Nirma University

Institute of Technology

Chemical Engineering Department

NAAC Criterion 1.1.3.1

CE101 **Art of Programming** **[3 1 2 5]**

Learning Outcome:

- Students will get acquainted with basic components and capabilities of a typical computing system.
- Students will be able to critically think about basic problems and develop algorithms to solve, validate and verify with computing systems.
- Students will be able to identify appropriate language constructs and approach to computational problems.
- Students will be acquainted with coding standards including documentation which are required to be used for the development of effective, efficient and maintainable programs.

Syllabus:

Introduction to Computer Systems: Basic computer organisation, operating system, editor, compiler, interpreter, loader, linker, program development.

Data Storage and Operations: Various data representation techniques, data types, constants, variables, arrays, various arithmetic and logical operations in a typical programming environment.

Algorithms and Flow charting: Introduction to computer problem solving, concepts and algorithms and flow chart, tracing of an algorithms.

Algorithm to Program : Specifications, top down development and stepwise refinement as per programming environment needs. Imperative style of correct and efficient programming, introductory concepts of time and space complexities.
Loops and Controls Construct : conditional and unconditional execution. Simple versus nested controls. Various aspects of repetitive executions, iterative versus recursive programming styles, assertions and loop invariants.
Errors and Debugging: Types of errors, debugging, tracing/stepwise execution of program, watching variables values in memory.
Structured Programming: Introduction to modular approach of problem solving, concepts of procedure and functions for effective programming.
Coding Conventions: Variable naming, function naming, indentation, usage and significance of comments for readability and program maintainability.

Laboratory Work:

Above concepts are to be implemented in any High Level Programming Language (preferably C- language) atleast 10 experiments are to be carried out.

References:

1. Joyce Farrell, Programming Logic and Design Comprehensive, Cenage Learning

2. Dromey R.G., How to solve it by computers, Prentice Hall of India
3. Jean-Paul Tremblay, Richard B. Bunt, Introduction to Computer Science, McGraw Hill
4. Kernighan., Ritchie, ANSI C Language, Prentice Hall of India
5. Sedgewick R., Algorithms in C, Addison Wesley
6. Yashwant Kanitker, Let Us C, BPB Publications
7. Schaum Ourline Series, Programming in C, , McGraw-Hill
8. V. Rajaraman, Fundamentals of Computers, Prentice Hall of India

MA101 **Calculus** **[3 1 0 4]**

Learning outcomes:

On completion of the course student

CLO1: will be able to find higher ordered derivatives and hence represent function in power series of (x-a)

CLO2: will apply the knowledge of function of several variables , its derivatives in engineering problems

CLO3: will apply the knowledge of special functions(Gamma, Beta, Elliptic, Error) and its application in engineering problems

CLO4: will apply the knowledge of multiple integration and its application in engineering problems

Syllabus:

Unit I: Differential Calculus Review of limits, continuity and differentiability, Successive differentiation, Leibnitz theorem (without proof), Indeterminate forms, Taylor's and Maclaurin's expansion of single variable, Partial Differentiation, Total derivative, Chain Rule, Implicit function, Euler's theorem and its applications, Taylor's and Maclaurin's expansion of function of several variables, Maxima and Minima of function of several variables, Lagrange's method of undetermined multipliers, Jacobian.

Unit II: Integral Calculus Review of proper and improper integrals, Reduction formulae, Beta-Gamma functions, Error function, Tracing of curves, Rectification, Quadrature, Volume of solid of revolution, Area of surface of revolution, Double integral and evaluation, Change of order of integration, Change of variable, Triple integral and evaluation, Area using double integration, Volume as double and triple integration, Volume of solid by double integration.

References:

1. Thomas' Calculus(Latest edition), Pearson publication.
2. G B Thomas and R. L. Finney, Calculus and Analytic Geometry (Latest edition), Narosa Publication, Delhi.
3. James Stewart, Calculus (Latest edition), Thomson Learning.
4. B. S. Grewal, Higher Engineering Mathematics, (Latest edition) Khanna publication, Delhi.
5. Dr. K. R. Kachot, Higher Engineering Mathematics Vol I (Latest edition), Mahajan Publication, Ahmedabad.
6. Sharma and Yeolekar, Engineering Mathematics Vol. I. (Latest edition), PHI, New Delhi.

Course Code	MA102
Course Title	Calculus and Differential Equations

Course Learning Outcomes (CLO)

At the end of the course, students will be able to-

1. apply differential and integral calculus to solve engineering problems,
2. use power series to solve differential equations appears in engineering filed,
3. deal with functions of several variables that are essential in engineering.

Syllabus:

Calculus **Teaching hours: 7**

Evaluation of definite and improper integrals, Beta and Gamma functions and their properties, Applications of definite integrals to evaluate surface areas and volumes of revolutions

Infinite Series **Teaching hours: 7**

Convergence of series, tests for convergence, power series, Taylor's and Maclaurin's series. Series for exponential, trigonometric and logarithmic functions

Multivariable Calculus: Differentiation **Teaching hours: 7**

Limit, continuity and partial derivatives, total derivative and chain rule, Euler's theorem, Taylor's series in two variables, Tangent plane and normal line, Maxima, minima and saddle points Method of Lagrange multipliers

Multivariable Calculus: Integration **Teaching hours: 9**

Multiple Integration: double and triple integrals (Cartesian and polar), change of order of integration in double integrals, Change of variables (Cartesian to polar), Applications: areas and volumes by (double integration) Center of mass and Gravity (constant and variable densities).

Ordinary Differential Equations **Teaching hours: 10**

Second order linear differential equations with constant coefficients, Cauchy-Euler equation; Power series solutions; Legendre polynomials, Bessel functions of the first kind and their properties

Partial Differential Equations: First Order **Teaching hours: 5**

First order partial differential equations, solutions of first order linear and non-linear PDEs

Tutorials

This shall consists of at least 8 tutorials (TA) based on the syllabus

Self-Study

Self-study contents will be declared at the commencement of the semester. Around 10% of the questions will be asked from the self-study contents.

Suggested Readings:

1. G B Thomas and R L Finney, Calculus and Analytic geometry; Pearson
2. T Veerarajan, Engineering Mathematics; McGraw-Hill

3. B V Ramana, Higher Engineering Mathematics; McGraw-Hill
4. N P Bali and M Goyal, A text book of Engineering Mathematics; Laxmi Publications
5. B S Grewal, Higher Engineering Mathematics; Khanna Publishers
6. E Kreyszig, Advanced Engineering Mathematics; John Wiley & Sons
7. W E Boyce and R C DiPrima, Elementary Differential Equations and Boundary Value Problems; Wiley India
8. S L Ross, Differential Equations; Wiley India
9. E A Coddington, An Introduction to Ordinary Differential Equations; Prentice Hall India
10. E L Ince, Ordinary Differential Equations; Dover Publications
11. G F Simmons and S G Krantz, Differential Equations; McGraw Hill

L = Lecture, T = Tutorial, P = Practical, C = Credit

L	T	P	C
3	1	2	5

Course Code	CE104
Course Title	Computer Programming

Course Learning Outcomes (CLOs):

At the end of the course, students will be able to –

1. recognize the importance and apply C language constructs in program development,
2. analyse the problem and select the most appropriate method to solve it,
3. evaluate the correctness of the developed solution.

Syllabus:	**Teaching hours:**
Unit I Introduction to Computers: Introduction to Computers and the Internet in Industry and Research, The Internet and World Wide Web, web Resources, Hardware and Software, Computer Organization, Programming Languages, Introduction to the C Programming Language, Typical C Program Development Environment and steps. Test-Driving a C Application in Linux, Running a C program Using GNU for debugging.	5
Unit II Introduction to Programming: Memory Concepts, datatypes, operators and expressions, Decision Making, Bitwise Operators, Flowchart, Algorithms, Pseudocode, Test-cases, Repetition Statement, Counter-Controlled Repetition, Sentinel-Controlled Repetition, Nested Control Statements. Introduction some Simple C Program, I/O handling. Programming with C: keywords, syntax and library functions, datatypes, declarative, imperative and decision statements. Control structures.	9
Unit III Functions: Math Library Functions, User defined functions, Function Call Stack and Stack frames, Passing Arguments by Value and By Reference, Scope Rules, Recursion, Recursion vs. Iteration. Arrays: Defining Arrays, Sorting Arrays, Searching Arrays, Multidimensional	10

Arrays, Variable-Length Arrays, Passing Arrays to Functions.

Unit IV 11

Pointers: Pointer Variable Definitions and Initialization, Pointer Operators, Passing Arguments to Functions by Reference, Pointer Expressions and Pointer Arithmetic, Relationship between Pointers and Arrays, Arrays of Pointers, Pointers to Functions. Introduction to dynamic memory allocation.

Characters and Strings: Fundamentals of Strings and Characters, Character-Handling Library Functions, String-Conversion Functions, Standard Input/Output Library Functions for string, String-Manipulation Functions of the String-Handling Library, Comparison Functions of the String-Handling Library.

Unit V 10

Structures: Structure Definitions, Defining Variables of Structure Types, Operations That Can Be Performed on Structures, Initializing Structures, Accessing Structure Members, Using Structures with Functions

File Processing: Files and Streams, Creating a File, Reading and writing Data from a File.

Self-Study:

The self-study contents will be declared at the commencement of semester. Around 10% of the questions will be asked from self-study contents.

Laboratory Work:

Above concepts are to be implemented in C-language atleast with emphases on logic development and debugging, 10 experiments are to be carried out.

Tutorial Work:

The tutorial work will be based on the topics covered in the syllabus. Minimum 10 tutorials should be carried out.

Suggested Readings^:

1. Deitel and Deitel , C How to Program, Pearson
2. E. Balagurusamy, 'Programming in ANSI C", McGraw Hill
3. Yashwant Kanitker, Let Us C, BPB Publications
4. V. Rajaraman, Fundamentals of Computers, Prentice Hall of India
5. Joyce Farrell, Programming Logic and Design Comprehensive, Cenage Learning
6. David Gries, The Science of Programming, Springer
7. Dromey R.G., How to solve it by computers, Prentice Hall of India
8. Jean-Paul Tremblay, Richard B. Bunt, Introduction to Computer Science, McGraw Hill
9. Kernighan., Ritchie, ANSI C Language, Prentice Hall of India
10. Sedgewick R., Algorithms in C, Addison Wesley
11. Schaum Ourline Series, Programming in C, , McGraw-Hill
12. E. Balagurusamy, Pointer in C, McGraw Hill

L= Lecture, T= Torial, P= Practical, C= Credit[1]

EE102 Electrical Workshop Practices [0 0 2 1]

Learning Outcome:
By studying this course, at the end, students will be in position to apply wiring and soldering skills in real practice while making any electronic circuit. Student will start appreciating safety device and will learn about safety measures. It is expected that student can detect faults and preliminarily repair some house hold equipments. Student will be aware of different luminaries available for lighting and their selection. Student will be exposed to basics of solar power and LED lighting.

Syllabus:

Wiring Techniques: Designing of domestic and industrial wiring, selection of wire, load calculations

Introduction to Electronic Components: Study of various electronic components like, power and signal diodes, zener diodes, BJTs, FETs, LED, LDR, Photo diode, Photo transistor, SMD components, general purpose ICs, use of bread board

Lab equipments: CRO, DC regulated power supply, function generator, multimeter, single-phase and three-phase auto-transformer (variac)

Introduction to Electrical Components: Study of different types of switches, solid state and electromagnetic relays, contactors, rheostats, different types of capacitors, resistors, variable inductor (choke) etc.

Soldering Techniques: Basics of soldering techniques, effectiveness of soldering and problem associated with soldering, general purpose board soldering.

Basics of Household Electrical Equipments: rewiring / replacement of fuse, switch board layout, functioning of switch, fan regulator, tube light, electric iron, electric heater

Basic Network Communication: Types of computer network communication, network cabling

Designing of Electrical Panel: Basic design steps and criteria, selection of various components, layout of panel, ferruling, crimping, lugging, annunciation, display, mimic, meter mounting etc.

Introduction to Lighting: Study of illumination requirements, illumination units, lumen requirements, energy savers, solar power lights, LED lighting.

Introduction to DC Machine: Study of various parts of DC machine. Operation of DC machine as DC motor

Laboratory Exercise:

This shall consist of at least 10 hands-on exercises based on the above syllabus.

References:

1. Electric Wiring - Mr. S. Samaddar, New central book agency (P) Ltd., Calcutta.
2. Electrical Design Estimating and Costing- Surjit Singh, Dhanpat Rai & Sons
3. Principles and Reliable Soldering Techniques – Sengupta R., New Age International (P) Ltd.
4. Electrical Technology Vol – III – B. L. Theraja, A. K. Theraja, S. Chand Publishers., New Delhi.

5. Fundamentals of Maintenance of Electrical Equipments – K. B. Bhatia, Khanna Publishers.
6. Electronic Product Design Vol - I – Er. Mehta S. D., S. Chand Publishers., New Delhi.
7. Projects in Electrical, Electronics, Instrumentation and Computer Engineering – Dr. S. K. Bhattacharya, Dr. S. Chatterji, S. Chand Publishers., New Delhi.
8. National Electrical Code: Bureau of Indian Standards, Govt. Of India, 2011.
9. Operating Manuals of Various Equipments

EE103 Elements of Electrical and Electronics Engineering [2 4 0 4]

Course Outcomes (CO)

COs are clear statements of the expectations for student achievements in the course. At the end of the course, a student will be able to –

1. interpret the importance of electrical energy and relate its usage in various applications,
2. illustrate the role of circuit elements in different system conditions,
3. distinguish the operational aspects of ac-dc systems and comprehend the principles of electromechanical energy conversion,
4. recognise the functions of electronic devices and basic circuits,
5. apply the concepts of number based conversion and Boolean algebra for digital logic design.

Syllabus

Review of dc Circuits

Kirchhoff's laws, solution of star-delta circuits, Joule's law of electric heating, relationship between various energy units, charging and discharging of capacitor, series-parallel magnetic circuits, fringing effect, comparison between electric and magnetic circuit, Concept of induced emfs, series-parallel connection of inductors, rise and decay of current in inductive circuit.

