BAPATLA ENGINEERING COLLEGE : BAPATLA
(Autonomous)
SCHEME OF INSTRUCTION & EXAMINATION
FOR
CHEMICAL ENGINEERING
w.e.f 2010-2011 (Semester System)

First Year B.Tech., (SEMESTER – I)

Code No.	Subject	Scheme of Instruction (Periods per week)			Scheme of Examination (Maximum marks)			No. of Credits
		Theory	Tutorial	Lab	CA	FE	Total Marks	
CH111 / MA01	Mathematics-I	4	1		40	60	100	4
CH112 / PH01	Engineering Physics-I	3	1		40	60	100	3
CH113 / CY01	Engineering Chemistry-I	3	1		40	60	100	3
CH114 / EN01	English Language and Communication	3	1		40	60	100	3
CH115 / BT01	Environmental Studies	3			40	60	100	3
CH116 / ME01	Engineering Graphics	3	3		40	60	100	3
CH151 /PHL01	Physics Laboratory-I	-	-	3	40	60	100	2
CH152 / CYL01	Chemistry Laboratory-I	-	-	3	40	60	100	2
CH153/MEL01	Work Shop	-	-	3	40	60	100	2
	TOTAL	19	7	9	360	540	900	25

CA: Continuous Assessment **FE:** Final Examination

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First Year B.Tech., (SEMESTER – II)

Code No.	Subject	Scheme of Instruction (Periods per week)			Scheme of Examination (Maximum marks)			No. of Credits
		Theory	Tutorial	Lab	CA	FE	Total Marks	
CH121 / MA02	Mathematics-II	4	1		40	60	100	4
CH122 / PH02	Engineering Physics-II	3	1		40	60	100	3
CH123 / CH02	Engineering Chemistry-II	3	1		40	60	100	3
CH124	Introduction to Chemical Engineering	3	1		40	60	100	3
CH125 / CE01	Engineering Mechanics	4	1		40	60	100	4
CH126 / CS01	Computer Programming with C	4	1		40	60	100	4
CH161 / PHCYL01	Physics& Chemistry Laboratory-II	-	-	3	40	60	100	2
CH162 /ENL01	English Language Laboratory	-	-	3	40	60	100	2
CH163 / CSL01	Computer Programming Lab	-	-	3	40	60	100	2
	TOTAL	21	6	9	360	540	900	27

CA: Continuous Assessment **FE:** Final Examination

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Second Year B.Tech., (SEMESTER – I)

Code No.	Subject	Scheme of Instruction (Periods per week)			Scheme of Examination (Maximum marks)			No. of Credits
		Theory	Tutorial	Lab	CA	FE	Total Marks	
CH211/MA03	Mathematics-III	4	-		40	60	100	4
CH212/EE01	Electrical & Electronics Engineering	3	1		40	60	100	3
CH213/CY03	Organic Chemistry	4	1		40	60	100	4
CH214	Material Technology	4			40	60	100	4
CH215	Material & Energy Balance	4	1		40	60	100	4
CH216	Momentum Transfer	4	1		40	60	100	4
CH251/EEL01	Electrical & Electronics Engineering Laboratory	-	-	3	40	60	100	2
CH252/CYL02	Organic Chemistry Laboratory	-	-	3	40	60	100	2
CH253	Momentum Transfer Laboratory	-	-	3	40	60	100	2
	TOTAL	23	4	9	360	540	900	29

CA: Continuous Assessment **FE:** Final Examination

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FOR
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w.e.f 2010-2011 (Semester System)

Second Year B.Tech., (SEMESTER – II)

Code No.	Subject	Scheme of Instruction (Periods per week)			Scheme of Examination (Maximum marks)			No. of Credits
		Theory	Tutorial	Lab	CA	FE	Total Marks	
CH221/MA06	Probability & Complex Analysis	4	-		40	60	100	4
CH222/ME02	Applied Mechanics & Mechanical Engineering	3	1		40	60	100	3
CH223	Process Heat Transfer	4	1		40	60	100	4
CH224	Chemical Engineering Thermodynamics-I	4	1		40	60	100	4
CH225	Mechanical Unit Operations	4	1		40	60	100	4
CH226	Process Instrumentation	4	0		40	60	100	4
CH261	Process Heat Transfer Lab	-	-	3	40	60	100	2
CH262	Mechanical Operations Laboratory	-	-	3	40	60	100	2
CH263/MEL02	Mechanical Engineering Lab	-	-	3	40	60	100	2
	TOTAL	23	4	9	360	540	900	29

CA: Continuous Assessment **FE:** Final Examination

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w.e.f 2010-2011 (Semester System)
Third Year B.Tech., (SEMESTER – V)

Code No.	Subject	Scheme of Instruction (Periods per week)			Scheme of Examination (Maximum marks)			No. of Credits
		Theory	Tutorial	Lab	CA	FE	Total Marks	
CH 311	Mass Transfer operations-I	4	1		40	60	100	4
CH 312	Energy Engineering	3	1		40	60	100	3
CH 313	Chemical Engineering Thermodynamics-II	3	1		40	60	100	4
CH 314	Chemical Reaction Engineering-I	4	1		40	60	100	4
CH 315	Chemical Technology	3	1		40	60	100	3
CH 316	Process Dynamics and Control	4	1		40	60	100	4
CH 351	Instrumentation & Process Control Lab	-	-	3	40	60	100	2
CH 352	Mass Transfer operations lab-I	-	-	3	40	60	100	2
CH 353/ CYL03	Chemical Technology Laboratory	-	-	3	40	60	100	2
	TOTAL	21	6	9	360	540	900	27

FE: Final Examination **CA: Continuous Assessment**

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w.e.f 2010-2011 (Semester System)
Third Year B.Tech., (SEMESTER – VI)

Code No.	Subject	Scheme of Instruction (Periods per week)			Scheme of Examination (Maximum marks)			No. of Credits
		Theory	Tutorial	Lab	CA	FE	Total Marks	
CH 321	Mass Transfer Operations-II	4	1		40	60	100	4
CH 322	Chemical Process Equipment and Design-I	4	1		40	60	100	4
CH 323	Industrial Pollution Control Engineering	3	1		40	60	100	3
CH 324	Chemical Reaction Engineering-II	4	1		40	60	100	4
CH 325	Process Modeling & Simulation	3	1		40	60	100	3
CH 326	Elective-I	3	1		40	60	100	3
CH 361/ ENL02	Soft Skills lab	-	-	3	40	60	100	2
CH 362	Mass Transfer Operations Laboratory-II	-	-	3	40	60	100	2
CH 363	Chemical Reaction Engineering Laboratory	-	-	3	40	60	100	2
	TOTAL	21	6	9	360	540	900	27

CA: Continuous Assessment **FE: Final Examination**

Elective-I:

CH326 (A): Membrane Technology CH326 (B): Nano Technology

CH326 (C): Polymer Technology CH326 (D): Particulate Technology

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Final Year B.Tech., (SEMESTER – VII)

Code No.	Subject	Scheme of Instruction (Periods per week)			Scheme of Examination (Maximum marks)			No. of Credits
		Theory	Tutorial	Lab	CA	FE	Total Marks	
CH 411/ ME05	Industrial Management & Entrepreneurship Development	3	1		40	60	100	4
CH 412	Chemical Process Equipment Design-II	4	1		40	60	100	4
CH 413	Transport Phenomenona	4	1		40	60	100	4
CH 414	Bio-Chemical Engineering	3	1		40	60	100	3
CH 415	Core Elective -II	3	1		40	60	100	3
CH 416	Open Elective	3	1		40	60	100	3
CH 451	Term paper	-	-	3	40	60	100	2
CH 452	Chemical Process Equipment Design Lab	-	-	4	40	60	100	2
CH 453	Environmental Engineering Lab	-	-	3	40	60	100	2
	TOTAL	20	6	10				27

CA: Continuous Assessment **FE:** Final Examination

Core Elective-II

CH 415 (A): Computer Aided Design
CH 415 (B): Petroleum Refinery engg.
CH 415 (C): Pilot Plant models and scale up methods in Chemical Engineering
CH 415 (D): Interfacial science.

Open Elective

CH 416 (A): Industrial Polution and Control
CH 416 (B): Energy Engineering.

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Final Year B.Tech., (SEMESTER—VIII)

Code No.	Subject	Scheme of Instruction (Periods per week)			Scheme of Examination (Maximum marks)			No. of Credits
		Theory	Tutorial	Lab/ Project	CA	FE	Total Marks	
CH 421	Safety and Hazard Analysis	3	1		40	60	100	3
CH 422	Professional Ethics &Human Values	3	1		40	60	100	3
CH 423	Optimization of Chemical Process	3	1		40	60	100	4
CH 424	Elective-III	3	1		40	60	100	3
CH 461	Project Work	-	-	9	50	100	150	10
CH 462	CAD lab	-	-	6	40	60	100	2
	TOTAL	12	4	15	250	400	650	25

CA: Continuous Assessment **FE:** Final Examination

Elective III

CH 424 (A): Biofuels

CH 424 (B): Design and Analysis of Experiments

CH 424 (C): Corrosion Engineering

CH 424 (D): Pinch Technology

(Common for all branches)

CH111/MA01

I B.Tech I Semester

L	**T**	**C**	**:**	**4**	**1**	**4**	**Continuous Assessment**	**:**	**40**
Final Exam			**:**	**3 hours**			**Final Exam Marks**	**:**	**60**

UNIT - I

Matrix Algebra: Rank of a Matrix, Linear Independence, Vector Space, Solutions of Linear Systems, Inverse of a Matrix by Gauss-Jordan Elimination, Vector Spaces, Inner Product Spaces, Linear Transformations. Eigen Values, Eigen Vectors, Some applications of Eigen value problems. Symmetric, Skew-Symmetric and Orthogonal Matrices.

UNIT - II

Matrix Algebra: Complex Matrices: Hermitian, Skew-Hermitian and Unitary.
Similarity of Matrices, Basis of Eigen Vectors, Diagonalization.

Differential Calculus: Rolle's Theorem, Lagrange's Mean Value Theorem and Taylor's Theorem (without Proofs), Taylor's and, Maclaurin's Series for functions of one variable. Maxima and Minima of functions of Two Variables, Lagrange's method of Multipliers.

UNIT - III

First Order Differential Equations: Basic concepts, Geometrical meaning, Separable Differential Equations, Exact Differential Equations, Integrating Factors, Linear Differential Equations, Bernoulli's Equation, Orthogonal Trajectories of curves, Some Engineering Applications: Growth-Decay and Newton's Law of Cooling.

UNIT - IV

Linear Differential Equations of Second Order: Homogeneous Linear Equations of Second Order, Second Order Homogeneous Equations with Constant Coefficients, Case of Complex Roots, Euler-Cauchy Equations, Non-Homogeneous Equations, Solution by Undetermined Coefficients, Solution by Variation of Parameters, Applications-Modeling of Electric Circuits.

TEXT BOOK:

1. Erwin Kreyszig, "Advanced Engineering Mathematics", 8th edition, John Wiley & Sons.

REFERENCE BOOK:

1. George B, Thomas, Jr. and Ross L. Finney, "Calculus and Analytic Geometry", Addison Wesley.

ENGINEERING PHYSICS – I

(Common to all branches)

CH112/PH01

L	**T**	**C**	**:**	**3**	**1**	**3**	**Continuous Assessment**	**:**	**40**
Final Exam			**:**	**3 hours**			**Final Exam Marks**	**:**	**60**

UNIT – I

OPTICS (11 Periods)

INTERFERENCE: Two-wave interference, coherence, cosine law, Michelson interferometer and its applications, (determination of wavelengths of monochromatic light and resolution of two nearby wavelengths).

DIFFRACTION: Fresnel &Fraunhoffer diffraction, fraunhoffer diffraction due to single slit, plane diffraction grating, dispersive and resolving power of grating.

POLARISATION: Introduction, Brewester's and Malus law, double refraction,Nicol prism, quarter wave plate, half wave plate.

UNIT – II

LASERS & FIBER OPTICS (10 Periods)

LASERS: Properties of lasers**,** Spontaneous and stimulated emission, Population inversion, active medium, Solid state (Ruby) laser, Gas(He-Ne) laser, semiconductor (Ga-As) laser, Applications.

HOLOGRAPHY: Principle, recording and reproduction of holography, Applications.

FIBER OPTICS: Structure and types of optical fibers, acceptance angle, Numerical aperture, fiber optic communication and its advantages.

UNIT – III

ELECTRICITY & MAGNETISM (10 Periods)

Gauss's law in static electricity (qualitative only), Gauss's law of magnetism, circulating charges, Cyclotron-constructing, working and limitations, Hall effect and its applications, displacement current, Maxwell's equations (qualitative treatment), E M oscillations, velocity of EM waves, energy transport and the pointing vector, radiation pressure, AC circuit containing series LCR circuit-resonance condition.

UNIT – IV

MODERN PHYSICS (11 Periods)

Dual nature of light, de-Brogli's concept of matter waves, Davison-Germer electron diffraction experiment, Heisenberg's uncertainty experiment and applications (non-existence of electron in a nucleus and finite width of spectral lines), one dimensional time- independent Schrödinger wave equation, physical significance of wave function, applications of time-independent wave equation to particle in a box(one dimensional), tunneling, the scanning tunneling microscope.

TEXT BOOKS:

1. R.K Goure and S.C. Gupta, "Engineering Physics", New Delhi.
2. Halliday, Resnik, Krane, "PHYSICS", John Wiley & Sons.

REFERENCE BOOKS:

1. "Optics", A. Ghatak (TMH).
2. "Concepts of Modern Physics", AurthurBeiser (TMG).
3. "A text book of engineering physics", M.N. Avadhanulu, P.G. Kshirasagar, S.Chand& Co.,.
4. Serway and jewett, "Physics for scientist and engineers with Modern physics", 6^{th} edition, Tomson Brooks/Cole, Indian reprint.

ENGINEERING CHEMISTRY – I

(Common to all branches)

CH113/CY01

L	**T**	**C**	**:**	**3**	**1**	**3**	**Continuous Assessment**	**:**	**40**
Final Exam			**:**	**3 hours**			**Final Exam Marks**	**:**	**60**

UNIT – I

WATER TECHNOLOGY **(11 Periods)**

Characteristics – alkalinity – types of alkalinity and determination – hardness – types and estimation by EDTA method (problems); Domestic water treatment – disinfection methods (Chlorination, ozonation. UV treatment) – Boiler feed water – requirements – disadvantages of using hard water in boilers: Scales, Sludges, Caustic embrittlement, boiler corrosion, Priming and foaming – internal conditioning (phosphate, calgon and carbonate conditioning methods) – external conditioning –demineralization process –Lime Soda Process-desalination of brackish water by electro dialysis and reverse osmosis.

UNIT – II

POLYMERS: **(12 Periods)**

Polymers: Definition, Polymerization, types, addition and condensation polymerization, free radical polymerization mechanism.

Plastics: Classification, Preparation, Properties and uses of PVC, Teflon, polycarbonate, polyurethane, nylon-6,6, PET.

Rubber: vulcanization of rubber, synthetic Rubbers: Buna-S, Buna-N and Polyurethane rubbers.

SURFACE CHEMISTRY:

Surface Chemistry: Solid surfaces, types of adsorption, Frendlich and Longmuir adsorption isotherm, BET adsorption equip. Calculation of surface area of solid & application adsorption: role of adsorbents in catalysis, ion-exchange adsorption and pollution abatement; classification of colloids, Electrical & optical properties micelles, applications of colloids in industry.

UNIT – III

(11 Periods)

RENWEBLE AND NON RENWEABLE ENERGY SOURCES

Thermal and Chemical energy: Introduction to solid fuels - calorific value (lower, higher)-determination of calorific value(Bomb Calorimeter) - pulverized coal – carbonization (Bee Haive method - Otto Hoffman by product method)- Proximate and ultimate analysis of coal - Flow Chart in Thermal Power Stations.- Introduction to Geo Thermal Energy-working – applications-Introduction to Solar Cells –Solar Panels-Applications-Green House Concept - wind energy – fuel cells – hydrogen – oxygen fuel cell – batteries – alkaline batteries – lead–acid, nickel–cadmium and lithium batteries.

UNIT – IV

ENGINEERING MATERIALS **(11 Periods)**

Refractories – classification – acidic, basic and neutral refractories – properties: refractoriness, refractoriness under load, dimensional stability, porosity, thermal spalling – manufacture of alumina, magnesite and zirconia bricks, Abrasives – natural and synthetic abrasives – quartz, corundum, emery, garnet, diamond, silicon carbide and boron carbide.

Composites: definition, types, polymer matrix composites.

Lubricants – mechanism of lubrication, liquid lubricants - properties: viscosity index, flash and fire points, cloud and pour points, oiliness –solid lubricants – graphite and molybdenum sulphide.

Nanomaterials: Introduction to nanochemistry – preparation of few Nano materials:carbon nanotubes, Fullerenes etc – Properties of Nano materialas and their Engineering applications.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. P.C.Jain and Monica Jain, "Engineering Chemistry", DhanpatRai Pub, Co., New Delhi (2002).
2. S.S. Dara & Mukkati K., "A text book of engineering chemistry", S.Chand & Co.Ltd., New Delhi (2006).
3. "Text Books of Engineering Chemistry", C.P. Murthy, C.V. Agarwal, A. Naidu B.S. Publications, Hyderabad (2006).

REFERENCE BOOKS:

1. B.K.Sharma, "Engineering chemistry", Krishna Prakasan Media (P) Ltd., Meerut (2001).
2. B. Sivasankar, "Engineering Chemistry", Tata McGraw-Hill Pub.Co.Ltd, New Delhi (2008).
3. "Enginering Chemistry", J.C. Kuriacase & J. Rajaram, Tata McGraw Hill co., New Delhi 1. (2004).
4. "Chemistry of Engineering Meterials", R.P Mani and K.N.Mishra, CENGAGE learning.
5. "Applied Chemistry – A text for Engineering & Technology", Springar (2005).
6. "Text Book of Engineering Chemistry", ShasiChawla, DhantpatRai Publishing Company, NewDelhi (2008).
7. "Engineering Chemistry", R. Gopalan, D. Venkatappayya, D.V. SulochanaNagarajan, Vikas Publishers (2008).

ENGLISH LANGUAGE AND COMMUNICATION

(Common to all branches)

CH114/EN01

L	**T**	**C**	**:**	**3**	**1**	**3**	**Continuous Assessment**	**:**	**40**
Final Exam			**:**	**3 hours**			**Final Exam Marks**	**:**	**60**

Objective of the course: To impart Basic skills of communication in English in through intensive practice to the First year student, So as to enable them to function confidently and effectively in that language in the professional sphere of their life.

UNIT– I

Grammar: This area exposes the learners to improve the standard proficiency level, avoiding grammatical mistake in communication.

1. Tenses
2. Preposition
3. Parts of speech

UNIT– II

Writing skills: This area promotes a format and well structured sentences required in professional writing

1. Paragraph writing
2. Letter writing
3. Essay writing

UNIT-III

Vocabulary: This unit offers an extensive knowledge of words and word meaning, essential for communication and contemporary test

1. Analogies
2. Idioms and phrases and their use
3. Antonyms & Synonyms

UNIT-IV

Reading skills: Reading skills enable the student to turn writing into meaning and achieve the goals of reading independently, comprehensibly and fluently

1. Reading comprehension 2. Scanning 3. Skimming 4.Glance

TEXT BOOK:

1. "Objective English for Competitive Examination (Third edition)", Hari Mohan Prasad, Uma ReniSinha, Tata McGraw Hill.

REFFRENCE BOOKS:

1. “Effective Technical Communication”, M.AshrafRizvi, Tata McGraw Hill.
2. “Cambridge Preparation Guide for TOFEL”.
3. “Dictionary of Technical Terms”.
4. “Cambridge Advanced Learner’s Dictionary”.
5. “Cambridge Idioms Dictionary”.
6. “Basic Correspondence & Report Writing”, Sharma, Tata McGraw Hill.
7. “Business Correspondences and Report Writing”, R.C.Sharma, Krishna Mohan, Tata McGraw Hill.
8. “Dictionary of Misspelled and Easily Confused Words”, David Downing, Deborah K.Williams, Tata McGraw Hill.

ENVIRONMENTAL STUDIES

(Common for all branches)

CH115/BT01

L	**T**	**C**	**:**	**3**	**0**	**3**	**Continuous Assessment**	**:**	**40**
Final Exam			**:**	**3 hours**			**Final Exam Marks**	**:**	**60**

UNIT – I

Introduction: Definition, Scope and Importance, Need for public awareness.

