CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY
CHEMICAL ENGINEERING
B.Tech III – Year

I – Semester

THEORY						
S. No	**Code**	**Subject**	**L**	**T**	**P**	**Credits**
1	CH 311	Chemical Reaction Engineering – II	4	0	0	3
2	CH 312	Mass Transfer Operations – I	4	0	0	3
3	CH 313	Process Dynamics and Control	4	0	0	3
4	CH 314	Process Heat Transfer	4	0	0	3
5	CH 315	Process Instrumentation	4	0	0	3
6	CE 444	Human Values and Professional Ethics	2*	0	0	0
PRACTICALS						
7	CH 316	Chemical Reaction Engineering Lab	0	0	3	2
8	CH 317	Process Heat Transfer Lab	0	0	3	2
9	EG 221	Soft Skills and Employability Enhancement	0	0	2	1
TOTAL			**22**	**00**	**08**	**20**

L: Lecture, T: Tutorial, D: Drawing, P: Practical
* 21 periods per semester

II – Semester

THEORY						
S. No	**Code**	**Subject**	**L**	**T**	**P**	**Credits**
1	CH 321	Bio Chemical Engineering	4	0	0	3
2	CH 322	Chemical Engineering Thermodynamics - II	4	0	0	3
3	CH 323	Energy Engineering	4	0	0	3
4	CH 324	Process Modeling Simulation and Optimization	4	0	0	3
5	CH 351 CH 352	**Elective – I** Surface Coatings Technology Technology of Vegetable oils and Fats	4	0	0	3
PRACTICALS						
6	CH 325	Process Dynamics and Control Lab	0	0	3	2
7	CH 326	Process Modeling Simulation And Optimization Lab	0	0	3	2
8	CH 355 CH 356	**Elective - I Lab** Surface Coatings Technology Lab Technology of Vegetable Oils and Fats Lab	0	0	3	2
9		Industrial Visit	0	0	0	0
TOTAL			**20**	**00**	**09**	**21**

CH 311

CHEMICAL REACTION ENGINEERING – II

Instruction	4L Periods per week
Duration of University Examination	3 Hours
University Examination	75 Marks
Sessionals	25 Marks
Credits	3

Course Objectives:

1. To understand various models in non-ideal reactors
2. Develop rate laws for reactor design based on reaction data from a reactor or set of reactors in heterogeneous systems.
3. Predict reactor performance in situations where the observed reaction rate is significantly influenced by internal mass transfer in porous heterogeneous catalysis

Course Outcomes:

1. Should be able to predict conversions in non-ideal reactors using various models.
2. Describe the steps in a catalytic mechanism and to derive a rate law, mechanism, and rate-limiting step that are consistent with experimental data.

UNIT - I

Analysis of Non ideal Reactors - Basic concepts. Compartment models - hints, suggestions and possible applications. Dispersion number from C and F curves, Conversion using dispersion and tanks in series models for the first order irreversible reaction

UNIT - II

Solid Catalysts - Adsorption, adsorption isotherms, surface area, void volume and solid density, pore volume distribution. Theories of heterogeneous catalysis, classification of catalysts, catalyst preparation, promoters and inhibitors.(to the extent covered in J.M. Smith only)

UNIT - III

Solid Catalyzed Reactions - Introduction; Development of rate expressions from L- H - H - W models for reaction A + B↔ R + S under adsorption, surface reaction and desorption controlling condition. Pore diffusion resistance combined with surface kinetics (Single cylindrical pore, first order reaction) Porous catalyst particles. Experimental methods for finding rates

UNIT - IV

Catalyst deactivation- Mechanisms of catalyst deactivation, the rate and performance equations: The rate equation from experiment, determining the rate for batch solid in contact with fluid in batch, mixed flow and plug flow modes for independent deactivation. Effect of pore diffusion resistance.

UNIT - V

Kinetics of fluid - fluid reactions. The rate equation for straight mass transfer of A (absorption). The general rate equation and the rate equation for reaction with mass transfer.

Kinetics of fluid-particle reactions, selection of a model, PCM, SCM, comparison of models with real situations. Shrinking core model for spherical particles of unchanging size: Diffusion through gas film controls, Diffusion through ash layer controls, chemical reaction controls. Rate of reaction for shrinking spherical particles

Text Books:

1. Octave Levenspiel,"Chemical Reaction Engineering", John Wiley & Sons - Third edition , 1999
2. J.M.Smith, "Chemical Engineering kinetics",McGraw - Hill, Third Edition , 1981

Suggested Reading:

1. H.ScottFogler," Elements of Chemical reaction Engineering", Prentice - Hall, Fourth edition , 2005

CH 312

MASS TRANSFER OPERATIONS – I

Instruction	4L Periods per week
Duration of University Examination	3 Hours
University Examination	75 Marks
Sessionals	25 Marks
Credits	3

Course Objectives: This course helps the students to understand
1. The rate equations, Mass transfer coefficients, Interphase Mass transfer
2. Various unit operations viz., absorption, humidification, drying & crystallization.

Course Outcomes: At the end of the course, the students will be able to
1. Write rate equations for any mass transfer operations
2. Design Absorber/Stripper by equilibrium methods
3. Design Cooling towers, dryers and crystallizers.

UNIT - I

Diffusion and Mass Transfer – Mass transfer operations & their applications. Molecular diffusion –Fick's first law – steady state molecular diffusion in binary mixtures of gases, liquids and solids – Determination of diffusivity in gases by Steffan-Maxwell method – estimation of diffusion coefficients in binary mixtures of liquids and gases by correlation.
Eddy diffusion – Basic concepts of mass transfer theories – Film mass transfer coefficients for the cases of equimolar counter diffusion and diffusion of one component (**A**) in stagnant component (**B**) - Correlation's for mass transfer coefficients and Reynolds & Colburn analogies.

UNIT - II

Interphase Mass Transfer – overall mass transfer coefficients – Two resistance theory – Gas phase and liquid phase controlled situations.
Gas – liquid contact: Description of Continuous and stage wise contact equipment, packing for packed columns – Liquid distribution.
Mass transfer coefficients in packed columns, Flooding in packed and plate columns, Ideal stage, Murphree, point and overall column efficiency, Comparison of packed and plate columns.

