If a candidate is failed to satisfy the attendance requirement in a course registered during summer then he has to repeat the course in the subsequent summer programme when offered next.
3. The method of internal evaluation is same as for the regular B.Tech programme. I mid examination shall be completed by the end of IV weeks and II mid to be completed by the end of VIII weeks of the programme.
4. The earlier internal marks secured in the regular semester for the subjects registered in the summer programme are nullified and internal marks from the latest summer programme shall be final.
5. The end semester examinations for the summer programme shall be conducted on the immediately following Saturdays and / or Sundays as the need arises
6. Attendance and completion of subjects during the summer programme shall be suitably reflected in the consolidated marks memo.



***SYLLABI FOR
III & IV SEMESTERS***

PROBABILITY AND STATISTICS

Course Code: ABM1105

L	T	P	C
4	1	0	4

Aim :

To acquire basic knowledge in concepts of probability and statistics.

Objective :

The student shall be able to apply the methods of probability distributions, perform Statistical analysis and draw inference in various engineering problems.

UNIT-I

PROBABILITY: Probability, The axioms of probability, some elementary theorems - Conditional probability –Baye's theorem. (3.3-3.7)

UNIT-II

DISCRETE RANDOM VARIABLES: Random variables , mean and variance, Chebyshev's theorem, Binomial distribution, Poisson distribution (4.1,4.2, 4.4-4.7)

UNIT-III

CONTINUOUS RANDOM VARIABLES: Continuous Random Variable, normal distribution, Normal approximation to Binomial distribution, Uniform distribution (5.1-5.3, 5.5)

UNIT-IV

SAMPLING DISTRIBUTION OF MEANS: Population and sample, Sampling distributions of mean, Point estimation, Interval estimation (6.1-6.3, 7.1, 7.2)

UNIT-V

INFERENCES CONCERNING MEAN: Null hypothesis and tests of hypothesis, Inference concerning one mean and two means (7.3-7.5 ,7.8)

UNIT-VI

INFERENCES CONCERNING VARIANCES: Sampling distribution of the variance, the estimation of Variance, Hypothesis concerning one and two variances (6.4, 8.1-8.3)

UNIT-VII

INFERENCES CONCERNING PROPORTIONS: Estimation of Proportions, Hypothesis concerning one proportion, several proportions (9.1-9.3)

UNIT-VIII

CORRELATION REGRESSION: The method of least squares , Curvilinear regression, multiple regression, correlation(excluding causation)

(11.1,11.3, 11.4,11.6)

Text Book:

Miller Freund's" Probability and Statistics for Engineers" Richard A Johnson, CB Gupta, Pearson education , Seventh Edition 2005.

References:

1. S.C Gupta and V.K. Kapoor" Fundamentals of Mathematical Statistics" Ninth Revised Edition, Sultan Chand & Sons educational Publishers
2. Dr. B.S. Grewal " Higher Engineering mathematics" 40th Edition, Khanna Publishers.



MOMENTUM TRANSFER

Course Code: ACH1102

L T P C

4 1 0 4

Aim:

This subject introduces the student in applying the fundamental principles of fluid mechanics in transportation and pumping liquids.

Objective:

To make the students analyse the system of units and impart him with the knowledge of applying basic quantitative laws and equation of fluid flow. It also enables him to handle important engineering tasks of moving fluids through process equipment and measuring & controlling fluids in flow.

UNIT –I

Unit operations and unit processes, unit systems, dimensional analysis, basic concepts, nature of fluids, hydrostatic equilibrium, applications of fluid statics.

UNIT- II

Fluid flow phenomena-Laminar flow, Shear rate, Shear stress, Rheological properties of fluids, Turbulence, Boundary layers, Basic equation of fluid flow –Mass balance in a flowing fluid; continuity, differential momentum balance; equations of motion, Macroscopic momentum balances, Mechanical energy equations.

UNIT-III

Incompressible Flow in pipes and channels- shear stress and skin friction in pipes, laminar flow in pipes and channels, turbulent flow in pipes and channels, pressure drop due to changes in velocity or direction, Forces on bends, Multiple pipe systems: Pipes in series and parallel, reservoir junctions.

UNIT-IV

Flow of compressible fluids- Definitions and basic equations, Processes of compressible flow, Isentropic flow through nozzles, adiabatic frictional flow, and isothermal frictional flow.

UNIT-V

Flow past immersed bodies, Drag and Drag coefficient, flow through bed of solids, motion of particles through fluids.

UNIT-VI

Fluidization, Conditions for fluidization, Minimum fluidization velocity, Types of fluidization, Expansion of fluidized bed, Applications of fluidization. Continuous fluidization; slurry and pneumatic transport

UNIT-VII

Transportation and Metering of fluids- Pipes, fittings and valves, pumps: positive displacement pumps, and centrifugal pumps.

UNIT-VIII

Fans, blowers, and compressors, Measurement of flowing fluids- full bore meters, insertion meters. Measurement of fluid flow in open channel flows using weirs.