Ecosystems: Introduction, types, Structure and Functions of Ecosystems, Forest, Grassland, Desert, Aquatic (lakes, rivers and estuaries)

Biodiversity: Definition and levels of Biodiversity, Bio-geographical Classification of India, India as a mega diversity nation and Hot Spots of Biodiversity.

Values of Biodiversity: Consumptive use, Productive use, Social, Ethical, Aesthetic and Option values.

Threats to Biodiversity: Habitat loss, Extinction of Species, Poaching of wildlife

Conservation of Biodiversity: In-situ and Ex-situ conservation of biodiversity

UNIT – II

Natural Resources: Exploitation and Related Pollution Problems

Land: Land as a resource, causes and effects of land degradation

Forest: Use of forests, causes and effects of deforestation and conservation of forests

Water: Distribution of Water Resources, floods and drought, causes, effects and control of water pollution.

Energy: Classification of Resources, Importance of energy, causes and effects of nuclear pollution.

Causes, Effects and Control of Air Pollution and Noise Pollution.

Solid Waste Management: Urban and Industrial wastes, Composting and Vermiculture and 3 R - approach.

UNIT –III

Sustainability: Theory and Practice, Equitable use of resources for sustainable life styles. Rain water harvesting, Watershed management, Cloud Seeding, Acid rain, Ozone layer depletion, Global warming, Population Growth and its Impact on environment, Green Revolution, Resettlement and Rehabilitation program, Mining and Dams and their conflictions, Environmental Impact Assessment

UNIT –IV

Environmental acts: Water (Prevention and Control of pollution) act, Air (Prevention and Control of pollution) act, Environmental protection act, Wild life protection act, Forest Conservation act.

International Conventions: Stockholm Conference 1972, Earth Summit 1992 and Copenhagen Conference 2009

Case Studies: Chipko movement, Narmada BachaoAndolan, Silent Valley Project, Madhura Refinery and TajMahal, Chernobyl Nuclear Diaster, Ralegaon Siddhi (Anne Hazare) and Bhopal Tragedy.

Text Book:

1. Environmental Studies by Benny Joseph,Tata McGraw-Hill Publishing Company Limited, New Delhi.

Reference Books:

1. Text Book of environmental studies, ErachBharucha, UGC.
2. Environmental Studies, AnubhaKaushik and C. P. Kaushik.
3. A basic course in environmental studies, S. Deswal and A. Deswal, DhanapathRai& Co.
4. Essentials of environmental studies, Kurian Joseph and R.Nagendram, Pearson Education Pt Ltd, Delhi.
5. Environmental studies, R.Rajagopalan, Oxford University Press.
6. Environmental Pollution Control Engineering, C. S. Rao, Wiley Eastern Ltd., New Age International Ltd.,
7. Introduction to Environmental Science, Anjaneyulu Y, B S Publications
8. Principles of Environmental Studies, Manoharachary C and Jayarama Reddy P, B S Publications.
9. Comprehensive environmental studies- JP Sharma, Laxmi Publications.
10. Environmental Science, 11th Edition – Thomson Series – By G Tyler Miller, Jr.
11. Environmental Science and Engineering by Dr. Suresh, K.Dhaneja, Publishers SK Kataria& Sons, New Delhi-110006.

ENGINEERING GRAPHICS

(Common to all branches)

CH116/ME01

L	**T**	**C**	**:**	**3**	**3**	**3**	**Continuous Assessment**	**:**	**40**
Final Exam			**:**	**3 hours**			**Final Exam Marks**	**:**	**60**

UNIT – I

INTRODUCTION: Introduction to Drawing instruments and their uses, geometrical construction procedures ***2x3 =6 periods***

CURVES: Conic sections – general construction methods for ellipse, parabola and hyperbola.

Other methods to construct ellipse only, cycloid, involute of a circle ***4x3=12periods***

UNIT – II

METHOD OF PROJECTIONS: Principles of projection - First angle and third angle projection of points. Projection of straight lines.Traces of lines.

6x3=18periods

UNIT – III

PROJECTIONS OF PLANES : Projections of plane figures: circle, square, rhombus, rectangle, triangle, pentagon and hexagon.

4x3=12periods

UNIT – IV

PROJECTIONS OF SOLIDS: Projections of Cubes, Prisms, Pyramids, Cylinders and Cones with varying positions.

5x3=15 periods

UNIT – V

ISOMETRIC PROJECTIONS: Isometric Projection and conversion of Orthographic views into isometric views. (Treatment is limited to simple objects only). **3*x3=9 periods***

ORTHOGRAPHIC PROJECTIONS: Conversion of pictorial views into Orthographic views. (Treatment is limited to simple castings). ***4x3=12 periods***

TEXT BOOK:

1. Engineering Drawing by N.D. Bhatt & V.M. Panchal. (Charotar Publishing House, Anand). (First angle projection)

REFERENCE BOOK:

1. Engineering Drawing by Dhananjay A Jolhe, Tata McGraw hill publishers
2. Engineering Drawing by Prof.K.L.Narayana& Prof. R.K.Kannaiah.

PHYSICS LAB – I

(Common to all branches)

CH 151/PH L01

L	**T**	**C**	**:**	**3**	**0**	**2**	**Continuous Assessment**	**:**	**40**
Final Exam			**:**	**3 hours**			**Final Exam Marks**	**:**	**60**

LIST OF EXPERIMENTS

1. Determination of acceleration due to gravity at a place using compound pendulum.
2. Study the variation of intensity of magnetic field along the axis of a circular coil using Stewart-Gee's apparatus.
3. Determination of thickness of thin wire using air wedge interference bands.
4. Determination of radius of curvature of a Plano convex lens by forming Newton's rings.
5. Determination of wavelengths of mercury spectrum using grating normal incidence method.
6. Determination of dispersive power of a given material of prism using prism minimum deviation method.
7. Draw the resonant characteristic curves of L.C.R. series circuit and calculate the resonant frequency.
8. Draw the characteristic curves of a photocell and calculate the maximum velocity of electron.
9. Verify the laws of transverse vibration of stretched string using sonometer.
10. Determination of numerical aperture of an optical fiber.

CHEMISTRY LAB – I

(*Common to all branches)*

CH 152 / CY L01

L	T	C	:	3	0	2	Continuous Assessment	:	40
Final Exam			:	3 hours			Final Exam Marks	:	60

LIST OF EXPERIMENTS

1. Introduction to Chemistry Lab (the teachers are expected to teach fundamentals like Primary, Secondary Standard Solutions , Normality, Molarity, Molality etc and laboratory ware used, error ,accuracy, precision, Theory of indicators, use of volumetric titrations.

2. Volumetric Analysis:

a. Estimation of acid content in un-known solution
b. Estimation of Iron by Dichrometric method
c. Estimation of Copper by Iodometric method
d. Estimation of available chlorine in bleaching powder

3. ANALYSIS OF WATER: Estimation of :

a. TOTAL HARDNESS BY EDTA METHOD
b. TURBIDITY
c. CONDUCTIVITY
d. pH
e. TOTAL DISSOLVED SALTS
f. SALANITY
g. ALKALINITY
h. DISSOLVED OXYGEN

4. BACTERIAL COUNT: The student has to get his water sample and the teacher has to explain the analysis and the results are to be compared with the INDIAN STANDRDS.

5. CONSTRUCTION OF GALVANIC CELL: Based on the position of the metals in the electrochemical series a model electrochemical Cell is constructed and the values are determined and effect of metal ion concentration, Temperature etc. on emf are calculated.

TEXT BOOKS:

1. "Practical Engineering Chemistry", K. Mukkanti, etal, B.S. Publications, Hyderabad.
2. "Inorganic quantitative analysis", Vogel.

REFERENCE BOOKS:

1. "Text Book of engineering chemistry", R. N. Goyal and HarrmendraGoel.
2. "A text book on experiments and calculation Engg.", S.S. Dara.
3. "Instrumental methods of chemical analysis", Chatwal, Anand, Himalaya publications.

WORKSHOP

(Common to all branches)

CH 153/ ME L01

L	T	C	:	3	0	2	Continuous Assessment	:	40
Final Exam			:	3 hours			Final Exam Marks	:	60

1. **Carpentry**

a. Half Lap joint
b. Dovetail joint
c. Mortise &Tenon joint

2. **Welding using electric arc welding process/gas welding**

a. Lap joint
b. Tee joint
c. Butt joint

3. **Sheet metal operations with hand tools**

a. Trapezoidal tray
b. Funnel
c. T-joint

4. **House wiring**

a. To control one lamp by a single switch
b. To control two lamps by asingle switch
c. Stair-case wiring

MATHEMATICS – II

(Common for all branches)

CH 121/MA02

I B.Tech. II Semester

L	**T**	**C**	**:**	**4**	**1**	**4**	**Continuous Assessment**	**:**	**40**
Final Exam			**:**	**3 hours**			**Final Exam Marks**	**:**	**60**

UNIT – I

Fourier Series: Periodic Functions, Trigonometric Series, Fourier Series, Functions of Any Period P = 2L, Even and Odd Functions, Half Range Expansions, Complex Fourier Series, Approximation by Trigonometric polynomials.

UNIT – II

Laplace Transforms: Laplace Transform, Inverse Transform, Linearity, Shifting, Transforms of Derivatives and Integrals, Differential Equations, Unit Step Function, Second Shifting Theorem, Dirac's Delta Function, Convolution theorem (without proof).

UNIT – III

Integral Calculus: Evaluation of double integrals (Cartesian & Polar), Changing the order of integration, Evaluation of triple integrals, Applications of triple integrals to find area and volume.

UNIT – IV

Vector calculus: Scalar and vector point functions, Gradient of a scalar field, Directional derivative, Divergence of a vector field, curl of a vector field, Line integrals, Line integrals independent of path, Green's theorem in the plane (without proof), Surface integrals, Triple integrals, Divergence theorem of Gauss (without proof), Applications to Engineering problems, Stokes theorem(without proof).

TEXT BOOK:

1. "Advanced Engineering Mathematics", Erwin Kreyszig, 8th edition, John Wiley & Sons.

REFERENCE BOOKS:

1. "Advanced Engineering Mathematics", Peter V. O'Neil, Thomsons Brooks/Cole.
2. "Advanced Calculus", Murray R Spiegel, Schaum's outline series.

ENGINEERING PHYSICS – II

(Common to all branches)

CH 122/PH02

L	**T**	**C**	**:**	**4**	**1**	**4**	**Continuous Assessment**	**:**	**40**
Final Exam			**:**	**3 hours**			**Final Exam Marks**	**:**	**60**

UNIT - I

Electron theory of solids & semiconductor physics (10 periods)

Electron theory of solids:Failure of classical free electron theory, quantum free electron theory, Fermi-Dirac distribution and its temperature dependence, Kronig-Penny model (Qualitative), effective mass of electron, concept of hole.

Semiconductor physics: Classification of semiconductors, P-N junction diode and its characteristics, carrier concentration in P and N type semiconductors, Equation of continuity.

UNIT – II

Magnetic, Dielectric and Ferro-electric materials (10 periods)

Origin of magnetic moment of an atom, Bohr magneton, Weiss theory of Ferro magnetism (Qualitative), Hysteresis curve, soft and hard magnetic materials, ferrites and its applications.

Dielectric materials, Types of polarizations, internal field (qualitative), Classius – Mossetti equation, Frequency dependence of polarization, Ferroelectrics and its applications.

UNIT – III

Advanced materials (12 periods)

Nano-materials: Introduction to nano-materials, Fabrication of nano-materials and carbon nano tubes (CVD and sol-gel), physical and chemical properties of nano materials, Applications of nano materials (Structural point, Storage of information, Strength point)

Superconductivity: Meissner effect, types of superconductors, elements of BCS theory, Applications of superconductors.

Opto-electronic devices: Working and applications of solar cell,LED, LCD, Photo Diode.

UNIT – IV

Analytical techniques (10 periods)

Nuclear techniques: Radio isotopes and its applications (Medical and Industrial), GM-counter, scintillation counter.

Ultrasonics: Properties of ultrasonics, General applications of ultrasonics.

Medical applications: Cardiology, Neurology, Ultrasonic imaging.

NDT: Pulse echo technique, cavitation effect, Time of flight diffraction technique.

Structure determination: Crystal planes, Bragg's law, structural analysis of crystal using X-Ray powder diffraction method.

TEXT BOOKS:

1. "Engineering physics",M.R.Sreenivasan, Newage International Publication.
2. "Engineering Physics", Palaniswamy, ScitechPulishers.

3. "Solid State Physics", Dekkar.

REFERENCE BOOKS:

1. "Material Science for scientists and Engineers", Srinivasan&Srivastava, TMH Publishers.
2. "A text book of engineering physics", M.N.Avadhanulu& P. Krushisagar, S.Chand Pub.
3. "Material Science", VijayaRangarajan.

ENGINEERING CHEMISTRY – II

(Common to all branches)

CH 123/CY02

L	**T**	**C**	**:**	**3**	**1**	**3**	**Continuous Assessment**	**:**	**40**
Final Exam			**:**	**3 hours**			**Final Exam Marks**	**:**	**60**

UNIT – I

ELECTROCHEMISTRY (11 Periods)

Electrochemical cells – reversible and irreversible cells – EMF – measurement of emf – Single electrode potential – Nernst equation (problem) – reference electrodes –Standard Hydrogen electrode -Calomel electrode – Ion selective electrode – glass electrode and measurement of pH – electrochemical series – significance –potentiometer titrations (redox - Fe^{2+}vs dichromate and precipitation – Ag^{+} vs Cl^{-}titrations) and conduct metric titrations (acid-base – HCI vs, NaOH) titrations.

UNIT - II

CORROSION AND CORROSION CONTROL (11 Periods)

Chemical corrosion – Pilling – Bedworth rule – electrochemical corrosion – different types – galvanic corrosion – differential aeration corrosion – factors influencing corrosion – corrosion control – sacrificial anode and impressed cathodic current methods – corrosion inhibitors – protective coatings – paints – constituents and functions – metallic coatings – electroplating (Au) and electroless (Ni) plating.

GREEN CHEMISTRY: Introduction-concepts-Engineering Applications.

UNIT – III

LIQUID AND GASEOUS FUELS AND COMBUSTION: Petroleum based: **(12 Periods)**

Petroleum processing and fractions – cracking – catalytic cracking and methods-knocking and anti-knocking Agents – octane number and cetane number – synthetic petrol – Fischer Tropsch and Bergius processes.

Gaseous fuels- water gas, producer gas, CNG and LPG, Flue gas analysis – Orsat apparatus – theoretical air for combustion.

PHASE RULE AND ALLOYS: Statement and explanation of terms involved – one component system – water system – condensed phase rule – construction of phase diagram by thermal analysis – simple eutectic systems (lead-silver system only) – alloys – importance, ferrous alloys – nichrome and stainless steel – heat treatment of steel, non-ferrous alloys – brass and bronze.

UNIT – IV

ANALYTICAL TECHNIQUES: (11 periods)

Beer-Lambert's law (problem) – UV-visible spectroscopy and IR spectroscopy –principles – instrumentation (problem) (block diagram only) – estimation of iron by colorimetry – flame photometry – principle – instrumentation (block diagram only) –estimation of sodium by flame photometry – atomic absorption spectroscopy – principles – instrumentation (block diagram only) – estimation of nickel by atomic absorption spectroscopy.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. P.C.Jain, Monica Jain, "Engineering Chemistry", DhanpatRai Pub, Co., New Delhi (2002).
2. S.S.Dara, Mukkanti K.,"A text book of Engineering Chemistry", S.Chand& Co., Ltd., New Delhi (2006).
3. B. Sivasankar, "Engineering Chemistry", Tata McGraw-Hill Pub.Co.Ltd, New Delhi (2008).

REFERENCE BOOKS:

1. B.K.Sharma, "Engineering Chemistry", Krishna Prakasan Media (P) Ltd., Meerut (2001).
2. "Enginering Chemistry", J.C.Kuriacase&J.Rajaram, Tata McGraw Hill, New Delhi (2004).
3. "Chemistry of Engineering Materials", R.P Mani, K.N.Mishra, CENGAGE learning.
4. "Applied Chemistry - A text for Engineering & Technology", – Springar (2005).
5. "Text Book of Engineering Chemistry", ShasiChawla, DhantpatRai Publishing Company, NewDelhi (2008).
6. "Engineering Chemistry", R. Gopalan, D. Venkatappayya, D.V. SulochanaNagarajan, Vikas Publishers (2008).

INTRODUCTION TO CHEMICAL ENGINEERING
CH124

L	T	C	:	3	1	3	Continuous Assessment	:	40
Final Exam			:	3 hours			Final Exam Marks	:	60

UNIT – I

Definition of Chemical Engineering, Basic Concepts in Chemical Engineering: Unit Operations, Basic laws, Useful mathematical methods, Units and Dimensions.
Flow of fluids: Nature of Fluid, Viscosity, Flow Field, Flow of Fluid Past a Solid Surface, Conservation Of Mass and Energy, Friction Loses in Laminar Flow through a Circular Tube, Hagen-Poiseuille Equation, Friction Losses in Turbulent Flow, Fanning Equation

UNIT – II

Heat Transfer: Fundamental Concepts of Conduction, Convection and Radiation.
Heat Transfer Equipment: Double Pipe, Shell and Tube Heat Exchangers and Evaporators (Description with Diagrams)

Mass Transfer:
Uses and Characteristics of Separation Processes: Examples: Cane Sugar Refining, Manufacture of P-Xylene, Importance and Variety of Separations, Economic Significance of Separation Processes, Inherent Separation Factors: Equilibrium Processes and Rate Governed Processes

UNIT – III

Chemical Kinetics: Introduction, Thermodynamics of Reactions, Determination of the Rate Equation, Effect of Temperature on Reaction Rate, Reactors (Description with Diagrams)

UNIT – IV

Natural Resources and Their utilization: Water based resources, Air based resources.Solvay process, Contact and Chamber Processes, Haber process, Crude oil refining.

Text Book:

1. Introduction to Chemical Engineering, S. K. Ghosal, S. K. Sanyal& S. Datta, Tata-McGraw-Hill,.
2. Separation Processes by C.Judson King, Tata-McGraw Hill (For Mass Transfer)

Reference Books:

1. Introduction to Chemical Engineering, Walter L. Badger & Julius T. Banchero, Tata-McGraw-Hill, New Delhi.
2. Unit Operations of Chemical Engineering, Warren L.McCabe, Julian C.Smith, Peter Harriot, 7^{th} edition, McGraw Hill, New Delhi.

3. Mass Transfer Operations, Robert E. Treybal, 3rd edition, McGraw Hill, New Delhi.
4. Introduction to Chemical Engineering, Smith J. M., McGraw Hill, New Delhi.

ENGINEERING MECHANICS

(Common to all branches except Mechanical Engineering)

CH 125/CE01

L	T	C	:	4	1	4	Continuous Assessment	:	40
Final Exam			:	3 hours			Final Exam Marks	:	60

UNIT – I

General Principles: Mechanics, Fundamental concepts, Units of measurements, International systems of units, Numerical calculations, General procedure for analysis.

Force Vectors: Scalars and vectors, Vector operations, Vector addition of forces, Addition of a system of coplanar forces.

Equilibrium of a Particle: Condition for equilibrium of a particle, The free body diagram, Coplanar force system.

Force System Resultants: Moment of a force (Scalar formation), Principle of moments, Moment of a couple (Scalar formation), and Equivalent system, Resultants of a force and couple system (Coplanar force system), further reduction of a force and couple system (Coplanar force system).

Equilibrium of a Rigid Body: Conditions for rigid body equilibrium (Equilibrium in two dimensions), Free body diagrams, Equations of equilibrium, Two and three force members.

UNIT – II

Friction: Characteristics of dry friction, Problems involving dry friction.

Center of Gravity and Centroid: Center of gravity and center of mass for system of particles, Center of gravity, center of mass and centroids for a body, Composite bodies.

Moments of Inertia: Definition of moments of inertia for areas, Parallel axis theorem for area, radius of gyration of an area, Moments of inertia of an area by integration, Moments of inertia for composite areas.

UNIT – III

Kinematics of a Particle: Introduction, Rectilinear kinematics: Continuous motion, General curvilinear motion, Curvilinear motion: Rectangular components, Motion of a projectile, Curvilinear motion: Normal and tangential components, Absolute dependent motion analysis of two particles.

Kinetics of a Particle: Force and Acceleration: Newton's law of motion, The equation of motion, Equation of motion for a system of particles, Equation of motion: Rectangular coordinates, Equation of motion: Normal and tangential coordinates.

UNIT – IV

Kinetics of Particle: Work and Energy: The work of a force, Principle of work and energy, Principle of work and energy for a system of particles, Power and efficiency, Conservative forces and potential energy, Conservation of energy.