Single-phase AC Circuits

Generation of alternatingemf, instantaneous, rms, peak, average values and related other terms, vector representation of AC quantities, Steady state analysis of R, L, C series and parallel circuits, power triangle, resonance in series and parallel circuits.

Three-phase AC Circuits

Generation of three-phase emf, star connection, delta connection, relationship between line and phase quantities, power measurement in three-phase circuit, variation in wattmeter reading with power factor.

Electromechanical Energy Conversion

Concept of electro-mechanical conversion, energy balance, elementary concept of electrical machines, types of rotating electrical machines.

Analog Electronics

Half and full wave rectifiers, special purpose diodes, regulator, BJT and its applications, amplifier, oscillator, overview of opto-electronics devices, opto-couplers, transducers, Operational amplifier, Comparator, Timer IC and multivibrators.

Digital Electronics

Number systems and its arithmetic, binary codes, Boolean-algebra & simplification of Boolean expression; logic gates, concept of universal logic; implementation of Boolean expressions using logic gates, application of digital circuits (e.g. adder, subtractor, multiplexer, de- multiplexer, analog to digital converter, digital to analog converter

References

1. B.L.Theraja, A.K. Theraja, Textbook of Electrical Technology Volume I –, S. Chand & Co.
2. A. E. Fitzgerald, Arvin Grabel, David E. Higginbotham, Textbook of Basic Electrical Engineering –TMH

Publishing Co.
3. U. A. Patel, Textbook of Elements of Electrical Engineering, Mahajan Publishing House, Ahmedabad.
4. J. Nagrath, Basic Electrical Engineering, TMH Publishing Co. Ltd.
5. Vincent Del Toro, Textbook of Principles of Electrical Engg., Prentice Hall of India Pvt. Ltd., New Delhi.
6. Mr. S. Samaddar, Textbook of Electric Wiring, New Central Book Agency (P) Ltd., Calcutta.
7. Surjit Singh, Textbook of Electrical Design Estimating and Costing, Dhanpat Rai & Sons.
8. Robert Boylestad, Louis Mashlsky, Electronics Devices and Circuit theory, Peerson
9. M. Morris Mano, Digital logic and computer Design, PHI

EE101 Elements of Electrical Engineering [3 0 2 4]

Learning Outcome:

The course is designed to introduce to a novice about the fundamentals of the electrical engineering. At the end of the course, it is expected that student will be able to express the behavior of basic electrical components like resistor, inductor and capacitor under DC and AC application. The students are exposed to single-phase and poly-phase systems and circuits and shall be able to comprehend the same. The student will be able to appreciate safety requirements and usage of safety devices. The learner will be able to understand and apply the basics of electrical engineering in their respective field of engineering.

Syllabus:

Review of DC Circuits

Resistor, temperature effect on resistance, Kirchhoff's laws, solution of series-parallel and star-delta circuits, Joule's law of electric heating, relationship between various energy units, types of capacitor, charging and discharging of capacitor, fundamentals of magnetic circuits, fringing effect, series-parallel magnetic circuits, comparison between electric and magnetic circuit

Electromagnetic Induction

Faraday's laws of electromagnetic induction, concept of induced emfs, coefficient of coupling, series- parallel connection of inductors, rise and decay of current in inductive circuit, hysteresis and eddy current loss

Single-phase AC Circuits

Generation of alternating emf, instantaneous, rms, peak, average values and related other terms, vector representation of AC quantities, Steady state analysis of R, L, C series and parallel circuits, power triangle, resonance in series and parallel circuits

Three-phase AC Circuits

Generation of three-phase emf, star connection, delta connection, relationship between line and phase quantities, introduction to rotating vector, power measurement in three-phase circuit, solution of balanced and unbalanced systems

Domestic and Industrial Wiring

Basic domestic wiring methods, types of cable, accessories, PVC conduit and PVC casing, salient features of industrial wiring, consideration on cross sectional area and insulation strength based on voltage and current rating, design calculations, protective systems, Indian standard wiring practices

Electrical Safety and Protection

Safety, electric shock, safety protections in electrical laboratory, methods of earthing, protective devices - fuses, MCB, ELCB and relays

Batteries

Different types of batteries, need of batteries, charging and discharging of batteries, methods of charging

Laboratory Work:

This shall consist of at least 10 practicals based on the above syllabus.

References:

1. Electrical Technology, Volume I – B.L.Theraja, A.K. Theraja; S. Chand & Co.
2. Basic Electrical Engineering – A. E. Fitzgerald, Arvin Grabel, David E. Higginbotham, TMH Publishing Co.
3. Elements of Electrical Engineering – U. A. Patel, Mahajan Publishing House, Ahmedabad.
4. Basic Electrical Engineering – I. J. Nagrath, TMH Publishing Co. Ltd.
5. Principles of Electrical Engg.– Vincent Del Toro, Prentice Hall of India Pvt. Ltd., New Delhi.
6. Electric Wiring – Mr. S. Samaddar, New central book agency (P) Ltd., Calcutta.
7. Electrical Design Estimating and Costing – Surjit Singh, Dhanpat Rai & Sons.

8.

ME101 **Engineering Graphics** **[2 0 4 4]**

Course Learning Outcomes:

After successful completion of the course, student will be able to

- Understanding the fundamental principles of engineering graphics and related drawing standards
- explain the various methods of producing and presenting graphic information.
- communicate graphically using traditional means and the computer aided tools.
- develop capability to visualize and represent geometry in two dimensions and in three dimensions.
- appreciate role of engineering graphics and modeling for various disciplines of engineering.

Syllabus:

Introduction to Engineering Drawing
Importance and Applications of Engineering Drawing for various branches of engineering, Drawing instruments, BIS Code of Practice, Lines, Lettering and Dimensioning, Scales, Basic Geometrical Construction, Sheet Layout

Engineering Curves
Equations of conic curves and cycloid and their relevance to construction.
Construction of conics by Focus Directrix Method, Construction of Ellipse by Arcs of Circle Method, Parabola by Rectangle Method, Rectangular and oblique Hyperbola.
Construction of Cycloid, Epicycloids and Hypocycloid. Construction of Involutes.
Constructions of Archimedean spiral and helix.

Solid Geometry
Concept of Orthographic Projections and Projections of Points, Projections of straight lines inclined to one and both reference planes, Projections of Planes inclined to both reference planes, Projections of solids and sections of solid.

Developments of Surfaces by parallel line method and radial line method.

Interpenetration of Solids

Determination of lines / curves of intersection for interpenetration of Prism to prism, Cylinder to cylinder, Cylinder to cone, Cone to cylinder.

Orthographic Projections
Conversion of pictorial views in to orthographic Projections. Sectional orthographic Projections.

Isometric Projections

Conversion of orthographic views into isometric projections / views.

Computer Aided Drafting Tools

Basic Drawing Creation Tools- creating a line, circle, Arc, Donut, Ellipse, Point, Multi-Line, Polygon, Spline. Using editing tools such as Dividing and Measuring.

Modifying Commands and Views- Rectangular and Polar arrays, modify using BREAK, CHAMFER, COPY, EXPLODE, EXTEND, FILLET, MIRROR, MOVE, OFFSET, PEDIT, ROTATE, SCALE,

STETCH, TRIM. Adding Text to Drawings, Dimensioning Tools.

Conventional Representation

Symbols for standard machinery components such as nuts, bolts, locking devices, riveted and welded joints, foundation bolts. Symbols used in electrical, electronics and civil engineering.

Self Study:

The self study contents will be declared at the commencement of semester. Around 10% of the questions will be asked from self study contents.

Laboratory Work:

Laboratory Work will be based on the above syllabus consisting of minimum six drawing sheets.

References:

1. N D Bhatt, Engineering Drawing, Charotar publication
2. K. C. John, Engineering Graphics, PHI Publication.
3. Warren J Luzzader and Jon M Duff, Fundamentals of Engineering Drawing, PHI publication.
4. James D Bethune, Engineering Graphics with AutoCAD® , PHI Publication.
5. IS SP 46 : 2003. Engineering Drawing Practices for Schools and Colleges.

HM102 **English (Foreign Language)** **[2 0 2 3]**

Course Learning Outcome:

By the end of this course

- Student will be able to understand and speak a new language
- Student will be more aware about the world outside
- It will add to the knowledge of culture other than their own
- Multi-Linguistic skills will equip them with better communication skills too

Syllabus of English Language:

The course content will encompass following topics

Grammar

- Tenses
- Helping and Modal auxiliary verb
- Concords
- Prepositions
- Idioms
- Synonyms –Antonyms
- Confusables

Prose

- Open Window by Saki
- A Cup of Tea by Katherine Mansfield
- The Piece of String by Guy De Maupassant
- Text of Steve Jobs' Commencement address -2005
- How to be an Alien by George Mikes

Poems

- Ode to the skylark – by P B Shelley
- Where The Mind Is Without Fear - by Rabindranath Tagore.
- The Road Not Taken- Robert Frost
- On The Move - by Thom Gunn.

Methodology:

Readings, exercises, role plays, videos will be the basic tools for teaching

As the course on foreign language will be offered by different experts, depending on the availability of the experts and demand, the syllabus of the offered foreign language will be approved by the Dean time-to-time before start of the every semester.

References:

1. Leech Geoffery and Svartik Jan, 'A Communicative Grammar of English', Pearson pub.
2. Murphy Raymond, 'Grammar in Use Intermediate with Answers', Cambridge University Press.

Selected text in the form of handouts.

C	P	T	L
3	2	1	1

2HSI101/2HSB101	Course Code
English Communication	Course Title

Course Learning Outcomes (CLO):

At the end of the course, students will be able to -

- acquire adequate proficiency in English communication including reading and listening, comprehension, writing and speaking skills,
- apply the dynamics of communication skills.

Syllabus:

Vocabulary Building
Teaching hours: 4 hrs (L)

Origin of English Language, Types of English, The concept of Word Formation, Root words from foreign languages and their use in English, Acquaintance with prefixes and suffixes from foreign languages in English to form derivatives, Synonyms, antonyms, and standard abbreviations.

Basic Writing Skills
Tutorial hours: 3 hrs (T)

Sentence Structures, Use of phrases and clauses in sentences, Importance of proper punctuation, Creating coherence, Organizing principles of paragraphs in documents, Techniques for writing precisely.

Identifying Common Errors in Writing
Teaching hours: 2 hrs (L), Tutorial hours: 2hrs (T)

Subject-verb agreement, Noun-pronoun agreement, Misplaced modifiers, Articles, Prepositions, Redundancies, Cliches.

Nature and Style of sensible Writing
Teaching hours: 3hrs (L)

Describing, Defining, Classifying, Providing examples or evidence, Writing introduction and conclusion.

Writing Practices
Tutorial hours: 4 hrs (T)

Comprehension, Precis Writing, Essay Writing, Idea Expansion.

Oral Communication
Tutorial hours: 6 hrs (T)

Listening Comprehension, Pronunciation, Intonation, Stress and Rhythm.

Persuasive Communication
Teaching hours: 6 hrs (L)

Communication at Workplace: Report, Application and email writing, Referencing, Interviews, Formal Presentations.

Laboratory Work

Practices related to tenses, prepositions, word formation/transformation concord, affixes, one-word substitutes, idioms etc. Vocabulary building, Presentations and Group Discussions.

Self-Study

The self-study contents will be declared at the commencement of semester. Around 10% of the questions will be asked from self-study contents.

Suggested Readings:

(i) Selected Texts and excerpts.
(ii) Selected movies and TED talks
King's Speech
Babel
Episodes of Yes Prime minister
Episode of Sherlok
(iii) Practical English Usage, Michael Swan, OUP. 1995.
(iv) Remedial English Grammar, F.T. Wood, Macmillan. 2007
(v) On Writing Well, William Zinsser, Harper Resource Book. 2001.
(vi) Study Writing, Liz Hamp-Lyons and Ben Heasly, Cambridge University Press. 2006.
(vii) Communication Skills, Sanjay Kumar and PushpLata, Oxford University Press. 2011.
(viii) Word Power Made Easy, Norman Lewis.
(ix) Raymond Murphy, Essential English Grammar: A Self-Study Reference and Practice Book for Elementary Students of English with Answers, Cambridge University Press.
(x) Collins Academic Skills Vocabulary Organizer.
(xi) Collins Writing Skills B2+.
(xii) Real Life Real Listening-Collins.

CL103 Environmental Studies [1 0 1 2]

Course Learning Outcomes:

At the end of the course, students will be able to –

1. appraise the multidisciplinary nature of environment and sustainability
2. explain types of environmental pollution and its control measures
3. outline social issues related to environment

Syllabus:

Unit 1: Multidisciplinary Nature of Environment

Environment and its multidisciplinary nature, Ecosystems, biodiversity and its conservation, concept of sustainability, Environmental Impact Assessment, public awareness towards environmental conservation, Environmental legislation, carbon credit and carbon trading

Unit 2: Environmental Pollution, Global Warming and Climate Change

Types of environmental pollution and pollutants, causes, effects and control measures of – air pollution, water pollution, soil/land pollution, noise pollution, radioactive pollution. Role of an individual in prevention of pollution. Case studies on pollution, Effects – acid rain, ozone layer depletion and greenhouse effect. Sources, types and effects of waste, waste disposal and management, e-waste management

Unit 3: Social Issues related to Environment

Environment ethics- issues and solutions. Energy and water conservation, rain water harvesting, water shed management, rehabilitation problems and concerns, environmental protection acts.

Self-Study:

The self-study contents will be declared at the commencement of semester.

Tutorial Work:

Tutorial work will be based on above syllabus with minimum 05 Assignments to be incorporated.

Suggested Readings:

1. Dara, S. S., & Mishra, D. D. A textbook of Environmental Chemistry and Pollution Control. S. Chand & Company Ltd.
2. Bharucha, E., Textbook of Environmental Studies, Universities Press.
3. Dhameja, S. Environmental Studies. S. Kataria and Sons.
4. Ristinen, R., & Kraushaar, J. Energy and the Environment, Wiley Publications.
5. Masters, G. Introduction to Environmental Engineering and Science. Prentice-Hall Publications.
6. Basak, A. Environmental Studies. Pearson Publications.

HM111 French Language (Foreign Language) [2 0 2 3]

Course Learning Outcomes:

At the end of the 40 hours course, students will be evaluated on the basis of 4 competences:

- Writing (Filling forms, post cards, small emails, messages),
- Speaking (To present oneself in details, to be able to ask questions in certain given situations, Role Play),
- Written Comprehension (Small texts, post cards, messages),
- Oral Comprehension (Understanding the basic day to day conversations).