Text Books:

1. Unit Operations of Chemical Engineering by W.L.McCabe, J.C.Smith & Peter Harriot, McGraw-Hill, 6th ed, 2001
2. Fluid Mechanics for Chemical Engineers, McGraw Hill Noel de Nevers

References:

1. Transport processes and unit operations by Christie J. Geankoplis, PHI
2. Unit operations, Vol-1 –Chattopadhyaya, Khanna publishers
3. Principles of Unit Operations, Foust et. al, 2nd ed., John Wiley, 1999
4. Chemical Engineering, Vol-I, Coulson and Richardson, Pergamon Press.



CHEMICAL PROCESS CALCULATIONS-I

Course Code: ACH1103

L	T	P	C
4	0	0	4

Aim:

To give quantitative training in the practical applications of the principles of Material and energy balance to the solution of industrial problems

Objectives:

- i) To develop systematic problem solving skills
- ii) To learn what material balance are, how to formulate , apply and solve them
- iii) To learn how to deal with the complex process problems

UNIT-I

Stoichiometric relation: basis of calculations, methods of expressing compositions of mixtures and solutions, density and specific gravity, Baume' and API gravity scales.

UNIT-II

Behavior of Ideal gases: Kinetic theory of gases, application of ideal gas law, gaseous mixtures, gases in chemical reactions.

UNIT-III

Vapor pressure: Liquefaction and liquid state, vaporization, boiling point, effect of temperature on vapor pressure, Antoine equation, vapor pressure plots.

UNIT-IV

Vapor pressure of immiscible liquids and ideal solutions, Raoult's law. Non volatile solutes.

UNIT-V

Humidity and Saturation: Relative and percentage saturation, dew point, wet bulb and dry bulb temperatures.

UNIT-VI

Use of humidity charts for engineering calculations.

UNIT-VII

Estimation of Physical and Transport Properties using group contribution methods, Estimation of normal Boiling Point, Latent heat, Specific Heat, Diffusivity, Viscosity Thermal Conductivity and Critical Properties.

UNIT-VIII

Material balances: Tie substance, Yield, conversion, processes involving chemical reactions.

Text Books:

1. Chemical process principles, Part -I, Material and Energy Balance by Hougen O A, Watson K.M. and Ragatz R.A. John Wiley and Sons, New York, 1963, 2nd Ed.
2. The properties of gases, liquids and solids” By Bruce E. Poling, J. M. Prausnitz, John Paul O’Connell, Edition: 4 - 1987

References:

1. Basic principles and calculation in chemical engineering by D.H. Himmelblau, 5th Ed. PHI, 2001
2. Stoichiometry by B.I. Bhatt and S.M. Vora (3rd Ed.) Tata McGraw Hill publishing company, Ltd. New Delhi (1996).



PHYSICAL CHEMISTRY

Course Code: ABC1104

L	T	P	C
4	0	0	4

Aim:

To provide necessary physical chemistry background to chemical engineering students.

Objective:

To make the student capable to tackle chemical engineering problems in their career .

UNIT -I

THERMODYNAMICS-I: Thermodynamics terms and Basic concepts- Thermodynamic processes- Reversible and irreversible process- pressure-volume work- Internal energy- First Law of thermodynamics – Enthalpy- Molar Heat Capacities – Adiabatic and isothermal expansion of an ideal gas .

UNIT -II

THERMODYNAMICS-II: Spontaneous process- Entropy- Second Law of thermodynamics- Carnot Cycle- Derivation of entropy from Carnot cycle – Physical significance of entropy- Free energy- Gibbs Helmholtz Equations- Clausius- Clapeyron Equation- Vant Hoffs isochores.- Third law of thermodynamics:

UNIT -III

DISTRIBUTION LAW: Statement. - Nernst Distribution law- Explanation and limitations of law- Modification of Distribution law when association or dissociation of the solute occurs – Determination of Equilibrium constant from Distribution coefficient- Extraction of a solute from solution with an immiscible solvent- Applications of Distribution law

UNIT -IV

PHASE RULE: Definitions and explanation of terms- Thermodynamics derivation of Phase rule- one component system: water system-and sulphur system- Two component systems – Liquid-liquid systems- completely miscible, partially miscible and immiscible systems –Distillation of zeotropic mixtures, Azeotropic mixtures, solid-liquid systems- Eutectic systems- Lead-silver systems.

UNIT -V

ELECTRO CHEMISTRY: Specific and equivalent conductance-measurement- effect of dilution on specific and equivalent conductance- relative speeds of ions- Transport number and its determination- Hittorfs method and moving boundary method- Kohlrauschs law and its applications.

UNIT -VI

CHEMICAL KINETICS: Basic Terms –Methods of determining order of reaction- Theories of reaction rates: Arrhenius, Collision and Absolute reaction rate theories- Simultaneous reactions: Consecutive reactions, parallel reactions, Reversible or opposing reactions- Chain reactions: Hydrogen and bromine

UNIT -VII

CATALYSIS: Definition-Types- Homogeneous and heterogeneous catalysis- Characteristics of catalytic reactions- promoters- catalytic poisoning- Autocatalysis- Negative catalysis- Activation energy and catalysis- Theories of Catalysis – Acid-base catalysis- Langmuir's adsorption isotherm

UNIT -VIII

COLLOIDAL STATE: Definition of colloids- Classification of colloids- Solids in liquids (Sols): kinetic, optical and electrical properties- stability of colloids: protective action, Hardy-Schultz Law- Gold Number- Liquids in liquids (emulsions): types of emulsions, preparation, Emulsifier- Liquid in Solids (gel): Classification, preparation and properties- General applications of colloids

Text Books:

1. Physical Chemistry, Arun Bahl, BS Bahl & Tuli
2. Physical Chemistry – Puri, Sharma and Pathania

References:

1. Physical Chemistry – Glasston & Lewis.
2. Advanced Physical Chemistry – Gurudeep Raj, Goel Publishing House.
3. Physical Chemistry – Atkins.
4. Physical Chemistry – Walter J. Moore.
5. Physical Chemistry – Castalin.