Kinetics of Particle: Impulse and Momentum: Principle of linear impulse and momentum, Principle of linear impulse and momentum for a system of particles, Conservation of linear momentum for a system of particles, Impact.

TEXT BOOK:

1. "Engineering Mechanics Statics and Dynamics", R.C. Hibbeler and Ashok Gupta. Pearson Education.

REFERENCE BOOKS:

1. "Vector mechanics for Engineers Statics and Dynamics", Beer and Johnston, Tata McGraw-Hill publishing company, New Delhi.
2. "Engineering Mechanics", S. Timoshenko and D. H. Young – McGraw-Hill International Edition.
3. "Engineering Mechanics Statics and Dynamics", J. L. Meriam and L. Kraige.
4. "Engineering Mechanics for Engineers. Statics and Dynamics", Beer and Irving H. Shames, Pearson Education.

COMPUTER PROGRAMMING WITH C

(Common to all Branches)

CH 126/ CS01

L	**T**	**C**	**:**	**4**	**1**	**4**	**Continuous Assessment**	**:**	**40**
Final Exam			**:**	**3 hours**			**Final Exam Marks**	**:**	**60**

UNIT – I

Introduction:

Computer Fundamentals: Computer and it's components, hardware/software**,** algorithm, characteristics of algorithms, flowchart, symbols used in flowchart, history of C, basic structure of a C program.

C Tokens: Character set, variables, keywords, data types and sizes, type qualifiers, numeric constants and their forms of representation, character constants, string constants, declaration and initialization of variables.

Operators & Expressions: Arithmetic operators and expressions, type-conversion rules, coercion, assignment operators and expressions, increment and decrement operators, conditional operator, statements, preprocessor directives, input/ output functions and other library functions. Relational operators and expressions, boolean operators and expressions, operator precedence and associativity.

Control Statements: if-else statement, else-lf statement and switch statement.

Programming Exercises for Unit I :

C-expressions for algebraic expressions, evaluation of arithmetic and boolean expressions. Syntactic errors in a given program, output of a given program, values of variables at the end of execution of a program fragment, filling the blanks in *a* given program. Programs using Scientific and Engineering formulae.Finding the largest of the three given numbers.Computation of discount amount on different types of products with different discount percentages. Finding the class of an input character, finding the type of triangle formed with the given sides, computation of income-tax, computation of electricity bill and conversion of lower case character to its upper case.

UNIT – II

Control Statements: while loop, for loop, do while loop, nested Control statements, break and continue statements.

Arrays: One-Dimensional numeric and character arrays and Two-Dimensional numeric and character arrays.

Programming Exercises for Unit - II:

To print the sum of the digits of a given number and to display the image of a given number.To find whether a given number is prime, printing Fibonacci sequence and to find prime factors of a given number.To print graphic patterns of symbols and numbers and computation of statistical parameters of a given list of numbers.To find the length of a string,

compare strings, reverse a string, copy a string and to find whether the given string is palindrome or not. Transpose of a matrix, product and sum of matrices and sorting of names using arrays.

UNIT – III

Functions: Function definition, parameter passing mechanisms and simple recursion.
Scope & extent: Scope rules and storage classes.
Pointers and Dynamic Memory Allocation: Pointer variables**,** pointer arithmetic, dynamic memory allocation, array of pointers, command line arguments, passing pointer variables as parameters to functions.

Programming Exercises for Unit - III:

Functions - Insertion sort, Linear search. Recursive functions to find factorial &GCD(Greatest Common Divisor), string operations using pointers and pointer arithmetic and dynamic memory allocation. Swapping two variable values. Sorting a list of names using array of pointers and command line arguments.

UNIT – IV

Structures: Structures, array of structures, pointers to structures, unions and difference between structure and union.
Files: File handling functions for input and output.

Programming Exercises for Unit - IV:

Operations on complex numbers, matrix operations with the matrix and the size of the matrix as a structure, sorting a list of student records on register number using array of pointers and to read an input file of marks and generate a result file.

TEXT BOOK:

1. Byron Gottfried, “Programming with C”, Schaum's Outline series.

REFERENCE BOOKS:

1. Kernighan BW and Dennis Ritchie M, “C programming language”, 2nded, Prentice Hall.
2. Yashavant P. Kanetkar, “Let us C”, BPB Publications.
3. E.Balagurusamy, “Programming in ANSI C”, 4thed, Tata Mcgraw-Hill.
4. Herbert Schildt, “C: The Complete Reference”, 4th edition, Tata Mcgraw-Hill.

PHYSICS & CHEMISTRY LABORATORY – II

(Common to all branches)

CH 161/PHCY L01

L	**T**	**C**	**:**	**3**	**0**	**2**	**Continuous Assessment**	**:**	**40**
Final Exam			**:**	**3 hours**			**Final Exam Marks**	**:**	**60**

(A Selected list of Experiments from the following)

PHYSICS LAB-II

1. Determine the rigidity modulus of the given material of the wire usingTorsionalpendulum.
2. Determination of room temperature using platinum resistant thermometer.
3. Draw the load characteristic curves of a solar cell.
4. Determination of Hall coefficient of a semiconductor.
5. Determination of velocity of ultrasonic wave in a given liquid usingultrasonicinterferometer.
6. Draw the characteristic curves of a G.M. counter and calculate the bestoperatingvoltage.
7. Determination of voltage and frequency of an A.C. signal using C.R.O.
8. Draw the I/V characteristic curves of a P-N junction diode.
9. Determination of Forbidden energy gap of Si &Ge.
10. Determination of wavelength of laser source using Diode laser.

CHEMISTRY LAB – II

1. **PRODUCTION OF BIODIESEL**: The teacher has to perform the transesterfication reaction of FATTY ACID and the Biodiesel thus produced can be used for analysis.
2. Estimation of properties of oil:

a. Acid Number
b. Viscosity
c. Saponification value
d. Aniline point
e. Flash and Fire points
f. Pour and Cloud point.

3. **PREPARATION OF**:

a. PHENOL –FORMALDEHYDE RESIN
b. ASPIRIN
c. Phenylbenzoate
d. Soap

4. **SOIL ANALYSIS**: pH, Determination of Zinc, Iron and Copper.
5. **Kinetics:** To determine the rate constant of hydrolysis of methyl acetate catalyzed by an acid and also the energy of activation. (or) To study the kinetics of reaction between $K_2S_2O_8$ and KI.

6. **Demonstration Experiments (Any two of the following) :**

a. Determination of dissociation constant of weak acid-by pH metry
b. Preparation of Thiokol rubber
c. Adsorption on Charcoal
d. Heat of reaction

7. **FOOD ANALYSIS:** Determination Saturated and Unsaturated Fatty Acids, pH,etc.

TEXT BOOKS:

1. Practical Engineering Chemistry by K. Mukkanti, etal, B.S. Publications, Hyderabad.
2. Vogels Text Book of Quantitative Chemical Analysis 6th Edition (2002).

REFERENCE BOOKS:

1. Text Book of engineering chemistry by R. N. Goyal and HarrmendraGoel.
2. A text book on experiments and calculation Engg. S.S. Dara.
3. Instrumental methods of chemical analysis, Chatwal, Anand, Himalaya Publications, 5th edition 2004

ENGLISH LANGUAGE LAB

(Common to all branches)

CH 162/EN L01

L	**T**	**C**	**:**	**3**	**0**	**2**	**Continuous Assessment**	**:**	**40**
Final Exam			**:**	**3 hours**			**Final Exam Marks**	**:**	**60**

OBJECTIVES

This course enables the students to expedite the process of improving communication in both formal and in formal situation. A special attention has been paid to the needs of competitive and current demands.

Introduction to communication: Difference between communication and communication skills, Types of communication, Barriers to communication.
Introduction to skills: Listening skills, writing skills, Reading skills, and Speaking skills.
Pronunciation drills: Phonetics, British English and American English.
Conversational skills: Dialogue, Telephonic Interaction.
Professional writings & skills: Resumes, Reports, Business letters and Interview skills.
Practical: Extempore Debates, Group discussion, and Oral presentation.

RECOMMENDED SOFTWARES:

Digital Language Lab - Networking Software, HiClass – Software.

English Language – Listening, Speaking Reading, Writing Skills: A lania series – English Mastery, Levels A, B (Set of 2 CDs), English Discoveries (Set 0f 12 CDs).

English Grammar / Pronunciation: Live Action English Interactive, Speech Solutions

Dictionaries: Cambridge Advanced Learner's**,** Oxford Genie & Advanced

Writing: Easy writer, Creative writing

Professional English: Telephonic English**,** English in mind

English for ETS: Barron's**,** TOEFL Mastery**,** IELTS**,** GRE

COMPUTER PROGRAMMING LAB

(Common to all Branches)

CH 163/CS L01

L	T	C	:	3	0	2	Continuous Assessment	:	40
Final Exam			:	3 hours			Final Exam Marks	:	60

LIST OF PROGRAMS

1. A program for electricity bill taking different categories of users, different slabs in each category. (Using nested if else statement).

Domestic Customer:	
Consumption Units	**Rate of Charges(Rs.)**
0 – 200	0.50 per unit
201 – 400	100 plus 0.65 per unit
401 – 600	230 plus 0.80 per unit
601 and above	390 plus 1.00 per unit
Commercial Customer:	
Consumption Units	**Rate of Charges(Rs.)**
0 – 50	0.50 per unit
100 – 200	50 plus 0.6 per unit
201 – 300	100 plus 0.70 per unit
301 and above	200 plus 1.00 per unit

2. Write a C program to evaluate the following (using loops):

a) $1 + x^2/2! + x^4 / 4!+ \ldots$upto ten terms

b) $x + x^3/3! + x^5/5!+ \ldots$ upto 7 digit accuracy

3. Write a C program to check whether the given number is

a) Prime or not.

b) Perfect or Abundant or Deficient.

4. Write a C program to display statistical parameters (using one – dimensional array).

a) Mean

b) Mode

c) Median

d) Variance.

NOTE: Use functions for each subtask in the following programs

5. Write a C program to read a list of numbers and perform the following operations

a) Print the list.

b) Delete duplicates from the list.

c) Reverse the list.

6. Write a C program to read a list of numbers and search for a given number using Binary search algorithm and if found display its index otherwise display the message “Element not found in the List”.

7. Write a C program to read two matrices and compute their sum and product.
8. A menu driven program with options (using array of character pointers).

a) To insert a student name
b) To delete a name
c) To print the names

9. Write a C program to read list of student names and perform the following operations

a) To print the list of names.
b) To sort them in ascending order.
c) To print the list after sorting.

10. Write a C program that consists of recursive functions to

a) Find factorial of a given number
b) Solve towers of Hanoi with three towers (A, B & C) and three disks initially on tower A.

11. A Bookshop maintains the inventory of books that are being sold at the shop. The list includes details such as author, title, price, publisher and stock position. Whenever a customer wants a book the sales person inputs the title and the author and the system searches the list and displays whether it is available or not. If it is not an appropriate message is displayed, if it is then the system displays the book details and request for the number of copies required ,if the requested copies are available the total cost of the requested copies is displayed otherwise the message "required copies not in stock" is displayed. Write a program for the above in structures with suitable functions.
12. Write a C program to read a data file of student's records with fields(Regno, Name, M1,M2,M3,M4,M5) and write the successful students data (percentage > 40%) to a data file.

MATHEMATICS – III
CH211 / MA03
(CE/CH/CS/EC/EEE/EI/IT/ME)

L	T	C	:	4	0	4	Continuous Assessment	:	40
Final Exam			:	3 hours			Final Exam Marks	:	60

Objectives: The main objective of the course is to reach the needs of the engineering and physical sciences curricula by providing an applications-oriented introduction to Fourier integrals and transforms, Fourier series solutions of Heat & Wave equations. Topics in function approximation, linear and nonlinear equations, interpolation, numerical integration and differentiation, and ordinary differential equations will be dealt with using numerical computational techniques.

Pre-requisites: 10+2 Maths, CH111, CH121.

UNIT – I

Fourier integrals: From Fourier series to the Fourier integral, Application of the Fourier integral, Fourier Cosine and Sine integral, Evaluation of integrals, Fourier cosine and sine Transforms: Fourier Cosine Transforms, Fourier Sine Transforms, Linearity, Transforms of Derivatives, Fourier Transform: Complex form of the Fourier integral, Fourier Transform and its inverse, Linearity. Fourier Transform of Derivatives, Convolution. **(16 Periods)**

UNIT – II

Partial differential equations: Basic concepts, Modeling-Vibrating string, Wave Equation Separation of Variables Use of Fourier series, D'Alembert's Solution of the Wave Equation, Heat Equation-Solution Fourier series, Steady-State Two-Dimensional Heat Flow **(16 Periods)**

UNIT – III

Numerical Methods in general: Introduction, Solution of Equations by Iteration, newton's Method for Solving Equations f(x) = 0, Convergence of Newton's method, Interpolation: Lagrange interpolation, Newton's divided difference interpolation, Equal spacing: Newton's forward Difference formula, Newton's Backward Difference formula, Inverse interpolation, Numerical integration and Differentiation: Trapezoidal Rule, Error Bounds and Estimate for the Trapezoidal Rule, Simpson's Rule of integration, Error of Simpson's rule. **(16 Periods)**

UNIT – IV

Numerical methods in linear algebra: Linear Systems: Gauss Elimination, LU Factorization, Gauss-Seidel iteration Method, Method of least Squares, Methods of First order Differential Equations: Euler's method, Runge-Kutta methods, Methods for Elliptic Partial Differential Equations: Laplace equation, Poisson equation **(16 Periods)**

TEXT BOOK

1. "Advanced Engineering Mathematics", Erwin Kreyszig, 8th edition, John Wiley & Sons.

REFERENCE BOOKS

1. "Advanced Engineering Mathematics", Peter V. O'Neil, Thomsons Brooks/Cole.

ELECTRICAL & ELECTRONICS ENGINEERING
CH212 / EE01

L	**T**	**C**	**:**	**3**	**1**	**3**	**Continuous Assessment**	**:**	**40**
Final Exam			**:**	**3 hours**			**Final Exam Marks**	**:**	**60**

Course Objective: The objective of this course is to know the basic concept of electric power supply & the basic principles of all electrical machines which are used in industrial as well as household purposes. It also tells about the different types of power supply i.e AC and DC. It also tells about the principles of electronic devices, power supplies and their measurements, their applications in recent trends.

Pre-requisites: PH01, 10+2 Physics.

UNIT- I

Basic Electrical Circuits: Kirchoff's law

DC generators and Motors: Constructional features of DC machines and functions of component parts, Methods of excitation, Calculation of induced e.m.f, Characteristics of shunt, series and compound generators and applications, Torque developed in a motor, Motor Starters, losses and efficiency calculations, Testing of DC machines.

Alternating currents: Definition of peak value, RMS value, average value, Form factor of alternate current, Behavior of resistance, Inductance and capacitance to sinusoidal voltage.

UNIT- II

Vector and J-notation as applied to the resolution of AC circuit, Vector diagrams, Single-phase series, Parallel and Series-parallel circuits.

Polyphase circuits: 3-phase supply, star-delta connections, Voltage, current and Power relationships.

Transformers: EMF equation, regulation, efficiency of single phase transformers, testing of transformers

Three-phase induction motors: Production of rotating magnetic field, Theory of slip-ring and squirrel cage induction motors, Torque-slip characteristics

UNIT- III

Electronic devices: Characteristics of Semiconductor junction, Diode and transistor, Zener diode, SCR, **Power supplies:** Half-wave and full-wave rectifiers, Bridge rectifier, Study of capacitance, inductance and filters, Voltage stabilization by Zener Diode

Transistor amplifiers: Classification, baising small signal- low frequency.

UNIT- IV

Oscillators: Classification, RC phase shift, wien-bridge, Hartley and Colpitts oscillators

Electronic Measurements: Principles and applications of multimeters, VTVMs and CROs, Introduction to transducers and their applications.

Text Books

1. Principles Electrical Engineering, V.K.Mehta & Rohit Mehta, S.Chand & Co., New Delhi
2. Basic Electronics, N.N.Bhargava & Kulasresta, Tata McGraw Hills, New Delhi

References Books

1. Electrical Technology, H.Cotton, 7th edition, CBS publishers, New Delhi.
2. Applied Electronics, G.K Mithal, Khana Publishers.
3. Electronic devices and Circuits, Millman and Haiking, Tata McGraw Hills, New Delhi
4. Electronic Fundamentals and Applications, John D Ryder, PHI publishers, New Delhi

ORGANIC CHEMISTRY
CH213 / CY03

L	T	C	:	4	1	4	Continuous Assessment	:	40
Final Exam			:	3 hours			Final Exam Marks	:	60

Course Objective: The main objective of this subject is to impart a sound knowledge on the basic principles of Organic Chemistry, importance & uses of bio-molecules with special emphasis on the mechanisms of various chemical reactions and their industrial applications required for all chemical engineering students.

Prerequisites: CH113, CH123.

UNIT – I

Structure and Properties: Elemental Analysis Qualitative and Quantitative, Empirical and molecular formula determination, Problems based on Molecular and Empirical formula determinations.

Electron Displacements in a molecule: Inductive, mesomeric and electromeric effects, resonance, hyper conjugation, Reaction mechanisms of SN1, SN2, E1, and E2 reactions, Free radical, cationic & anionic polymerization, Zigler-natta polymerization, hydrogen bonding in organic molecules and its effect.

Stereo Chemistry: Basics of optical and geometrical isomerisms - Enantiomers, Diastereoisomers, Meso compounds, sequence rules, 'R' and 'S', E&Z configuration, Keto-enol tautomerism.

Pre-requisites: 10+2 Chemistry.

UNIT – II

Alkanes: Classification by structure, conformations of Ethane and n-butane. Preparation methods – Wurtz reaction, Kolbes electrolytic method. Halogenation in alkanes (alkyl halides) – Free radical substitution method.

Cyclo alkanes: Stability of cyclo alkanes, Bayers strain theory, conformation analysis of cyclo hexane and di-substituted cyclo hexanes.

Alkenes: Preparation by de-hydration of alcohols, de-hydro halogenation of alkyl halides (Saytzeff rule). Addition reactions. Markownikoff's and Anti Markownikoff's rule. 1,2 and 1, 4 additions in dienes.

Benzene: Aromaticity, Huckels rule, Electrophilic aromatic substitution, Mechanism of Nitration, Friedel-Crafts alkylation and acylation – Orientation in disubstituted benzenes, activating and deactivating groups, aryl halides, aralkyl halides.

UNIT – III

Heterocyclic compounds: Furan, Thiphene, Pyrrole, Pyridine, Indole, their important derivatives.

Hydroxy compounds: Manufacture of alcohol from molasses, Phenols: acidity comparison with alcohol. Reactions of phenol – Riemer Tiemann reaction, Kolbe's reaction, Fries re-arrangement.

Carbonyl compounds: Aldehydes and ketones–Preparation–Grignards reagent, Gatterman, Koch reaction. Nucleophilic addition reactions of carbonyl compounds, Cannizzaro reaction, aldol condensation, Perkin, Reformatsky, Claisen condensation, Clemmenson reduction, Wolfkishner reduction, Pinacol–Pinacolone rearrangement, Tishenko reaction, Haloform reaction, Benzoin condensation.

UNIT – IV

Carboxylic acids: Acidity, influence of substitutents on acidity, functional derivatives of carboxylic acids – acid halides, amides, anhydrides, esters.

Aliphatic and Aromatic amines: 1^o, 2^o, 3^o amines – distinguishing tests, preparation by Hofmann's degradation of amides, basicity of amines, diazonium salts, preparation and synthetic importance – sand mayer reaction.

Biomolecules: Nomenclature, classification of Carbohydrates, Proteins & Lipids, structure and general reactions of glucose and fructose and their inter conversions, muta rotation.

Text Books

1. Text Book of Organic Chemistry, R.T.Morrison and R.N.Boyd, 6^{th} edition, PHI, Delhi.
2. Fundamentals of Biochemistry, J.L. Jain

Reference Books

1. Text Book of Organic Chemistry, Vol.1, I.L.Finar, Longman group
2. Principles of Organic Chemistry, M.K.Jain, 9^{th} edition. S.Nagin & Co.
3. Text Book of Organic Chemistry, B.S.Bahl and Arun Bahl, S.Chand & Co., Delhi.

MATERIAL TECHNOLOGY
CH214

L	**T**	**C**	**:**	**4**	**0**	**4**	**Continuous Assessment**	**:**	**40**
Final Exam			**:**	**3 hours**			**Final Exam Marks**	**:**	**60**

Objectives: An interdisciplinary study programme, ranging from the study of crystal structure to the development of new materials. It is an important priority topic of study for Chemical Engineers to have a better understanding of suitable materials of construction in Process Industries.