Pedagogy: Communicative and Action Oriented Approach

Supplementary:

Cultural activities of Alliance Française d'Ahmedabad.

COURSE CURRICULUM

Main guidelines

1. To introduce oneself
2. To ask information about someone
3. To count
4. To communicate in a class
5. To Greet
6. To take leave
7. To ask personal information
8. To ask politely
9. To give personal information
10. To ask the price
11. To ask about likings
12. To express about our likings
13. To talk about a city
14. To name and find out different places in a city
15. To ask and give an explanation
16. To thank and to reply
17. To write a message
18. To give impressions about a place
19. To talk about ones' activities
20. To say where we live
21. To talk about the weather
22. To fix or postpone a meeting
23. To talk briefly about oneself
24. To ask the time and the timings
25. Telephonic conversation
26. To talk about the family
27. To talk about seasons
28. To understand simple information about the weather
29. To appreciate
30. To precise the quantities
31. With relevant vocabulary and grammar points

HM131 German Language (Foreign Language) [2 0 2 3]

Course Learning Outcomes : On completion of the course, the student would be able to:

1. understand & convey expressions associated with everyday routine and topics related to direct circumstances and common requirements in Germany (e.g. seeking and sharing personal information, handling simple conversations related to shopping, making reservations, ordering in restaurants, airports, banks, railway stations, universities and other all such public places).
2. get an insight into the day-to-day socio-economic culture of Germany.
3. appreciate a foreign culture and the importance of learning a foreign language.
4. understand and put basic German grammar such as various types of verbs, nouns, adjectives, tenses and cases to practical & functional use.
5. read, write, speak and understand elementary German and be able to hold simple, short conversations confidently.

Themes & Topics Covered:

- German Greetings & Good-bye's
- Introduction (Seeking introductions & introducing yourself thoroughly in German)
- Orientation: Learning directions & interpreting city plans (Finding your way in the city, inquiring about places, communicating with localities, making basic conversations in Post Offices, Airports, Railway Stations & public places)
- Learning Countries, States & Capitals
- Professions
- Making reservations: Hotels, Taxis & other such routine bookings
- Placing order in Restaurants & learning to find your way around routine requirements
- Learning time, dates, days of the week, numbers & occasions/festivals.

Grammar Covered:

Nouns- In depth study of nouns, with emphasis on case-specific changes

1. Verbs- Regular, Irregular, Helping, Separable & Modal verbs. All with their conjugations
2. Subjects- Nominative and accusative. Correlation between a subject & a verb
3. Cases- Nominative, accusative & dative. Effect of each on nouns & the corresponding changes
4. Articles- Definite & indefinite articles. Its impact & ultimate effect on cases
5. Sentences: Imperative, declarative, exclamatory & interrogative. Positive & negative sentence construction shall also be covered (e.g: "Ja", "doch", as well as " nein", "nicht" & "kein" respectively)
6. Concepts such as adjectives, possessive pronouns, prepositions & adverbsSentence Construction

L	T	P	C
1	0	0	1

Course Code	CH101
Course Title	Introduction to Chemical Engineering

Course Learning Outcomes (CLO):

At the end of the course, students will be able to –

1. explain the importance of chemical engineering,
2. describe basic concepts of unit operations and unit processes,
3. recognize types and characteristics of chemical industry,
4. identify the role and challenges of chemical engineer in chemical industry.

Syllabus		Teaching Hours
Unit 1	**Importance of Chemical Engineering** History and Introduction of Chemical Engineering, Chemical Engineering in everyday life	**02**
Unit 2	**Basic Concepts** Concepts of unit operations and unit processes, role and importance of basic science in Chemical Engineering	**05**
Unit 3	**Types and Characteristics of Chemical Industry** Features of organized chemical processing from chemistry to chemical engineering, Chemical Industry – scope and emerging trends	**03**
Unit 4	**Role and Responsibilities of Chemical Engineer** Role of Chemical Engineer, need of interdisciplinary approach in industry, overview of process instrumentation and control, safety, health and environment in chemical industry, challenges and career opportunities for Chemical Engineer	**05**

Self Study:

The self study contents will be declared at the commencement of semester. Around 10% of the questions will be asked from self study contents.

Suggested Readings:

1. S. Pushpavanam, Introduction to Chemical Engineering, PHI Learning Pvt. Ltd.
2. R. Smith, Chemical Process Design and Integration, Wiley Publication.
3. W. L. Badger and J. Banchero, Introduction to Chemical Engineering, McGraw Hill, Inc.

L: Lecture, T: Tutorial, P: Practical, C: Credit

ME102 **Mechanical Workshop Practices** **[0 0 2 1]**

Course Learning Outcomes:

After successful completion of the course, student will be able to

- comprehend safety measures required to be taken while work in the mechanical workshop.
- select proper tools and cutting data for a given material and manufacturing process.
- properly operate the equipment in the mechanical workshop.
- competent to read and use an engineering drawing for the given job.

Syllabus:

(a) Instruction / demonstration is given for each of the following shops/trades, new materials, tools and equipment used.

1. Joining process
2. Plumbing (metalic & non metalic pipe fittings)
3. Fitting /Assembly practice
4. Sheet Metal work
5. Electroplating
6. Carpentry/ Pattern Making
7. Blacksmithy
8. Painting

(b) Exercise and Term work: Each student is required to prepare simple exercises in the following so as to have a feeling of how the jobs / parts are prepared and use of tools / equipments.

1. Arc Welding / Soldering------02 Hrs
2. Fitting / Assembly. ----------05 Hrs
3. Carpentry Practice ----------02 Hrs
4. Blacksmithy Practice----------02 Hrs

Self Study:

The self study contents will be declared at the commencement of semester. Around 10% of the questions will be asked from self study contents.

References:

1. H S Bawa, Workshop Practice -I and II by, TMH Publication.
2. Hasan Ali and Khan R A, Manufacturing Processes and Workshop Practice, Scitech Publication
3. K C John, Mechanical Workshop Practice by, PHI Publications.
4. B S Raghuvanshi, A course on workshop technology I and II, Dhanpatrai and sons.

CL102 Mechanics of Solids [3 1 2 5]

Course Learning Outcome:
After successful completion of the course, student will be able to

- describe force systems and to compute geometrical properties
- classify materials and characterise them
- analyse various structural elements subjected to different types of force systems
- compute stresses & strains for structural elements
- conduct experiment, infer and report outcomes

Syllabus:
Statics: Principles of statics, particle, rigid body, Coplanar, concurrent and non-concurrent parallel and non-parallel forces, composition and resolution of force, couples and their properties, combination of coplanar couple and forces, forces in truss, force in cable, rigid body assemblies, forces in space
Distributed forces: center of gravity, moment of inertia
Friction: Static and sliding friction, inclined plane friction, ladder friction, wedges, belt and rope friction
Principle of Virtual work
Strength and Elasticity: Stresses; Axial, normal, in-plane, tensile, compressive, shear, flexural, Thermal and hoop, complementary shear. Strain: Linear, shear, Lateral, Thermal and volumetric, Poission's ratio, Elastic constants and relation between them and bodies subjected to loads in three directions.
Shear force and Bending moment: Types of supports, support reactions, Bending moment and shear force diagrams in statically determinate beams subjected to different types of loading, Relation between bending moment, shear force and rate of loading
Stresses in beams: Theory of simple bending, bending stresses and their distribution, moment of resistance, modulus of section, composite beam sections, distribution of shear stress in different sections.
Torsion: Torsion of solid and hollow circular shafts, shear stress due to torsion, angle of twist, Torsional moment of resistance.
Principal Plane and stresses: Compound stresses, analysis of principal planes and principal stresses
Thin cylinder and spherical vessels under pressure
Mechanical Properties of Materials

Self Study:
The self study contents will be declared at the commencement of semester. Around 10% of the questions will be asked from self study contents.

Laboratory Work:
Laboratory work will be based on above syllabus with minimum 11 experiments to be incorporated.

Tutorial Work:
Tutorial work will be based on above syllabus with minimum 10 tutorials to be incorporated.

References:

(xiii) Meriam and Karaige, Engineering Mechanics: Static, Wiley-India.
(xiv) R. C. Hibbler, Mechanics of Materials, Pearson.
(xv) Beer, Johnston and Dewolf, Mechanics of Materials, Tata McGraw-Hill Education.
(xvi) H. J. Shah and S. B. Junnarkar, Mechanics of Structure Vol. I, Charotar Publishing House Pvt. Limited.

L	T	P	C
2	1	2	4

Course Code	PY103
Course Title	Physics

Course Outcomes (CO):

At the end of the course, students will be able to -

1. Acquire the knowledge of fundamental principles of physics and relate to the engineering science,
2. Apply the concepts of Physics for solving Engineering problems,
3. Relate principles of Physics for solving new and challenging problems of technology.

Syllabus: **Teaching hours**: **30**

Physics of Nanomaterials: Introduction to Quantum Physics: Particle in a three dimensional box, Introduction – Nanoscale; Nanomaterials: Methods for synthesis of nanomaterials, Properties of nanomaterials – Electrical, Magnetic, Optical, Mechanical, Characterization techniques – X ray Diffraction (XRD) - Single Crystal, Powder and Laue techniques, Low energy Electron Diffraction (LEED), Scanning Electron Microscopy, Tunnelling Electron Microscopy, Nanostructures; Carbon nanotubes Characteristics and applications, Nanotechnology and environment. — 06

Lasers and Holography: Introduction, Basics of Interaction of radiation with matter, Condition for light Amplification, Population inversion and metastable state, pumping, the principle pumping scheme: Three and Four level scheme, Construction and working of optical resonator, Optical amplifier, Applications of laser beam, Holography. — 06

Introduction to Fiber Optics: Introduction of fiber-optic system, Principle and construction of fiber cable, Acceptance angle and numerical aperture, Types of Optical fiber: Based on material & based on mode of propagation, Index profile, Fiber optic communication link, Fiber optic sensor, Advantages of fiber optic system. — 04

Nuclear and Plasma Physics: Introduction to nuclear physics, types of nuclear reactions, nuclear reaction cross sections, Radius of Gyration, particle accelerators – pinch of synchrotron radiation, nuclear fission as a source of energy, Nuclear radiation counters – Geiger Mullar Counter, scintillation counter. — 05

Basic concepts of Plasma physics: Introduction to Electrostatics and Electromagnetics, Curl, Divergence and Gradient of fields, Maxwell's equations, Motion of charged particle in E and B homogeneous field, Pinch effect, Magnetic trapping of plasma, Van Allen radiation belt.

Physics of Vacuum Techniques and Cryogenics: Creation of vacuum with different pumps-rotary pump, diffusion pump, Measurement of vacuum with different gauges; Need of vacuum in Plasma unit, Cryogenics – use of liquid Nitrogen and liquid Helium, Applications of cryogenics in refrigeration, space and medical field — 04

Engineering of Auditorium and Ultrasonics: Introduction, Defection due to reflection of sound, Sabine's empirical formula, Reverberation theory, Eyring's equation, Acoustical defects and their remedies, Acoustic materials, Ultrasonic waves, Piezoelectric method, Properties and application of ultrasonic waves — 05

Self- Study:

Self-study contents will be declared at the commencement of the semester. Around 10% of the questions will be asked from the self-study contents.

Suggested Readings:

1. M N Avadhnulu and P. Kshirsagar, A Text Book of Engineering Physics, S Chand.
2. T. Pradeep, Nano: The Essentials, New Central book Agency.
3. S. N. Goswami, Elements of Plasma Physics, Tata McGraw Hill publication.
4. B. L. Theraja, Physics for Engineers, S Chand Publication

L= Lecture, T= Tutorial, P= Practical, C= Credit

CY102 **Chemistry** **[2 0 2 3]**

At the end of the course, students will be able to –

1. relate the fundamentals and their application in various field of engineering,
2. identify and apply the principles of green chemistry in improving the existing technology,
3. categorize the materials on the basis of their properties,
4. select appropriate method of analysis and interpret its result.

Syllabus		Teaching Hours
Unit 1	**Water and its Treatment** Introduction, Sources of water impurities, Hardness of water, Degree of hardness, Softening of water, Water treatment processes, Problems with boiler feed water and its treatments Specifications for drinking water (BIS standards)	**08**
Unit 2	**Fuel** Calorific Value, Types of fuel, Selection of fuels, Analysis of coal:- proximate and ultimate analysis, Flue gases:- Orsat apparatus, Alternative fuels:- Compressed Natural Gas (CNG), Liquefied Natural Gas (LNG), Ethanol, Bio-diesel	**05**
Unit 3	**Lubricants** Classification and functions of lubricants, Properties:- lubricating oil and greases, Selection of lubricants	**04**
Unit 4	**Polymers and Composite materials** Introduction to Polymers and Polymerization, Elastomers, classification and uses, Biopolymers:-Cellulose and starch, Advanced polymeric materials, Composites:- Introduction, classification and applications	**05**
Unit 5	**Green Chemistry** Overview, Set of Principles of Green Chemistry, Industrial applications	**03**
Unit 6	**Engineering Materials** Adhesives:- characteristics, classification, and uses, Fullerenes:- structure, properties and applications, Nano rods:- brief introduction, Organic Electronic Materials:- introduction, types and applications, Liquid Crystals:- Introduction, classification and applications, Explosives:- Introduction, Classification, Characteristics, Disarmament, Weapons of Mass Destruction (WMD), peaceful uses of explosives	**04**
Unit 7	**Overview of electrochemical systems**	**01**

Laboratory Work:
Laboratory work will be based on above syllabus with minimum 12 experiments to be incorporated.

References:

1. P.C. Jain and Monika Jain, Textbook of Engineering Chemistry, Dhanpat Rai Publishing Co.
2. Shashi Chawla, Textbook of Engineering Chemistry, Dhanpat Rai Publishing Co.
3. S.S. Dara, Textbook of Engineering Chemistry, S. Chand and Company.
4. Mike Lancaster, Green Chemistry: An Introductory Text, Royal Society of Chemistry.
5. J.C. Kuriacose and J. Rajaram, Chemistry in Engineering and Technology, Tata Mc Graw Hill.
6. Prasanta Rath, Engineering Chemistry, Cengage Learning.
7. Sunita Rattan, A Textbook of Engineering Chemistry, S.K. Kataria & Sons.