MECHANICAL UNIT OPERATIONS

Course Code: ACH1104

L	T	P	C
4	0	0	4

Aim:

To study the behaviour of solid particles as per the requirement of chemical engineering.

Objectives:

To have good understanding on

- Properties, mixing and transportation of solids
- Laws and equipment of size reduction
- Separation processes like screening, filtration and crystallization
- Mixing of solids with liquids

UNIT-I

Properties, handling and mixing of particulate solids: Characterization of solid particles, properties of particulate masses, storage and mixing of solids, types of mixers, mixers for cohesive solids, mixers for free flowing solids.

UNIT-II

Transportation of solid particulate mass, belt, screw, apron conveyers, bucket elevators, pneumatic conveying

UNIT-III

Size reduction: Principles of comminution, computer simulation of milling operations, size reduction equipment-crushers, grinders, ultra fine grinders, cutting machines, Equipment operation.

UNIT-IV

Screening, Industrial screening equipments, Filtration, cake filters, centrifugal filters,

UNIT-V

Principles of cake filtration. Clarifying filters, liquid clarification, gas cleaning, principles of clarification. Cross flow filtration, types of membranes, permeate flux for ultra-filtration, Concentration polarization, particle rejection of solutes

UNIT-VI

Micro filtration, Separations based on motion of particles through fluids, gravity settling processes and centrifugal settling processes, float and sink method, differential settling, coagulation, Flotation-separation of ores, flotation agents

UNIT -VII

Agitation and mixing of liquids: Agitation of liquids, circulation velocities, power consumption in agitated vessels. Blending and mixing of liquids, suspension of solid particles, dispersion operations.

UNIT-VIII

Crystallization: crystal geometry, principles of crystallization equilibria and yields, nucleation, crystal growth,

Text book:

1. Unit Operations in Chemical Engineering by W.L. McCabe and J.C. Smith and Peter Harriott, Mc Graw Hill 5th ed. 1993.

References:

1. Chemical engineers hand book, J.H. Perry, 7th ed. Mc Graw Hill
2. Introduction to Chemical Engineering by J.T.Banchero & W.L.Badger.,TMH,1997.
3. Unit Operations by Foust et.al



PROCESS INSTRUMENTATION

Course Code : ACH1105

L	T	P	C
4	0	0	4

Aim:

To understand the instrumentation requirements of Chemical Process Industry.

Objective:

Control the different process variables such as temperature, pressure, flow rate, etc in improve efficiency of the process thereby enhance the economics of plant.

UNIT –I

Elements of instruments, static and dynamic characteristics, basic concepts of response of first order type instruments, mercury in glass thermometer, bimetallic thermometer, pressure spring thermometer, static accuracy and response of thermometers.

UNIT-II

Thermo electricity: Industrial thermocouples, thermocouple wires, thermo couple wells and response of thermocouples.

UNIT –III

Thermal coefficient of resistance, industrial resistance thermometer bulbs and circuits, radiation receiving elements, radiation, photoelectric and optical pyrometers.

UNIT-IV

Composition analysis, spectroscopic analysis by absorption, emission, mass and color measurement spectrometers, gas analysis by thermal conductivity, analysis of moisture, gas chromatography, refractometer.

UNIT-V

Pressure vacuum and head: liquid column manometers, measuring elements for gauge pressure and vacuum, indicating elements for

pressure gauges, measurement of absolute pressure, measuring pressure in corrosive liquids, static accuracy and response of pressure gauges.

UNIT -VI

Head, density and specific gravity, direct measurement of liquid level, pressure measurement in open vessels, level measurements in pressure vessels, measurement of interface level, density measurement, and level of dry materials.

UNIT -VII

Head flow meters, area flow meters, open channel meters, viscosity meters, quantity meters, flow of dry materials, viscosity measurements.

UNIT -VIII

Recording instruments, indicating and signaling instruments, transmission of instrument readings, control center, instrumentation diagram, process analysis.