Prerequisites: CH112, CH113, CH122, CH123

UNIT – I

Atomic structure and chemical bonding: Structure of an atom, quantum states, periodic table, Ionization potential, electron affinity and Electro negativity.
Chemical bonding: Types of bonds, Ionic covalent, metallic and secondary bonding, properties and bond characteristics.
Crystal geometry and structure determination geometry of crystals: space lattices, crystal structures, miller indices of crystallographic phases and directions, structure determination by x-ray diffraction, Bragg law powder method.
Structures of solids and crystal imperfections: crystalline and non crystalline solids, inorganic solids, ionic solids, metals and alloys, cubic systems packing efficiency and co-ordination number.
Crystal imperfections: point, line and surface imperfections.

UNIT – II

Phase diagrams and phase transformations: Constitution of alloys, phase rule, single component systems, two component systems, binary phase diagrams – tie line rule, lever rule, isomorphus, eutectic, eutectoid, peritectic and peritectoid systems with examples. Non equilibrium cooling: coring, Phase transformation, solidification and crystallization.

Metal shaping processes and their brief study: Rolling, forging, drawing, extrusion.
Strengthening of metals and alloys: Grain refinement, solid solution strengthening, dispersion strengthening, strain hardening and precipitation hardening.
Heat treatment of steels applied to the materials used in chemical industry: Annealing, normalising, hardening and tempering.

UNIT – III

Elastic behavior of materials Plastic deformation: Mechanism of slip and twinning.
Creep: Mechanism and methods to reduce Creep in materials.

Fracture in ductile and brittle materials, Fatigue-Mechanism and preventive methods
Oxidation and corrosion: Basic principle, types of corrosion, various combating methods.

UNIT – IV

Types of metals and alloys used in chemical process industry, Criteria of selection of materials of construction in process industry. Brief study of composite materials and stress-strain analysis

Text Books

1. Material Science and Engineering, V.Raghavan, PHI
2. Material Science and Engineering, D.Callisters Jr,Weily & Sons

Reference Books

1. Material Science and Metallurgy, Dr.V.D.Kodgire,New age India.
2. Material Science and Engineering, R.K.Rajput, S.K.Kataria & Sons.

MATERIAL AND ENERGY BALANCE
CH215

L	T	C	:	4	1	4	Continuous Assessment	:	40
Final Exam			:	3 hours			Final Exam Marks	:	60

Course Objectives: To teach the fundamental aspects of chemical engineering problem solving and provide the foundation for all subsequent chemical engineering courses, To teach students the basics and applications of material & energy balances, psychometric charts, enthalpy concentration diagrams and fundamental laws.
Prerequisites: CH112, CH113, CH122, CH123.

UNIT – I

Mathematical Procedures: Solutions of equations by trial and error, simultaneous equations, graphical integration and differentiation, use of log-log, semi-log, and triangular graphs, conversion of units.
Stoichiometric and composition relations: Stoichiometric reaction, basis of calculations, method of expressing composition of mixture and solutions, density and specific gravity.
Behavior of ideal gases and governing equations: Kinetic theory of gases, application of ideal gas law, gaseous mixtures, gases in chemical reactions.

UNIT – II

Vapor Pressure: Liquefaction and liquid state, vaporization, boiling point, effect of temperature on vapor pressure, vapor pressure plots, estimation of critical properties, vapor pressures of immiscible liquids and solutions, Raoult's law and its limitations.
Humidity and saturation: Relative and percent saturation, dew point, wet and dry bulb temperatures, use of humidity charts for solving engineering problems.

UNIT – III

Material balances: Law of conservation of mass, mass calculation for chemical and combustion reactions, analysis of system with by-pass, recycle and purge-with and without chemical reaction.

UNIT – IV

Thermophysics: Concept of energy, energy balance equation, heat capacity of gases, liquids and mixtures in energy balance problems, Kopp's rule, latent heat, heats of fusion and vapourization, Trouton's and Kishtyakowsky equations.
Thermochemistry: Calculation and application of heat reaction, combustion, formation and neutralization in reaction and their heat effect. Enthalpy concentration charts.

Text Books

1. Chemical process Principles Part–1, Material and Energy Balances, Hougen,O.A., Watson, K.M., and Ragatz, R.A., 2nd Edition, New Age International

Reference Books

1. Basic Principles and Calculations in Chemical Engineering, David Himmelblau Printice Hall of India
2. Stoichiometry, B. I. Bhatt and Vora, Tata McGraw Hill
3. Stoichiometry and Process Calculations, K. V. Narayanan and B. Lakshmikutty, Prentice-Hall of India Private Limited, New Delhi.

MOMENTUM TRANSFER
CH216

L	T	C	:	4	1	4	Continuous Assessment	:	40
Final Exam			:	3 hours			Final Exam Marks	:	60

Course Objectives: You will develop a working understanding of the basic theory of incompressible fluid mechanics, the governing integral and differential equations for viscous and in viscid fluids and will apply these equations to internal and external flows. You will learn problem-solving techniques and have the opportunity to apply your knowledge to a variety of problems.
Prerequisites: CH112, CH122, CH215.

UNIT – I

Basic Concepts: Units and dimensions, dimensional analysis, similarity, equations of state, material and energy balances.
Fluid Statics: Nature of fluids, pressure concept, hydrostatic equilibrium, manometers and decanters.
Fluid flow phenomena: Concept of stream lines, stream tubes, velocity field, viscosity, types of fluids, turbulence and its nature, flow in boundary layers, its formation and growth in tubes and on plates.

UNIT – II

Basic equations of fluid flow: Continuity, momentum and Bernoulli's equations.
Flow of incompressible fluids: Relation between skin friction and wall shear, laminar flow in pipes, Hagen-Poiseuille equation, turbulent flow in pipes, velocity distribution equations, friction factor, flow through channels of non-circular cross section, friction from changes in velocity or direction, flow of liquids in thin layers.

UNIT – III

Flow of compressible fluids: Continuity equation, total energy balance, processes of compressible flow, isentropic flow, adiabatic frictional flow.
Flow past immersed bodies: Friction in flow through beds of solids, fluidization, mechanism of fluidization, pressure drop in fluidization, applications of fluidization.

UNIT – IV

Transportation of fluids: Pipes, fittings, valves, pumps, fans, blowers, compressors, vacuum pumps, jet ejectors.
Metering of fluids: Venturi meter, Orifice meter, Rotameter, Pitot tube, Brief introduction to target meters, Turbine meters, Magnetic meters, Ultrosonic meters, Thermal meters.

Text Book

1. Unit Operations of Chemical Engineering, Warren L.McCabe, Julian C.Smith, Peter Harriot, 7th Edition, McGraw Hill.

Reference Books

1. Unit Operations, Brown et al. – Asia Publishing House.
2. Perry's Chemical Engineers Hand Book, Robert H. Perry, 7th edition, McGraw Hill
3. Coulson & Richardson's Chemical Engineering, Volume-1, J.F. Richardson, J. H. Harker and J. R. Backhurst, 4th edition, Elsevier.

ELECTRICAL AND ELECTRONICS ENGINEERING LABORATORY
CH 251 / EEL01

L	**T**	**C**	**:**	**3**	**0**	**2**	**Continuous Assessment**	**:**	**40**
Final Exam			**:**	**3 hours**			**Final Exam Marks**	**:**	**60**

1. Study and calibration of Ammeter, Voltmeter & Wattmeter.
2. Measurement of low, medium & insulation resistance.
3. Verification of KCL and KVC.
4. Parameters of choke coil.
5. OC and SC Tests on transformer
6. Load Test D.C. self excited machine.
7. O.C. Test on D.C. self excited machine.
8. Swinburnes test.
9. 3-phase induction motor(Brake test)
10. VI Characteristics of Junction diode
11. VI Characteristics of Zener diode
12. Half wave Rectifier and Fullwave rectifier.
13. OR AMP Applications
14. Common Emitter configuration
15. Characteristics of FET
16. Characteristics of UJT

ORGANIC CHEMISTRY LABORATORY
CH 252 / CYL02

L	T	C	:	3	0	2	Continuous Assessment	:	40
Final Exam			:	3 hours			Final Exam Marks	:	60

1. Preparation of Aspirin
2. Preparation of Benzanilide
3. Preparation of m-dinitrobenzene
4. Preparation of Benzoic acid
5. Preparation of Dibromo aniline
6. Preparation of Methyl Orange
7. Preparation of Parabenzoquinone
8. Preparation of Nerolin
9. Detection of Extra elements
10. Analysis of compound-1
11. Analysis of compound – 2
12. Analysis of compound – 3
13. Analysis of compound – 4
14. Analysis of compound – 5
15. Analysis of compound – 6.

Note: Analysis of organic compound with single functional groups containing phenol, aldehyde, ketone, carboxylic acid, amides, amines, monosaccharides with two derivatives

MOMENTUM TRANSFER LABORATORY
CH253

L	T	C	:	3	0	2	Continuous Assessment	:	40
Final Exam			:	3 hours			Final Exam Marks	:	60

1. Determination of Friction factor
2. Determination of Minor losses
3. To study the effect of Reynolds number on coefficient of discharge of orifice meter
4. To study the effect of Reynolds number on coefficient of discharge of ventury meter
5. To determine the overall efficiency and to study Characteristics of centrifugal pump
6. To determine the overall efficiency and to study Characteristics of Reciprocating Pump
7. To determine the type of flow using Reynolds apparatus
8. To verify Bernoulli's principle using Bernoulli's Apparatus
9. To verify minimum fluidization velocity of Packed Bed
10. To measure point velocity in a pipe using Pitot tube
11. To determine the discharge coefficient of rota meter

PROBABILITY AND COMPLEX ANALYSIS
CH221 / MA06

L	**T**	**C**	**:**	**4**	**0**	**4**	**Continuous Assessment**	**:**	**40**
Final Exam			**:**	**3 hours**			**Final Exam Marks**	**:**	**60**

Objectives: The main objectives of the course are (1) to create, simulate, and analyze elementary probabililty models (2) to explain the advantages and limitations of the statistical inferences made from them(3)to equip the students with the techniques of Complex analysis.

rerequisites: 10+2 Maths

UNIT – I

Sample spaces and Events, Probability, Axioms of probability, Some elementary theorems, Conditional probability, Bayes' theorem, Continuous random variables, The Normal distribution, The Normal approximation to the Binomial distribution, Other probability densities, The Uniform distribution, The log-normal distribution, The Gamma distribution, The Beta distribution, The Weibull distribution.

UNIT – II

Populations and samples, Sampling distribution of the mean(σ known), Sampling distribution of the mean(σ unknown), Sampling distribution of the variance, Point estimation, Interval estimation, Tests of Hypotheses, Null hypotheses and Significance of Tests, Hypotheses concerning one mean, Inferences concerning two means.

UNIT – III

Complex numbers and functions: Introduction to Complex Numbers, Derivative. Analytic Function, Cauchy's- Riemann equations. Laplace equation.
Complex Integration: Line integral in the complex plane, Cauchy's Integral Theorem, Cauchy's Integral Formula,

UNIT – IV

Taylor , Laurent series and Residue Integration: Taylor Series and Maclaurin series, Laurent Series, singularities and zeros. Infinity, Residue integration method, evaluation of Real Integrals.

TEXT BOOKS

1. Miller & Freund's "Probability and Statistics for Engineers", Richard A. Johnson, 6th Edition, PHI.

2. "Advanced Engineering Mathematics", Erwin Kreyszig, 8th Edition, John Wiley,2000

REFERENCE BOOKS

1. "Probability & Statistics for Engineers and Scientists", R.E Walpole, R.H. Myers & S.L. Myers, 6th Edition, PHI.
2. "Theory and Problems of Complex Variables", Murray R Spiegel, Schaum's outline series.

APPLIED MECHANICS AND MECHANICAL ENGINEERING
CH222 / ME02

L	**T**	**C**	**:**	**3**	**1**	**3**	**Continuous Assessment**	**:**	**40**
Final Exam			**:**	**3 hours**			**Final Exam Marks**	**:**	**60**

Objectives: To impart both concepts and principles of applied mechanics and mechanical engineering so as to enable the students to perform design of the materials and component.

Pre-requisites: 10+2 Physics

UNIT I

Forces: Composition and Resolution of coplanar Forces, Equilibrium of Coplaner forces.
Section Properties: Centre of gravity and Moment of Inertia of simple and composite elements.

UNIT II

Stress and Strain: Simple stress and strain, Hooke's Law, factor of safety, thermal stresses, Lateral strain, modules of rigidity, bulk modules, strain energy.
Thin and Thick Cylinders: Thin and thick circular cylinders subjected to internal and external pressure. Thin and thick cylinders with spherical ends. Lame's theorem and application to thick cylinders.

UNIT III

Steam: Generation of steam, Properties of steam, use of steam tables and Mollier chart.
Steam Generators: Classification – Cochran and Babcock-Wilcox boilers - accessories and mountings.

UNIT IV

Drives: Belts, expression for the ratios of tensions on the slack and tight side, power transmitted, V-belts, chain drives.
Gears: Spur, helical, Bevel gear trains – simple and compound.
Bearings: Purpose of bearings, slipper bearing, thrust bearing, ball and roller bearings.
Couplings: Flange, flexible couplings, hooks joint, universal coupling.

Text Books

1. Thermal Engineering, Ballaney, Khanna Publishers, New Delhi.
2. Theory of Machines, Ballaney, Khanna Publishers, New Delhi

Reference Books

1. Applied Mechanics & Strength of Materials, R. S. Khurmi, S. Chand & Co.
2. Strength of materials, Sadhu Singh, Khanna Publishers, New Delhi.

PROCESS HEAT TRANSFER
CH223

L	**T**	**C**	**:**	**4**	**1**	**4**	**Continuous Assessment**	**:**	**40**
Final Exam			**:**	**3 hours**			**Final Exam Marks**	**:**	**60**

Course Objectives: To know the basic principles like modes of heat transfer and related law, thermal properties and analogies among heat, momentum, mass and electric flow. To estimate the rate of heat transfer from the existing processes in steady and unsteady processes, with phase change and without phase change. To make students familiar with all basics of heat exchangers like condensers, evaporators shell and tube and double pipe heat exchanger etc.

Prerequisites: 10+2 Physics**.**

UNIT – I

Introduction: Modes of heat transfer, basic laws of heat transfer, Analogy between heat flow and electric flow.

Conduction: The Fourier heat conduction equation, steady state one dimensional heat conduction through plane wall, cylindrical wall, spherical wall and composite structures. Critical insulation thickness. Unsteady state heat conduction through a semi infinite solid, infinite slab, cylinder and sphere.

UNIT – II

Convection: The convective heat transfer coefficient, introduction to thermal boundary layer, Dimensionless numbers in heat transfer and their significance. Dimensional analysis.

Forced Convection: Heat transfer by forced convection, inside tubes and ducts in laminar, transition and turbulent flow. Analogy between heat and momentum transfer, Reynold's, Prandtl and Colburn analogies.

Natural convection: Grashoff number, natural convection from vertical and horizontal surfaces.

Heat transfer to liquid metals: Forced convection over exterior surfaces. Heat transfer for tubes in cross flow.

UNIT – III

Heat transfer to fluids with phase change: Heat transfer from condensing vapours, film wise and drop wise condensation. Derivation and practical use of Nusselt equation. Condensation of super heated vapours. Effect of non-condensable gases on rate of condensation. Heat transfer to boiling liquids. Boiling of saturated liquid. Maximum heat flux and critical temperature drop-minimum flux and film boiling. Sub-cooled boiling.

Heat transfer by Radiation: Thermal radiation, Black body radiation, Kirchhoff's law, emissivity, Grey body and laws of black body radiation. Geometric factor, Radiation in enclosures with concentric cylinders and spheres. Combined heat transfer by conduction, convection and radiation,

UNIT – IV

Heat Exchange equipment: Types of heat exchangers, log-mean temperature difference (LMTD) Correction factor. Energy balances, overall heat transfer coefficients. Heat exchanger effectiveness. Fouling factors, Design and description of heat transfer equipment, Heat exchangers, condensers, boilers and kettles. Extended surface equipment, Empirical relations in agitated vessels, packed beds.

Evaporation: Types of evaporators. Capacity and economy of evaporators, boiling point elevation and Duhring's rule. Material and energy balances in single effect evaporator. Multi effect evaporators, methods of feeding, capacity and economy of multiple effect evaporators.

Text Book

1. Unit Operations of Chemical Engineering, Warren,L., McCabe, Julian C.Smith, Peter Harriot, 7^{th} Edition, McGraw Hill .

Reference Books

1. Fundamentals of Heat and Mass Transfer , Incropera, De Witt, Bergman, Lavine.
2. Fluid Dynamics and Heat Transfer, James G.Knudsen, Donald L.Katz.
3. Process Heat Transfer, Donald, Q.Kern, McGraw Hill

CHEMICAL ENGINEERING THERMODYNAMICS–I
CH224

L	**T**	**C**	**:**	**4**	**1**	**4**	**Continuous Assessment**	**:**	**40**
Final Exam			**:**	**3 hours**			**Final Exam Marks**	**:**	**60**

Course Objectives: The objective of this course is to enable the student to assimilate the basic laws of thermodynamics and their applications and also to assimilate the foundation on which the property estimations of the pure fluids is developed to be applied for thermodynamic design of chemical unit operations and refrigeration.

Prerequisites: CH113, CH215

UNIT – I

Relevance and scope of chemical engineering thermodynamics, internal energy, first law of thermodynamics, energy balance for closed systems, thermodynamic state and state functions, equilibrium, the phase rule, the reversible process, constant volume and constant pressure processes, enthalpy, heat capacity, mass and energy balances for open systems.

UNIT – II

PVT behavior of pure substances, Virial equations of state, the ideal gas, applications of Virial equations, cubic equations of state, generalized correlations for gases and liquids.
Second law of thermodynamics, heat engines, thermodynamic temperature scales, entropy, entropy and probability, entropy changes of an ideal gas, mathematical statement of second law, entropy balance for open systems, calculation of ideal work and lost work, third law of thermodynamics.

UNIT – III

Property relations for homogeneous phases, Maxwell's equations, residual properties, two phase systems, thermodynamic diagrams, generalized property correlations for gases.

Thermodynamics of flow processes –duct flow of compressible fluids, Turbines, compression processes**.**

UNIT – IV

Refrigeration, Carnot refrigeration, vapor – compression cycle, choice of refrigerant, absorption, refrigeration, heat pump, liquefaction process.

Text Book

1. Introduction to Chemical Engineering Thermodynamics, Smith, J.M., Van Ness,H.C., and Abbott,M.M., 6th Edition, McGraw Hill.

Reference Books

1. Chemical Engineering Thermodynamics, Daubert McGraw Hill
2. Chemical Engineering Thermodynamics, Y.V.C.Rao, Universities press.

MECHANICAL UNIT OPERATIONS
CH225

L	**T**	**C**	**:**	**4**	**1**	**4**	**Continuous Assessment**	**:**	**40**
Final Exam			**:**	**3 hours**			**Final Exam Marks**	**:**	**60**

Objectives: Study the different physical separation processes based on mechanical unit operations, with emphasis on a physical understanding of these processes. Provide the necessary tools to obtain quantitative solutions to engineering problems involving basic mechanical unit operations involving solids and fluids like, size reduction and screen analysis, filtration, settling etc.,

Pre-requisites: CH216

UNIT – I

Properties and handling of particulate solids: Characterization of solid particles, shape and size, mixed particle size analysis, specific surface of mixtures, average particle size, screen analysis and standard screen series. Properties of particulate masses, different types of conveyers and storage of solids.

Size Reduction: Principles of comminution, size reduction equipment–crushers, grinders, ultra fine grinders and cutting machines. Open circuit and closed circuit operation.

UNIT – II

Size separation: Screening, screening equipment–grizzlying, gyratory, vibrating, revolving screens. Capacity and effectiveness of screens.

Materials Separation: Magnetic separators, Electro- static separators and froth flotation.

UNIT – III

Filtration: Theory of filtration and filtration equipment, Principles of Cake filtration: Pressure drop calculations, constant rate filtration, constant pressure filtration and principles of centrifugal filtration.

UNIT – IV

Motion of particles through fluids: Drag coefficient – free and hindered settling. Sink and float method, classifiers and thickness, cyclones, hydroclones, centrifuges, jigging and tabling.

Agitation and mixing: Purpose of agitation, agitation equipment, power consumption in agitated vessels, mixing equipment.

Text Books

1. Unit Operations of Chemical Engineering, Warren,L., McCabe, Julian C.Smith, Peter Harriot, 7th Edition. – McGraw Hill.
2. Unit Operations, R. S. Kulakarni and Hiremath, Everest Publishers.