L	T	P	C
3	1	0	4

Course Code	2MA201
Course Title	Linear Algebra

Course Learning Outcomes (CLO)

At the end of the course, students will able to-

1. acquire basic knowledge of matrix theory,
2. comprehend basic concept of vector space and linear transformation,
3. apply the knowledge of linear algebra in engineering problems.

Syllabus:

Matrix Theory

Teaching hours: 23

Review of algebra of matrices, Rank of matrix, Inverse of matrix by Gauss-Jordan method, Solution of system of algebraic simultaneous equations, Linearly dependent and Linearly independent functions, Caley-Hamilton Theorem (without proof), eigen values and eigen vectors, Eigen values and eigen vectors of orthogonal, symmetric, skew-symmetric matrices, Hermitian matrix, skew-Hermitian matrix, Unitary matrix, Normal matrix, Algebraic and geometric multiplicity, Diagonalization, Spectral theorem for Real symmetric matrices, Application of quadratic forms.

Vector Space and Linear Transformation

Teaching hours: 22

Definition of vector space, subspaces, linear combination, Linearly dependent and linearly independent vectors, Basis of vector space, Dimension, Rank-Nullity theorem (statement and verification by examples), Definition of linear transformation, types of linear transformations (Rotation, Reflection, Expansion, Contraction, Projection), Matrix of Linear transformations, Change of basis and similarity.

Tutorials

This shall consists of at least 8 tutorials (TA) based on the syllabus

Self-Study

Self-study contents will be declared at the commencement of the semester. Around 10% of the questions will be asked from the self-study contents.

Suggested Readings:

1. D C Lay, Linear Algebra and its Application; Pearson Publication
2. E Kreyszig, Advanced Engineering Mathematics; John Wiley Publication
3. H Anton, Elementary linear algebra with applications; John Wiley Publication
4. K Hoffman and R Kunze, Linear Algebra; PHI Publication
5. S Kumaresan, Linear algebra - A Geometric approach; PHI Publication
6. J P Sharma and M Yeolekar, Engineering mathematics Vol-II; PHI Publication

L = Lecture, T = Tutorial, P = Practical, C = Credit

L	T	P	C
2	1	0	3

Course Code	2MA301
Course Title	Applied Mathematics for Chemical Engineering

Course Learning Outcomes (CLO):

At the end of the course, students will be able to-

1. comprehend and apply probability distribution in engineering problems
2. apply the basic concepts of modern numerical techniques to solve chemical engineering problems
3. use Laplace transform to solve differential equations

Syllabus: Teaching hours:

Unit I **6**

Laplace Transforms: Definition, Linearity property, Laplace transforms of elementary functions, Shifting theorem, Inverse Laplace transforms, Laplace of differentiation and integration, Convolution theorem, application of Laplace transforms in solving ordinary differential equations, Laplace transforms of periodic, Unit step and impulse functions

Unit II **3**

Solution of Transcendental and Algebraic equations: Solution of algebraic and transcendental equations by Bisection, Regula-Falsi, Newton-Raphson iteration methods

Unit III **5**

Finite Differences and Interpolation: Finite differences, Interpolation, Finite difference operators (forward, backward and central differences), Interpolation formulae: Newton's forward, Newton's backward, Lagrange's and Sterling's formula

3

Unit IV

Numerical Differentiation and Integration: Numerical differentiation, Numerical integration: Trapezoidal rule, Simpson's 1/3rd rule, Simpson's 3/8th rule

Unit V **6**

Numerical Solutions of Differential Equations: Solution of first order differential equations: Taylor series method, Euler's method, 4th order Runge–Kutta method, Finite difference method to solve partial differential equations

Unit VI **2**

Solution of System of Linear Equations: Iterative methods: Gauss-Seidel and Gauss-Jacobi methods

Unit VII **5**

Statistics: Introduction to probability and conditional probability, Mean, median, mode and standard deviation, Random variables, Poisson, Normal and Binomial distributions, Linear regression analysis

Tutorials:

This shall consists of at least 8 tutorials based on the syllabus.

Self-Study:

Self-study contents will be declared at the commencement of the semester. Around 10% of the questions will be asked from the self-study contents.

Suggested Readings^:

1. B. S. Grewal, Higher Engineering Mathematics, Khanna Publications.
2. S. C. Chapra and R. P. Canale, Numerical Methods for Engineers with Programming and Software Applications, McGraw-Hill Publications.
3. Erwin Kreyszig, Advanced Engineering Mathematics, Wiley Eastern Publications.
4. M. K. Jain and S R K Iyengar Numerical Methods for Scientific & Engineering Computation, New age International Publication.
5. S C Gupta and V. K .Kapoor, Fundamentals of Mathematical Statistics: S Chand
6. Jay I. Devore, Probability and Statistics for Engineers and Scientists; Pearson

L = Lecture, T = Tutorial, P = Practical, C = Credit

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SS341 Economics for Engineers [2 0 0 2]

Course Learning Outcome (CLO):

After successful completion of the course, students will be able to

- understand the basic economic theory and economic way of thinking
- analyze macro - economic policies
- evaluate the economic efficiency in engineering projects

Syllabus

Module: - 1 MICRO ECONOMICS

1. Basic Economic Concepts: Meaning and understanding of basic economic concepts

2. Demand and Supply: Meaning and Determinants of Demand and Supply, Law of Demand and Supply, Elasticity of Demand and Supply.

3. Production Function: Meaning, production with one variable input, the law of variable proportion, the laws of returns to scale. Economies of Scale

4. Cost Function: Different types of costs, the short run and long run cost functions.

5. Market Structure: Meaning and characteristics of different types of market –

Perfect Competition
Monopoly
Monopolistic Competition and
Oligopoly

Module-2 MACRO ECONOMICS

6. Introduction to Macro Economics: Basic Macro Economic Concepts, National Income Accounting, Concepts of National Income and Methods of National Income Computation

7. Inflation: Meaning, types, causes, effect and remedial measures.

8. Money and Banking: Meaning and Functions of money, Money Supply, Commercial Banks and Central Bank-Meaning and Functions

9. Public Finance: Government Expenditure, Receipts, Budget and Deficits.

Self-Study: The self -study contents will be declared at the commencement of semester. Around 10% of the questions will be asked from self study contents.

Suggested Books:

(1) Micro Economics Robert S Pindyck, Daniel L Rubinfeld, Prem L Mehta - Pearson
(2) Principles of Economics N.Gregory Mankiw, Thomson South Western , Pearson
(3) Modern Economics – H.L.Ahuja – S.Chand & Company
(4) Macro Economics – Rudiger Dornbush, Stanley Fisher, Richard Startz – Tata Mc-Graw-Hill
(5)Principles of Macro Economics, C.Rangarajan and B.H.Dholakia, The McGraw Hill
(6) Economics , Samuelson and Nordhaus, Tata McGraw Hill
(7) Managerial Economics: Principles and Worldwide Applications, Dominick Salvatore, Adapted by Ravikesh Srivastava, Oxford University Press

List of Journals/Periodicals/Magazines/Newpapers: Economist, Indian Economic Review, Asian Economic Review, American Economic Review, Economic and Political Weekly (EPW), Economic Times, Business Standard etc.

Websites Recommended: www.finmin.nic.in www.rbi.org.in www.planningcommission.nic.in etc.

CH304 **Fluid Flow Operations** **[3 0 2 4]**

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

- understand the various physical properties and flow regimes of fluids
- understand and apply the basic equations to solve related problems
- evaluate the operations involving flow through pipes
- select and evaluate the performance of various fluid transport and metering devices

Syllabus:
Units and Dimensions - Dimensional analysis, Units and dimensions of various terms involved in fluid flow operations, Basic concepts.
Fluid Properties and Fluid Statics: Concept of fluid and flow, Ideal and real fluids, Properties of fluids, Pressure concept, Pascal's law, Hydrostatic equation.
Fluid Flow Phenomena: Rheology of fluids, Viscosity, Reynolds no., Laminar flow, Turbulence, Boundary layer.
Basic Fluid Flow Equations: Mass balance, Momentum Balance, Mechanical Energy Equation, Correction factors.
Incompressible Fluids in Pipes: Shear stress and friction in pipes, Laminar flow in pipes, Turbulent flow in pipes, Effect of Roughness, Friction Factor Chart, Hagen-Poiseuille law, Hydraulic gradient, Series and Parallel connection of pipes.
Agitation and Mixing of Fluids: Standard Agitated Vessel, Power Consumption.
Transportation and Metering of Fluids: Pipe and Joints, Pumps– Positive Displacement Pumps, Centrifugal Pumps, Characteristics, Applications, Efficiency, Cavitation and NPSH, Vacuum pumps, Fans, Blowers and Compressors; Valves–Types and Applications, Measurement of Flowing Fluids- Types of Flowmeters, Principle, Application, Notches and Weirs.
Introduction to Compressible Fluids. Introduction to Multiphase Flow.

Self Study:
The self study contents will be declared at the commencement of semester. Around 10% of the questions will be asked from self study contents.

Laboratory Work:
Laboratory work will be based on above syllabus with minimum 12 experiments to be incorporated.

References:

1. W.L. McCabe, and J. C. Smith, Unit Operations of Chemical Engineering, Mc-Graw Hill Publication.
2. J.M. Coulson and J.F. Richardson, Coulson and Richardson's Chemical Engineering, Vol-I, Pergamon Press.
3. Frank Kreith, Fluid Mechanics, CRC Press.
4. James O. Wilkes, Fluid Mechanics for Chemical Engineers, Prentice Hall Publication.
5. Mathieu Mory, Fluid Mechanics for Chemical Engineers, Wiley Publication.

CH302 Heat Transfer Operations [3 1 2 5]

Course Outcomes:

After successful completion of the course, student will be able to

- explain the characteristics of different modes of heat transfer
- understand mechanism/ phenomenon of evaporation and working of different types of evaporators
- select the suitable heat exchanger and its trouble shooting
- appreciate the advancements in the area of heat transfer operations

Syllabus:

Introduction to heat transfer: Its relation with thermodynamics and three modes of heat transfer. Prime laws for each mode. General laws of heat transfer. Analogies with other transport processes and electricity.

Heat conduction: Steady State one dimensional conduction, Heat transfer by conduction through plane & composite wall, cylinder & spheres. Insulating materials- concept of critical radius of insulation for cylinders & sphere. Extended surfaces and temperature distribution for extended surfaces under various conditions and effectiveness of fins. Introduction to unsteady state heat conduction.

Convection:- Mechanism of convection, Types of convection- natural and forced, Determination of convective heat transfer coefficient by different methods, Forced & Natural convection- in laminar and turbulent flow over different bodies, Significance of dimensionless numbers.

Thermal radiation: Introduction and developed theories of radiation. Different laws of Radiation, Concept of Black body and related aspects, Radiation transfer between surfaces, Radiation shields, Radiation through semitransparent materials.

Heat transfer with phase change: Boiling of liquids, mechanism of boiling, nucleate boiling, and film boiling, Condensation of vapors, Film wise and drop wise condensation.

Evaporation: Introduction, performance of an evaporator, individual and overall heat transfer coefficients, capacity and economy of evaporators, Single & multiple effect evaporators, Concept of boiling point elevation, Duhring's rule, and effect of liquid head & friction on pressure drop, Types and application of evaporators.

Heat exchange equipments: Introduction and types of heat exchange equipments, Individual and overall coefficient, LMTD, Variable overall heat transfer coefficients, Fouling factors, LMTD correction factors, General constructions of shell and tube heat exchangers, NTU & Heat exchange equipment effectiveness.

Self Study:

The self study contents will be declared at the commencement of semester. Around 10% of the questions will be asked from self study contents.

Laboratory Work:

Laboratory work will be based on the above syllabus with minimum 12 experiments and 2 Virtual laboratory experiments to be incorporated.

Tutorial Work:

Tutorial work will be based on above syllabus with minimum 10 tutorials to be incorporated.

References:

1. Warren L. McCabe, Julian C. Smith, Peter Harriott, Unit Operations of Chemical Engineering, McGraw Hill Publication
2. Gupta and Prakash, Engineering Heat Transfer, Nemchand & Bros., Rurk
3. Y.V.C. Rao, Heat Transfer, University Press Circulation

SS342 ICT Tools & Security [0 0 2 1]

Course Learning Outcome:

After successful completion of this course, student will be able to

- identify various modern ICT based tools and technologies
- understand features of the tools which are useful for academic/research/application development
- use ICT based tools for programme specific applications

Syllabus:

Appropriate IT security aspect as per latest vulnerabilities and appropriate number of tools are to be identified and studied as per programme specific needs, to be decided by the respective Course **Coordinator and to be approved by Dean, FoTE before commencement of the course.**

CH301 Physical & Analytical Chemistry [3 0 2 4]

Course Outcomes:

After successful completion of the course, student will be able to

1. understand physical properties of compounds and physical methods to determine those properties and their kinetics and catalysis of the reactions
1. understand fundamental of analytical techniques like, spectroscopy such as UV-Vis, NMR, fluorescence and fundamentals of photochemistry
2. apply appropriate techniques in context to different industries
3. acquire the knowledge of Chromatography and its different types such as: Column chromatography, HPLC, GC, TLC, HPTLC, GPC

Syllabus:

Measurement of pH: Introduction, Determination of pH, ion selective electrode, Instrumentation, Application of pH measurement.

Experimental Techniques in Reaction Kinetics: The determination of rate laws from measurement of physical properties, Flow method's for studying reaction kinetics in open systems, rapid reaction methods.

Physical Properties and Chemical Constitution: Classification of physical properties, Surface tension and chemical constitutions, Parachor in elucidating structure, Viscosity and chemical constitution, Dipole moments, Molar refraction and constitution.

Catalyst: Classification of catalysis, Theories of catalysis, Acid base catalysis, Enzyme Catalysis, Surface Catalysis, Heterogeneous catalysis, Catalysis in industry.

Photochemistry: Photo chemical reactions, photochemical cell, Laws of photochemistry, Quantum yield, photosensitized reactions, Photo physical processes.