Text Book:

1. Industrial instrumentation by Donald P.Eckman, Wiley eastern, 1950.

References:

1. Principles of industrial instrumentation by Patra Nabis, TMH.
2. Instruments for measurements and control by Holbrock W.C. Van Nostrand East West.
3. Hand book Instrumentation, Considine, McGraw Hill,
4. Instrumentation for Process measurement and Control, Norman A. Anderson, 3rd Edition, CRC press



MECHANICAL UNIT OPERATION LAB

Course Code: ACH1106

L	T	P	C
0	0	3	2

1. To determine the time of grinding in a ball mill for producing a product with 80 % passing a given screen. Major equipment - Ball mill Apparatus, Sieve shaker, Different sizes of sieves, weighing balance
2. To verify the laws of crushing using any size reduction equipment like crushing rolls or vibrating mills and to find out the working index of the material.
Major equipment – Jaw Crusher, Sieve shaker, Different sizes of sieves, Weighing Balance, Energy meter
3. To find the effectiveness of hand screening of a given sample by a given screen. Major equipment - Vibrating Sieve shaker, Different sizes of sieves, Weighing Balance
4. To separate a mixture of oil into two fractions using froth flotation technique. Major equipment - Froth flotation cell
5. To obtain batch sedimentation data and to calculate the minimum thickener area under given conditions. Major equipment- Sedimentation apparatus
6. To determine the specific cake resistance and filter medium resistance of a slurry in plate and frame filter press.
Major equipment - Plate and Frame filter press.
7. To separate a mixture of particles by Jigging. Major equipment - Jigging apparatus
8. Studies on cyclone separator. Major equipment - Cyclone separator
9. Studies on pulverizer. Major equipment - Pulverizer
10. Verification of Stoke's law.
Major equipment – Stoke's law apparatus
11. Grinding studies on hard/ soft materials. Major equipment - Grinder

PHYSICAL CHEMISTRY LAB

Course Code: ABC1105

L	T	P	C
0	0	3	2

1. Distribution of iodine between Carbon Tetrachloride, Chloroform and Water
2. Distribution of benzoic acid between benzene and water.
3. Study of inversion of sucrose by polarimetry.
4. Study of hydrolysis of an ester.
5. Determination of order of reaction between persulphate and iodide.
6. Conductimetric titration of strong acid versus strong base.
7. Conductimetric titration of weak acid versus strong base.
8. PH metric titration of strong acid versus strong Base
9. Determination of CST of Phenol- Water system
10. Determination eutectic temperature of binary systems. (UREA-Benzoic Acid)
11. Potentiometric determination of solubility of a sparingly soluble salt (AgCl)
12. Colorometric determination of Manganese in Steel



HEAT TRANSFER

Course Code: ACH1107

L	T	P	C
4	0	0	4

Aim:

To study the basics and applications of conduction, convection and radiation heat transfer in the areas pertaining to chemical engineering.

Objectives:

To have good understanding on

- Fourier's law of conduction, conduction equation
- Heat transfer in laminar and turbulent flow, heat transfer with and without phase change, heat transfer in forced and natural convection
- Radiation
- Heat exchangers
- Evaporators

UNIT - I

Heat transfer by conduction in Solids - Fourier's law, thermal conductivity, steady state conduction in plane wall, cylinder and sphere; resistances in series and parallel, unsteady state heat conduction, heat conduction equation with and without internal heat generation, semi-infinite solid, finite solid, Critical insulation thickness.

UNIT- II

Principles of heat flow in fluids - Typical heat exchange equipment, range, approach, temperature versus length curves, countercurrent and parallel current flows, energy balances, Overall heat transfer coefficient, LMTD, resistance form of overall coefficient, fouling factors, effective coefficients for unsteady-state heat transfer.

UNIT- III

Heat Transfer to Fluids without Phase change - Thermal boundary layer, heat transfer by forced convection in laminar and turbulent flows, viscosity correction factor, analogies between transfer of momentum and heat, heat transfer to liquid metals, heating and cooling of fluids in forced convection outside tubes, brief discussion about heat transfer to fluids in laminar flow with constant heat flux and constant wall temperature.

UNIT- IV

Natural convection- Natural convection to air from vertical shapes and horizontal planes, effect of natural convection in laminar-flow heat transfer, free convection in enclosed spaces, mixed free & forced convection.

UNIT- V

Heat transfer to fluids with phase change - Heat transfer from condensing vapors, heat transfer to boiling liquids.

UNIT- VI

Radiation - Introduction, properties and definitions, black body radiation, real surfaces and the gray body, absorption of radiation by opaque solids, radiation between surfaces, radiation shielding, radiation to semi transparent materials, combined heat transfer by conduction, convection and radiation.

UNIT - VII

Evaporators - Evaporators, performance of tubular evaporators, capacity and economy, multiple effect evaporators, vapor recompression.

UNIT- VIII

Heat exchange equipment - General design of heat exchange equipment, heat exchangers, condensers, boilers and calorifiers, extended surface equipment, heat transfer in agitated vessels, scraped surface heat exchangers, Compact Heat Exchangers, Plate type Heat Exchangers, Heat transfer in packed beds, heat exchanger (effectiveness)NTU method, LMTD method, Rating, Sizing.

Text Book:

1. Unit Operations of Chemical Engineering by McCabe, Smith and Peter Harriot, McGraw- Hill 7th edition 1993

References:

1. Process heat transfer D.Q.Kern, McGraw-Hill
2. Heat Transfer by J.P.Holman
3. Y.V.C.Rao, Heat Transfer, University Press.
4. Heat transfer-Schaum's series, McGraw-Hill publications
5. Chemical Engineering, Vol-I, Coulson and Richardson
6. Transport processes and Unit operations, Christie J. Geankoplis, PHI
7. Heat Transfer- a basic approach - Necati Ozisik



MANAGEMENT SCIENCE

Course Code: AHM1102

L	T	P	C
4	0	0	4

Objective:

To familiarize with the process of management and to provide basic insights to select contemporary management practices.