Reference Books

1. Chemical Engineering vol. – II, Coulson, J.H., and Richardson, Paragon Press and ELBS.
2. Unit Operations, Brown George, CBS
3. Mechanical Operations for Chemical Engineers, C. M. Narayana and B.C.Bhattacharyya, Khanna Publishers.
4. Coulson & Richardson's Chemical Engineering, Volume:2, 4th edition, J.F. Richardson, J. H. Harker and J. R. Backhurst, Elsevier.
5. Perry's Chemical Engineers Hand Book, Perry Rober H, 7th edition,McGraw Hill

PROCESS INSTRUMENTATION
CH226

L	**T**	**C**	**:**	**4**	**0**	**4**	**Continuous Assessment**	**:**	**40**
Final Exam			**:**	**3 hours**			**Final Exam Marks**	**:**	**60**

Objectives: The objectives of the course are to enable student to assimilate concepts and principles required to design and operate instruments used in chemical process industry.

Pre-requisites: 10+2 Physics, PH02.

UNIT – I

Elements of instruments, static characteristics, dynamic characteristics, dynamic response of 1^{st} order systems.
Temperature measurement: Expansion thermometers, thermo- electric temperature measurement. Resistance thermometers, radiation temperature measurement.

UNIT – II

Measurement of pressure and vacuum, measurement of head and level, flow metering.

UNIT – III

Methods for composition analysis: Absorption spectroscopy, emission spectroscopy, mass spectroscopy, color measurement by spectrometers, gas analysis by thermal conductivity, refractometer, Gas chromatography.

UNIT IV

Process Instrumentation: Recording instruments, indicating and signaling instruments, transmission of instrument readings, the control center, instrumentation diagram, diagrammatic control center layout, process analysis.

Text Book

1. Industrial Instrumentation, Donald P. Eckman, Wiley Eastern Ltd.,

Reference Books

1. Principles of Industrial Instruments, Patrenabis, Tata McGraw Hill
2. Electronics Devices – circuits, Milliman and Haiking.
3. Introduction to Chemical Analysis, Robert D.Braun, McGraw Hill.

PROCESS HEAT TRANSFER LABORATORY
CH261

L	**T**	**C**	**:**	**3**	**0**	**2**	**Continuous Assessment**	**:**	**40**
Final Exam			**:**	**3 hours**			**Final Exam Marks**	**:**	**60**

1. Determining the thermal conductivity of a metal rod
2. Estimating the natural convective heat transfer coefficient for a vertical tube
3. Determining the temperature distribution along a pin fin under natural convection and forced convection
4. Estimating the heat transfer coefficient in forced convection flow of fluid.
5. Determining the overall heat transfer coefficient of fluid in parallel and counter flow in double pipe heat exchanger.
6. Finding the Stefan- Boltzmann constant.
7. Estimating the emissivity of a test plate
8. Finding the thermal conductivity of lagged materials in a lagged pipe.
9. Analyzing the temperature distribution through composite walls.
10. Studying the boiling heat transfer phenomena
11. Estimating the overall heat transfer coefficient for a fluid flow in a shell and tube heat exchanger.
12. Calculating the heat transfer coefficient from a metal rod by unsteady state heating and cooling processes.
13. Estimating the overall heat transfer coefficient for a fluid flow in agitated vessels.
14. Estimating the overall heat transfer coefficient for a fluid flow in a jacketed kettle.
15. Calculating the rate of evaporation in Single effect evaporator.
16. Estimating the heat transfer coefficient in Drop wise & film wise type condensation.
17. Finding the heat flux for a fluid flow through heat pipe.

MECHANICAL UNIT OPERATIONS LABORATORY
CH262

L	**T**	**C**	**:**	**3**	**0**	**2**	**Continuous Assessment**	**:**	**40**
Final Exam			**:**	**3 hours**			**Final Exam Marks**	**:**	**60**

1. Sampling by Riffle, Cone & Quartering and Bulk method
2. Determining the Grindability index (G.I.) of coal.
3. Verification of crushing laws using Ball Mill
4. Verification of crushing laws using Jaw Crusher
5. Verification of crushing laws using Roll Crusher
6. Demonstration of sink and float Principle
7. Find the optimum time of sieving.
8. Determining the effectiveness of a given screen by hand sieving
9. Determining effectiveness of a given screen using vibrating/ Rotap sieving
10. Estimation of terminal settling velocity in viscous medium.
11. Estimation of cake resistance in Plate and Frame filter press
12. To demonstrate the principle of centrifugal separator.
13. To demonstrate the principle of cyclone separator.

MECHANICAL ENGINEERING LABORATORY
CH263 / MEL02

L	**T**	**C**	**:**	**3**	**0**	**2**	**Continuous Assessment**	**:**	**40**
Final Exam			**:**	**3 hours**			**Final Exam Marks**	**:**	**60**

1. To determine the flash point of the given oil sample using Abbe's Flash Point Tester
2. To determine the impact strength of the given material using Impact Testing Machine
3. To conduct hardness test on given specimens and determine the Brinell's hardness number of the specimen
4. To draw the load characteristics of a diesel Engine
5. To study the load characteristics between viscosity and temperature of the given sample of oil using Redwoods Viscometer-I
6. To study the load characteristics between viscosity and temperature of the given sample of oil using Redwoods Viscometer-II
7. To draw the valve timing diagram of the given models
8. To draw the valve timing diagram of the Block stone diesel Engine
9. To calibrate the given pressure gauge and draw the calibration curves

MASS TRANSFER OPERATIONS – I
CH311

L	T	C	:	4	1	4	Continuous Assessment	:	40
Final Exam			:	3 hours			Final Exam Marks	:	60

Course Objectives: The objective of this course is to enable the students to understand the basic concepts of different mass transfer operations and few separation processes and their governing laws and to acquire knowledge on the design of different types of equipment involved.

Prerequisites: CH 112, CH 113, CH 122, CH 123, CH 124

UNIT – I

Introduction to Mass Transfer Operations

Molecular diffusion in fluids: Steady-state molecular diffusion in fluids at Rest and in laminar flow.

Mass transfer coefficients: Mass transfer coefficients in laminar and turbulent flow, Analogy between momentum, heat and mass transfer in laminar and turbulent flow - correlations for mass transfer coefficients in simple situations, diffusion in solids.

UNIT – II

Inter phase Mass Transfer: Equilibrium, Diffusion between phases, Material balances in steady state co-current and counter-current processes.

Equipment for gas-liquid operations: **Gas Dispersed:** Sparged vessels (bubble columns), mechanically agitated vessels, mechanical agitation of single phase liquids, mechanical agitation, gas liquid contact tray towers. Sieve trays (qualitative treatment), Murphee tray efficiency, and overall tray efficiency.

Liquid dispersed: Venturi scrubbers, wetted–wall towers, spray chambers, packed towers, mass transfer coefficients and packed towers, counter current flow of gas and liquid, end effects and axial mixing, tray Vs packed towers.

UNIT – III

Humidification Operations: Definitions of fundamental terms, psychrometric charts- theory of adiabatic saturation and wet bulb temperature - Lewis relation, gas liquid contact operations – Design of packed bed for humidification and dehumidification, cooling towers, Non-adiabatic operation - evaporative cooling.

Drying: Equilibrium, batch drying, drying rate curve, time of drying calculations, mechanism of batch drying, continuous drying, equipment for batch and continuous drying operations.

UNIT – IV

Absorption: Solubility of gases in liquids, two component systems - ideal and non-ideal solutions - choice of solvent for absorption, single component absorption material balance – counter current multi stage operations, HETP, HTU, NTU concepts for single component absorption in continuous contact equipment – graphical construction for transfer units,

Text Book

Mass Transfer Operations, Robert E. Treybal, 3rd edition, International Edition, McGraw Hill.

Principles of Mass Transfer and Separation Process, Binay K. Dutta, PHI, New Delhi.

Reference Books

Unit Operations of Chemical Engineering, Warren,L., McCabe, Julian C.Smith, Peter Harriot, 7th Edition, McGraw Hill.

Transport process and separation process principles, Christie John Geankoplis, 4th edition, PHI

Separation Process Principles, J D Seader and E J Henly, John Wiley & sons.

Perry's Chemical Engineers Hand Book, Robert H. Perry, 7th edition, McGraw Hill

ENERGY ENGINEERING
CH312

L	T	C	:	3	1	3	Continuous Assessment	:	40
Final Exam			:	3 hours			Final Exam Marks	:	60

Course Objectives: Provide overview of energy consumption and generation, Compare different forms of energy resources and their uses and Design different types of energy conversion and advanced energy generation technologies. Explore energy conservation technologies.

Prerequisites: CH 115

UNIT – I

Conventional energy resources, the present scenario, scope for future development.

Coal: Origin, occurrence and reserves, classification, ranking, analysis and testing, coal carbonization, manufacture of coke, coal gasification, coal liquefaction.

UNIT – II

Petroleum: Origin, occurrence and reserves, composition, classification, characteristics, exploration and production.

Petroleum Refining: Refinery processes, petroleum products, testing and analysis of petroleum products.

UNIT – III

Non conventional energy sources: Solar energy, solar radiation, principles of heating and cooling, photo voltaic cells.

Bio gas products, bio-mass, wind energy, hydrogen energy, geothermal and ocean thermal energy, fuel cells.

UNIT – IV

Energy storage, mechanical energy storage, water storage, solar pond, phase change storage, chemical storage.

Energy Conservation: Conservation methods in process industries, Theoretical analysis, practical limitations, equipment for energy saving / recovery.

Text Books

Conventional Energy technology, S.B.Pandy, Tata McGraw Hill
Fuel Science, Harker and Allen, Oliver & Boyd.
Energy conversion, Culp, Mc Graw Hill.

Reference Books

Hand book of energy technology, Considine D. M.
Fuels and energy, Harker and Backhusst, Academic press
Solar Energy Thermal Process, John A Duffie.

CHEMICAL ENGINEERING THERMODYNAMICS–II
CH313

L	**T**	**C**	**:**	**3**	**1**	**4**	**Continuous Assessment**	**:**	**40**
Final Exam			**:**	**3 hours**			**Final Exam Marks**	**:**	**60**

Course Objectives: The objective of this course is **t**o enable the students to assimilate the thermodynamic design of industrial reactions and the conceptual development of solution thermodynamics to lead to its logical conclusion of studying the phase and chemical reaction equilibria.

Prerequisites : CH 215, CH 216, CH 223, CH 311

UNIT – I

Heat effects: Sensible heat effects, temperature dependence of heat capacity, heat effects accompanying the phase changes, the standard heat of reaction, formation and combustion, temperature dependence of ΔH^0, heat effects of industrial reactions.

UNIT – II

Solution thermodynamics: Fundamental property relation, chemical potential, criterion for phase equilibria, partial properties, ideal gas mixtures, fugacity and fugacity coefficients, generalized correlations for fugacity coefficients, the ideal solution, excess properties.

Solution Thermodynamics Applications: Liquid phase properties from VLE data, activity coefficient, excess Gibb's energy, Gibb's Duhem equation, data reduction, thermodynamic consistency, models for excess Gibb's energy, property changes of mixing, heat effects of mixing processes.

UNIT – III

Phase equilibria, VLE: Nature of equilibrium, Phase rule, Duhem's Theorem, VLE: Qualitative behavior, simple models for VLE, VLE, modified Raoult's Law, VLE from k – values correlations. The Gamma / Phi formulation of VLE, VLE from cubic equations of state, equilibrium and stability, LLE, VLLE, SLE, SVE.

UNIT – IV

Chemical Reaction Equilibrium: The reaction coordinate, application of equilibrium criteria to chemical reactions, the standard Gibbs-Energy change and the equilibrium constant, effect of temperature on the equilibrium constant, evaluation of equilibrium constants, relation of equilibrium constants to composition, equilibrium conversions for single reactions, phase rule and Duhem's theorem for reacting systems, multireaction equilibria, Fuel cells.

Text Book

Introduction to Chemical Engineering Thermodynamics, Smith, J.M., Van Ness,H.C., and Abbott,M.M., 6th Edition, McGraw Hill.

Reference Books

Chemical Engineering Thermodynamics, Daubert, McGraw Hill.

Chemical Engineering Thermodynamics, Y.V.C.Rao, University Press.

CHEMICAL REACTION ENGINEERING – I
CH314

L	**T**	**C**	**:**	**4**	**1**	**4**	**Continuous Assessment**	**:**	**40**
Final Exam			**:**	**3 hours**			**Final Exam Marks**	**:**	**60**

Course Objectives: The objective of this course is to present reaction kinetic principles and different types of reactors to achieve the required reaction and gain knowledge on the selection of right type of reactor for the required reaction.

Prerequisites: CH215, CH 216, CH 223, CH 224, CH 225, CH 311, CH 313

UNIT – I

Thermodynamics, chemical kinetics, classification of reactions, variables affecting the rate of reaction, definition of reaction rate.

Kinetics of homogeneous reactions: Concentration dependent term of rate equation, temperature dependent term for rate equation, searching for a mechanism, predictability of reaction rate from theory.

UNIT – II

Interpretation of Batch Reactor Data: Constant volume batch reactor, variable volume batch reactor, temperature and reaction rate, search for a rate equation.

UNIT – III

Introduction to Reactor design.

Single ideal Reactor: Ideal batch reactor, space time and space velocity, steady state mixed flow reactor, steady state plug flow reactor, holding time and space time for flow systems.

UNIT – IV

Design for Single Reactions: Size comparison of single reactors, multiple reactor systems, recycle reactor, autocatalytic reactions.

Design for multiple reactions: Reactions in parallel, reactions in series, contacting patterns, product distribution.

Text Book

Chemical Reaction Engineering, Octave Levenspiel, 3rd edition, Wiley Eastern

Reference Books

Elements of chemical reaction engineering, H.S.Fogler, 2nd edition, PHI

Chemical Engineering Kinetics, J.M.Smith, 3rd edition, McGraw Hill.

Chemical Reaction Engineering, Octave Levenspiel, 2nd edition, Wiley Eastern.

CHEMICAL TECHNOLOGY
CH315

L	**T**	**C**	**:**	**3**	**1**	**3**	**Continuous Assessment**	**:**	**40**
Final Exam			**:**	**3 hours**			**Final Exam Marks**	**:**	**60**

Course Objectives: The objective of this course is to explain the manufacturing procedures of different organic and inorganic chemicals that are of industrial significance

Prerequisites: CH 124

UNIT – I

Introduction: Objectives, unit processes and unit operations. General Fundamentals

Water: Water conditioning and waste water treatment.

Ceramic industries: Raw materials and manufacturing processes, refractories

Cement: manufacture, special cements

Industrial gases: Nitrogen, Carbon dioxide, Oxygen

UNIT – II

Nitrogen industries: Synthetic ammonia, urea, other nitrogenous fertilizers, nitric acid.

Phosphate Industries: Phosphoric Acid, calcium phosphate and super phosphate

Sulfur and sulfuric acid: manufacture of sulfur and sulfuric acid.

Nuclear industries: Uranium and thorium fission, nuclear fuels

UNIT – III

Rubbers: Classification, natural rubber, monomers of synthetic rubber, manufacture of SBR.

Petroleum Refining: Constituents of petroleum, Products of Refining, petroleum refining process- Cracking, reforming, polymerization, alkylation, isomerization, hydro-cracking

Plastic industry: Classification of plastics, outlines and manufacture of phenols,

Paints and Varnishes: Constituents of paints and varnishes and their manufacturing procedures

UNIT – IV

Sugar and starch industry: Manufacture of cane sugar, production of starch from maize.

Soaps and detergents: Continuous process for the production of fatty acids and soap, production of detergents.

Fermentation industry: manufacture of alcohol from molasses

Pulp and paper industry: Methods of pulping, production of sulphate and sulphite pulp, production of paper–wet process

Text Books

Shreve's Chemical Process Industries Ed. By Austin, G.T., McGraw Hill, 5th edition, 1985

Dryden's Outlines of chemical technology Ed. By M.Gopal Rao and M.Sitting, 3rd edition, East West Press.

Reference Books

Text Book of Chemical Technology (Organic), G.N.Panday, Vikas Publishers

Chemical Process Industries, Vol. II, CBS Publishers & Distributors

PROCESS DYNAMICS AND CONTROL
CH316

L	**T**	**C**	**:**	**4**	**1**	**4**	**Continuous Assessment**	**:**	**40**
Final Exam			**:**	**3 hours**			**Final Exam Marks**	**:**	**60**

Course Objectives

The main objective of this course is to teach the fundamental aspects of process control and understanding the elements of the process control structure to choose the suitable elements. Designing classical controller for single-input single-output systems.

Pre-Requisites: CH 211, CH 215, CH 216, CH 223, CH 226.

UNIT – I

Basic Principles and problems of process control: Laplace transform, inversion by partial fractions and properties of transforms.

Linear open loop systems: Response of 1^{st} order systems, physical examples, response of 1^{st} order systems in series, 2^{nd} order systems and transportation lag.

UNIT – II

Linear closed loop systems: Control systems, controllers and final control elements, block diagram of a chemical reactor control system, closed loop transfer function, transient response of simple control systems, stability and root locus.

UNIT – III

Frequency response: Introduction, substitution rule, Bode diagrams.

Control system design by frequency response: Temperature control systems, stability criteria, Ziegler–Nichols control settings, transient response.

UNIT – IV

Advanced control strategies: Cascade control, feed forward control, ratio control, internal model control, controller tuning and process identification: Tuning, tuning rules, process identification.

Control Valves: Valve construction, sizing, characteristics, positionor. Distributed parameter system.

Text Book

Process systems analysis and control, Coughanour, D.R. &Koppel, McGraw Hill.

Reference Books

Chemical Process Control, George Stephanopoulos, PHI.

Process Control, Peter Harriot, Tata-McGraw-Hill.Coulson & Richardson's Chemical Engineering, Volume:3, J.F. Richardson, J. H. Harker and J. R. Backhurst, 4^{th} edition, Elsevier.

INSTRUMENTATION & PROCESS CONTROL LABORATORY
CH351

L	**T**	**C**	**:**	**3**	**0**	**2**	**Continuous Assessment**	**:**	**40**
Final Exam			**:**	**3 hours**			**Final Exam Marks**	**:**	**60**

1. Study the response of Hg –Glass bare thermometer for a step change in input variable
2. Study the response of a two tank non-interacting liquid level system and determining the time constant
3. Study the response of a two tank interacting liquid level system and determining the time constant
4. Study of inherent characteristics of Control valve
5. Study EMF Vs temperature relationship of the thermocouple.
6. Characteristics of P/I & I/P Converter
7. Study the performance of Level control system for different sets of control parameters and for different load disturbances.
8. Study the performance of Flow control system for different sets of control parameters and for different load disturbances.
9. Study the performance of Pressure control system for different sets of control parameters and for different load disturbances.
10. Study the performance of Temperature control systemfor different sets of control parameters and for different load disturbances.
11. Study the performance ON / OFF control
12. Study the Characteristics of Pressure, Level & Flow Transmitters
13. Study the performance of a Feed Forward Temperature Control
14. Study the performance of a Cascade Control
15. Study the performance of a Ratio Controller
16. Study of Hysteresis Characteristics of a Pressure Transducer

MASS TRANSFER OPERATIONS LABORATORY-I
CH352

L	**T**	**C**	**:**	**3**	**0**	**2**	**Continuous Assessment**	**:**	**40**
Final Exam			**:**	**3 hours**			**Final Exam Marks**	**:**	**60**

1. Determination of Cell Constant for liquid-Liquid System
2. Determination of Diffusion coefficient of organic vapors through Air
3. Determination of Gas Phase Mass transfer coefficient in surface evaporation also find the Himus Constant
4. Calculation of Rate of Drying and generating the drying Curve
5. Study of Humudification & De Humidificatin Phenomena & Determine mass transfer coefficients.
6. Estimation of volumetric mass transfer coefficient in a Spray column
7. Determination of effective interfacial area as a fuction of superficial liquid velocity in a packed column.
8. Hydrodynamics of single drop extraction
9. Hydrodynamics in a spray column
10. Determination of mass transfer coefficient in packed bed absorption column

CHEMICAL TECHNOLOGY LABORATORY
CH353

L	**T**	**C**	**:**	**3**	**0**	**2**	**Continuous Assessment**	**:**	**40**
Final Exam			**:**	**3 hours**			**Final Exam Marks**	**:**	**60**

1. Preparation of dyes and pigments
    a. preparation of azodyes
    b. preparation of copper pigment
    c. preparation of chrome yellow pigment
2. Preparation of winter green oil (Methyl salcylate)
3. Preparation of linear alkyl benzene sulphonate
4. Analysis of water: chlorides and sulphates
5. Analysis of oil: Acid value and iodine number
6. Analysis of coal: Proximate analysis
7. Analysis of lime: Estimation acid insolubles, available lime and calcium carbonate
8. Analysis of starch/ Glucose: Estimation of total reducing sugars
9. Analysis of saw dust: Estimation of total cellulose
10. Estimation copper present in brass alloy
11. Estimation of urea
12. Testing of fuels by Orast analysis
13. Preparation of soap; determination of total active matter and total fatty matter in soaps
14. Preparation of Resign
15. Determination of adulteration in food and oils.