Ultraviolet spectroscopy: Origin and theory of Ultraviolet spectra, Types of transition of Organic and Inorganic molecules, Chromophore, Auxochrome, Bathochromic shift, Hypsochromic shift, Woodward-Fisher rules for calculating λ_{max}.

Introduction to Chromatography: Definition of Chromatrography, Types of Chromatography, Principle and applications of High performance thin layer chromatography (HPLC), Gel permeation chromatography (GPC), Gas Chromatography etc.

Introduction to Nuclear Magnetic Resonance (NMR): Definition of NMR spectroscopy, Principle, Instrumentation and Applications.

Self Study:

The self study contents will be declared at the commencement of semester. Around 10% of the questions will be asked from self study contents.

Laboratory Work:

Laboratory work will be based on above syllabus with minimum 12 experiments to be incorporated.

References:

1. B. S. Bahl, G. D. Tuli, Arun Bahl, Essential of Physical Chemistry, S. Chand Publisher.
2. Chatwal, Anand, Instrumental Methods of Chemical Analysis, Himalaya Publishing House.
3. Peter Atkins, Julio de Paula, The Elements of Physical Chemistry, Oxford University Press.

L	T	P	C
2	0	0	2

Course Code	HS342
Course Title	Principles of Economics

Course Learning Outcomes (CLO):

At the end of the course, students will be able to-

1. interpret the various basic economic principles
2. relate the economic fundamentals with engineering practices
3. infer the macro-economic aspects of engineering projects

Syllabus: **Teaching hours:**

Unit I **3**

Basic Economic Concepts: Needs, wants, means/resources – marginal principle and economic efficiency, trade - off, opportunity cost, rationality, externalities, differences between micro economics and macro economics

Unit II **3**

Demand and Supply: Meaning and determinants of demand and supply, law of demand and law of supply equilibrium between demand and supply.. The concept of elasticity – meaning and types

Unit III **3**

Production, Cost and Revenue: Production function, law of variable proportion and laws of returns to scale, different types of costs – variable cost, fixed cost, total cost, average cost, average fixed cost, average variable cost and marginal cost, Total revenue, average revenue and marginal revenue, profit function

Unit IV **6**

Market Structures & Pricing: Concept of market and equilibrium-characteristics of perfect competition, monopoly, monopolistic competition and oligopoly

Unit V **7**

Macro-Economic Environment: Basic macro- economic concepts –aggregate demand aggregate supply, money, income employment consumption savings and investment. National Income Accounting-concepts and methods of national income

Unit VI

Banking: Meaning and functions of commercial banks and central bank **3**

Unit VII **2**

Inflation: Meaning, and types of inflation, Causes and effect of inflation on different **s**ectors of the economy

Unit VIII **3**

International Trade: Meaning and significance of International Trade, Cases for and against globalization. World Trade Organization (WTO) – functions and recent deliberations in World Trade Organization (WTO)

Self -Study:

The self -study contents will be declared at the commencement of semester. Around 10% of the questions will be asked from self-study contents.

Suggested Readings^:

1. Mankiw, N. G. Principles of Economics. Mason. Mason,USA: South-Western Cengage Learning.
2. Samuelson P.A. & Nordhaus, W.D. Economics. India: Tata McGraw Hill Education.
3. Pindyck, R.S., Rubinfeld, D. L. & Mehta, P.L. Micro Economics. New Delhi, India: Pearson.
4. Ahuja H.L. Modern Economics. New Delhi,India: S. Chand & Company Ltd.
5. Dornbusch, R., Fisher, S, & Startz, R. Macro Economics. India: Tata McGraw Hill Education.
6. Gupta, G. S. Macro Economics Theory and Applications. India:Tata McGraw Hill.

L =Lecture, T =Tutorial, P= Practical, C=Credit

^ this is not an exhaustive list

CH303 **Solid Fluid Operations** **[3 0 2 4]**

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

- carryout the particle size distribution of particulate solids
- understand the principles of size reduction and various equipments used for size reduction
- appreciate the applications of various mechanical separations like filtration, sedimentation, centrifugal separations
- understand the significance of mixing of solids and how to evaluate the mixer performance have deep insight into other separation methods like froth floatation, jigging, tabling, electrostatic separation

Syllabus:
Particulate Techniques: Solids and its flow properties, definitions of the mean diameters of the solid particles, cumulative and differential analysis, screening.
Size Reduction: Crushing laws, classification of the size reduction equipments, principles, construction, working and application of the size reduction equipments like crushers, grinders, ultra-fine grinders and cutters.
Mechanical Separations: Study of the filtration techniques, filter aids, filter media, types of filters, screening and classification, sedimentation and thickening, centrifugal separation, cyclone separation, clarifiers, close and open circuit grinding, fluidization and conveying.
Mixing and Agitation: Mixing of solids, equipments used for the mixing and agitation of the solids, mixing of slurries and blends, mixing index for the dry solids and slurries, size enlargement techniques, other separation methods like elutriation, flotation, jigging, electrostatic and magnetic separation, classification, tabling etc.

Self Study:
The self study contents will be declared at the commencement of semester. Around 10% of the questions will be asked from self study contents.

Laboratory Work:
Laboratory work will be based on above syllabus with minimum 12 experiments to be incorporated.

References:
1. Warren McCabe, Julian Smith and Peter Harriott, Unit operations in Chemical Engineering, McGraw Hill Publication.
2. J. F. Richardson, J. H. Harker and J. R. Backhurst, Coulson and Richardson's Chemical Engineering Vol-2, Particle Technology and Separation Processes, Butterworth-Heinemann Publication.
3. K. A. Gavhane, Fluid Flow and Mechanical Operations, Nirali Prakashan.

L	T	P	C
3	1	0	4

Course Code	2CH404
Course Title	Chemical Engineering Thermodynamics

Course Outcome:

At the end of the course, student will be able to -

1. develop and interpret mathematical expressions of various phase and reaction equilibrium phenomena
2. estimate heat and work interactions for different processes
3. apply the fundamentals of solution thermodynamics to calculate various phase equilibrium properties of pure components and mixtures
4. evaluate equilibrium conversion and product composition of chemical reactions

Syllabus:		Teaching Hours
Unit I	**Heat and Work Interactions** Basic concepts in thermodynamics. Use of first and second law for heat and work calculations.	**06**
Unit II	**Phase Equilibrium** PVT behaviour of pure substances – qualitative discussions, different equations of state for real gases, Generalized correlations for gases and liquids. Maxwells relationship and its applications. Introduction to phase equilibrium, phase rule, Duhem theory, concept of ideal solutions and non ideal solutions, qualitative vapour liquid equilibrium behaviour, simple models of vapour liquid equilibrium estimation for ideal solutions, DePriester chart for vapour liquid equilibrium calculations of hydrocarbons, flash calculations, vapour liquid equilibrium calculations for non ideal solutions at low pressure, concept of azeotropes, vapour liquid equilibrium from azeotropic data.	**12**
Unit III	**Solution Thermodynamic Theory** Partial molar properties, Gibbs-Duhem equation, chemical potential, criteria of phase equilibrium, fugacity, and fugacity co-efficient for pure components and for mixture of gases and for liquids, Lewis Randall rule, Henry's law, excess property.	**08**
Unit IV	**Solution Thermodynamics Applications** Liquid phase properties from vapour liquid equilibrium data, excess Gibbs free energy models, vapour liquid equilibrium data reduction to obtain the constants for various activity coefficient models.	**07**
Unit V	**Chemical Reaction Equilibrium** Heat capacities of gases as a function of temperature, Heat effects associated with industrial reactions. Criteria for equilibrium, evaluation of equilibrium constant, effect of temperature and pressure on equilibrium constant, evaluation of equilibrium conversion for gas phase reaction and liquid phase reactions, heterogeneous reactions, introduction to multi reaction equilibrium.	**12**

Suggested Readings:

- Smith, J. M., Van Ness, H. C. and Abott, M. M., *Introduction to chemical engineering thermodynamics*. McGraw Hill Publication.

- Sandler, S. I., *Chemical, biochemical, and engineering thermodynamics*. John Wiley.
- Narayanan, K. V., *A textbook of chemical engineering thermodynamics*. PHI Learning.
- Rao, Y. V. C., *Chemical engineering thermodynamics*. Universities Press.

L = Lecture, T= Tutorial, P=Practical, C=Credit

CH405 Chemical Engineering Thermodynamics-I [3 0 0 3]

Course Outcomes:

After successful completion of the course, student will be able to

- apply basic principles of thermodynamics in engineering
- develop mathematical models for the calculation of heat and work association for any process changes
- calculate properties of pure compounds using different models of equations of state and other mathematical models
- understand the interaction of heat during the process (chemical or physical) and able to apply appropriate model to calculate the energy requirement of any process
- apply knowledge of various flow processes in process industries

Syllabus:

Introduction: Conservation of energy & first law of thermodynamics, Application to steady state flow process, Enthalpy, Internal energy, Equilibrium state, Phase rule, Reversible & irreversible processes, Heat capacity & specific heat.

Properties of pure substances: PVT behavior – qualitative discussions , Ideal & non-ideal gases, Different equations of state for real gases like Virial equation of state, Cubic equations of state, Corresponding state theorems, Generalized correlations for gases and liquids.

Heat effects: Heat capacities of gases as a function of temperature, Heat effects associated with industrial reactions.

Second law of thermodynamics: Thermodynamic temperature scale, Ideal gas temperature scale, Concept of entropy, Entropy change & irreversibility, Third law of thermodynamics.

Thermodynamic properties of fluid: Mathematical relation among thermodynamic functions, Maxwell's relations, Interrelation between H, S, U, G, Cp, Cv, Properties of single & two phase system.

Thermodynamics of flow process: Fundamental Relation for Flow in Pipes, Maximum Velocity in Pipe Flow, Throttling Process, Flow through Nozzles, Single Stage & Multi Stage Compressors.

Refrigeration & Liquefaction: Carnot refrigeration cycles, Air refrigeration cycle, Absorption refrigeration, Heat pump, Choice of refrigeration, Liquefaction processes.

Self Study:

The self study contents will be declared at the commencement of semester. Around 10% of the questions will be asked from self study contents.

References:

1. J. M. Smith, H. C. Van Ness and M. M., Abbott Introduction to Chemical Engineering Thermodynamics, McGraw Hill Publication.
2. Y. V. C. Rao, Chemical Engineering Thermodynamics, Universities Press.
3. K. V. Narayanan, A Text book of Chemical Engineering Thermodynamics, Prentice Hall Publication.

CH402 Chemical Process Industries [4 0 2 5]

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

- understand various manufacturing processes of chemicals on industrial scale
- explain various unit operations and unit processes and their applications in chemical process industries
- appreciate the modern techniques and recent developments for producing various products
- understand the major engineering problems encountered during the manufacturing processes
- comprehend the process flow diagrams

Syllabus:
Introduction of Chemical Industries: concept of unit operations and unit processes.
Fertilizer Industries: Nitrogenous Fertilizers, phosphatic fertilizers, bio fertilizer.
Chlor-Alkali Industries: Soda ash, Caustic soda and Chlorine.
Pulp and Paper Industries: Pulp, paper products, cellulose and lignin chemicals.
Drugs and Pharmaceuticals: Classification, antibiotics, drug products
Dyes and Dye intermediates: Various dye intermediates, classification of dyes, azo dyes, vat dyes and indigo dyes.
Oils, Soap, Detergents and Glycerin: Classification of oils, extraction and hydrogenation of oil, manufacturing of soap, classification of detergent, surfactants, glycerin.
Brief outlook of other important Chemical Industries: Sulfur and sulfuric acid, Coal and Coal Chemicals, Carbohydrates and Fermentation industries, Food industries, Biotechnology.
Introduction to polymerization techniques, biocatalytic processes, biofuels production processes.

Self Study:
The self study contents will be declared at the commencement of semester. Around 10% of the questions will be asked from self study contents.

Laboratory Work:
Laboratory work will be based on above syllabus with minimum 12 experiments to be incorporated.

References:
1. George T. Austin, Shreve's Chemical Process Industries, Tata Mc-Graw Hill Publication.
2. M. Gopala Rao and Marshell Sittig, Dryden's Outlines of Chemical Technology, East West Press.

CH503 Instrumentation and Process Control [3 0 2 4]

Course Outcomes:

After successful completion of the course, student will be able to

- understand open and closed loop control systems
- analyse the order of control system with its transfer function
- evaluate the performance of control system with controllers and control valve
- design control loops with appropriate controllers and control valve
- apply appropriate instruments for various applications in chemical plant

Syllabus:

Linear Open-Loop Control Systems: Response of first-order systems, physical examples of first-order systems, response of first-order systems to various inputs, first-order systems in series, higher-order systems: second-order and transportation lag.

Linear Closed-Loop Control Systems: Control system, closed-loop transfer functions, stability, root locus, introduction to frequency response.

Controllers and Final Control Elements: Controllers, final control elements, control valves.

Computers in Control System: Introduction to microprocessor based controllers, distributed control system (DCS), programmable logic control (PLC), supervisory control and data acquisition (SCADA).

Elements of Measurement Instruments: Types of measurement, classification of instrument, parts of instruments, performance characteristics.

Measurement of Temperature: Temperature scales, solid, liquid and gas expansion thermometers, filled system thermometers, electrical temperature sensors, thermistor, thermocouple, pyrometers, etc.

Measurement of Pressure: Elastic pressure transducers, electrical transducers, inductance type pressure transducers, forced balanced pressure gauge, measurement of differential pressure, vacuum measurement, techniques for protection of pressure gauges, comparison of pressure sensors.

Measurement of Level: Direct level measurement, indirect level measurement methods like hydrostatic, electrical capacitance, radiation, ultrasonic, solid level measurement.

Laboratory Work:

Laboratory work will be based on above syllabus with minimum 12 experiments to be incorporated.

Self Study:

The self study contents will be declared at the commencement of semester. Around 10% of the questions will be asked from self study contents.

References:

1. Donald R. Coughanowr, Process systems analysis and control, McGraw Hill publications.
4. Donald P Eckman, Industrial Instrumentation, John Wiley & Sons Inc. Publications.
5. George Stephanopoulos, Chemical Process Control: An Introduction to Theory and Practice, PHI Learning.
6. A. P. Kulkarni, Process Instrumentation and Control, Nirali Prakashan.
7. V. R. Radhakrishnan, Instrumentation and Control for Chemical, Mineral and Metallurgical Processes, Allied Publishers.