UNIT - III

Absorption and Stripping: counter current and co-current isobaric absorption and stripping of single component – Operating Lines – Minimum flow rates – Determination of number of plates – absorption factor.
Determination of number of transfer units and height of a continuous contact packed absorbers. Kremser – Brown equation for tray towers and packed towers

UNIT - IV

Humidification: Vapour, gas mixtures – Humidity and relative saturation. Dew point adiabatic saturation and wet bulb temperatures – psychometric charts – Enthalpy of gas vapor mixtures.
Humidification and Dehumidification – Operating lines and design for cooling towers and dehumidifiers. Construction and working of Spray chambers

UNIT - V

Drying: moisture contents of solids – equilibrium, bound and unbound moisture.
Design conditions – Rate of batch drying under constant drying conditions – Mechanism of batch drying – total time for batch drying, Description of batch and continuous dryers.
Crystallization: Principles – primary and secondary nucleation, equipment – construction and working,

Text Books:

1. R.E. Treybal, "Mass Transfer operations", 3rd Edition, McGraw Hill Book Co., 1981

Suggested Reading:

1. Christie John Geonkoplis "Transport Processes and Separation Process Principles", 4th edition. PHI, New Delhi.
2. J Coulson and Richardson,"Fluid Flow, Heat and Mass Transfer", Volume 1, 6th Edition, Pergoman Press, 2009.

CH 313

PROCESS DYNAMICS AND CONTROL

Instruction	4L Periods per week
Duration of University Examination	3 Hours
University Examination	75 Marks
Sessionals	25 Marks
Credits	3

Course Objectives: To provide a conceptual and methodological framework to
1. Analyze the transient behavior of simple chemical processes (using mathematical modeling from first principles and Laplace transforms)
2. Feedback control of processes - concepts, terminology, methods, and performance
3. Advanced control strategies with industrial examples.

Course Outcomes: The student will be able to:
1. Characterize and analyze the dynamic behavior of linear systems (1^{st} and 2^{nd} order)
2. Construct block diagrams for simple chemical processes
3. Analyze stability, speed of response, frequency response, of simple feedback control systems
4. Analyze and tune process controllers to achieve desired performance
5. Empirically identify process dynamics

UNIT – I

Introduction: Response of First order system, Transfer Function, Transient response to step, impulse, sinusoidal forcing function, physical examples of first order systems, liquid level, mixing process, concept of time constant, linearization, response of first order systems in series, interacting and non-interacting systems

UNIT – II

Response of Second Order Systems: Transient response of under damped, critically damped, over damped systems to step, impulse and sinusoidal forcing functions. Transportation lag

Control Systems: Negative and Positive feedback control systems, Servo and Regulatory control problems, Development of Block diagram, Controllers and final control elements, Ideal transfer functions of P, PI, PD and PID controllers

UNIT – III

Reduction of physical control systems to block diagrams. Closed loop transfer functions for servo and regulator problems. Overall Transfer functions for multi loop control systems. Transient response of simple control systems for servo and regulator problems, measurement lags. Stability of a control system by Routh's Criterion

UNIT – IV

Root Locus: concept of root locus, plotting of the root locus diagram for feedback control systems, Transient response of control system from root locus plot.

Frequency response: Bode diagrams for first order, first order system in series, second order systems and for controllers and transportation lag. Bode stability criterion. Gain margin and phase margin

UNIT – V

Advanced Control Strategies: Cascade Control, Feed Forward Control, Ratio control

Controller Tuning and Process Identification: ISE, ITAE, IAE, Ziegler – Nicholas and Cohen-Coon tuning methods, process identification by step, frequency and pulse testing.

Control valves: Construction, sizing, Characteristics and valve Positioner

Dynamics and control of Heat Exchangers (Lumped and Distributed parameter systems) and pH Process

Text Books:

1. Donald R. Coughanowr , Steven E LeBlanc, "Process Systems Analysis and Control", 3^{rd} edition, McGraw Hill Inc, 2009

Suggested Reading:

1. George Stephanopoulos , "Chemical Process Control: An Introduction to Theory and Practice", Prentice-Hall of India, 1984
2. Peter Harriott , "Process Control", Tata McGraw Hill Ltd.
3. Seborg, Edgar, Mellichamp& Doyle, "Process Dynamics and Control", 3^{rd} Edition, Wiley India Pvt. Ltd., 2014

CH 314

PROCESS HEAT TRANSFER

Instruction	4L Periods per week
Duration of University Examination	3 Hours
University Examination	75 Marks
Sessionals	25 Marks
Credits	3

Course Objectives:

1. To provide an overall view of different modes of heat transfer applicable to process industries.
2. To analyze an evaporator.
3. To impart the concept and functioning of different heat exchangers.

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

1. Distinguish between different types of heat transfer
2. Find out the rate of heat transfer with and without change of phase.
3. Decide the type of evaporator required for a specific purpose
4. Analyze the concepts of heat exchanger

UNIT - I

Modes of Heat Transfer – derivation of heat conduction equation in rectangular co-ordinates – one dimensional heat conduction without heat generation through plane, cylindrical and spherical walls – Resistance concept - situations involving conduction and convection – critical and optimum insulation thickness – Numerical problems on unsteady heat conduction through semi-infinite slab, infinite slab and cylinder – lumped capacity systems.

UNIT - II

Heat Transfer to Fluids Without Phase Change – forced convection in laminar flow over plates and in tubes – dimensional analysis. Correlations for heat transfer in turbulent flow, natural convection, Agitated vessels, packed beds – Analogy between heat and momentum transfer – Reynolds, Prandtl and Colburn analogies.

UNIT - III

Heat Transfer to Fluids With Phase Change – heat transfer from condensing vapors – Drop wise and Film wise condensation – Derivation and practical uses of Nusselt equation. Boiling of saturated liquid – maximum heat flux and critical temperature drop, minimum flux and film boiling. Typical heat exchange equipment – counter and parallel flows, energy balances, log-mean temperature difference and correction for mixed and cross flow – Rating of single and multiple heat exchangers – Description of extended surface heat exchangers.

UNIT - IV

Evaporators - Types– capacity and economy of evaporators – material and energy balances in evaporation – multiple effect evaporation and methods of feeding – Barometric leg, steam traps – heat transfer coefficients in evaporators – Description and working of crystallizers

UNIT - V

Radiation - Fundamentals of radiation heat transfer, laws of black body radiation, radiating heat exchange between non-black surfaces, combined heat transfer by conduction, convection and radiation, radiation shields

Text Books:

1. W.L.McCabe, ,J.C. Smith and P. Harriot, "Unit Operations Of Chemical Engineering", 7thEdition, Mc-Graw Hill, 2005

Suggested Reading:

1. Donald Q.Kern, "Process Heat Transfer", MGH publishers 1st Edition, 2001
2. J.P .Hollman, "Heat Transfer", 10th edition MGH publishers, 2011
3. J. Coulson and R.S Richardson, "Fluid Flow, Heat and Mass Transfer", Volume 1, 6th Edition , Pergoman Press, 2009
4. B.K.Dutta, "Heat Transfer Principles and applications", PHI publishers, 2004

CH 315

PROCESS INSTRUMENTATION

Instruction	4L Periods per week
Duration of University Examination	3 Hours
University Examination	75 Marks
Sessionals	25 Marks
Credits	3

Course Objectives:

1. To give fundamental concepts about different instruments in chemical process industries.
2. Detailed study of instruments and their applications that leads to safety of employee and industry.