MASS TRANSFER OPERATIONS–II
CH321

L	**T**	**C**	**:**	**4**	**1**	**4**	**Continuous Assessment**	**:**	**40**
Final Exam			**:**	**3 hours**			**Final Exam Marks**	**:**	**60**

Course Objectives: The objective of this course is to enable the students to understand the major separation processes like distillation, leaching, crystallization, adsorption, ion-exchange etc along with the design aspects of different types of equipment involved.

Prerequisites: CH 112, CH 113, CH 122, CH 123, CH 124, CH 311

UNIT – I

Distillation: Principles of VLE for binary systems–phase diagrams, relative volatility, azeotropes, enthalpy concentration diagrams, flash vaporization, partial condensation, differential distillation, steam distillation, continuous distillation–McCabe Thiele method–Ponchon Savarit method, Tray efficiencies, batch distillation with reflux open steam process, reboilers and condensers, azeotropic and extractive distillation.

UNIT – II

Liquid-Liquid Extraction: Introduction, liquid–liquid equilibria, Analytical and graphical solutions for single and multi stage operations, continuous counter-current operations without reflux, fractional extraction, equipment for liquid-liquid contacting operations–single stage, multi stage and continuous contact.

UNIT – III

Leaching: Preparation of solid, steady and unsteady state operation,equipment for leaching operations, methods of calculation for single and multi stage operations.

Crystallization: Crystal Geometry, Equilibrium and yields, nucleation and crystal growth rates, controlled growth of crystals, Crystallization equipment , Precipitation

UNIT – IV

Adsorption: Theory of adsorption, industrial adsorbents, adsorption equilibria, Freundlich equation, single and multi stage operations, unsteady state adsorption, equipment for stage and continuous contact.

Ion-Exchange: Principles of Ion-Exchange, techniques and applications, rate of Ion-Exchange. **Chromatography.**

Text Book

1. Mass Transfer Operations, Robert E. Treybal, Third Edition, International Edition, McGraw Hill.
2. Principles of Mass Transfer and Separation Process, Binay K. Dutta, PHI, New Delhi.

Reference Books

1. Unit Operations of Chemical Engineering, Warren, L., McCabe, Julian C.Smith, Peter Harriot, 7th Edition, McGraw Hill.
2. Transport process and separation process principles, Christie John Geankoplis, 4th edition, PHI
3. Separation Process Principles, J D Seader and E J Henly, John Wiley & sons, NY 1998.
4. Perry's Chemical Engineers Hand Book, Robert H. Perry, 7th edition, McGraw Hill

CHEMICAL PROCESS EQUIPMENT DESIGN- I
CH 322

L	**T**	**C**	**:**	**4**	**1**	**4**	**Continuous Assessment**	**:**	**40**
Final Exam			**:**	**3 hours**			**Final Exam Marks**	**:**	**60**

Course Objectives: To give a basic understanding of the engineering design concept flow sheet making to the equipment specifications with all engineering instrumentation including design reports. Make students more efficient in design of transportation of materials (solids and fluids) based economical and operational feasibilities and to design a reactor and the effecting parameters in major class of reactors like batch reactor, Plug flow reactor and CSTR.

Pre Requisites: CH223, CH 224, CH 225, CH 226, CH 311, CH 313, CH 314, CH 316, CH 321, CH 324

UNIT – I

Introduction: Overall design considerations-Process design development, Flow sheet development, Anatomy of manufacturing project with a specific example, profitability analysis of investments, Optimum Design, Practical considerations in design.

Process Design Development: Development of design database, Types of design and flow diagrams, Equipment design specifications, Preliminary design with a specific example, Plant Location and layout.

UNIT – II

Fluids Handling Equipments: Basic concepts of fluid Transports, Piping in fluid transport processes, pumping of fluids, Compression and Expansion of fluids.

Handling and Transport of Solids: selection of solids handling equipment and general design of solids handling equipments, selection and general design of solids transport equipment.

UNIT – III

Heat transfer equipment design: Basic theory of heat transfer in exchangers, determination of heat transfer coefficients and pressure drop in heat exchangers and selection of heat exchange equipment.

Design of key heat exchangers: Design of Double Pipe heat exchangers, design of Shell and Tube heat exchanger, design of condensers and design of evaporators.

UNIT – IV

Reactor design: Reactor principles, Reaction and Reactor Performance, Types of Reactions, Reactor and catalyst equipment- Selection of Catalyst.

Design of Reactor Systems: Types of Reactors and Selection of Reactors, Design of Ideal Batch Reactors, Plug flow reactors and Back mix reactors.

Text Books

Plant Design and Economics for Chemical Engineers, Peters. M. S. and Timmerhaus, K.D., 5th Edition, McGraw Hill, (UNIT-I to III)

Chemical Engineering, Vol-6, Coulson J.M., Richardson J.F. and Sinnott, R.K., Pergamon press.

Process Heat Transfer by Q. Kern

Reference Books

Process Plant Design, Backhurst J.R. and Harker.J.H. Heineman, Educational Books

Coulson & Richardson's Chemical Engineering, Volume:2, J.F. Richardson, J. H. Harker and J. R. Backhurst, 4th edition, Elsevier.

INDUSTRIAL POLLUTION & CONTROL ENGINEERING
CH323

L	**T**	**C**	**:**	**3**	**1**	**3**	**Continuous Assessment**	**:**	**40**
Final Exam			**:**	**3 hours**			**Final Exam Marks**	**:**	**60**

Course Objectives: The aim of the course is to give a broad overview of major pollutants that pollute the atmosphere and their relationships with the industrial processes. The course helps in giving a brief introduction to industrial pollution prevention measures. The course will help in identifying the methods of control of particulates, gaseous pollutants and water pollutants

Prerequisites: CH213, CH214, CH315

UNIT – I

Man & Environment, Types of Pollution, Pollution control aspects, Industrial emissions-Liquids, Gases, Environmental Legislation, Water quality management in India, Air (Prevention & Control of Pollution) Act.

UNIT – II

Removal of BOD, Biological oxidation, Anaerobic treatment, Removal of Chromium, Removal of Mercury, Removal of Ammonia, Urea, Treatment of Phenallic effluents.

UNIT – III

Removal of Particulate matter, Removal of Sulfur Oxides, Removal of Oxides of Nitrogen, Removal of Organic vapors from Effluent.

UNIT – IV

Pollution control in Chemical Industries, General considerations, pollution control aspects of Fertilizer industries, Pollution control in Petroleum Refineries and Petrochemical units, Pollution control in Pulp and Paper Industries.

Text Book

1. Pollution control in Process Industries, S.P .Mahajan, Tata McGraw Hill Publishing Company Ltd, New Delhi

Reference Books

1. Environmental Pollution Control Engineering, C.S.Rao, Wiley Eastern Ltd., New Age International Ltd.,
2. Air pollution, M.N.Rao, H.V.N.Rao, Tata McGrawhill.
3. Water Pollution control, W.Wesley Eckenfelder Jr.Industrial, Tata McGrawHill.

CHEMICAL REACTION ENGINEERING – II
CH324

L	**T**	**C**	**:**	**4**	**1**	**4**	**Continuous Assessment**	**:**	**40**
Final Exam			**:**	**3 hours**			**Final Exam Marks**	**:**	**60**

Course Objectives: The objective of this course is to introduce various types of Reactions and Reactors that are commonly used in Chemical Engineering operations and students will get ability in deciding and designing the type of Reactors that are necessary for a particular type of reaction in an Industry. They also learn mechanism and control of several types of reactions.

Prerequisites: CH215, CH 216, CH 223, CH 224, CH 225, CH 311, CH 313, CH314.

UNIT – I

Temperature and pressure effects: Single reaction and multiple reactions

Thermal characteristics and design of reactors: Batch reactor, PFR, CSTR under adiabatic conditions for first order irreversible reactions

UNIT – II

Non-ideal reactors: Residence time distribution of fluid in vessel, measurement of the RTD (Tracer Techniques), Characteristics of the RTD, RTD in ideal reactors, Reactor modeling with the RTD: Segregation model, the Tanks in series model, the Dispersion (plug flow) model for closed vessel. Concept of micro and macro mixing

UNIT – III

Introduction to design for heterogeneous reacting systems: Rate equations for heterogeneous reactions, contacting patterns for two phase systems.

Fluid particle reactions: Selection of a model, un-reacted core model for spherical particles, rate of reaction for shrinking spherical particles, determination of rate controlling steps.

UNIT – IV

Heterogeneous catalysis: Catalyst properties, Estimation of surface area, pore volume, physical adsorption and chemisorptions, adsorption isotherms-Derivations of rate equations for various mechanisms with rate limiting steps(Adsorption, surface reactions, desorption controlling etc.,) Data analysis for heterogeneous catalytic reactors, isothermal packed bed (PFR) reactor design, Diffusion and reaction within porous solids: effectiveness factor and internal pore diffusing criteria for internal pore diffusing limitation.

Text Books

1. Chemical Reaction Engineering, Levenspiel, Octave, 3rd edition, Wiley Eastern (UNIT-I to III)
2. Chemical Engineering Kinetics, Smith J.M. McGraw Hill.(UNIT-IV)

Reference Book

1. Elements of Chemical Reaction Engineering, Fogler, H.S., 2nd edition, PHI

PROCESS MODELLING AND SIMULATION
CH325

L	**T**	**C**	**:**	**3**	**1**	**3**	**Continuous Assessment**	**:**	**40**
Final Exam			**:**	**3 hours**			**Final Exam Marks**	**:**	**60**

Course Objectives: Students after completion of this course are expected understand the mathematical models developed for various processes in chemical engineering (Which are not complex) and simulate them using numerical methods. Therefore the students are expected to assimilate the principles of modeling and simulation and the tools so as to work out some case studies by the end of the course.

Prerequisites: CH 215, CH 216, CH 223, CH 224, CH 226, CH 311, CH 313, CH 314, CH 316, CH 321, CH 322, CH 324

UNIT – I

Mathematical models for chemical engineering systems: Introduction, Use of mathematical models, Scope of coverage, Principles of formation, Fundamental laws, Continuity equation, Energy equation, Equation of motion, Transport equations, Equations of state, Equilibrium, Chemical kinetics.

UNIT – II

Examples of mathematical models of chemical engineering systems: Introduction, Series of isothermal, constant hold up CSTRs, CSTRs with variable hold-ups, Two heated tanks, Gas phase pressurized CSTR, Non-isothermal CSTR, Single component vaporizer, Multi-component flash drum, Batch reactor, Reactor with mass transfer, Ideal binary distillation: Batch distillation with holdup, pH systems.

UNIT – III

Methods for solving non-linear equations

General Concepts of Simulation for Process Design: Introduction, Process simulation models, Recycle partitioning and tearing, Simulation examples.

UNIT – IV

Computer simulation: Simulation examples, Gravity flow tank, Three CSTRs in series, Non-isothermal CSTR, Binary distillation column, Multi-component distillation column, Batch reactor.

Text Books

1. Process Modeling Simulation and Control for Chemical Engineers, 2nd edition, W.L.Luyben, McGraw Hill.
2. A.W.Westerberg, H.P.Hutchison, R.L.Motard and P.Winter – Process Flowsheeting – Cambridge University Press – 1985.

Reference Books

1. Process Dynamics: Modelling, Analysis and simulation, B.W.Bequette, Prentice Hall
2. Computational Methods for Process Simulation, W.Fred Ramirez (Betterworthus Series in Chemical Engineering)

MEMBRANE TECHNOLOGY
(Qualitative Treatment Only)
CH 326(A)

L	**T**	**C**	**:**	**3**	**1**	**3**	**Continuous Assessment**	**:**	**40**
Final Exam			**:**	**3 hours**			**Final Exam Marks**	**:**	**60**

Course Objectives: The objective of the course is to impart in-depth knowledge of membranes, modules for design of various membrane processes along with their progress and competition to other conventional processes

Prerequisites: CH 311

UNIT – I

Introduction: Introduction to barrier separation processes, Definitions and principles membrane separation process, mechanism of membrane action, classification of membrane process, modules, modes of operation (Cross-flow and dead end flow), process configuration, requirements for ideal membrane, comparison with conventional separation processes.

UNIT – II

Membranes: Synthetic membranes for various processes, Characteristics of Membrane Materials, classification, methods of preparation, Membrane Characterization, structural properties, liquid membranes.

UNIT – III

Driving forces and transport through microfiltration, ultrafiltration, nanofiltration, reverse osmosis, Dialysis and electrodialysis, gas permeation, pervaporation, vapor permeation, liquid membrane separations and their Industrial applications.

UNIT – IV

Driving forces and transport through porous and non-porous membranes, Concentration polarization, Fouling, factors affecting fouling, Methods to reduce fouling and flux enhancement, cleaning of membranes.Membrane modules. Introduction to membrane reactors.

Text Book

1. Basic principles of membrane technology, Marcal Mulder, Kluwer Academic publications

Reference Books

1. Industrial membranes, Scott, Elsevier.
2. Ultrafiltration and Microfiltration, Munir Cheryan, Technomic Publishing Co.,
3. Progress in separation and purification, Vol. I, E. S. Perry, Inter Science Publishers.
4. Process in Separation and Purification, Vol.-III edited, E. S. Perry and C. J. Vaness, Inter science Publishers.
5. Synthetic Polymeric membranes, R. E. Kesting, McGraw Hill
6. Diffusing and Membrane Technology, S. B. Tuwiner, Reinhold Publishing Corpn.NY.
7. Perry's Chemical Engineers Hand Book, Robert H. Perry, 7^{th} edition, McGraw Hill

NANOTECHNOLOGY
CH 326(B)

L	**T**	**C**	**:**	**3**	**1**	**3**	**Continuous Assessment**	**:**	**40**
Final Exam			**:**	**3 hours**			**Final Exam Marks**	**:**	**60**

Course Objectives: The objective of the course is to serve as an overview of recent developments in the field of nanoscience and nanotechnology. The course will help the students to explain how the structure of the materials can be controlled down to the nanometer scale through various processing methods.
Prerequisites: CH 214

UNIT-I

Introduction to nanotechnology, molecular and atomic size, surface and dimensional spaces.
Molecular nanotechnology: Atoms by inference, electron microscopes (SEM) nanomanipulator, nanotweezers, atom manipulation, nanodots, nanolithography, spectroscopy techniques.

UNIT-II

Nanopowders and nanomaterials: Preparation, plasma arcing, chemical vapor deposition, sol-gels, electrodeposition, ball milling, applications.
Carbon nanotubes: Types, formation, assemblies, purification, properties and uses.

UNIT-III

Molecular mimics: Catenanes and rotaxanes, various molecular switches, synthesis of rotaxanes and catenanes, molecular computers, chemical rotors, prodders, flippers, atom shuttles, actuators, contacts.
Optics, photonics and solar energy: Properties of light and nanotechnology, interaction.

UNIT-IV

Nanobiometrics: Lipids as nano-bricks and mortar, self-assembled monolayers, proteins, 3-D structures arising from amines acids, nanoscale motors, biological computing, ion channels as sensors, information in DNA structure, using DNA to build nano-cubes, hinges, smart glue, wire template.

Text Book

1. Nanotechnology (Basic Science and Engineering technologies) Mick Wilson, KKGeoff Smithj, Michella Simmons, Burkhard Raguge, Overseas Press.

Reference Book

1. Introduction to Nanotechnology, Charles P. Poole, Jrl and Frank J Owens, Wiley - Interscience

POLYMER TECHNOLOGY
CH326(C)

L	**T**	**C**	**:**	**3**	**1**	**3**	**Continuous Assessment**	**:**	**40**
Final Exam			**:**	**3 hours**			**Final Exam Marks**	**:**	**60**

Objectives: The objective of the course is to impart in-depth knowledge of polymer chemistry, characterization, preparation or manufacture and applications

Prerequisites: CH 113

UNIT–I

Definitions – Monomer, polymer, functionality, homo and copolymers, heterochain and homochain polymers, polymer blends.

Classification of Polymers: Based on origin, applications, thermal behavior and polymerization.

Structural formulae of some common polymers. Average molecular weights and their distribution of polymers.

Measurement of Molecular Weights: By end group analysis, colligative properties, intrinsic viscosity, Gel permeation chromatography and light scattering methods.

Chemical structure and physical states of polymers: Configuration & conformations, crystalline and amorphous states.

General properties of polymers: Mechanical, chemical, thermal, electrical and optical properties.

UNIT – II

Mechanism and kinetics of: (I) step growth or condensation polymerization, (II) addition or chain growth a) free radical, b) anionic, c) cationic and d) coordination polymerizations.

Copolymerization of binary monomer system: Kinetics and relation of copolymer composition to monomer ratio.

Role of: Initiator, catalyst, solvents, inhibitors, chain transfer agents in polymerization.

Methods of polymerization: Bulk or mass, solution, suspension and emulsion polymerization techniques.

Polymer chemical reactions: Degradation, curing or cross linking and vulcanization

UNIT – III

Compounding of polymers: Role of various additives such as fillers, reinforcing agents, stabilizers, antioxidants, lubricants, fire retardants, coupling agents.

Brief description of processing methods: a) Extrusion, b) moulding, c) injection moulding, d) calendaring, e) fibre spinning.

Brief description of manufacture, properties and applications of addition polymers:

a) polyethylene, b) polypropylene, c) polyvinyl chloride, d) polystyrene, e) polymethyl methacrylate, f) polytetra fluoroethylene and g) natural rubber.

UNIT – IV

Brief description of preparation, properties and application of condensation polymers:

a) phenolic resins, b) polyesters c) unsaturated and saturated: PET & polycarbonate, d) Polyamides (nylon 6 & nylon 6,6) e) polyurethanes, f) epoxy resins, g) silicone resins, h) cellulose and its derivatives.

Brief description of FRP composites.

Structural formulae and applications of engineering and specialty polymers.

Brief description of analysis and testing of polymers: Identification, chemical analysis, spectroscopic and x-ray methods, DSC, TGA.

Text Book

1. Polymer science, Gowarikar R.A., New Age publishers.

Reference Books

1. Polymer science and technology, Joel R. Fried, PHI publishers.
2. Polymer science and technology of plastics and rubbers, Premamoy Ghosh, Tata McGraw Hills, New Delhi
3. Text Book of polymer science, Fred Billmayer.Jr., John Wiley & Sons,

PARTICULATE TECHNOLOGY
CH 326(D)

L	**T**	**C**	**:**	**3**	**1**	**3**	**Continuous Assessment**	**:**	**40**
Final Exam			**:**	**3 hours**			**Final Exam Marks**	**:**	**60**

Course Objectives: The objective of the course is to enable student to model and analyze the fluidized particulate systems in view of chemical engineering

Prerequisites: CH 216, CH 311, CH 321

UNIT I

Introduction: industrial significance of Solid Particulate systems, in particular fluidized bed systems. Single Particle Suspension: Motion of solid particles in a fluid, Drag coefficient, Terminal setting velocity, Particle characterization; Multiple Particle Systems: Momentum balance for multiphase system Fluid flow through particle beds, Ergun's equation, Fixed bed reactors

UNIT –II

Fluidization: Fundamentals, Minimum fluidization velocity, Geldart's classification of powders, Bubble mechanics, Stability and quality of fluidization; Fluidization Flow Regimes:

UNIT –III

Flow regime diagrams for G/S, bubble column and GLS systems, Hydrodynamics of bubbling, turbulent, and fast fluidized beds, and pneumatic conveying, Flow regime characterization and transitions through signals

UNIT –IV

Signal Analysis Methods: Statistical and spectral analysis methods, Chaos, fractal and wavelet transformation analysis; Fluidized Bed Reactor Modeling, Two-phase flow model, Numerical model, CFD for multiphase systems.Design and Scaling of Fluidized Bed Reactors: Scale-up issues, Scaling low, Cyclone, hopper, distributor plate design, Industrial applications

Text Book

Fluidization Engineering, Kunii, D. and Levenspiel, O., Butterworth-Heinemann, Boston (1991),

Reference Books

1. Particulates and Continuum: Multiphase Fluid Dynamics, Soo, S.L., (1989).
2. Theory of Multicomponent Fluids, Drew, D.A. and Passman, S.L. Springer, New York (1999)
3. Fluidization-Dynamics: the Formulation and Application of a Predictive Theory for the Fluidized State, Gibilaro, L.G., Butterworth-Heinemann, Boston (2001).
4. Multiphase Flow and Fluidization: Continuum and Kinetic Theory Descriptions, Gidaspow, D., Academic Press, Boston (1994).
5. Thermo-Fluid Dynamic Theory of Two-Phase Flow, Ishii, M., Eyrolles, Paris (1975).
6. Bubbles, Drops, and Particles, Clift, R., Weber, M.E. and Grace, J.R., Academic Press, New York (1978).
7. Introduction to Particle Technology, Rhodes, M., John Wiley & Sons, New York (1998).