Outcome:

To understand the management processes and evolve management levels for effective decision making

Unit I

INTRODUCTION TO MANAGEMENT: Concepts of Management and Organization – Nature, Importance and Functions of Management, Taylor’s Scientific Management Theory, Fayol’s Principles of Management, Mayo’s Hawthorne experiments, Maslow’s Theory of human needs, Douglas Mc Gregor’s Theory X and Theory Y, Herzberg’s Two factor Theory of motivation, Systems approach to Management, Leadership styles

Unit II

DESIGNING ORGANIZATIONAL STRUCTURES: Basic concepts related to Organization, Departmentation and Decentralization, Types of mechanistic and organic structure of organization (Line Organization, Line and staff Organization, Functional Organization, Committee Organization, Matrix Organization, Virtual Organization, Cellular Organization, Team Structure, Boundaryless Organization, Inverted Pyramid Structure, Lean and Flat Organization Structure) and their merits, demerits and suitability

Unit III

OPERATIONS MANAGEMENT : Principles and Types of Plant Layout, Methods of Production (Job, Batch and Mass Production), Work Study, Basic procedure involved in Method Study and Work

Measurement, Statistical Quality Control: R chart, P chart, C chart
(Simple numerical problems)

Unit IV

MATERIALS MANAGEMENT : Objectives, Need for Inventory control, EOQ, ABC & VED Analysis, Purchase Procedure, Stores Management and Stores Records (simple numerical problems)

Just in Time System (JIT)

Unit V

MARKETING MANAGEMENT: Functions of Marketing, Marketing mix, marketing strategies based on product life cycle, Channels of distribution, Consumer behavior and Customer relationship management

Unit VI

HUMAN RESOURCES MANAGEMENT: Concepts of HRM, HRD and Personnel Management and Industrial Relations (PMIR), HRM vs. PMIR, Basic functions of HR Manager : Manpower planning, Recruitment, Selection, Training and Development, Placement, Performance Appraisal, Job Evaluation and Merit Rating Grievance handling and Welfare Administration

Introduction to Social Security Laws: Payment of Gratuity Act (1972), Employees Provident Fund & Miscellaneous Provisions Act (1958), Employees State Insurance Act (1948)

Unit VII

PROJECT MANAGEMENT (PERT / CPM): Network Analysis, Programme Evaluation and Review Technique (PERT), Critical Path Method (CPM), Identifying critical path, probability of completing the project within given time, project cost analysis, project crashing (simple numerical problems)

Unit VIII

STRATEGIC MANAGEMENT : Mission, Goals, Objectives, Policy, Strategy, Programmes, Elements of Corporate Planning Process, Environmental Scanning, Steps in strategy formulation and implementation, value Chain Analysis, SWOT Analysis.

Corporate social responsibility, business ethics and corporate governance

Text Books:

1. A R Aryasri : Management Science, Tata McGraw Hill, 2/e, 2007
2. O P Khanna : Industrial Engineering and Management, Dhanpat Rai Publishers, 2/e,2007

Reference Books:

1. Kazmi: Business Policy and Strategic Management, Tata McGraw Hill
2. S D Sharma : Operations Research, Kedarnath Ramnath& Co
3. Philip Kotler & Keller : Marketing Management, Pearson Education
4. C B Mamoria & C B Mamoria : Personnel Management, Himalaya Publishers
5. B S Goel: Production and Operations Management, Pragati Prakasan
6. Strategic Management: R Srinivasan, Eastern Economy Edition
7. L M Prasad: Principles and Practice of Management, Sultan Chand & Sons



CHEMICAL PROCESS CALCULATIONS-II

Course Code: ACH1108

L	T	P	C
4	1	0	4

Aim:

To give quantitative training in the practical applications of the principles of Material and Energy balance to the solution of industrial problems

Objectives:

- i) To develop systematic problem solving skills
- ii) To learn what material balance are, how to formulate , apply and solve them
- iii) To learn what energy balances are and how to apply them
- iv) To learn how to deal with the complex process problems

UNIT-I

Material balance calculation involving drying,

UNIT-II

Dissolution and crystallization., theory and associated problems.

UNIT-III

Problems on processes involving recycle, bypass and purge.

UNIT-IV

Thermo physics: Energy, energy balances, heat capacity of gases, liquid and mixture solutions. Kopp's rule, latent heats, heat of fusion and heat of vaporization, Trouton's rule, Kistyakowsky equation for non polar liquids enthalpy and its evaluation.

UNIT-V

Thermo chemistry: Calculation and applications of heat of reaction, combustion, formation and neutralization, Kirchhoff's equation, enthalpy concentration change.

UNIT-VI

Calculation of theoretical and actual flame temperatures.

UNIT-VII

Introduction Calorific value of fuels, Various Fuels (Qualitative Analysis), Combustion Calculations, Orsat Analysis.

UNIT-VIII

Numerical Simulation of Material Balance Equations-Simultaneous and Sequential Modular approaches: Learning how to arrange equations and solve them using both techniques.