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

1. Understand he working mechanism of important instruments used in process industry.
2. Learn the applications of various instruments in the required fields.

UNIT - I

Introduction: Importance of instrumentation, applications & their significance in chemical process industries

Instruments for analysis: Recording instruments, indicating and signaling instruments, instrumentation diagram.

Qualities of measurement: Elements of instruments, static and dynamic characteristics, basic concepts of response of first and second order type instruments.

UNIT - II

Flow Measurement: Head flow meters, open channel meters, area flow meters, flow of dry materials, viscosity measurement, level measurement, direct measurement of liquid level, level measurement in pressure vessels, measurement of interface level, level of dry materials.

UNIT - III

Expansion Thermometers: Mercury in glass thermometer, bimetallic thermometer, bimetallic, pressure spring thermometer, static accuracy and response of thermometers.

Temperature Measurement: Industrial thermocouples, thermocouple lead wires, thermocouple wells industrial resistance and digital thermometers, heat flux sensors fiber-optic sensors. Radiation receiving elements, radiation, photoelectric and optical pyrometers. Response of thermocouples

UNIT - IV

Pressure Measurement: Pressure, vacuum and head manometers, measuring elements for gauge pressure and vacuum, measuring pressure in corrosive liquids, static accuracy and response of pressure gauges.

UNIT - V

Composition Analysis: Spectroscopic analysis by absorption, infrared, UV and X-ray. Emission spectroscopy, Mass spectroscopy, color measurement by spectrometers. Gas analysis by thermal conductivity. Analysis of moisture in gases, wet bulb and dry bulb thermometer, dew point method, polarograph, gas & liquid chromatography, refract meter.

Text Books:

1. Donald P. Eckman. "Industrial Instrumentation", Wiley Eastern Ltd. 2004
2. Patranabis D. "Principles of Industrial Instrumentation", 2nd Edition, Tata McGraw-Hill Publishing Company, New Delhi, 1999

Suggested Reading:

1. William C. Dunn, "Fundamentals of Industrial Instrumentation and Process Control", 1st Edition, Tata McGraw-Hill Education Private Limited, 2009

CE 444

HUMAN VALUES AND PROFESSIONAL ETHICS
(common to all branches of B.E/B.Tech)

Instruction	21L Periods per semester (7 *3)
Duration of University Examination	2 Hours
University Examination	50 Marks
Sessionals	-
Credits	-

Course Objectives:
1. To develop the critical ability among students to distinguish between what is of value and what is superficial in life
2. To enable the students understand the values, the need for value adoption and prepare them meet the challenges
3. To enable the students develop the potential to adopt values, develop a good character and personality and lead a happy life
4. To motivate the students practice the values in life and contribute for the society around him and for the development of the institutions /organization around they are in.
5. To make the students understand the professional ethics and their applications to engineering profession

Course Outcomes:
1. Students develop the capability of shaping themselves into outstanding personalities, through a value based life.
2. Students turn themselves into champions of their lives.
3. Students take things positively, convert everything into happiness and contribute for the happiness of others.
4. Students become potential sources for contributing to the development of the society around them and institutions / organizations they work in.
5. Students shape themselves into valuable professionals, follow professional ethics and are able to solve their ethical dilemmas.

UNIT-1 Concepts and Classification of Values – Need and challenges for value Adoption

Definition of Values - Concept of Values - Classification of Values - Hierarchy of Values - Types of Values -Espoused and Applied Values - Value judgement based on Culture - Value judgement based on Tradition - Interdependence of Values

Need for value education - Findings of Commissions and Committees- Corruption and illegal practices - Science and Technology without values- Exploitation of nature - Increasing use of violence and intoxicants - Lack of education in values - Implications of education in values - Vision for a better India. Challenges for Value adoption - Cultural, Social, Religious, Intellectual and Personal challenges

UNIT – 2 Personal Development and Values in Life

Personal Development: Enlightened self-interest - Accountability and responsibility - Desires and weaknesses - Character development - Good relationships, self-restraint, Spirituality and Purity - The quest for Character - Tests of Character - The key to good character

Values in Life: Building an ethical policy - Integrating values in everyday life - Archaic Social Values - Parenting practices - Critical Thinking - Analyzing and Prioritizing values - Practicing Yoga and Meditation

UNIT – 3 Practicing Values for the Development of Society

Resentment Management and Self-analysis - Positive Thinking and Emotional Maturity - The importance of Women , Children and Taking care of them - Helping the poor and needy - Fighting against addictions and atrocities - Environmental awareness - Working for the Sustainable development of the society

Values in Education system: Present Scenario- Engineering education –Current trends- Need for quality improvement- Adoption of value education – Principles of Integrity-Institutional Development.

UNIT – 4 Basic Concepts of Professional Ethics

Ethics, Morals and Human life , Types of Ethics, Personal Ethics, Professional ethics, Ethical dilemmas, Indian and Global thoughts on ethics, Profession, Professional and Professionalism, Ethical role of a professional Basic ethical principles, Some basic ethical theories, use of ethical theories. Science, Religion Ethics, Genders and ethics, Media and ethics, Computer Ethics, Case Studies on Professional Ethics, Exemplary life sketches of prominent Indian personalities

UNIT-5 Ethics in Engineering Profession

Engineering profession-Technology and Society-Engineering as Social Experimentation-Engineering ethics-Ethical obligations of Engineering Professionals-Role of Engineers-Engineers as Managers-Professional responsibilities of Engineers- Engineers Responsibility for Safety- A few Case Studies on Risk management

Conflicts of Interest- Occupational Crimes- Plagiarism-Self plagiarism-Ethics Audit-Consideration for ethics audit-Ethics Standards and Bench Marking

Text Books:
1. Subramanian R., " Professional Ethics " , Oxford University Press , 2013
2. Nagarajan R.S., " A Text Book on Human Values and Professional Ethics " New Age Publications , 2007
3. Dinesh Babu S., " Professional Ethics and Human Values " , Laxmi Publications , 2007

Suggested Reading:
1. Santosh Ajmera and Nanda Kishore Reddy " Ethics , Integrity and Aptitude " ,Mc Graw hill Education Private Limited , 2014
2. GovindaRajan M., Natarajan S., Senthil Kumar V.S." Professional Ethics and Human Values " PHI Private Limited , 2012
3. Course Material for Post Graduate Diploma In "Value Education & Spirituality " Prepared by Annamalai University in Collaboration with Brahma Kumaris , 2010