SOFT SKILLS LABORATORY
CH 361

L	**T**	**C**	**:**	**3**	**0**	**2**	**Continuous Assessment**	**:**	**40**
Final Exam			**:**	**3 hours**			**Final Exam Marks**	**:**	**60**

Introduction to Communication:

1.1 Elements of Communication 1.2 Theories of Communication
1.3 Barriers to Communication 1.4 Successful Communications 1.5 Types of Communication

Introduction to Skills:

2.1 Listening skills 2.2 Speaking skills 2.3 Reading skills 2.4 Writing Skills
2.5 Study skill 2.6 People skills 2.7 Soft skills 2.8 Linguistic skills
2.9 Communication skills

Accent Training:

3.1 Phonetics 3.2 Intonation 3.3 British English
3.4. American English 3.5 Indian English 3.6 International English

Career English:

4.1 Resumes 4.2 Letters 4.3 Reports 4.4. Technical Write-up
4.5 Writing with a purpose

Conversational English:

5.1 Conversational styles 5.2 Face – to – Face interaction
5.3 Telephonic interaction 5.4 Group Interaction 5.5 Body language

Performance:

6.1 Elocution 6.2 Debates 6.3 Group Discussion
6.4 Presentation 6.5 Brainstorming 6.6 Interpretation
6.7 Extempore

MASS TRANSFER OPERATIONS LABORATORY-II
CH362

L	**T**	**C**	**:**	**3**	**0**	**2**	**Continuous Assessment**	**:**	**40**
Final Exam			**:**	**3 hours**			**Final Exam Marks**	**:**	**60**

1. Demonstrate the principles of immiscible liquid mixtures.
2. Verification of Rayleigh's equation & modified Rayleigh's equation
3. Determination of H.E.T.P for a given system at total reflux condition.
4. Obtain equilibrium data & plot boiling point diagram and equilibrium curve.
5. Obtain equilibrium data for ternary liquid mixtures. And determine the plait point.
6. Determine Mass transfer coefficient in a single drop extraction
7. Find Stage efficiency in single and multi stage extraction operations (batch process)
8. To verify the applicability of Freundlich's equation for a given system.
9. Obtain solid- liquid equilibrium data and draw ponchon savarit diagrams.
10. Determination of Mass transfer coefficient using spray column (Extraction)

CHEMICAL REACTION ENGINEERING LABORATORY
CH363

L	**T**	**C**	**:**	**3**	**0**	**2**	**Continuous Assessment**	**:**	**40**
Final Exam			**:**	**3 hours**			**Final Exam Marks**	**:**	**60**

1. Determination of the order of a reaction using a Batch reactor and analyzing the data by (a) differential method, (b) integral method.
2. Determination of activation energy of a reaction using a batch reactor
3. To determine the specific reaction rate constant of a reaction of known order using a batch reactor
4. To determine the specific reaction rate constant of a reaction of known order using a CSTR (Continuous Stirred Tank Reactor).
5. To determine the order of the reaction and the rate constant using tubular reactor.
6. To determine the order of the reaction and the rate constant using a plug flow reactor
7. To determine the RTD and the dispersion number in a tubular reactor using a tracer
8. To determine the RTD and the dispersion number in a CSTR
9. To determine the RTD and the dispersion number in a CSTR's in series.
10. To determine the RTD and the dispersion number in a combined reactor.
11. Mass transfer with chemical reaction (Liquid–Liquid system) to determine the mass transfer coefficient in the stirred cell
12. Mass transfer with chemical reaction (Solid-liquid system). To determine the mass transfer coefficient of stirred cell.
13. Axial mixing in a packed-bed. To determine the RTD and the dispersion number for a packed-bed using a tracer
14. Langmuir adsorption isotherm. To determine the surface area of activated charcoal.

INDUSTRIAL MANAGEMENT AND ENTREPREUNERSHIP DEVELOPMENT
CH 411

L	T	C	:	3	1	4	Continuous Assessment	:	40
Final Exam			:	3 hours			Final Exam Marks	:	60

UNIT- I

General management:Management definition, functions of management and principles of management. Forms of Business Organization:Salient features of Sole Proprietorship, Partnership, Joint Stock Company; Private Limited and Public Limited companies; Cooperative and Government owned companies; Merits and Demerits of above types;

Marketing Management: Functions of Marketing; Concepts of Selling and Marketing-Difference; Market Research; Product pricing; Distribution channels; Marketing mix (4 Ps); Advertising and sales promotion; Product life cycle.

UNIT- II

Production and Materials Management: Functions of Production planning and control; Production systems-Types; Inventory control-Relevant costs, EOQ,Deterministic single item model with static demand, ABC, VED and FSN analysis; Introduction to MRP; **Financial Management**:Concept of time value of money; Interest formulae; Present and Future worth amounts for different cash flow patterns; Evaluation of alternative investment proposals (Capital budgeting); Types of Capital-Fixed and Working capital; Working capital management- Factors and Principles; **Depreciation**- Straight line depreciation, declining balance and Sum of Years digits methods.

UNIT- III

Personnel Management:Functions of personnel management, human resource planning, recruitment, selection, placement, training and development and performance appraisal.
Motivation theories, leadership styles.

UNIT- IV

Entrepreneur Development: Introduction, Entrepreneural characteristics, Functions of an Entrepreneur; Factors affecting entrepreneurship; Role of communication in entrepreneurship; Entrepreneurial development-Objectives, Need of Training for enterprises; Finance for the enterprises; Product, Process and Plant Design- Product analysis and Product Design process. Steps in process design and Plant Design.

Text Books

1. Industrial Engineering and Operations Management, S.K.Sharma, Savita Sharma and Tushar Sharma.
2. Industrial engineering and production management, Mahajan
3. Industrial Economics, R.R.Bharatwal

Reference Books

1. Operations Management, Joseph G Monk.
2. Production, Planning and Control, Samuel Eilon.
3. Marketing Management, Phillip Kotler.
4. Financial Management I.M.Pandey.
5. Projects, Prasanna Chandra.
6. The Essence of Small Business, Barrow colin.
7. Small Industry Ram K Vepa.

CHEMICAL PROCESS EQUIPMENT DESIGN- II
CH 412

L	T	C	:	4	1	4	Continuous Assessment	:	40
Final Exam			:	3 hours			Final Exam Marks	:	60

Course Objectives Make the students more efficient in selection and design of all heat transfer, mass transfer and chemical reaction equipment.
Prerequisites: CH 223, CH 311, CH 314, CH 321, CH 322, CH 324

UNIT – I

Heat transfer equipment design: Basic theory of heat transfer in exchangers, determination of heat transfer coefficients and pressure drop in heat exchangers, selection of heat exchange equipment.

Design of key heat exchangers: Design of Double Pipe heat exchangers; Shell and Tube heat exchanger: design of fixed tube sheet, U-tube type heat exchangers;

UNIT – II

Design of evaporators: Design of single effect and triple effect forward-feed evaporators;

Design of dryers: Design of rotary dryer and spray dryers.

UNIT – III

Design of separating columns: Choice between plate and packed columns.

Design of plate columns: selection of plate type, estimating number of ideal stages using McCabe Thiele diagram; Design of sieve trays: operating characteristics of sieve trays, liquid flow arrangement, tower diameter, perforations and active area, weir crest, weir height, plate pressure drop, down comer liquid backup, check for flooding, weeping velocity, entrainment.

Design of packed columns: Types of packing, estimation of packed bed height for absorption and distillation columns, HTU concept, column diameter, column internals, wetting rates.

UNIT – IV

Design of Reactor Systems: Types of Reactors and Selection of Reactors, Design of Ideal Batch reactors, Plug flow reactors and Back mix reactors, Fluidized bed reactors.

Text Books

1. Plant Design and Economics for Chemical Engineers, Peters. M. S. and Timmerhaus, K.D., 5th Edition, McGraw Hill, (UNIT-I & II)
2. Coulson & Richardson's Chemical Engineering, Vol-6, Third edition, 'Chemical Engineering design' by R.K.Sinnott, Butterworth Heinemann Pub Ltd.
3. Process Equipment Design, Shrikant D.Dawande, Volume 2, Dennet & Co.

Reference Books

1. Coulson & Richardson's Chemical Engineering, Volume:1, sixth edition, Coulson J.M., Richardson J.F. with J. R. Backhurst and J. H. Harker
2. Process Plant Design, Backhurst J.R. and Harker.J.H. Heineman, Educational Books.

TRANSPORT PHENOMENA
CH 413

L	T	C	:	4	1	4	Continuous Assessment	:	40
Final Exam			:	3 hours			Final Exam Marks	:	60

Course Objectives: students to learn to setup shell balances for conservation of momentum, energy, and mass; employ shell balance equations to obtain desired profiles for velocity, temperature and concentration; recognize and apply analogies among momentum, heat and mass transfer;
Prerequisites: CH 215, CH 216, CH 223, CH 224, CH 311, CH 314, CH 321

UNIT – I

Introduction to momentum transport, viscosity and the mechanism of momentum transport, Newton's law of viscosity, non-Newtonian fluids, pressure and temperature dependence of viscosity of liquids and gases. Estimation of the viscosity of a gas mixture. Viscosity distribution in laminar flow, shell momentum balances and boundary conditions, flow of falling film-flow through circular tubes and annulus, adjacent flow of two immiscible liquids.

UNIT – II

Equations of continuity and motion-application of Navier strokes equation and Euler equation for laminar, steady flow problems tangential annular flow of a Newtonian fluid-shape of the surface of a rotating liquid.

UNIT – III

Energy transport by steady state conduction, thermal conductivity mechanism of energy transport, Fourier's law, effect of temperature and pressure on thermal conductivity. Temperature distribution in solids and in laminar flow, shell energy balances, boundary conditions, heat conduction with electrical heat source, viscous heat source, forced convection and free convection. Heat transfer coefficients–forced convection in tubes & around submerged objects, Heat transfer coefficients for forced convection through packed beds, heat loss by free convection from a horizontal pipe.

UNIT – IV

Diffusivity and mechanism of mass transport, definition of concentration, velocities and mass fluxes, Fick's law of diffusion, temperature and pressure dependence of mass diffusivity, shell mass balances, boundary conditions and applications diffusion through a stagnant gas film, diffusion with heterogeneous and homogeneous chemical reactions. Diffusing into falling liquid film. Equation of continuity for binary mixtures.

Text Books

Transport Phenomena, R.B.Bird, Warrin.E, Stewat and Edwin N.Light Foot, Wiley International Edition.

Reference Books

1. Transport process and separation process principles, Christie John Geankoplis, 4th edition, PHI
2. Transport Phenomena, A Unified approach, Roberts, Broadkey and Harry C. Hershey, McGraw Hill.

BIO-CHEMICAL ENGINEERING
CH 414

L	**T**	**C**	**:**	**3**	**1**	**3**	**Continuous Assessment**	**:**	**40**
Final Exam			**:**	**3 hours**			**Final Exam Marks**	**:**	**60**

Objectives: To teach students how to utilize chemical engineering principles in bio-related problems.

Prerequisites: CH 213, CH 215, CH 223, CH 311, CH 314, CH 321, CH 324

UNIT – I

An overview of industrial bio chemical processes and comparing with chemical processes. Industrially important microbial strains, their structure and classification. Chemicals of life: Lipids, proteins, polysaccharides & Nucleic acids.

UNIT – II

The kinetics of enzyme–catalyzed reactions: The enzyme substrate complex, Michaelis-Menten kinetics, enzyme inhibition, other factors affecting on enzyme activity–pH and temperature.

Applied enzyme catalysis: Applications of enzymes, enzyme immobilization, immobilized enzyme kinetics.

UNIT – III

The kinetics of cell cultures: Monod growth kinetics, growth cycle phases for batch cultivation.

Bio reactors: Ideal batch rector, fed batch reactor, enzyme–catalyzed reactions in CSTRs, CSTR reactors with recycle, plug flow reactor, Immobilised and free cell reactors.

Multiphase Bio reactors: Packed bed reactors, fluidized bed bio reactors, trickle bed reactors.

UNIT – IV

Product recovery operations: Recovery of particulates - Filtration, centrifugation, sedimentation.

Production Isolation: Extraction, precipitation, membrane separations. Purification - Chromatographic techniques. Final production isolation, Drying and crystallization.

Text Book

1. Biochemical Engineering fundamentals, J.B.Bailey and D.F.Ollis, McGraw Hill

Reference Books

1. Biochemical Engineering, 2nd edition, A.Aiba, E.Humphrey and N.R.Milli, ,
2. Bio process Engineering Basic Concepts, 2nd edition, Michel L. Shuler, Fikeet Kargi,

COMPUTER AIDED DESIGN
CH 415 (A)

L	**T**	**C**	**:**	**3**	**1**	**3**	**Continuous Assessment**	**:**	**40**
Final Exam			**:**	**3 hours**			**Final Exam Marks**	**:**	**60**

Course Objectives: Development of system design skills for chemical processes and Experience solving a complex engineering problem using Algorithms. Ability to perform economic evaluation of chemical processes and capital projects, and economic optimization of designs.

Prerequisites: CH101, CH 107, CH 215, CH 216, CH 224, CH 226, CH 314, CH 324, CH 312, CH 322.

UNIT-I

Introduction of computer aided design (CAD) a review of tools for CAD (computer systems: file and data management)**.** Scope of computer aided design of process equipment. The techniques of digital simulation: Construction of Information flow Diagram and encoding IFD into various numerical forms.

CAD of fluid flow systems: Pipe line design calculations for Newtonian and Non-Newtonian flow, Design of pipe line networks, Pipe line design calculations for two phase flows in pipes (Gas-solid, liquid-solid), Sizing of pumps (calculation of power requirements).

UNIT – II

CAD of heat transfer equipment: Performance calculations of Triple effect Evaporators, heat exchangers (double pipe, shell and tube), condensers and vertical thermo siphon reboilers.

UNIT – III

CAD of mass transfer equipment: Flash Calculations, Performance of distillation columns for binary systems by McCabe-Thiele method, multicomponent systems by Tomich method, Performance calculations of Tray and packed absorbers, Performance of single stage and multi-stage counter current (without reflux) extraction columns.

UNIT – IV

CAD of chemical reactors: Calculation of equilibrium compositions of a set of simultaneous reactions, Performance calculation for batch reactor, plug flow reactor and CSTRs, homogeneous and heterogeneous flow reactors for specific reactions (Pyrolysis of Ethane for manufacture of ethylene, manufacture of Ethanol amines, Hydrogenation of Benzene in an adiabatic fixed bed reactor)

Text Books

1. Chemical Process Computations, Raghu Raman, Elsevier Applied Science Publishers
2. Computer Aided Process Plant Design, M.E.Leesley, Gulf Publishing Co.,

Reference Books

1. Computer Applications in chemical Engineering: Process Design & simulation, Robert G. Squires.
2. Fortran programs for Chemical Process Design, Analysis and Simulation, Coker A.K, Gulf Publishing Co.
3. Catalytic Reactor Design, Orhan Tarhan, McGraw Hill
4. Chemical Engineering Vol.6, Sinnot, Pergamon Press.

PETROLEUM REFINERY ENGINEERING
CH 415(B)

L	T	C	:	3	1	3	Continuous Assessment	:	40
Final Exam			:	3 hours			Final Exam Marks	:	60

Course Objectives: Explain the need for petroleum refining and provide a basic understanding of how a petroleum refinery works; Introduce and review physical and chemical processes used to convert crude oil into desired products; Present methods for the characterization of crude oil and refining products.

Prerequisites: CH 213, CH 311, CH 321, CH 314, CH 324

UNIT – I

Origin and formation of petroleum, reserves and deposits of the World, Indian petroleum industry, composition of crudes. Refinery products and test methods. Evaluation of crudes. Crude pretreatment, dehydration and desalting, pipe still heater, atmospheric and vacuum distillation of crude oil.

UNIT – II

Treatment of products, additives, blending of gasoline, treatment of gasoline, kerosene, lubes and lubricating oil, wax.

UNIT – III

Thermal and catalytic cracking, hydrocracking and hydrotreating, catalytic reforming

UNIT – IV

Coking, visbreaking, alkylation, isomerization, polymerization, asphalt and air blown asphalt.

Text Book

1. Modern petroleum Refining Processes, B.K.B.Rao, Oxford IBH.

Reference Books

1. Petroleum Refining Engineering, Nelson, McGraw Hill
2. Hand Book of Petroleum Processing, David S J Stan Jones & Peter R Pujado, Spinger

PILOT PLANTS, MODELS AND SCALE-UP METHODS IN CHEMICAL ENGINEERING
CH 415(C)

L	**T**	**C**	**:**	**3**	**1**	**3**	**Continuous Assessment**	**:**	**40**
Final Exam			**:**	**3 hours**			**Final Exam Marks**	**:**	**60**

Course Objectives: The objective of the course is to enable student to assimilate and set up scale studies in chemical engineering

Prerequisites: CH 216, CH 223, CH 311, CH 321, CH 314, CH 324

UNIT-I

Introduction, Pilot Plants and Models, Principles of similarity

Dimensional Analysis: Dimensional homogeneity, Buckingham's theorem, Rayleigh's method of indices

Differential equations: Mechanical processes, thermal processes, Diffusion processes, chemical processes.

The Regime concept: Different Regimes, conditions for reliable scale up or down, effect of temperature, effect of agitation, Mixed Regime

UNIT - II

Similarity criteria and Scale Equations: Static Regime, Load controlling, Mass controlling, Mixed Regime, Fluid systems, viscosity control, gravity control, surface tension control, thermal Regime, Natural convection control, Radiation control, Chemical Regime, Surface control (Heterogeneous reactions), Mixed Regime.

Extrapolation, Boundary effects in Scale-up, Scale up of Ducts and flow passages, Filters, Scale up of mixing equipment.

UNIT -III

Scale up of heat transfer equipment, Heat exchange systems

Scale up of Packed Towers: Similarity criteria, liquid distribution, Flooding point Pressure drop, height of packing Gas absorption, evaporation, Liquid extraction

UNIT -IV

Scale up of Chemical Reactors: Tubular Reactors, Catalytic Reactors, Continuous Stirred-tank Reactors Scale up of Equipment: Ball Mills, Pressure-jet spray nozzles, Centrifugal disc atomizers, Screw Extruders.

Scale up of Furnaces and kilns: Furnace Aerodynamics, Geometry of flames, Behaviour of solid fuel beds, Heat transfer, physical and Chemical changes in the charge, flow of molten material and slags, Flow of cooling water, Behaviour of Refractories.

Textbooks

1. Pilot Plants, Models and scale-up Methods in Chemical Engineering, R. E. Johnstone and M. W. Thring, McGraw Hill Book Company.
2. Process Plant Design – J.R. Backhurst and J.H. Harker, Heinemann Educational Books, London.

Reference Books

1. Pilot Plants and Scale up studies – Ibrahim and Kulhor

CH 416(D) INTERFACIAL SCIENCE
CH 415 (D)

L	**T**	**C**	**:**	**3**	**1**	**3**	**Continuous Assessment**	**:**	**40**
Final Exam			**:**	**3 hours**			**Final Exam Marks**	**:**	**60**

Course Objectives: The objective of the course is to enable the student to grasp the study of surface properties and phenomena of industrial importance like adsorption, wetting, floatation and detergency.

Prerequisites: CH 214, CH 224, CH 313

UNIT-I

Thermodynamics of surfaces: Introduction, surface energy and its consequences, Thermodynamics of surfaces, The Gibbs adsorption equation.

Thermodynamic behavior of small particles, Equilibrium shape of a crystal, behaviour of liquids in capillaries, homogeneous nucleation.

UNIT-II

Limits of applicability of the Kelvin and Young-Laplace equations, Contact angle and wetting behaviour, theoretical estimation of surface properties, contact angle hysteresis, measurements of surface tension and contact angle: maximum bubble pressure method, drop weight method, ring method, wilhelmy side method, pendant method, sessile drop or bubble method, flow methods, capillary waves method.