Text Books:

1. Chemical process principles, Part -I, Material and Energy Balance by Hougen O A, Watson K.M. and Ragatz R.A. John Wiley and Sons, New York, 1963, 2nd Ed.
2. Basic principles and calculation in chemical engineering by D.H. Himmelblau, 5th Ed. PHI, 2001

Reference:

1. Stoichiometry by B.I. Bhatt and S.M. Vora (3rd Ed.) Tata McGraw Hill publishing company, Ltd. New Delhi (1996)



MATERIALS SCIENCE FOR CHEMICAL ENGINEERS

Course Code: ACH1109

L	T	P	C
4	0	0	4

Aim:

To make students learn the structure-property- processing interrelationship in engineering materials

Objectives:

- i) To enable students selects suitable materials for specific applications
- ii) To process the materials so as to tailor the materials properties for given application

UNIT-I

Introduction - Classification of Engineering Materials – Fundamental Blocks of Matter. A brief review on Atomic(micro) Structure and Atomic Bonding- Energy of the Atomic system. Ionization potential, Electron Affinity- Ionic radii and Equilibrium Distance, Bond Length, $\Delta H_{\text{Crystal}}$, $\Delta H_{\text{Lattice}}$, Ionic, Covalent and metallic Bonding, Secondary bonding- Property relation to Bond characteristics.

UNIT-II

Crystal Geometry And Structure Determination - Space lattice, Unit cell-Primitive cell, Double Cell, Triple Cell, Multiple Cell- Crystal and Crystalline Substance, Amorphous Material-Bravais lattices, Crystal systems and their characteristics with suitable examples. Lattice points –Lattice Co-ordinates, Miller indices for directions and planes, Miller-Bravais indices, Linear and Planer Densities, Slip Directions and slip Planes, Packing efficiencies and fractions Close Packed Structures(CPS), C/A ratio for HCP Structures- Bragg's law of X-Ray Diffraction and determination of Cubic Crystal structure, Lattice Constant and identification of metals using powder method, problems relating to these topics.

UNIT-III

Crystal Defects and Imperfection - What is a crystal defect and how does it arise in Crystal point (Zero dimensional and one dimensional defect) Types of point Defect, configurational Entropy, Determination of defect concentration , expression for one and two –dimensional defect concentration , Significance of point defects in the determination of properties of materials- Dislocations, Line defects- Edge and Screw Dislocations, Burgers Vector, Burgers Circuit, Dislocation motion – Dislocation reactions– Role of Dislocations on the properties of materials , dislocation density- surface defects, dislocation Energy , stress required to move a dislocation , multiplication of dislocation – Frank read source and mechanism of dislocations.

UNIT-IV

Basic thermodynamic functions -Free Energy of Transformation – Criteria for transformation – Nucleation and Growth – Homogeneous and Heterogeneous nucleation and their applications. Solid Solutions- Polymorphs – Types of Solid Solutions – Temp – Time – Cooling curves for different systems – Solid – Solid phase equilibrium – Tie Line, Lever Rule and its application. Phase Rule, Phase Changes and its application to Thermal Equilibrium diagrams or Phase Diagrams of Unary System, - Binary Systems – Eutectic Eutectoid alloys – Cu-Ni, Bi-Cd, Pb-Sn, Fe-Fe₃C systems.

UNIT-V

Phase transformations in steels – Modifications in structure of Steel by Heat Treatment – Time – Temperature – Transformation Curves for Eutectoid Steel – Classification of Steels and Cast Irons – Types and their properties. Alloys of Steel and their uses in Chemical Industry.

UNIT-VI

Mechanical behavior of metals and alloys - Elastic, Plastic and anelastic behavior of materials. Viscoelastic materials, behavior of polymers and plastics. Critical Resolved Shear strength, Schmidt's Law and prediction of Tensile Strength of materials, Strengthening mechanisms – Work Hardening or Strain Hardening, Alloying – Cold

and Hot working – Recovery and Recrystallization, Grain Growth, Grain Size and Yield Strength, Age hardening of Aluminum alloys – Al-Cu system. Composite Materials and their mechanical behavior, expressions for Tensile Strength and strains in Composite Materials – Fracture of Materials Ductile, Brittle, Creep and Fatigue fractures – Simple Problems related to these topics.

UNIT-VII

Corrosion- Materials in the service of Chemical and Marine Environments – Basis for corrosion , Corrosion reactions and Mechanisms of Corrosion – Eight forms of Corrosion- Uniform Corrosion , Galvanic , Differential Aeration Corrosion , Stress corrosion Cracking, Intergranular Corrosion, Localized Corrosion and Fatigue Corrosion . Corrosion of Stainless steel- Oxidation, Tarnishing, behavior of non-ferrous materials used in Chemical Industry – Effect of environmental factors on corrosion.

UNIT-VIII

Corrosion Prevention , Pilling – Bedworth ratios Conventional methods – Estimation of Corrosion rates, different Corrosion rate expressions, Remedial measures for Galvanic, Stress Corrosion Cracking , Intergranular and Pitting Corrosion , Anodic and Cathodic protection techniques, Conventional methods on organic and Inorganic coatings, Electroplating , Alloying – Cladding- Design Procedures of chemical equipment and structure to mitigate or completely prevent corrosion in Chemical Plants.