CH 316

CHEMICAL REACTION ENGINEERING LABORATORY

Instruction	3 Periods per week
Duration of University Examination	3 Hours
University Examination	50 Marks
Sessionals	25 Marks
Credits	2

LIST OF EXPERIMENTS

(Minimum of 8 Experiments in the list are to be performed)

1. Studies in Batch Reactor: To find the Arrhenius form of temperature dependency of reaction.
2. Studies in Mixed Flow Reactor (CSTR) : To find kinetics from reactor performance of CSTR
3. Studies in Tubular Reactor: To determine the rate constant and to verify the order of reaction from performance of the reactor.
4. Studies in Tubular Reactors in series: To verify the performance of the reactor sections connected in series.
5. Mass Transfer with Chemical Reaction: (Liquid – Liquid Reaction System) To find out the mass transfer coefficient in a stirred cell: With chemical reaction and without chemical reaction.
6. Mass Transfer with Chemical Reaction: (solid – Liquid Reaction System)
7. To find the mass transfer co-efficient without chemical reaction and with chemical reaction.
8. R.T D Studies in Packed bed reactor: To determine the axial mixing (axial dispersion) in the packed column.
9. R T D Studies in Tubular Column To determine the variance of residence time distribution and the dispersion number in a tubular column
10. Studies in Batch Reactor: With Equimolar Feed (M = 1) : To determine the rate constant and to verify the order of reaction by differential method of analysis.
11. Studies in Batch Reactor: With Equimolar Feed (M = 1) : To determine the rate constant and to verify the order of reaction by integral method of analysis
12. Studies in Batch Reactor: With feed of Initial molar ratio (M) $\neq 1.0$: To determine the rate constant and to verify the order of reaction by differential method of analysis.
13. Studies in Batch Reactor: With feed of Initial molar ratio (M) $\neq 1.0$: To determine the rate constant and to verify the order of reaction by integral method of analysis
14. Studies in Batch Reactor for Partial method of analysis for a reversible reaction with effect of excess reactant on forward reaction
15. Studies in Batch Adiabatic Reactor: to determine the kinetics of an exothermic reaction from the Temperature of the reaction system.
16. Studies in Mixed Flow Reactors in series: To compare the actual & ideal performances of a Reaction system.
17. Studies in Packed bed: To determine the rate constant and to verify the order of reaction from performance of the reactor.

CH 317

PROCESS HEAT TRANSFER LABORATORY

Instruction	3 Periods per week
Duration of University Examination	3 Hours
University Examination	50 Marks
Sessionals	25 Marks
Credits	2

LIST OF EXPERIMENTS

(Minimum of 8 Experiments in the list are to be performed)

1. Determination of Thermal conductivity of given insulating powder under steady state conditions.
2. Determination of interface temperatures in composite wall under steady state conditions.
3. Determination of heat transfer coefficient in Natural convection.
4. Determination of overall heat transfer coefficient in unsteady conditions
5. Determination of inside heat transfer coefficient in coil heat exchangers
6. Determination of overall heat transfer coefficient and effectiveness of a Double pipe heat exchanger
7. Determination of heat transfer area in a 1-2- shell and tube heat exchangers
8. Determination of heat transfer coefficient on a single tube by film wise and drop wise condensation.
9. Determination of emissivity and Boltzmann's constant of a sample body
10. Determination of heat transfer coefficient in forced convection.
11. Determination of fin efficiency of longitudinal fins of extended surface
12. Determination of peak flux and critical temperature drop in pool boiling of saturated liquid
13. Determination of heat transfer coefficient of a pin fin under free convection.
14. Determination of heat transfer coefficient of a pin fin under forced convection

EG 221

SOFT SKILLS AND EMPLOYABILITY ENHANCEMENT
(common to all branches of B.E and B.Tech)

Instruction	2 Periods per week
Duration of University Examination	3 Hours
University Examination	50 Marks
Sessionals	25 Marks
Credits	1

Course Objectives: To help the students

1. Participate in group discussions with confidence and to make effective presentations. Also to learn the art of communication.
2. With- resume packaging, preparing and facing interviews.
3. Build an impressive personality through effective time management & goal setting, self confidence and assertiveness.
4. Understand what constitutes proper grooming and etiquette in a professional environment. Also to understand academic ethics and value systems.

Course Outcomes: The students will be able to

1. Be effective communicators and participate in group discussions with confidence. Also be able to make presentations in a professional context.
2. Write resumes, prepare and face interviews confidently.
3. Be assertive and set short term and long term goals. Also learn to managetime effectively and deal with stress.
4. Make the transition smoothly from campus to corporate. Also use media with etiquette and know what academic ethics are.

Exercise 1

Communicative Competence – The Art of Communication, basic grammar, Indianisms, Effective listening skills, using English in different situations

Exercise 2

Group Discussion – dynamics of group discussion, intervention, summarizing, modulation of voice, body language, relevance, fluency and coherence

Elements of effective presentation – Structure of presentation – Presentation tools – Body language

Creating an effective PPT

Exercise 3

Interview Skills – Resume‟ writing – structure and presentation, planning, defining the career objective, projecting ones strengths and skill-sets

Interview Skills – concept and process, pre-interview planning, opening strategies, answering strategies, mock interviews

Exercise 4

Personality Development – Effective Time Management, setting realistic goals, self confidence and assertiveness, stress management, moral values.

Exercise 5

Corporate Culture – Grooming and etiquette, communication media etiquette

Academic ethics and integrity

Suggested Reading:

1. Madhavi Apte , “A Course in English communication”, Prentice-Hall of India, 2007
2. Leena Sen , “Communication Skills”, Prentice-Hall of India, 2005
3. Dr. ShaliniVerma, “Body Language- Your Success Mantra”, S Chand, 2006
4. Edgar Thorpe and ShowickThorpe , “Objective English”,2nd edition, Pearson Education, 2007
5. Ramesh, Gopalswamy, and Mahadevan Ramesh, “The ACE of Soft Skills”, New Delhi: Pearson, 2010
6. Gulati and Sarvesh, “ Corporate Soft Skills”, New Delhi: Rupa and Co. , 2006
7. Van Emden, Joan, and Lucinda Becker, “Presentation Skills for Students”, New York: Palgrave Macmillan, 2004
8. Covey and Stephen R, “The Habits of Highly Effective People”, New York: Free Press, 1989

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY
CHEMICAL ENGINEERING
B.Tech III – Year