CH404 Mass Transfer Operations-I [3 0 2 4]

Course Outcomes:

After successful completion of the course, student will be able to

- understand the fundamentals of mass transfer operations and various methods of conducting mass transfer operations
- estimate the diffusivity for the molecular diffusion in gases and liquids
- understand the concept of local and overall mass transfer coefficients for interphase mass transfer
- evaluate the performance of various mass transfer operations like diffusion, gas absorption, extraction and leaching

Syllabus:

Introduction and Classification of Mass Transfer Operations: Molecular Diffusion in Fluids: Molecular diffusion, steady state molecular diffusion in fluids at rest and in laminar flow, molecular diffusion and diffusivity of gases and liquids, concept of Mass transfer coefficient, relation between mass transfer coefficients, film theory, penetration theory, surface renewal theory, combined film-surface renewal theory surface stretch theory, analogies in transfer process.

Interphase Mass Transfer: Equilibrium, diffusion between phases, local two phase mass transfer, local overall mass transfer coefficient, material balances for co-current and countercurrent processes, concept of stages.

Equipment for Gas-Liquid Operations: Tray towers, packed towers, comparison between tray towers and packed towers.

Gas Absorption: Equilibrium solubility of gases in liquids, ideal and non-ideal solutions, choice of solvent for absorption, material balance for co-current and countercurrent flow, minimum liquid gas ratio for absorption and stripping, absorption factor, concept of HETP and HTU, NTU, absorption with chemical reaction.

Liquid-Liquid Extraction: Scope, liquid equilibrium, choice of solvent, stage wise contact, single-stage extraction, multi-stage crosscurrent and countercurrent extraction, insoluble liquids, continuous counter current extraction with reflux, performance of different types of extractors used in industries.

Leaching: Equilibrium diagrams, single-stage leaching, multistage cross and counter current leaching, equipment for leaching.

Self Study:

The self study contents will be declared at the commencement of semester. Around 10% of the questions will be asked from self study contents.

Laboratory Work:

Laboratory work will be based on above syllabus with minimum 12 experiments to be incorporated.

Tutorial Work:

Tutorial work will be based on above syllabus with minimum 10 tutorials to be incorporated.

References:

1. Robert E. Treybal, Mass Transfer Operations, McGraw-Hill International Editions.
2. J. F. Richardson, J. H. Harker and J. R. Backhurst, Coulson and Richardson's Chemical Engineering Vol-1, Fluid flow, Heat Transfer and Mass Transfer, Butterworth-Heinemann Publication.
3. K. A. Gavhane, Mass Transfer-II, Nirali Prakashan.
4. Kiran D. Patil, Principles of Mass Transfer Operations, Nirali Prakashan

CH401 Organic Chemistry [3 2 0 4]

Course Outcomes:

After successful completion of the course, student will be able to

- understand the fundamentals and derive the mechanism for the reaction types like substitution, addition, elimination, condensation, hydrolysis, oxidation and reduction
- understand the impact of organic chemistry in the fields of chemical industries, pharmaceutical industries, and its impact on the global economy
- comprehend and analyse organic molecule by performing different test and also acquire the knowledge of material safety data for the same
- know the synthesis, properties and applications of organic compounds

Syllabus:

Alkenes: Geometrical isomerism, markownikoff rule, antimarkownikoff rule, types of dienes and characteristics, polymerization.

Alkyl halides: SN1, SN2 reactions. E1 and E2 mechanisms, Grignard reagents and their importance.

Stereochemistry: Stereochemistry of compounds having two asymmetric carbon atoms, Walden inversion etc.

Carboxylic acid: Mechanism of esterification and hydrolysis, tautomerism, preparation of ethyl acetoacetic ester and importance in organic synthesis.

Chemistry of organic compounds: Synthesis, properties and industrial uses of chloroform, carbon tetrachloride, ethyl alcohol, methyl alcohol, acetone, acetic anhydride, formaldehyde, acetic acid.

Outlines of Biochemistry: Carbohydrates: classifications, stereo & chemical reactions of glucose, fructose and starch etc., introduction to enzymes, vitamins and coenzymes, lipids.

Chemistry of selected organic compounds: Aromatic nitro compound (Nitro benzene), Amino compound (Aniline), hydroxyl compound (Phenol), sulphonium compound (Benzene sulphonic acid), carboxylic acid (Benzoic acid, Salicylic acid and Phthalic acid) and diazonium compounds.

Polynuclear Aromatic compounds: Chemistry of naphthalene, and their derivatives, aromatic compounds and aromatics Huckel's rule, structure of benzene, aromatic substitution electrophilic and nucleophilic reactions and their mechanism.

Chemistry of Heterocyclic compounds: Contains five members and six membered rings: introduction, structure, preparation, properties and uses.

Chemistry of Dyes: Dyes and dying, colour and constitution, classification of dyes, classification based on chemical structure and their synthesis.

Self Study:

The self study contents will be declared at the commencement of semester. Around 10% of the questions will be asked from self study contents.

Laboratory Work:

Laboratory work will be based on above syllabus with minimum 12 experiments to be incorporated.

References:

1. Arun Bahl and B. S. Bahl, A Text book of Organic Chemistry, S.Chand and Company.
2. Michael B Smit and Jerry March, March's Advanced Organic Chemistry: Reactions, Mechanisms and Structure, John Wiley & Sons.
3. I.L.Finar, Organic Chemistry Vol. I & II, Longmans Green & Co.

L	T	P	C
2	0	0	2

Course Code	2HS341
Course Title	Principles of Management

Course Learning Outcomes (CLO):

At the end of the course, students will be able to-

1. interpret the various theories and processes of management
2. relate with different functional areas of management
3. appreciate the role and need of managers in different organisations

Syllabus: **Teaching hours:**

Unit I **8**

Nature of Management: Concept, Significance, Role & Skills, Levels of Management, Concepts of POSDCORB (Planning, Organizing, Staffing, Directing, Coordinating, Reporting and Budgeting). Overview of Decision making. Evolution of Management thoughts, Contribution of F.W Taylor, Henri Fayol and Contingency Approach. Overview of Indian thoughts on Management, Management by Objectives (MBO)

Unit II **4**

Planning: Meaning, Importance, Elements, Process

Unit III **6**

Organizing: Concepts, Structure (Formal & Informal, Line & Staff and Matrix), Meaning, Advantages and Limitations of organizing. Departmentation: Meaning, Basis and Significance, Span of Control: Meaning, Factors affecting span of Control, Centralization vs. Decentralization, Delegation: Authority & Responsibility relationship

Unit IV **6**

Directing, Co-ordination and Controlling: Leading : Concept of leadership, Directing: Meaning and Process, Co-ordination as an Essence of Management, Controlling: Meaning, Process and Technique

Unit V **6**

Functional Management: Introduction to different functional aspects of management- Finance, Operations, Marketing, Human Resource and Strategic Management

Self-Study:

Self-study contents will be declared at the commencement of the semester. Around 10% of the questions will be asked from the self-study contents

Suggested Readings^:

1. Koontz & Weihrich , Essentials of Management; Tata McGraw Hill
2. Tripathy & Reddy , Principles of Management; Tata McGraw Hill
3. Kreitner & Mohapatra, Management ; Biztantra
4. Robbins , Decenzo & Coulter, Fundamentals of Management; Pearson Education
5. Stoner, Freeman & Daniel R Gilbert, Management; Pearson Education
6. Robbins & Coulter, Management; Prentice Hall (India) Pvt. Ltd

L = Lecture, T = Tutorial, P = Practical, C = Credit

L	T	P	C
3	1	0	4

Course Code	2CH405
Course Title	Process Calculations

Course Outcomes (CO):

At the end of the course, students will be able to –

1. relate units, dimensions and basic chemical engineering principles
2. predict the performance of chemical processes by making use of the principles of material balance
3. appraise thermal property data for energy balance
4. discuss the principles of energy balance applied to chemical processes

Syllabus

Unit 1 **Dimensions and Units**

Dimensions and system of units, fundamental and derived units, conversions

Unit 2 **Basic Chemical Calculations**

Mole, atomic mass and molar mass, composition of solid & solid mixtures, liquid & liquid mixtures, gas & gaseous mixture, fundamentals laws

Unit 3 **Material Balance with and without Chemical Reactions**

Material balance of unit operations, material balance with and without recycle, bypass and purge streams, concept of limiting and excess reactants, percentage conversion, yield and selectivity, material balance involving chemical reactions with and without recycling, parallel and bypassing operations

Unit 4 **Energy Balance with and without Chemical Reactions**

Heat capacity, sensible heat changes in gases, liquids and solids, heat capacity of gas and liquid mixtures, latent heats, enthalpy changes accompanying chemical reactions, standard heat of formation, combustion and reaction, effect of temperature, energy balance for unit operations

Self Study:

The self study contents will be declared at the commencement of semester. Around 10% of the questions will be asked from self study contents.

Tutorial Work:

Tutorial work will be based on content of course.

Suggested Readings:

1. Bhatt, B. I. and Thakore, S. B., *Stoichiometry*, Tata McGraw Hill.
2. Himmelblau, D. M., *Basic Principles & Calculations in Chemical Engineering,* Prentice Hall Publisher.
3. Hougen, O. A., Watson, K. M., *Chemical Process Principles Part-I*, Material and Energy Balance, John Wiley and Asia Publisher.
4. Sikdar, D.C., *Chemical Process Calculations,* Prentice Hall of India.
5. Venkatramani, V., Anantharaman, N., Begum, K. M. Meera Sheriffa, *Process Calculations,* Prentice Hall of India.

L= Lecture, T= Tutorial, P= Practical, C= Credit

CH406 **Seminar** **[0 0 2 1]**

Course Outcomes:

After successful completion of the course, student will be able to

1. carry out critical literature survey
2. acquire knowledge in specific area
3. enhance technical report writing and presentation skills

Syllabus:

Under the above subject each student will be assigned the topics related to chemical engineering and on recent trends of technological development and allied fields. The student will make an upto date literature and information survey with reference to the topic assigned to him/her under the guidance of teaching staff members. He/She has to submit requisite number of copies of seminar reports.

CH501 Mass Transfer Operations-II [3 0 2 4]

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

- understand the fundamentals of various types of mass transfer operations
- analyse a given industrial problem and apply concepts of mass transfer operations
- calculate number of theoretical stages and optimum operating conditions
- select a suitable equipment required for various types of mass transfer operations
- evaluate the performance of mass transfer operations

Syllabus:
Distillation: Vapor-liquid equilibria, positive and negative deviation for ideality, single stage operation-flash vaporization, differential distillation, constant relative volatility, continuous rectification for binary systems, feed tray location, optimum reflux ratio, multistage tray towers-method of Mc-Cabe and Thiele, introduction of feed, location of the feed tray, total reflux or infinite reflux ratio, minimum reflux ratio, optimum reflux ratio, azeotropic distillation, extractive distillation, comparison of azeotropic and extractive distillation.
Humidification: Vapor-liquid equilibrium and enthalpy for a pure substance, vapor-gas mixtures, saturated and unsaturated vapor-gas mixtures, system of air-water, adiabatic saturation curves, equipments for humidification operations.
Adsorption: Types of adsorption, nature of adsorbents, adsorption equilibria, adsorption of solute from dilute solution, adsorption from concentrated solutions, stage wise operations, application of Freundlich equation, multistage cross current and counter current operation, break through curve, ion-exchange, equipments for adsorption operations.
Drying: Equilibrium curves, types of moisture, rate of batch drying, time of drying, equipments for drying operation.
Crystallization: Solubility curves, mechanism of crystallization, Mier's super-saturation theory, yield of crystallization process, equipments for crystallization.

Self Study:
The self study contents will be declared at the commencement of semester. Around 10% of the questions will be asked from self study contents.

Laboratory Work:
Laboratory work will be based on above syllabus with minimum 12 experiments to be incorporated.

References:

- R. E. Treybal, Mass Transfer Operations, Mc-Graw-Hill.
- Warren L. McCabe, Julian C. Smith, Peter Harriott, Unit operations of Chemical Engineering, Mc-Graw-Hill.
- Christie John Geankoplis, Transport Processes and Separation Process Principles, Prentice Hall.
- K. A. Gavhane, Mass Transfer-II, Nirali Prakashan.
- K. D. Patil, Principles of Mass Transfer Operations, Nirali Prakashan.
- B. K. Dutaa, Principles of Mass Transfer and Separation Processes, PHI

CH502 Chemical Engineering Thermodynamics-II [3 0 0 3]

Course Outcomes:

After successful completion of the course, student will be able to

- develop mathematical expressions of various phase and reaction equilibrium phenomena
- calculate phase equilibrium of binary/multi component systems using proper models
- identify the existence of azeotrope and calculate the azeotropic conditions
- apply the fundamentals of solution thermodynamics to calculate various phase equilibrium properties
- calculate equilibrium conversion and composition for reversible reactions

Syllabus:

Phase Equilibrium: Introduction to phase equilibrium, phase rule, Duhem theory, concept of ideal solutions and non ideal solutions, qualitative vapour liquid equilibrium behaviour, simple models of vapour liquid equilibrium estimation for ideal solutions, DePriester chart for vapour liquid equilibrium calculations of hydrocarbons, flash calculations, vapour liquid equilibrium calculations for non ideal solutions at low pressure, concept of azeotropes, vapour liquid equilibrium from azeotropic data.

Solution Thermodynamic Theory: Partial molar properties, Gibbs-Duhem equation, chemical potential, criteria of phase equilibrium, fugacity, and fugacity co-efficient for pure components and for mixture of gases and for liquids, Lewis Randall rule, Henry's law, excess property.

Solution Thermodynamics Applications: Liquid phase properties from vapour liquid equilibrium data, excess Gibbs free energy models, vapour liquid equilibrium data reduction to obtain the constants for various activity coefficient models.

Chemical Equilibrium: Criteria for equilibrium, evaluation of equilibrium constant, effect of temperature and pressure on equilibrium constant, evaluation of equilibrium conversion for gas phase reaction and liquid phase reactions, heterogeneous reactions, introduction to multi reaction equilibrium.

Self Study:

The self study contents will be declared at the commencement of semester. Around 10% of the questions will be asked from self study contents.