Vander Waals Forces: Introduction, van der Waals forces and their importance in colloid and surface chemistry, molecular interactions and power laws, molecular origins and the microscopic implications of van der Waals forces, van der Waals forces between large particles and over large distances.

UNIT -III

Calculating vander Waals forces between macroscopic bodies, theories of van der Waals forces based on bulk properties, effect of the medium on the van der Waals attraction; The electrical Double Layer and Double-layer Interactions: Introduction, surface charges and electrical double layer: background.

The capacitor model of the double layer, the diffuse double layer: The Debye-Huckel approximation, The Debye-Huckel approximation: results, the electrical double layer: Gouy-Chapman theory, overlapping double layers and inter particle Repulsion, “Not-Quite-Indifferent” electrolytes: stern adsorption.

UNIT -IV

Adsorption at Gas-Liquid Interfaces: Introduction, experimental and theoretical treatments of adsorption: an overview, Thermodynamics of adsorption: Phenomenological Perspective, Thermodynamics of adsorption: A statistical Perspective, Multi layer adsorption: The Brunauer- Emmett-Teller Equation, energetic of adsorption, adsorption in porous solids.

Wetting, Flotation and Detergency: Introduction, Wetting, water repellency, Flotation, Detergency.

Textbooks

1. Foundations of Colloid Science by Robert J. Hunter, Oxford science Publications, Vol-I
2. Principles of Colloid and Surface Chemistry, Third edition, Revised and Expanded, By Paul C. Hiemenz and Raj Rajagopalan.
3. Physical Chemistry of Sciences by Arthur Adamson.

INDUSTRIAL POLLUTION & CONTROL ENGINEERING
CH 416 (A)

L	**T**	**C**	**:**	**3**	**1**	**3**	**Continuous Assessment**	**:**	**40**
Final Exam			**:**	**3 hours**			**Final Exam Marks**	**:**	**60**

Course Objectives: The aim of the course is to give a broad overview of major pollutants that pollute the atmosphere and their relationships with the industrial processes. The course helps in giving a brief introduction to industrial pollution prevention measures. The course will help in identifying the methods of control of particulates, gaseous pollutants and water pollutants

Prerequisites: CH 213, CH 214, CH 315

UNIT – I

Man & Environment, Types of Pollution, Pollution control aspects, Industrial emissions-Liquids, Gases, Environmental Legislation, Water quality management in India, Air (Prevention & Control of Pollution) Act.

UNIT – II

Removal of BOD, Biological oxidation, Anaerobic treatment, Removal of Chromium, Removal of Mercury, Removal of Ammonia, Urea, Treatment of Phenallic effluents.

UNIT – III

Removal of Particulate matter, Removal of Sulfur Oxides, Removal of Oxides of Nitrogen, Removal of Organic vapors from Effluent.

UNIT – IV

Pollution control in Chemical Industries, General considerations, pollution control aspects of Fertilizer industries, Pollution control in Petroleum Refineries and Petrochemical units, Pollution control in Pulp and Paper Industries.

Text Book

2. Pollution control in Process Industries, S.P .Mahajan, Tata McGraw Hill Publishing Company Ltd, New Delhi

Reference Books

4. Environmental Pollution Control Engineering, C.S.Rao, Wiley Eastern Ltd., New Age International Ltd.,
5. Air pollution, M.N.Rao, H.V.N.Rao, Tata McGrawhill.
6. Water Pollution control, W.Wesley Eckenfelder Jr.Industrial, Tata McGrawHill.

ENERGY ENGINEERING

CH 416(B)

L	T	C	:	3	1	3	Continuous Assessment	:	40
Final Exam			:	3 hours			Final Exam Marks	:	60

Course Objectives: Provide overview of energy consumption and generation, Compare different forms of energy resources and their uses and Design different types of energy conversion and advanced energy generation technologies. Explore energy conservation technologies.

Prerequisites: CH 115

UNIT – I

Conventional energy resources, the present scenario, scope for future development.

Coal: Origin, occurrence and reserves, classification, ranking, analysis and testing, coal carbonization, manufacture of coke, coal gasification, coal liquefaction.

UNIT – II

Petroleum: Origin, occurrence and reserves, composition, classification, characteristics, exploration and production.

Petroleum Refining: Refinery processes, petroleum products, testing and analysis of petroleum products.

UNIT – III

Non conventional energy sources: Solar energy, solar radiation, principles of heating and cooling, photo voltaic cells.

Bio gas products, bio-mass, wind energy, hydrogen energy, geothermal and ocean thermal energy, fuel cells.

UNIT – IV

Energy storage, mechanical energy storage, water storage, solar pond, phase change storage, chemical storage.

Energy Conservation: Conservation methods in process industries, Theoretical analysis, practical limitations, equipment for energy saving / recovery.

Text Books

Conventional Energy technology, S.B.Pandy, Tata McGraw Hill

Fuel Science, Harker and Allen, Oliver & Boyd.

Energy conversion, Culp, Mc Graw Hill.

Reference Books

Hand book of energy technology, Considine D. M.

Fuels and energy, Harker and Backhusst, Academic press

Solar Energy Thermal Process, John A Duffie.

TERM PAPER
CH 451

L	**T**	**C**	**:**	**3**	**0**	**2**	**Continuous Assessment**	**:**	**40**
Final Exam			**:**	**3 hours**			**Final Exam Marks**	**:**	**60**

PURPOSE:

The Term paper helps to supplement the final year Project Work of the B.Tech students. It helps to identify their research area / topic and complete the groundwork and preliminary research required for it comfortably. It trains the students to make use of research tools and material available both in print and digital formats.

PROCEDURE:

The topic of term paper is chosen from the B.Tech curriculum. Based on the topic a hypothesis is to be made by the student. The hypothesis may be a null hypothesis also. The students are then required to collect literature and support information for their term paper from standard reference books, journals and magazines- Both printed and online. Each student should refer a minimum of 5 reference sources outside the prescribed Text Books. The term paper contains:

The Aim and Objective of the study.
The need for Rationale behind the study.
Identify the work already done in the field.
Hypothesis and Discussion
Conclusion
Appendix with support data (Illustrations, Tables, Graphs etc.,)

CHEMICAL PROCESS EQUIPMENT DESIGN LABORATORY
CH 452

L	**T**	**C**	**:**	**4**	**0**	**2**	**Continuous Assessment**	**:**	**40**
Final Exam			**:**	**3 hours**			**Final Exam Marks**	**:**	**60**

1. Flow chart symbols
2. Engineering drawings

Design of:

3. Storage tanks
4. Shell and Tube heat exchangers (1-2 or 2-4)
5. Plate type heat exchanger
6. Condenser and reboiler
7. Multiple effect evaporators
8. Fractionating columns: Plate and packed
9. packed bed absorber
10. Strippers
11. Batch Reactors
12. Stirred Tank Reactors
13. Continuous tubular reactor (homogeneous and heterogeneous)
14. Batch Distillation

ENVIRONMENTAL ENGINEERING LABORATORY
CH 453

L	**T**	**C**	**:**	**3**	**0**	**2**	**Continuous Assessment**	**:**	**40**
Final Exam			**:**	**3 hours**			**Final Exam Marks**	**:**	**60**

1. Suspended solids in air sample using high volume sampler.
2. CO_2 and CO concentrations in a given sample.
3. SO_2 concentrations in a given sample.
4. Hardness
5. pH value
6. Dissolved oxygen content.
7. BOD.
8. COD.
9. Iron content in a given industrial effluent sample.
10. Determination of Fluoride content in a given sample.
11. Determination of Chloride content in a given sample.
12. Nitrates
13. Determination of optimum dose of coagulant.
14. Determination of MLSS and MLVSS in a given industrial effluent sample.
15. Noise Measurement

SAFETY AND HAZARD ANALYSIS
CH 421

L	T	C	:	3	1	3	Continuous Assessment	:	40
Final Exam			:	3 hours			Final Exam Marks	:	60

Course Objectives: Introducing safety and hazards, assessing risk, designing in view of safety and measuring safety effectiveness.

Pre-Requisites: CH 226, CH 412.

UNIT – I

Definition of safety. The basis for safety. Chemical hazards and worker safety. Hazards of commercial chemical reactions and operations.

Hazop studies, Fault Tree analysis, Event Tree Analysis.

UNIT – II

Process design, instrumentation for safe operations, safety education and training.

UNIT – III

Effect of toxic agents, flammable materials, Risk assessment, Work permit systems.

UNIT – IV

Personnel protective equipment, fire extinguishing agents and their applications, measuring safety effectiveness.

Text Book

1. Industrial safety practices, Bob skeltor
2. Safety and accident prevention in chemical operations, Fewcett H.H. and W.S.Wood, John Wiley and Sons Inc.

Reference Book

1. Safety Handling of Hazardous Chemicals Enterprises, R.Pjatgo.A.K

PROFESSIONAL ETHICS AND HUMAN VALUES
CH 422

L	T	C	:	3	1	3	Continuous Assessment	:	40
Final Exam			:	3 hours			Final Exam Marks	:	60

Course Objectives: This course will develop students' knowledge of the nature of engineering ethics (legal, professional, historical and personal definitions of "engineering ethics" and the value of engineering ethics (varied contemporary and historical legal, professional, and personal reasons why an engineer should be ethical).

UNIT – I

Introduction to Ethical Concepts: Definition of industrial ethics and values, Ethical rules of industrial worker. Values and Value Judgments. Moral Rights and Moral rules, Moral character and responsibilities. Privacy, confidentiality, Intellectual property and the law. Ethics as law.

UNIT – II

Professional Responsibility: The basis and scope of Professional Responsibility, Professions and Norms of Professional Conduct, Ethical Standards versus Profession, Culpable mistakes, the Autonomy of professions and codes of ethics. Employee status and Professionalism. Central Professional Responsibilities of Engineers: The emerging consensus on the Responsibility for safety among engineers, Hazards and Risks.

UNIT – III

Workplace Rights and Responsibilities: Engineers and Managers. Organizational complaint procedures. Government agencies. Resolving Employee concerns. Limits on acceptable behaviour in large corporation.

Work environment: Ethical and legal considerations, Organizational responses to offensive behaviour and harassment. Ethics in a Global Context.

UNIT – IV

Industrial Integrity: The epitome of industrial success, Integrity and organization, Exploring learning process of integrity, Consequences of lack of integrity.

Text Books

1. Ethics in Engineering Practice and Research, Caroline Whitbeck, Elsevier.
2. Engineering Ethics, Govindarajan M, Natarajan S, Senthil Kumar V.S, Prentice hall of India, New Delhi.

Reference Books

1. Ethics in Engineering, Fourth Edition, Mike W. Martin, Rolan Schinzinger, Mc Graw Hill publishers
2. Engineering Ethics–An industrial Perspective, Gail Dawn Baura
3. Ethics and Values in Industrial-Organizational Psychology, Joel Lefkowitz

OPTIMIZATION OF CHEMICAL PROCESESS
CH 423

L	**T**	**C**	**:**	**3**	**1**	**4**	**Continuous Assessment**	**:**	**40**
Final Exam			**:**	**3 hours**			**Final Exam Marks**	**:**	**60**

Course Objectives: The course will cover fundamental concepts in optimization theory, algorithmic approaches as well as modeling optimization problems and their numerical solution. In particular, the topics will include elements of convex analysis, linear programming, sensitivity analysis, Lagrangian duality, local optimality conditions for unconstrained and constrained nonlinear problems, and introduction to discrete optimization.
Prerequisites: CH 111, CH 211

UNIT – I

Basic concepts of optimization, optimization of unconstrained function, one dimensional search.

UNIT – II

Nature and Organization of optimization problems, fitting models to data, formulation of objective functions.

UNIT – III

Linear programming and applications.

UNIT – IV

Optimization recovery of waste heat, shell and tube heat exchanger, evaporator design, liquid-liquid extraction process, optimal design of staged distillation column.

Optimal pipe diameter, optimal residence time for maximum yield in an ideal isothermal batch reactor, chemostat, optimization of a thermal cracker using linear programming.

Text Book

1. Optimization of chemical process, T.F.Edgar and Himmelblau.D.M., McGraw Hill.

Reference Book

Optimization: Theory and Applications, S.S.Rao, Wiley Eastran Ltd

BIOFUELS
CH 424(A)

L	T	C	:	3	1	3	Continuous Assessment	:	40
Final Exam			:	3 hours			Final Exam Marks	:	60

Course Objectives: To meet the current energy challenges and the importance of bio-fuels in achieving energy security and minimizing greenhouse gases emissions and identification of critical points in the different technologies & be able to make suggestions for different steps in bio fuel production technologies.

Pre-Requisites: CH 312, CH 415

UNIT – I

Sources of energy, introduction of biofuels, availability of bio mass, composition of biomass, terrestrial biomass, aquatic biomass. Physical and chemical properties of biomass. useful features of biofuels, undesirable features of biofuels, energy crops, modes of utilization of biomass and their environmental impacts.

UNIT – II

Biogas: The substrate, the digester, the microorganisms, the process of bio gas production, factors affecting bio gas yields, advantages, disadvantages.

Bioethanol: Bioethanol vs. Petrol, production of bio ethanol, ethanol recovery. Bio butanol.

UNIT –III

Bio diesel: Sources of lipids, production of lipids, methods of production of bio diesel, comparison of bio diesel with conventional diesel. Standards of bio diesel.

UNIT – IV

Bio hydrogen: Production of bio hydrogen from anaerobic bacteria, photosynthetic algae, photosynthetic–hydrogenase system.

Fuel cells: Enzymatic fuel cells, microbial fuel cells.

Text Book

1. Bio Technology – Expanding horizons, B.D.Sing, Kalyani Publishers, Ludhiana.

Reference Books

1. Fundamentals of Renewable Energy systems, D.Mukherjee, S.Chakrabarti, New Age International Publishers.
2. A Text Book of Biotechnology, R.C.Dubey, S.Chand & Company Ltd.,
3. Non-Conventional energy sources, G.D.Rai, Khanna Publishers.

DESIGN AND ANALYSIS OF EXPERIMENTS
CH 424(B)

L	**T**	**C**	**:**	**3**	**1**	**3**	**Continuous Assessment**	**:**	**40**
Final Exam			**:**	**3 hours**			**Final Exam Marks**	**:**	**60**

Course Objectives: The objective is to give basic knowledge of the subject and familiarity with techniques to use them effectively and to expose the students to elements of probability and probability distributions, and statistical inference.

Prerequisites: CH 221

UNIT- I

Introduction to probability, probability laws, Baye's theorem. Probability distributions, parameters and statistics

Normal and t-distributions, central limit theorem, random sampling and declaration of independence significance tests

UNIT- II

Randomization and blocking with paired comparisons significance tests and confidence interval for means, variances, proportions and frequencies.

Analysis of variance, experiments to compare k-treatment means

UNIT-III

Two-way factorial designs, blocking, Yate's algorithm

Fractional factorial designs at two levels, concept of design resolution

UNIT-IV

Simple modeling with least squares (regression analysis), Matrix versions of normal equations

Mechanistic model building, Empirical and mechanistic models, model building process, model testing with diagnostic parameters.

Text Book:

1. Statistics for experimenters by G.E.P. Box, William G. Hunter and J.S. Hunter, John Wiley & Sons.

Reference:

1. "Design and analysis of experiments" by D.C. Montgomery, 2nd edition John Wiley and sons, NewYork (1984).

CORROSION ENGINEERING
CH 424(C)

L	T	C	:	3	1	3	Continuous Assessment	:	40
Final Exam			:	3 hours			Final Exam Marks	:	60

Course Objectives: identifies the electrochemical reactions occurring at cathodes and anodes and various types of corrosion occurring on a material. Prediction of the corrosion rate from available data.

Prerequisites: CH101, CH104, CH107, CH311

UNIT – I

Introduction and Scope : Corrosion, definition, Wet and dry corrosion, mechanisms, Electro-chemical principles and aspects of corrosion, Faradays laws, specific conduction, specific resistance, transport no. mobility etc., various forms of corrosion, a brief review, corrosion rate expression, thermodynamic aspects of corrosion, equilibrium potential, Nernst equation for electrode potential, EMF series, over voltage, application of Nernst equation to corrosion reactions, calculation of Corrosion Rates.

UNIT – II

Polarisation and Corrosion potentials, reference electrodes for corrosion measurements, types of polarisation, concentration, activation and resistance polarisations, Tafel equation, Tafel constant, Evans diagrams, anodic control, cathodic control. Mixed control : Fourbaix diagram for Fe-H_2O system, galvanic corrosion, uniform attack, pitting corrosion, dezincification, cavitation erosion. Fretting corrosion, inter-granular and stress corrosion cracking, some remedial measures for the above.

UNIT – III

High temperature oxidation, pilling bedworth ratio, mechanisms of oxidation, corrosion testing procedures & evaluation.

Corrosion of iron and steel in aqueous media, effect of velocity, temperature and composition of media.

UNIT – IV

Prevention techniques, modification of the material by alloying, appropriate surface or core treatment, chemical and mechanical methods of surface treatment. Coatings, metallic, non-metallic linings, cathodic protection, passivity and anodic protection.

Text Book

1. Corrosion & Corrosion Control by H.H.Uhlig.

Reference Books

1. Electrochemistry by Samuel Glasstone
2. Corrosion engineering by Fontana and Greene.

PINCH TECHNOLOGY
CH 424(D)

L	T	C	:	3	1	3	Continuous Assessment	:	40
Final Exam			:	3 hours			Final Exam Marks	:	60

Course Objectives: To teach basics of pinch technology, laws of thermodynamics, the importance of heat integration step in process designing. Understand the network grid representation and finding pinch point, the data extraction and energy targeting.
Prerequisites: CH 223

UNIT – I

Introduction to Pinch Technology: Definition of pinch technology. Basis of Pinch Technology. Objectives of Pinch Analysis. Process Integration by Pinch Analysis. Development of Pinch Technology. Areas of applications of Pinch Technology. The concept of process synthesis. The role of thermodynamics in process design.

UNIT – II

Heat recovery: Basic concepts of heat exchange, the temperature-enthalpy diagram, Composite curves, A targeting procedure. The grand composite curve and shifted composite curves. The pinch and its significance.
Heat exchanger network design: Network grid representation, design for maximum energy recovery. Choosing dTmin, Supertargeting.
Methodology of Pinch Analysis: The range of pinch analysis techniques, Application of pinch study.

UNIT – III

Data Extraction: Data extraction: Heat and mass balance, stream data extraction, calculating heat loads and heat capacities, choosing streams, mixing, heat losses. Organics distillation plant–a case study.
Energy targeting: dTmin contributions for individual streams, Threshold problems. Organics distillation plant – a case study.

UNIT – IV

Process change and evolution: Basic objective, The plus-minus principle, appropriate placement applied to unit operations, reactor systems, distillation columns.
Case studies: Crude preheat train, Aromatics plant.

Text Books

1. A user guide on process integration for the efficient use of energy, B. Linnhoff, David W. Townsend, D. Boland and G.F. Hewitt
2. Pinch Anlysis and Process Integration, second edition: A user guide on process integration for the efficient use of energy, Ian C. Kemp, IChemE

Reference Book

Chemical Process: Design& Integration, Robin Smith, John Wiley and Sons.

PROJECT WORK
CH 461

L	**T**	**C**	**:**	**9**	**0**	**10**	**Continuous Assessment**	**:**	**50**
Final Exam			**:**	**3 hours**			**Final Exam Marks**	**:**	**100**

The project work should consist of a comprehensive design project of a chemical plant in the form of a report with the following chapters.

1. Introduction
2. Physical and chemical properties and uses.
3. Literature survey for different processes
4. Selection of the process
5. Material and energy balances
6. Specific equipment design / Experimentation
   (Process as well as mechanical design with drawing, including computer programs where possible, of heat transfer equipment / separation equipment / reactors)
7. General equipment specifications.
8. Plant location and layout
9. Materials of construction
10. Health and safety factors
11. Preliminary cost estimation
12. Bibliography.

CAD LABORATORY
CH 462

L	T	C	:	6	0	2	Continuous Assessment	:	40
Final Exam			:	3 hours			Final Exam Marks	:	60

Coding Using Matlab

1. N-R Technique
2. R-K Method

Application Using Simulink

3. Feed Back control using P, PI and PID controllers.

Simulations using C/C++/ Fortran/ Matlab4. Gravity flow tank

4. Heat Exchanger.
5. Bubble point / Dew point calculation.
6. Binary distillation column
7. Non-isothermal CSTR.
8. PFR

Using CHEMCAD

10. Rating of shell and tube heat exchanger using Aspen Plus software.
11. Rating of Distillation column using Aspen Plus/Chemcad software.
12. Simulation of Recycle Processes.
13. Simulation of PFR and CSTR.