I – Semester

THEORY						
S. No	**Code**	**Subject**	**L**	**T**	**P**	**Credits**
1	CH 311	Chemical Reaction Engineering - II	4	0	0	3
2	CH 312	Mass Transfer Operations - I	4	0	0	3
3	CH 313	Process Dynamics and Control	4	0	0	3
4	CH 314	Process Heat Transfer	4	0	0	3
5	CH 315	Process Instrumentation	4	0	0	3
6	CE 444	Human Values and Professional Ethics	2*	0	0	0
PRACTICALS						
7	CH 316	Chemical Reaction Engineering Lab	0	0	3	2
8	CH 317	Process Heat Transfer Lab	0	0	3	2
9	EG 221	Soft Skills and Employability Enhancement	0	0	2	1
TOTAL			**22**	**00**	**08**	**20**

L: Lecture, T: Tutorial, D: Drawing, P: Practical
* 21 periods per semester

II – Semester

THEORY						
S. No	**Code**	**Subject**	**L**	**T**	**P**	**Credits**
1	CH 321	Bio-Chemical Engineering	4	0	0	3
2	CH 322	Chemical Engineering Thermodynamics - II	4	0	0	3
3	CH 323	Energy Engineering	4	0	0	3
4	CH 324	Process Modeling Simulation And Optimization	4	0	0	3
5	CH 351 CH 352	**Elective - I** Surface Coatings Technology Technology of Vegetable oils and Fats	4	0	0	3
PRACTICALS						
6	CH 325	Process Dynamics and Control Lab	0	0	3	2
7	CH 326	Process Modeling Simulation And Optimization Lab	0	0	3	2
8	CH 355 CH 356	**Elective - I Lab** Surface Coatings Technology Lab Technology of Vegetable oils and Fats Lab	0	0	3	2
9		Industrial visit	0	0	0	0
TOTAL			**20**	**00**	**09**	**21**

CH 321

BIO-CHEMICAL ENGINEERING

Instruction	4L Periods per week
Duration of University Examination	3 Hours
University Examination	75 Marks
Sessionals	25 Marks
Credits	3

Course Objectives:
1. To apply the principles of Chemical Engineering to bioprocesses.
2. Conduct an analysis on the biological factors that are important in the design, operation, performance, and/or monitoring of a biological process

Course Outcomes: On successful completion of this module, students should be able to
1. Describe the basic structure and function of cells & Relate cell function to products and processes useful to man
2. Identify and explain the basic features of bioreactors
3. Describe the principles of the various separation procedures involved in the downstream processing of products

UNIT – I

Introduction to Biochemical Engineering, Molecular Biology& Bio Chemistry

Biochemical Engineering Principles, Biophysics and cell doctrine: Atomic Theory and Cell Theory,Important cell types, structure and functions of a typical cell and their components,Transport across cell membranes: Passive and facilitated diffusion, Active transport. Structure and functions of Bio Molecules: Carbohydrates, lipids, Nucleotides to Nucleic Acids - R N Aand DNA, Amino acids to Proteins - the building blocks of biochemical life.Biosynthesis and Metabolic Pathways: Biosynthesis of Small and Macro Molecules Introduction ofmetabolic pathways and end products of glucose metabolism.

UNIT – II

Introductory Microbiology

Introduction to Microbiology: Classification and Industrial uses of MicroorganismsGrowth and Reproduction of Microbes: Growth cycle phases for batch cultivation. Monod's growthkinetics – Growth Rate dependant classification of Microorganisms.Microbial Genetics: Recombinant DNA technology and mutant populations. Multiple Interacting Microbial populations: Neutralism, Mutualism, Commensalism, Amesanalism, Predatism and Parasitism

UNIT – III

Enzyme Technology

Enzymology: Enzymes as Biocatalysts - The enzyme substrate complex and enzyme action and Classification of Enzymes based on Functions. Kinetics of Enzyme Catalyzed Reactions: Simple enzyme kinetics with one and two substrates. Determination of rate constants, substrate activation and inhibition, modulation and regulation of enzyme activity / effect of PH and temp on enzyme activity. Immobilized Enzyme Technology: Types of Enzyme immobilization, Immobilized enzymes in industrial processes, Cofactors, Apo-enzymes and Coenzymes utilization and regeneration

UNIT – IV

Bioreactors and Down Stream Techniques - Introduction

Design and Analysis of Biological Reactors: Batch and CSTR reactors, Enzyme reactors Ideal Reactors for kinetic measurements: The ideal batch reactor / The ideal continuous flow stirred tank reactor - Alternate bio-reactor configurations Separation Processes: Filtration, Centrifugation, Adsorption, Reverse osmosis, Dialysis, Electrophoresis, Sedimentation and Extraction Purification Processes: Precipitation, Crystallization, and Chromatography

UNIT – V

Bioprocess Technology

Fermentation Technology: Types of Fermentation - Anaerobic and Aerobic Fermentation process. Surface and Submerged Fermentation process Medium formulation and Culture Propagation: Media composition and Sterilization, Inoculum's culture development under aseptic conditions of transfer. Environmental biotechnology: Effluent treatment. Industrial Biotechnology: Commercial enzymes, Antibiotics and single cell protein

Text Books:

1. James, E.Bailey and David F Ollis, "Biochemical Engineering fundamentals", 2ndEdition, McGraw-Hill Internal Edition.1986

Suggested Reading:

1. Michael L. Shuler and FikretKargi, "*Bioprocess Engineering: Basic Concepts"*. Second Edition Prentice Hall, 2002

CH 322

CHEMICAL ENGINEERING THERMODYNAMICS – II

Instruction	4L Periods per week
Duration of University Examination	3 Hours
University Examination	75 Marks
Sessionals	25 Marks
Credits	3

Course Objectives: This course helps the students to understand

1. VLE for binary mixtures.
2. To generate T-x-y and P-x-y, from the fundamentals of equilibrium and properties of fluid.

Course Outcomes: The students will be able to

1. Generate VLE data for binary mixtures for ideal and non- ideal systems
2. to determine equilibrium constant and composition of product mixture at given temperature and pressure

UNIT - I

Criterion of Phase Equilibrium: Fundamental property relations, Chemical potential, Partial Properties, Relation between Partial Properties and Molar properties, Fugacity, Fugacity Coefficients, Determination of Fugacity Coefficient by equations of states (Virial, Van der Waal, R.K. equation.)

UNIT - II

Solution Thermodynamics: Fugacity of pure liquids, Fugacity for Mixtures, Poynting factor, Residual Properties, Excess Properties, Lewis Randall Rule, Activity Coefficients, Heat Effects of mixing.