References:

1. J. M. Smith, H. C. Van Ness, M. M. Abbott, Introduction to Chemical Engineering Thermodynamics, McGraw Hill Publication.
2. S. I. Sandler, Chemical, Biochemical, and Engineering Thermodynamics, Wiley Publication.
3. K. V. Narayanan, A Text book of Chemical Engineering Thermodynamics, Prentice Hall Publication.
4. Y. V. C. Rao, Chemical Engineering Thermodynamics, Universities Press.

SS561 Creativity and Innovation [2 0 0 2]

Course Learning Outcome:

By the end of this course students will be able to:

- Understand the importance of R directed thinking complementing L directed thinking
- Infer and discover processes and methods of creative problem solving
- Enhance and correlate their creative and innovative thinking skills
- Understand various disruptive innovations and techniques
- Analyze and apply various tools of creativity to some basic problems

Syllabus:

1. INTRODUCTION:

- Introduction to Creativity and Innovation
- Creativity V/s. Innovation
- Creativity as thinking skill
- Critical Thinking V/s. Creative Thinking
- Lateral Thinking
- Engineering and Creativity
- Creativity in Problem Solving

2. TOOLS FOR CREATIVITY:

- Brain storming
- Mind mapping
- SWOC Analysis
- Fishbone diagram
- Six thinking hats
- Borrowing brilliance
- Da Vinci's seven principles
- Provocation and movement
- Examples and case studies

3. WHOLE NEW BRAIN

- L directed thinking V/s. R directed thinking
- From agriculture age to Industrial age to Information age to Conceptual Age
- Need to high touch – design, story symphony, empathy, play, meaning

4. SKILLS FOR DISRUPTIVE INNOVATORS

- Introduction
- Associating
- Questioning
- Observing
- Networking
- Experimenting
- Putting skills into practice
- Case studies

5. MEDICI EFFECT

- Introduction
- Intersection

- Creating medici effect
- Making intersectional ideas happen
- Case studies

6. TRIZ INNOVATION

- Introduction
- Ideality
- Resources
- Contradictions
- Pattern of innnovation
- Case studies

7. BIO MIMICRY

- Introduction
- Design of various products inspired by nature like Green building, bullet train, Nike Clothing, Velcro, Adhesive Tape, Turbine, self-heating plastic, friction reducing swimming suit, automated robot, screen display, deep blue

8. JUGAAD INNOVATION:

- Introduction
- Jugaad tactics: Seek Opportunities in Adversity, Do more with less, Think and act Flexibly, Keep it simple, Include the margin, Follow your heart.
- Case studies

9. CASE STUDY BY IDEO DESIGN THINKING MODEL

Self-study content will be declared at the commencement of the course. Approximately 10% of the assessment will be upon this content.

References:

1. Daniel H. Pink, A whole new mind, Pearson publication, New Delhi
2. Benyus, J.M.1997. Biomimicry:Innovation Inspired by Nature, HarperCollins,New York
3. Technical Innovation Center Inc, USA Altshuller G (1997) 40 Principles. TRIZ Keys to Technical Innovation. Technical Innovation Center Inc, USA Andrews P
4. Kelly, Tom (2001): The Art of Innovation, Lessons in Creativity from IDEO, America's Leading Design Firm, Doubleday, NY
5. Tina Seelig, Ingenius, A Crash course on Creativity Hayhouse, U.K
6. Edward de Bono, Lateral Thinking, Be more creative and productive, Penguin India
7. Edward de Bono, Teach Yourself to Think, Penguin India
8. Edward de Bono, Six Thinking Hats, Little Brown and Company
9. Jonah Lehrer, Imagine, How creativity works, Canongate, Edinburgh, London
10. John Adair, The Art of Creative Thinking, Kogan Page India, New Delhi
11. Jeff Dyer, Hall Gregersen & Clayton M. Christensen, The Innovator's DNA, Harvard Business Publishing
12. Daniel Goleman, Emotional Intelligence, Bloomsbury Publishing India P.Ltd.]
13. Howard Gardner, Five Minds for the Future, Harvard Business Review Press
14. Malcolm Gladwell, Blink: The Power of Thinking Without Thinking, Hachette Book Group USA
15. Navi Radjou, Jaideep Prabhu, Simone Ahuja, Jugaad Innovation, Wiley Publisher

Website References:

1. Ideo.com
2. Asknature.org
3. Edwdebono.com
4. Triz40.com

CH506 Environmental Pollution Control and Safety Management [4 0 0 4]

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

- understand and apply appropriate control and preventive measures for different types of pollution
- identify major process and occupational health hazards and apply hazard analysis techniques for risk assessment
- understand the impact of engineering solutions in a global and societal context
- acquire knowledge about the various environmental and safety standards and legislations

Syllabus:
Environmental Pollution: Introduction to environment and ecology, industrialization and allied pollution, global environmental issues like global warming, ozone layer depletion, preventive versus control approach.
Air Pollution and Mitigation Measures: Sources, types and characteristics, control at source, air pollution control equipments like cyclones, electrostatic precipitator, bag filter, scrubber.
Water Pollution and Mitigation Measures: Sources, types and characteristics, primary, secondary, and tertiary wastewater treatment, advanced oxidation processes, concept of common effluent treatment plant.
Solid Waste Treatment and Management: Landfill, composting, incineration.
Case Studies on Industrial Effluent Treatment Plants: Refinery, fertilizer.
Safety and Industry: Occupational and process related hazards**,** occupational safety and health administration **(**OSHA)'s process safety management (PSM) model, work permit system, use of personal protective equipments, green chemistry and process safety.
Concept and Applications of Inherent Safety, Toxicology and Industrial Hygiene
Introduction to Safety Devices and Safety Valves
Fires and Explosions: Mechanism and types of fires and explosions, flammability limits and their estimation, designs for control and prevention of fires and explosions in process industries.
Techniques for Hazard Identification, Analysis and Risk Assessment: Hazard and operability study (HAZOP), fault tree analysis (FTA), event tree analysis (ETA), Dow fire and explosion index, layer of protection analysis (LOPA).
Concept of Emergency Planning, Preparedness and Response
Introduction to Standardization: International organization for standardization (ISO) 14000, occupational health and safety advisory services (OHSAS) 18000, occupational safety and health administration (OSHA) 3133.
National and International Environmental and Safety Legislations
Case Studies of Industrial Accidents and Safety

Self Study:
The self study contents will be declared at the commencement of semester. Around 10% of the questions will be asked from self study contents.

References:

1. *Gilbert* M *Masters*, W P Ela, Introduction to *Environmental* Engineering and *Science*, PHI Learning.
- Rao C.S., *Environmental Pollution Control Engineering*, New Age International.
- Daniel A. Crowl, Josheph F. Lowar, Chemical Process Safety, Fundamentals with Applications, Prentice Hall.
- K. U. Mistry, Fundamentals of Industrial Safety and Health, Siddharth Prakashan.

CH504 Hydrocarbons Technology [4 0 2 5]

Course Outcomes:

After successful completion of the course, student will be able to

- understand the properties of crude oil and predict the refinery product fractions
- provide basic technological concepts associated with the production chain of various hydrocarbons
- appreciate the modern techniques and recent developments for producing various refinery products and petrochemicals
- apply hydrocarbon technology fundamentals in improving production methods
- provide basic technological concepts associated in production of various petrochemicals

Syllabus:

Introduction: Global and indian hydrocarbon industries, about up-stream and down-stream industries.

Basics of Crude Oil: Reservoirs, origin and formation of petroleum crude oil, composition and classification of crude oil.

Crude oil Exploration & Purification: Detection of crude oil, exploration of crude oil, properties of crude oil, purification of crude oil.

Crude Assay: Properties and characteristics of crude oil, various distillation techniques for predicting characteristics and product fractions of crude oil.

Processing of Crude Oil: Heating of crude oil, atmospheric distillation unit (ADU), vacuum distillation unit (VDU), crude oil refining and processing.

Comparison, Production methods & Properties of Refinery products: Refinery Gases, naphtha, gasoline, kerosene, jet fuel, diesel, gas oils, furnace oil, heating oil etc.

Thermal & Catalytic Cracking: Importance, feedstock, processes, technologies, products.

Catalytic Reforming: Importance, feedstock, process.

Hydrocracking: Importance, feedstock, processes, technologies, products.

Coking: Different coking operation and products.

Residue Upgradation

Petrochemicals: Introduction to global and indian petrochemical industries,

Production, technologies, major challenges and advancement of C1 to C4 Compounds: Methanol, formaldehyde, chloromethane, trichloroethylene, acetylene, polyvinylchloride, polyethylene, ethylene dichloride, ethylene oxide, propylene, glycerine, isopropanol, butadiene, benzene, styrene.

Self Study:

The self-study contents will be declared at the commencement of semester. Around 10% of the questions will be asked from self study contents.

Laboratory Work:

Laboratory work will be based on above syllabus with minimum 12 experiments to be incorporated.

References:

1. G.N. Sarkar, Advanced Petroleum Refining, Khanna Publishers.
2. B.K.B. Rao, Modern Petroleum Refining Processes, Oxford & IBH Publication.
3. Ram Prasad, Petroleum Refining Technology, Khanna Publishers.
4. R.E. Maples, Petroleum Refinery Process Economics, PennWell Corporation.
5. W.L. Nelson, Petroleum Refinery Engineering, McGraw-Hill International.
6. B.K. Bhaskar Rao, A Text on Petrochemicals, Khanna Publishers.
7. Sukumar Maiti, Introduction to Petrochemicals, IndiaBook House Publication.
8. P.Wiseman, Petrochemicals, Ellis Hood.

SS562 Law for Engineers [2 0 0 2]

Course Learning Outcome

By the end of the course, students will be able to

- Understand the Indian Legal System and Basics of different laws.
- Understand, explore, and acquire practical insight of legal system and its application in engineering profession.

Syllabus

Unit I

Introduction to Indian Legal System: Constitution of India, Sources of Law and Judicial system

Unit II

1.Contracts and its Elements: Employment contracts, Contract Interpretation, Service Contract, Contract of Indemnity, Law of Agency

2.Employment agreement

UNIT 3

1Legal Documentation: Drafting of legal documents including Non-Disclosure Agreements (NDA), Request for Proposal (RFP), collaboration agreements, joint venture agreements, tendering and sub-contracting

UNIT 4

1.Intellectual Property Rights (IPR): Overview

2.Trademarks, Copy Rights, Patents with special emphasis in Biotechnology Inventions, software, circuits and design

3. Protection in Foreign Countries

UNIT 5

1. Cyber Laws, E-Commerce and E-Governance

UNIT 6 Introduction to Labour Laws

1. Labour Laws: Provident Fund, ESIC, Gratuity, Bonus, Perquisites, Contract labour

2. Health, Safety and welfare of construction workers.

UNIT 7

Taxation: Income Tax, Service Tax, VAT, Excise Duty**UNIT 8**

Alternate Dispute Resolution (ADR) in Domestic and International dealings

UNIT 9

Introduction to Criminal Law, RTI Act

References

1. Karnika Seth, Computer Internet and New Technology Laws, Lexisnexis, First Edition 2013.
2. Prafulla C Pant, The Arbitration And Conciliation Act, 1996, Butterworths India, New Delhi.
3. Joseph Minattur, Indian Legal System, Indian Law Institute, New Delhi.
4. J. Beatson, Anson's Law Of Contract, Oxford University Press.
5. V. S. Datey , Indirect Taxes: Law And Practice, Taxmann Publications (P) Ltd, Latest Edition
6. Dr. Vinod K. Singhania And Dr. Monica Singhania , Student's Guide To Income Tax, Taxmann Publications (P) Ltd, Latest Edition.
7. S.C. Srivastava, Industrial Relations And Labour Laws, Vikas Publishing House Pvt. Ltd.

CH505 Plant Utilities and Energy Efficiency [3 0 0 3]

Course Outcomes:

After successful completion of the course, student will be able to

- understand the fundamentals of plant utilities and energy efficiency
- select utilities and equipments for process requirement
- identify energy saving opportunities in process utilities
- analyze the utility system for energy conservation and efficiency
- evaluate the performance of utility system

Syllabus:

General Aspects of Plant Utilities and Energy Efficiency

Steam Systems and Boilers: properties of steam, flash steam recovery system, efficient stream utilization and energy saving opportunities, performance evaluation and energy conservation opportunities in boiler,
boiler feed water treatments.

Furnaces: General fuel economy measures, excess air, heat distribution, temperature control, draft control, importance of waste heat recovery.

Waste-Heat Recovery: Commercially viable waste heat recovery technologies.

Pumps, Fans and Blowers: Performance evaluation, efficient system operation, flow control strategies, energy conservation opportunities.

Compressor: Compressor efficiency, compressed air system components, factors affecting the performance and efficiency.

Cooling Tower: Assessment of cooling towers performance, efficient system operation, cooling water treatment, energy saving opportunities.

Cogeneration: Need, advantage, application, classification, energy saving potential.

Fundamentals and Application of Refrigeration System, Inert Gas System and DG set

Self Study:

The self-study contents will be declared at the commencement of semester. Around 10% of the questions will be asked from self-study contents.

References:

1. Y.P. Abbi, Shashank Jain, Handbook on Energy Audit and Environment Management, TERI Press Publisher.
2. Bureau of Energy Efficiency (BEE), Energy Performance Assessment for Equipment and Utility Systems, Guide Books for National Certificate Examination.
3. Wayne C. Turner, Steve Doty, Energy Management Handbook, The Fairmont Press, Inc., Publication.
4. Jack Broughton, Process Utility Systems: Introduction to Design, Operation and maintenance, Institution of Chemical Engineers Publication.
5. Donald R. Wulfinghoff, Energy Efficiency Manual, Energy Institute Press Publication.
6. Pawan Kumar, Training Manual on Energy Efficiency for Small and Medium Enterprises, Asian Productivity Organization Publication.
7. Albert Thumann, William J. Younger, Terry Niehus, Handbook of Energy Audits, The Fairmont Press, Inc., Publication.