Text Books:

1. Materials Science and Engineering; V. Raghavan.; Prentice Hall of India Pvt. Ltd.,
2. Corrosion Engineering : MG,Fontana ,3rd Ed, Mc Graw Hill

References:

1. Science of Engineering Materials Vol. 1 &2; Manas chanda; McMillan Company of India Ltd.
2. Elements of materials science, Van Vlack, L.R.
3. Engineering Metallurgy Part-I(Applied Physical Metallurgy) 4th Ed, by Raymond A. Higgins, ELBS Pub.

MASS TRANSFER OPERATIONS-I

Course Code: ACH1110

L	T	P	C
4	1	0	4

Aim:

To separate individual components from the mixture through methods necessarily involving physical changes.

Objectives:

To study various operations that brings change in composition of the constituent mixture by employing only physical methods. The operations of the study are absorption, humidification, drying, distillation, extraction, leaching, adsorption etc.

UNIT- I

The Mass Transfer Operations - Classification of the Mass-Transfer Operations, Choice of Separation Method, Methods of Conducting the Mass-Transfer Operations, Design Principles, Molecular Diffusion In Fluids: Molecular Diffusion, Equation of Continuity, binary solutions, Steady State Molecular Diffusion in Fluids at Rest and in Laminar Flow, estimation of diffusivity of gases and liquids,

UNIT- II

Momentum and Heat Transfer in Laminar flow Diffusion - Diffusion in Solids, Fick's Diffusion, Unsteady State Diffusion, Types of Solid Diffusion, diffusion through polymers, diffusion through crystalline solids, Diffusion through porous solids & hydrodynamic flow of gases.

UNIT-III

Mass Transfer Coefficients - Mass Transfer Coefficients, Mass Transfer Coefficients in Laminar Flow (Explanation of equations only and no derivation), Mass Transfer Coefficients in Turbulent Flow, eddy diffusion, Film Theory, Penetration theory, Surface-

renewal Theory, Combination Film-Surface-renewal theory, Surface-Stretch Theory, Mass, Heat and Momentum Transfer Analogies, Turbulent Flow in Circular Pipes. Mass transfer data for simple situations.

UNIT-IV

Inter phase Mass Transfer - Concept of Equilibrium, Diffusion between Phases, Material Balances in steady state co-current and counter current stage processes, Stages, Cascades, Kremser – Brown equations (No derivation)

UNIT-V

Equipment For Gas-Liquid Operations: Gas Dispersed, Sparged vessels (Bubble Columns), Mechanical agitated equipments(Brief description),Tray towers, General characteristics, Sieve design for absorption and distillation (Qualitative Treatment), Different types of Tray Efficiencies, Liquid Dispersed venturi Scrubbers, Wetted-Wall Towers, Packed Towers, Counter current flow of Liquid & Gas through packing, Mass transfer coefficients for packed towers, End effects and Axial Mixing Tray tower vs Packed towers.

UNIT-VI

Absorption and Stripping: Absorption equilibrium, ideal and non ideal solutions selection of a solvent for absorption, one component transferred: material balances. Determination of number of Plates (Graphical), Absorption Factors, estimation of number of plates by Kremser Brown equation, Continuous contact equipment; HETP, Absorption of one component, Determination of number of Transfer Units and Height of the Continuous Absorber, overall coefficients and transfer units, dilute solutions, overall height of transfer units. Absorption with Chemical Reaction, multi component systems.

UNIT-VII

Humidification Operations: Vapor-Pressure Curve, Definitions, Psychro Charts, Enthalpy of gas-vapor Mixtures, Humidification and Dehumidification, Operating lines and Design of Packed Humidifiers, Dehumidifiers and Cooling towers, Spray Chambers

UNIT-VIII

Drying: Equilibrium, Definitions, Drying Conditions- Rate of Batch Drying under constant drying conditions, Mechanisms of batch drying, Drying time Through Circulation Drying, Classification of Drying Operations: Batch and Continuous Drying Equipment, Material and Energy Balances of Continuous Driers,

Text book:

1. Mass transfer operations by R.E. Treybal, 3rd ed. Mc Graw Hill, 1980.

References:

1. Diffusion: Mass Transfer in fluid system by E. L. Cussler.,Cambridge University Press, 2009
2. Transport processes and unit operations by Christie J. Geankoplis,Phi,3rd Ed ,2002
3. Principles of Mass Transfer and separation processes, B.K. Dutta, PHI, India
4. Separation Process Principles ,JD Seader,Ernest J.Henley, John Wiley



CHEMICAL ENGINEERING THERMODYNAMICS-I

Course Code: ACH1111

L	T	P	C
4	0	0	4

Aim:

The purpose of this subject is to present thermodynamics from a chemical engineering view point.

Objectives:

Chemical Engineering thermodynamics is primarily concerned with application of thermodynamics to phase equilibria and reaction equilibria in multi component system. It plays a supervisory role in engineering and its application in design of chemical engineering equipment in process in which approach to equilibrium is nearly 100% in practice.

UNIT-I

INTRODUCTION: The scope of thermodynamics, temperature, defined quantities; volume, pressure, work, energy, heat, Joules Experiments.