UNIT - III

The Nature of Phase Equilibrium: The Phase Rule, Duhem's Theorem, Models to calculate Activity Coefficients (Margules Equation, Van-laar, Wilson), Introduction to UNIQUAC, UNIFAC. Method to get activity coefficients (Margules and Van laar) by using Excess Gibbs Free Energy models

UNIT - IV

Application of Phase Equilibrium: To get T-x-y, P-x-y, Using Raoult's law, Modified Raoult's law for binary mixtures, following methods of BUBBL-T, Dew-T, BUBBL-P, DEW-P. Algorithm to find VLE by Peng- Robinson, R-K- Equation

UNIT - V

Chemical Reaction Equilibrium: Reaction Coordinate, Equilibrium criteria for chemical reactions, equilibrium constant and effect of temperature , temperature and pressure effects on conversion, Calculation of equilibrium conversion for single reactions in homogenous and heterogeneous systems, Duhem's Theorem for reacting systems, simple examples of multi-reaction equilibrium

Text Books:

1. J M Smith and H C VanNess, "Introduction to Chemical Engineering Thermodynamics", McGraw Hill, International Edition, Fourth edition, 1987

Suggested Reading:

1. Pradeep Ahuja, "Chemical Engineering Thermodynamics" , PHI Publishers, EEE, 2009
2. YVC Rao, "Chemical Engineering Thermodynamics" Universities Press , 2003

CH 323

ENERGY ENGINEERING

Instruction	4L Periods per week
Duration of University Examination	3 Hours
University Examination	75 Marks
Sessionals	25 Marks
Credits	3

Course Objectives:
1. Introduce the importance of energy sources
2. To explore the challenges facing and solutions found by energy engineers.
3. To introduce students to energy efficiency and renewable energy resources and how to develop a sustainable energy plan.

Course Outcomes: On successful completion of this module, students should be able to:
1. Understand scope of energy engineering
2· Quantify how much energy is available from renewable sources
3. Understand how deep energy efficiency improvements may be achieved

UNIT – I
Introduction: Introduction to conventional and non conventional energy sources, their significance & availability, consumption patterns in India.Energy survey and policies for India.

UNIT – II
Conventional Energy Sources:
Wood and Wood Charcoal, products of wood carbonization
Coal and Coal derived fuels, characteristics, production methods and uses.
Oil and Gases: Fuels derived from oil and gases, Characteristics, production methods and uses. Technology for combustion of fuels derived from oil and gas.
Shale oil and gas, oil sands.

UNIT – III
Non conventional Energy Sources:
Selective surfaces for solar Energy Conversion: Introduction. Heat balance. Physical Characteristics of Selective Surfaces
Use of Selective Solar Energy Collectors, Anti-Reflection Coatings,
Solar Reflector Materials, Selective and Non-Selective Surfaces. Types of Selective coatings, Intrinsic Solar Selective Materials
Photo Voltaic Cells: Introduction: Types of Solar Cells. Applications, Electrical Storage. Future developments
Wind-power: Introduction. Basic principles of wind energy conversion. Types of wind machines
Wave power: Introduction, advantages and disadvantages, energy and power from the waves. Wave energy conversion devices

UNIT – IV
Bio Fuels : Introduction. Bio mass conversion technologies. Wet processes, dry processes.Bio-gas generation. Factors affecting bio-digestion. Classification of biogas plants
Production methods, characteristics, uses of biodiesel, biobutanol, bioethanol
Second generation biofuel feed stocks
Fuel Cells: Working principle, Types, Advantages, Current and Future Applications.

UNIT - V
Nuclear Energy: Nuclear fission fuels processing, nuclear reactions and nuclear reactors
Energy Storage and Distribution: Mechanical Energy Storage, Hydroelectric Storage, Compressed Air Storage and Energy Storage via Flywheels. Electric Storage , Chemical Storage ,Thermal Energy Storage.

Text Books:
1. G D Rai, "Non -conventional energy sources," Khanna Publishers,4th edition, 2000
2. Samir Sarkar, "Fuels and Combustion", Universities Press,3rd Edition 2009

Suggested Reading:
1. Om Prakash Gupta, "Fundamentals of Nuclear Power Reactors", Khanna Publishers,
2. S Srinivasan, "Fuel Cells: From Fundamentals to Applications", Springer, 2006

CH 324

PROCESS MODELING SIMULATION AND OPTIMIZATION

Instruction	4L Periods per week
Duration of University Examination	3 Hours
University Examination	75 Marks
Sessionals	25 Marks
Credits	3

Course Objectives:

1. This course is helpful to learn the formulation of a mathematical process model through the application of material and energy balance.
2. Students are introduced to mathematical solution procedures like numerical methods and optimization techniques to solve the formulated process models**.**
3. The course is helpful to provide know-how on process simulation software required in chemical engineering field.

Course Outcomes:

1. The students gain the ability to analyze, formulate and apply the basic fundamentals of mathematics like numerical methods & programming languages to solve problems related to chemical processes
2. The course helps the students to understand the steps involved in applying process simulation software packages for design, solution and optimization that are a prerequisite for the development of process flowsheets

Note: The Programs are to be written in "MATLAB"

UNIT – I Formulation of Process Models

Definition of mathematical models, introduction to process models, types, uses, scope of coverage, principles of formulation, conservation principles of mass and energy laws.

Application of fundamental laws to develop: Total and component continuity equations, energy equation, momentum equation, chemical kinetic rate expressions.

UNIT – II Numerical Solutions of Linear and Non-linear process models

Uses, comparison and computational significance for problem solving in chemical engineering for:

Set of linear simultaneous equations by Gauss-Elimination, Gauss-Jordan and Gauss-Seidel methods.

Set of non-linear equations by Bi-section, Reguli-falsi and Newton Raphson methods.

UNIT – III Curve-fitting and Numerical Solutions of Ordinary Differential Process Models

Computational features and problem solving in chemical engineering for:Curve-fitting by Linear and nonlinear least square analysis,

Set of ordinary differential equations by Euler's modified Euler's and RungeKutta methods.

UNIT – IV Chemical Process Optimization

Nature and organization, basic concepts and elements of Optimization, single variable functions, direct, indirect and random search methods – with and without acceleration

Elimination methods for unrestricted and exhaustive search, Fibonacci search, Dichotomous search, Golden-section (gradient) search methods

UNIT – V Simulation of Chemical Processes

Process modeling, MATLAB programming and use of Process Simulator like CHEMCAD on:Gravity flow tank, Batch reactor, Three CSTRs in series, Gas-pressurized CSTRs, Two-heated tanks, Heat-exchangers, Distillation columns, Packed-bed columns.

Text Books:

1. William L Luyben, "Process Modeling, Simulation and Control for Chemical Engineers", McGraw Hill Publishing Company,2nd edition, 1990
2. Edger T.E., and Himmelbau D.M., "Optimization of chemical processes", McGraw Hill international edition, 1988

Suggested Reading:

1. Steven C. Chapra and Raymond P Canale, "Numerical methods for Engineers", McGraw Hill International, 2nd edition, 1988
2. S.S. Rao, "Engineering Optimization"
3. Mickley H.S., Sheerwood T.K., Reed C.E., "Applied mathematics in Chemical Engineering", McGraw Hill, New York, 1957

CH 351

SURFACE COATING TECHNOLOGY
(Elective - I)

Instruction	4L Periods per week
Duration of University Examination	3 Hours
University Examination	75 Marks
Sessionals	25 Marks
Credits	3

Course Objectives:
To give fundamental concepts in pigments, extenders, binders, solvents, paint formulation, paint applications, manufacturing of different paints, special type paints, paint tests and paint defects.

Course Outcomes:
The students will be able to distinguish the differences between various types of paints and their composition.
The applicability of different paints for industrial purposes can be decided.

UNIT-I
Introduction: Surface coatings- Scope, properties, applications & uses. Major components of surface coatings. Fundamentals of film formation
Classification of Paints: Air drying paints, stoving paints, their properties and uses. Liquid paints & powder paints, their properties & uses. Varnishes, Lacquers, resin their properties & uses.
Manufacture of Paints: Distempers- Manufacture, properties & uses. Powder Paints- Manufacture, properties & uses. Enamel - Manufacture, properties & uses.

UNIT – II
Pigments: Importance of pigments - their basic properties, uses & their applications.
Classification of pigments: Inorganic & organic pigments.
Special properties of pigments: Criteria for selection of color, tinting strength, fastness to light, bleeding, hiding power, refractive index, particle size & anti-corrosive properties.
Manufacture of Pigments: Titanium di-oxide, Zinc Oxide, Carbon black, red lead, Ultramarine blue, Prussian blue, Zinc chrome.

UNIT – III
Extenders: Importance, properties & significance.
Manufacture of Extenders: Blanc fixe, China clay, Gypsum, Mica & talc.
Solvents: Importance, uses & their properties,
Manufacture of solvents: Turpentine, di-pentene, pionoid, alcohols.
Natural Resins: Resin &shallock. Synthetic Resins: Alkyd resins, phenolic resins, amino resins.

UNIT – IV
Application methods of paints: Air drying paints, industrial liquid stoving paints & industrial stoving powder paints. Brush application, spray application, electrostatic spray application. Dip coating, Roller coating & electro deposition coating.
Testing of Paints: Wet paint & dry paint testing film thickness, adhesion & resistance coverage. Defects in paints & paintings & their remedies: defects in grinding skinning, sagging, bleeding, flooring, floating, brushing, orange peel, fish eye, brush marks, lifting.

UNIT – V
Special Coatings: Importance, Significance & their applications.
Powder Coatings, Water soluble coatings, Water Borne coatings, heat resistant coatings, automatic coatings, fire retardant coatings, space & air craft coatings & swimming pool coatings.

Text Books:
1. W.M. Morgans, “Outline of Paint Technology”, Edward Arnold Publishers, London, 1990
2. R. Lambourne& T A Strivens, “Paint & Surface coatings”, Second edition, 1999

Suggested Reading:
1. Patton Temple, “C Pigment Flow & Pigment Dispersion”, Wiley Inter science, 1979
2. Swaraj Paul, “ Surface Coatings science and technology” , 1995

CH 352

TECHNOLOGY OF VEGETABLE OILS AND FATS
(ELECTIVE – I)

Instruction	4L Periods per week
Duration of University Examination	3 Hours
University Examination	75 Marks
Sessionals	25 Marks
Credits	3

Course Objectives:

1. To impart knowledge about sources, types and composition of oils and fats
2. To comprehend the physicochemical characteristics
3. To familiarize the students about extraction and processing
4. To study the production of value added products from oils and fats

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

1. Analyze the various properties of fats and oils to determine their use in food, soap and other industries
2. Identify unit operations involved in extraction and refining processes
3. Will know about the degradation occurring during storage of oils and fats and prevention methods

UNIT – I

Introduction: Position of Oils & Oilseeds in India & world, definition, structure, composition of oils and fats, distinction between oils and fats

Glycerides: Definition and types – Simple, mixed triglycerides, mono and diglycerides, Distribution of fatty acids in glyceride molecule

Fatty Acids: Saturated fatty acids, unsaturated fatty acids (Fatty acids with one, two, three and more double bonds) Fatty acids of unusual structure: Hydroxyl and di-hydroxy acids - Acetylene acids – Epoxy acids and keto acids

Non-glyceride Components: Phosphatides, sterols, pigments, tocopherols, tocotrienols, oryzanol, β-carotene, squalene

UNIT – II Classification of Oils and Fats

Classification of Oils and Fats with Examples, Physical and chemical properties (structure indices – iodine value, saponification value, hydroxyl value) of oil and fats, detailed glyceride composition

Industrial Utilization of the following oils – palm, palm kernel, coconut, cotton seed, peanut, sunflower, safflower, sesame, rice bran, rapeseed and mustard, linseed (flax seed), soya been, Tung, castor oil, lard, tallow and fish

Nontraditional oils like neem, karanja and jatropafor industrial applications

UNIT– III Chemical Reactions of Oils and Fats

Reactions in the fatty acid chain - Hydrogenation, Oxidation reactions.Esterification andInteresterificationSopanification, formation of metal soaps ,Hydrogenolysis, formation of fatty amines, fatty amides and fatty chlorides, Halogenation, Addition of maleic anhydride, sulfation, sulfonation Chemical oxidation(hydroxylation), atmospheric oxidation (rancidity), Polymerization, Isomerisation and Reaction of hydroxyl groups

UNIT – IV Storage, Pretreatment and Extraction of Oil Seeds: Mechanical expression of oil – extruder expander, Solvent extraction, Fat Splitting (chemical and enzymatic methods)

UNIT – V Chemical and Physical Refining: De-gumming, neutralization, refining losses, Miscella refining, Bleaching, dewaxing, Deacidification and Deodorization

Partial and Total Hydrogenation: Mechanism, selectivity, continuous process, preparation of Raney Nickel catalyst. Products of hydrogenation - anaspati, Margarine and Shortening

Soap Manufacture: Raw materials required , selection of raw materials – Full boil process

Concepts about surfactants, detergents, cosmetics, lubricants, biodiesel, Regulations of FSSAI related to oils and fats

Text Books:

1. Ed. D Swern, "Bailey's Industrial Oils and Fats Products" , Wiley Inter Science publication, N.Y. John Wiley and Sons ,6th Edition, 2006