UNIT-II

THE FIRST LAW AND OTHER BASIC CONCEPTS: The first law of thermodynamics, thermodynamic state and state functions, enthalpy, the steady-state steady-flow process, equilibrium, the phase rule, the reversible process, constant-V and constant- P processes, heat capacity.

UNIT-III

VOLUMETRIC PROPERTIES OF PURE FLUIDS: The PVT behavior of pure substances, virial equations, the ideal gas, the applications of the virial equations, second virial coefficients from potential functions. Cubic equations of state, generalized correlations for gases, generalized correlations for liquids, molecular theory of fluids.

UNIT-IV

THE SECOND LAW OF THERMODYNAMICS: Statements of the second law, heat engines, thermodynamic temperatures scales, thermodynamic temperature and the ideal gas scale

UNIT-V

ENTROPY: Entropy changes of an ideal gas, mathematical statement of the second law, the third law of thermodynamics, entropy from the microscopic view point

UNIT-VI

THERMODYNAMICS OF FLOW PROCESSES : Principles of conservation of mass and energy for flow systems, analysis of expansion processes ; turbines, throttling ; compression processes – compressors and pumps ; calculation of ideal work and lost work.

UNIT-VII

REFRIGERATION AND LIQUEFACTION: The Carnot refrigerator, the vapor compression cycle, the comparison of refrigeration cycles, the choice of refrigerant, absorption refrigeration, the heat pump, liquefaction processes

UNIT-VIII

THERMODYNAMIC PROPERTIES OF FLUIDS: Property relations for homogeneous phases, residual properties, two phase systems, thermodynamic diagrams, tables of thermodynamic properties, generalized property correlation for gases

Text Books:

1. J.M.Smith and HC Van Ness, Introduction to Chemical Engineering Thermodynamics, 5th ed, Tata McGraw Hill,1996.

References:

1. Y.V. C.Rao, Chemical Engineering Thermodynamics, University publications.
2. K. V. Narayanan, Chemical Engineering Thermodynamics, PHI,2001
3. Chemical and Process Thermodynamics, B.G. Kyle, 3rd edition, Pearson, Prentice Hall, 1999

HEAT TRANSFER LAB

Course Code: ACH1112

L	T	P	C
0	0	3	2

1. Determination of total thermal resistance and thermal conductivity of composite wall.
Major equipment - Composite wall Assembly
2. Determination of thermal conductivity of a metal rod.
Major equipment - Thermal Conductivity apparatus
3. Determination of natural convective heat transfer coefficient for a vertical tube.
Major equipment - Natural convection heat transfer apparatus
4. Determination of critical heat flux point for pool boiling of water.
Major equipment- Pool boiling apparatus
5. Determination of forced convective heat transfer coefficient for air flowing through a pipe
Major equipment – Forced convection heat transfer apparatus
6. Determination of overall heat transfer coefficient in double pipe heat exchanger.
Major equipment - Double pipe heat exchanger apparatus
7. Study of the temperature distribution along the length of a pin-fin under natural and forced convection conditions
Major equipment - Pin fin apparatus
8. Estimation of un-steady state film heat transfer coefficient between the medium in which the body is cooled.
Major equipment - Heat transfer coefficient determination apparatus
9. Determination of Stefan – Boltzmann constant.
Major equipment - Stefan Boltzmann apparatus
10. Determination of emissivity of a given plate at various temperatures.
Major equipment - Emissivity determination apparatus
11. Determination of radiation constant of a given surface.
Major equipment - Emissivity determination apparatus.



MOMENTUM TRANSFER LAB

Course Code: ACH1113

L	T	P	C
0	0	3	2

1. Identification of laminar and turbulent flows
Major equipment - Reynolds apparatus
2. Measurement of point velocities
Major equipment - Pitot tube setup
3. Verification of Bernoulli's equation.
Major equipment – Bernoulli's Apparatus
4. Calibration of Rotameter
Major equipment – Rotameter Assembly
5. Variation of Orifice coefficient with Reynolds Number
Major equipment - Orifice meter Assembly
6. Determination of Venturi coefficient
Major equipment – Venturi meter Assembly
7. Friction losses in Fluid flow in pipes
Major equipment - Pipe Assembly with provision for Pressure measurement
8. Pressure drop in a packed bed for different fluid velocities
Major equipment - Packed bed with Pressure drop measurement
9. Pressure drop and void fraction in a fluidized bed
Major equipment - Fluidized bed with Pressure drop measurement
10. Studying the coefficient of contraction for a given open orifice
Major equipment - Open Orifice Assembly
11. Studying the coefficient of discharge in a V-notch
Major equipment - V-notch Assembly
12. Studying the Characteristics of a centrifugal pump
Major equipment - Centrifugal Pump
13. Viscosity determination using Stoke's law.
Major equipment – Terminal Velocity determination column



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JNT University-Kakinada

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Prof. V.S.R.K. PRASAD, B.Tech., M.Tech., Ph.D.
Principal, ANITS, Visakhapatnam; Former
Professor, Dept. of Chemical Engg.,
AU College of Engg., Member,
Gayatri Vidya Parishad.

Prof. A.B.K. RAO, Ph.D.
Professor, Dept. of Mechanical Engg.,
G.V.P. College of Engineering

Prof. P. VEERABHADRA RAO
Professor & Vice Principal,
GVP College of Engineering