Suggested Reading:

1. M M Chakrabarty , "Chemistry and Technology of Oils and Fats", Allied Publishers Pvt.Ltd., 1st Edition, 2007
2. O P Narula, "Treatise on fats,Fatty acids and Oleochemicals", Vol I and II, Industrial Consultants (India), 1994
3. R J Hamilton , "Recent Advances in Chemistry and Technology of Fats and Oils", Elsevier Applied Science 1987

CH 325

PROCESS DYNAMICS AND CONTROL LABORATORY

Instruction	3 Periods per week
Duration of University Examination	3 Hours
University Examination	50 Marks
Sessionals	25 Marks
Credits	2

List of Experiments:

1. Determination of order, time constant, and dynamic lag of a first order system
2. Determination of frequency response of a first order system
3. Determination of Bode plot from dynamic studies of first order system
4. Study the effect of PID controller parameters on closed loop servo response
5. Feedback controller tuning by Zeigler-Nicolas and Cohen Coon Methods
6. Determination of order, time constants, interaction effective time constant of interacting liquid level system
7. Determination of order, time constants of two tank non-interacting liquid level system
8. Determination of order, time constants, interaction, effective time constants and dynamic lag of a second order system
9. Determination of second order under damped characteristics from the dynamics of second order system (manometer)
10. Determination of pneumatic valve characteristics
11. Study of Cascade control system
12. Evaluation of model based nonlinear control on continuous bioreactor with input multiplicities
    a. Calculation of overall heat transfer coefficient and effectiveness of the given heat exchanger
    b. Study of dynamics of heat exchanger

Note: 1. Experiments (1 to 5) can be designed on any of the following computer controlled systems.
   a. Liquid-Level
   b. Flow
   c. Temperature
   d. Pressure
   e. Jacketed stirred tank

2. Minimum of 8 experiments have to be performed

CH 326

PROCESS MODELING SIMULATION AND OPTIMIZATION LABORATORY

Instruction	3 Periods per week
Duration of University Examination	3 Hours
University Examination	50 Marks
Sessionals	25 Marks
Credits	2

Course Objectives:

1. The laboratory sessions equip the students in computer aided problem solving. The sessions are further helpful in interpreting the results and to write technical reports in the form of lab records.
2. The course aims to provide the students with opportunity to run simple process simulators for the study of design and analysis of processes or equipment in chemical plant operation.
3. The lab sessions aim to provide an opportunity for team work in solving chemical engineering related simple problems.

Course Outcomes:

1. The students are able to express the experimental data in the form of suitable mathematical correlations and estimate the coefficients involved.
2. In the lab, the students are exposed to process simulation of common chemical engineering unit operations.
3. The students are able to work as a team and develop process models as well as apply their mathematical skills to solve them.

Note: The Programs are to be written in "MATLAB"

PART – A: INTRODUCTION

Basics of theoretical modeling, and Numerical solutions for Process Calculations:

1. Solution of ordinary differential equations by Euler`s, Modified Euler`s, Runge-Kutta methods
2. Solution of set of linear simultaneous equations by Gauss-elimination, Gauss-Jordan and Gauss-Seidel methods
3. Solution of non-linear equations by bisection, Regular-Falsi and Newton Raphson methods
4. Linear and Non-linear Least square analysis

PART – B: APPLICATION

(A minimum of 4 process systems to be simulated)

1. Series of isothermal, constant holdup CSTRs
2. Two heated Tanks
3. Gas-Phase Pressurized CSTR
4. Batch Reactor - Adiabatic or Isothermal
5. Ideal Binary distillation
6. Vapor Liquid Equilibrium : Bubble Point and Dew Point Calculations

PART – C: PROCESS SIMULATORS

Application of process simulation software packages like ChemCAD for:
understanding the basic concepts, steps involved for developing process flowsheet

Suggested Reading:

1. William L Luyben, “Process Modelling, Simulation and Control for Chemical Engineers”, McGraw Hill, 2nd edition 1990
2. B Wayne Bequette, “Process Modelling Analysis and Simulation”, Prentice Hall International Series, 1998
3. Steven C Chapra and Raymond P Canale, “Numerical methods for Engineers”, McGraw Hill, 2nd edition, 1988

CH 355

SURFACE COATING TECHNOLOGY LAB
(ELECTIVE - I LAB)

Instruction	3 Periods per week
Duration of University Examination	3 Hours
University Examination	50 Marks
Sessionals	25 Marks
Credits	2

Course Objectives

To understand the theoretical concepts of organic surface coating technology (Paints) the experimental procedure were designed like preparation of M.S. panels for painting, viscosity tests, adhesion tests, impact tests, gloss tests, thickness tests, paint spreading capacity tests and corrosion tests.

Course Outcomes:

With the conceptual experimental procedures, analysis with theoretical and experimental values and with good evaluation procedures, the students are made to be perfect in analytical skills and then these skills are useful to them in industries.

LIST OF EXPERIMENTS
(Minimum of 8 experiments are to be performed)

1. Preparation of panels for painting
2. Determination of apparent viscosity of paints, varnished lacquers and viscous products
3. Using B-4 ford cup (type I S . 101/IS 3944/BS 3900) - Determination of resistance to scratching under a specified load of a dried film of paint (as Per IS . 101)
4. Measurement of paint film thickness using dry film thickness gauge of a first coat (primer Paint) and second coat (finish paint)
5. Determination of flexibility and adhesion of the paints (as per 101 BS 3960 m and size ¼)
6. Determination of impact resistance of the painted panel
7. Measurement of hardness of magnesium phosphate coating
8. Measurement of gloss of painted film at 45 degree angle
9. Determination of drying consistency of different paints and varnishes
10. Determination of coverage or spreading capacity of different paints

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CH 356

TECHNOLOGY OF VEGETABLE OILS AND FATS LABORATORY
(ELECTIVE – I LAB)

Instruction	3 Periods per week
Duration of University Examination	3 Hours
University Examination	50 Marks
Sessionals	25 Marks
Credits	2

List of Experiments:

1. Determination of Acid value of given oil sample
2. Determination of percentage of free fatty acid present in given sample and its acid value
3. Determination of iodine value of given oil sample
4. Determination of saponification value of given oil sample
5. Determination of the hydroxyl value of given oil sample
6. Determination of unsaponifiable matter of given oil sample
7. Determination of oil content in oil seeds
8. Determination of slip melting point of Fats (Ex: vanaspati, tallow)
9. Determination of the percentage of moisture and any materials volatile under the conditions of test
10. Determination of Total Fatty Matter (TFM) in soaps

Note: Minimum of 8 experiments have to be performed