CH507 Mini Project – I [0 0 2 1]

Course Outcomes:

After successful completion of the course, students will be able to

- practice acquired knowledge within the chosen area of technology for project development
- identify, discuss and justify the technical aspects of the chosen project with a comprehensive and systematic approach
- reproduce, improve and refine technical aspects for engineering projects
- work as an individual or in a team in development of technical projects
- communicate and report effectively project related activities and findings

Syllabus:

Mini project may be carried out in one or more form of following:
product preparations, working/non-working models, prototype development, fabrication of set-ups, laboratory experiment development, process modification/development, simulation, software development, integration of software and hardware, statistical data analysis, survey, creating awareness in society.

The student is required to submit a report based on the work. The evaluation of the project shall be on continuous basis.

CH604 **Mini Project – II** **[0 0 2 1]**

Course Outcomes:

After successful completion of the course, students will be able to

- practice acquired knowledge within the chosen area of technology for project development
- identify, discuss and justify the technical aspects of the chosen project with a comprehensive and systematic approach
- reproduce, improve and refine technical aspects for engineering projects
- work as an individual or in a team in development of technical projects
- communicate and report effectively project related activities and findings

Syllabus:

Mini project may be carried out in one or more form of following:
product preparations, working/non-working models, prototype development, fabrication of set-ups, laboratory experiment development, process modification/development, simulation, software development, integration of software and hardware, statistical data analysis, survey, creating awareness in society.

The student is required to submit a report based on the work. The evaluation of the project shall be on continuous basis

CH612 Advanced Separation Techniques [3 0 0 3]

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

- understand the fundamentals of various types of advanced separation techniques
- analyse a given industrial separation/problem and apply concepts of advanced separation techniques
- explore use of alternative separation techniques to the existing ones
- analyse and compare membrane reactors with conventional reactors

Syllabus:
Introduction to Separation Processes: Importance and variety of separations, economic significance of separation processes.
Selection of Separation Processes: Factors influencing the choice of a separation processes, process alternatives.
Enhanced Distillation and Supercritical Extraction: Principle, methodology, applications and feasibility of extractive distillation, salt distillation, azeotropic distillation, reactive distillation and supercritical fluid extraction.
Adsorption: Pressure swing adsorption, thermal swing adsorption and chromatographic separation.
Membrane Separation Techniques: Introduction to membrane processes, physical and chemical properties of membranes. Preparation of membranes, types of membrane modules, selection of modules, plant configurations, mechanism of membrane separation processes, membrane separation models like capillary flow theory, solution diffusion model, viscous flow models, models for separation of gas (vapour) mixtures. Membrane fouling and cleaning.
Technologies: Principle, membranes, modules, design, selection, applications, current status and scope of following membrane based separation processes:-
Micro filtration, ultra filtration, nano-filtration, reverse osmosis, gas permeation, pervaporation, dialysis, electro-dialysis, liquid membranes. Principle, methodology and scope of membrane contactors, membrane distillation, membrane reactors, controlled drug delivery and membranes in medical science.
Introduction to Ultrasonication assisted separation methods.

Self Study:
The self study contents will be declared at the commencement of semester. Around 10% of the questions will be asked from self study contents.
References:

1. R. W. Baker, Membrane Technology and Applications, John Wiley & Sons.
2. J. D. Seader and Ernest J. Henley, Separation Process Principles, John Wiley & Sons.
3. C. Judson King, Separation Processes, Mc-Graw-Hill.
4. R. E. Treybal, Mass Transfer Operations, Mc-Graw-Hill.
5. Warren L. McCabe, Julian C. Smith, Peter Harriott, Unit operations of Chemical Engineering, Mc-Graw-Hill.
6. Christie John Geankoplis, Transport Processes and Separation Process Principles, Prentice Hall.

CH652 Air Pollution Control Engineering [3 0 0 3]

Course Learning Outcome:
After successful completion of the course, student will be able to

- understand the fundamentals of air pollution, the major collection mechanism and equipments/instruments for a given gaseous or particulate pollutants
- select and apply the most appropriate air pollution control system
- understand the fundamentals of indoor and odour pollution
- understand different methods for controlling emissions from stationaryand mobile sources
- apply the concept of air pollution control engineering to the professional society and general public

Syllabus:
Introduction to Air Pollution : Air pollution in India and the world, sources and classification of air pollutants, global concern of air pollutants, effects of air pollutants.
Meteorological Aspects of Air Pollution: Temperature lapse rates and stability, meteorological factors influencing air pollution, plume behavior, dispersion of air pollutants and estimation of plume rise.
Sampling and Measurement of Air Pollution: Types of pollutant sampling and measurement, ambient air sampling, stack sampling, analysis of air pollutants.
Source Correction Methods: Raw material change, process change, equipment modifications.
Particulate Control Techniques: Collection efficiency, particulate control equipments like gravity settling chambers, cyclone separator, filters, electrostatic precipitator, wet scrubbers.
Control Technologies for Gaseous pollutants: Scrubbers, absorption and adsorption, control of specific gaseous pollutants like SO_x, NO_x.
Control of Volatile Organic Compounds: Environmental significance of organic compounds and its control.
Odour and Its Control Techniques: Sources and characteristics of odour, measurement and control of odour.
Indoor Air Pollution: Indoor air pollutants and its effect, factor influencing indoor air quality, control of indoor air pollutants.
Air Pollution Legislation and Regulations: Air quality criteria and emission standards.
Control of Air Pollutants from Various Sources like Stationary and Mobile source
Recent Trends in Air Pollution Control Techniques

Self Study:
The self study contents will be declared at the commencement of semester. Around 10% of the questions will be asked from self study contents.

References:

1. Richard W. Bouble, Donald L. Fox, D. Bruce Turner, Arthur C. Stern, Fundamentals of Air Pollution, Academic Press.
2. C. S. Rao, Environmental Pollution Control Engineering, New Age International.
3. M N Rao, H V N Rao, Air Pollution, Tata McGraw Hill.
4. J. R. Mudakavi, Principles and Practices of Air Pollution Control and Analysis, I. K. International.
5. S. C. Bhatia, Textbook of Air Pollution and its Control, Atlantic Publishers & Distributors.
6. R. K. Trivedy, P. K. Goel, An Introduction to Air Pollution, BS Publications.

CH601 Chemical Reaction Engineering-I [3 0 2 4]

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

5. understand homogeneous reactions and their reaction mechanism
6. develop rate expression, select and design suitable reactor for single and multiple homogeneous reactions
7. analyse the effect of change in reaction parameters on the rate of desired product formation
8. understand the concept of residence time distribution for real reactors

Syllabus:
Kinetics of Homogeneous Reactions: Introduction to chemical kinetics, classification of reactions, variables affecting reaction rate, concentration dependent term of rate equation, temperature dependent term of rate equations, testing kinetic models, Arrhenius theory, collision theory, comparison of theories.
Interpretation of Batch Reactor Data: Integral and differential methods of analysis of data for constant volume and variable volume cases, searching a rate equation and mechanism to fit experimental data.
Introduction to Reactor Design: Mass and energy balances for steady state and unsteady state reactors.
Reactor Design for Single Reactions: Batch reactor, plug flow reactor, mixed flow reactor and their comparison. multiple reactor system, plug flow reactors in series, mixed flow reactors in series, reactors of different types in series, recycle reactors and auto catalytic reactions.
Design for Multiple Reactions: Series, parallel and complex reactions, contacting patterns and product distribution.
Temperature and Pressure Effects: Heat of reaction and equilibrium constants, optimum temperature progression.
Non-ideal Flow Behaviour: Basics of non-ideal flow, concept of residence time distribution (RTD), degree of segregation, earliness/lateness of mixing.

Self Study:
The self study contents will be declared at the commencement of semester. Around 10% of the questions will be asked from self study contents.

Laboratory Work:
Laboratory work will be based on above syllabus with minimum 12 experiments to be incorporated.

References:

1. Octave Levenspiel, Chemical Reaction Engineering, Wiley Eastern Pvt. Ltd.
2. H. Scott Fogler, Elements of Chemical Reaction Engineering, Prentice Hall.
3. J. M. Smith, Chemical Engineering Kinetics, McGraw-Hill.
4. Gilbert F. Froment and Kenneth B. Bischoff, Chemical Reactor Analysis and Design, John Wiley & Sons.

CH603 Computational Chemical Engineering Laboratory [0 0 2 1]

Course Outcomes:

After successful completion of the course, student will be able to

- manipulate various chemical engineering models for solution using numerical methods
- select appropriate inbuilt functions of computational tools for solving chemical engineering problems
- apply various computational tools for solving problems in chemical engineering field

Syllabus:

Application of numerical methods: Manipulation of chemical engineering models for solving with numerical methods, methods to solve single variable nonlinear models (Newton Raphson, Secant etc.), Methods to solve multivariable models, linear and nonlinear regression analysis, ordinary differential equations, selection of proper computational tools and functions for solution of a problem.

The experiments will cover the use of different software for solution of different models in the field of chemical engineering

Reference:

1. M. B. Cutlip, M. Shacham, Problem Solving in Chemical and Biochemical Engineering with POLYMATH, Excel, and MATLAB, Prentice Hall.
- B A Finlayson, Introduction to Chemical Engineering Computation, A John Wiley & Sons, INC. Publications.
- Nicholas P Chopey, Handbook of Chemical Engineering Calculations, McGraw-Hill Publications.
- David M Himmelblau, Basic Principles and Calculations in Chemical Engineering, Prentice Hall India.

CH641 Dyes and Dye Intermediates Technology [3 0 0 3]

Course Outcomes:

After successful completion of the course, student will be able to

1. understand various unit operations and unit processes involved in dyes and dye intermediates production
- understand various applicaitons and major engineering problems assoicated in production of dyes
4. provide basic technological concepts associated with the production chain of various dyes and pigments
- analyse case studies of manufacturing of dyes and dye intermediates

Syllabus:

Introduction: Classification and applications of dyes and intermediates, testing methods for dyes, like **n**itrite value, coupling value, hydrolysis value, absorption spectra etc.

Unit operations and unit processes involved for manufacturing of dyes and intermediates: Overview of unit operations like, filtration, drying, crystallization, size reduction etc. Unit processes like, nitration, sulfonation, alkylation, amination, halogenation, oxidation, diazotization, coupling, isolation.

Dyes: Manufaturing of Reactive Black B, Congo Red, Indigo, Methylene Blue, Anthraquinone dyes.

Dye intermediates: Manufacturing of acetic anhydride, acetic acid, glycerine, chloroacetic acid, phosgene, dimethyle sulphate, chlorobenzene, sulfanilic acid, pyridine, anthroquinone.

Pigments: Classifcation of pigments, manufacture of CPC Green, CPC Blue.

Self Study:

The self study contents will be declared at the commencement of semester. Around 10% of the questions will be asked from self study contents.

References:

1. K.M.Shah, Hand Book of Synthetic Dyes and Pigments, Trade Publications.
2. K.Venkat Raman, Chemistry of Synthetic Dyes, New York Academic Press.
3. P. H. Groggins, Unit Processes in Organic synthesis, Tata Mc Graw-Hill Publications.
4. SBP Consultant Engineers, Dyes and their Intermediates, SB Publication.
5. Klaus Hunger, Industrial Dyes, Wiley Publications.

CH651 Fertilizer Technology [3 0 0 3]

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

- understand various manufacturing process involved in production of fertilizers
- acquire basic knowledge of various nutrients required at different stage of plant growth and their deficiency symptoms.
- understand the major engineering problems encountered during the manufacturing processes
- acquire knowledge of bio fertilizers, slow release fertilizers and their applications.

Syllabus:
Introduction: Need of fertilizers, types of fertilizers, merits and demerits of fertilizers, applications of fertilizers, fertilizer industry in India and its comparison with world's fertilizer industry, various nutrients required at different stages of plants and their deficiency symptoms.
Nitrogenous Fertilizers: Production of ammonia, urea, nitric acid, ammonia nitrate, ammonia sulphate, sodium nitrate and potassium nitrate.
Phosphatic Fertilizers: Mining of phosphate rock, handling & storage, phosphate rock processing, production of normal superphosphate, triple superphosphate, phosphoric acid, ammonium phosphate, Nitrophosphate.
Potassic Fertilizers: Manufacture of potash, potassium sulphate, potassium nitrate, potassium hydroxide.
Mixed Fertilizers: Manufacture & granulation of mixed fertilizers, trace salts in fertilizers, application of various types of fertilizers with respect to crops and type of soil.
Bio-fertilizers: Introduction to bio-fertilizers, types of bio-fertilisers, methods of applications of bio-fertilizers, advantages of bio-fertilizers over other fertilizers.
Slow Release Fertilizers: Introduction to slow release fertilizers, advantages, micronutrients.

Self Study:
The self study contents will be declared at the commencement of semester. Around 10% of the questions will be asked from self study contents.

References:
1. G. F. Austin, Shreve's Chemical Process Industries, McGraw Hill Publications.
2. Slack A.V, Chemistry and Technology of Fertilizers, Wiley Interscience Publishers.
3. M. Gopala Rao, Marshell Sitting, Dryden's outlines of chemicals Technology, East West Publications.

CH602 Process Equipment Design [4 0 4 6]

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

2. understand the basic design requirements of the process equipment
   - appreciate function of process equipment or part of equipment
   - design important process equipment
   - understand the design considerations for cooling tower and pumps
   - understand fundamentals of mechanical design of process equipment

Syllabus:
Introduction to Process Equipment Design: Criteria and factors for design, need for design, basic considerations in equipment design, materials selection and protective coating, selection criteria of the particular separation methods or equipment, nature of design, types of process, codes and standards, factor of safety, degree of freedom and design variables.
Design of Heat Exchangers: Heat exchangers, condensers with binary and multi-component systems, kettle type and thermosyphon reboiler.
Distillation Column: Tray and packed towers for binary systems and multi-component systems.
Batch Distillation: Introduction to batch distillation operation, selection criteria, batch distillation design. **Absorption Column:** Introduction to absorption, different types of packing and packing supports, calculation of packing height and tower diameter for packed column.
Design of Decanter and Cyclone Separator.
Design Considerations for Piping and Cooling Towers.
Pumps: Selection of pumps, net positive suction head (NPSH), power requirement for pumps.
Mechanical Design: Introduction to mechanical design, overview of pressure vessel, storage vessel and tall vertical vessel design, types and selection of head.
Overview of Piping System.
Recent Developments in Process Equipment Design.

Self Study:
The self study contents will be declared at the commencement of semester. Around 10% of the questions will be asked from self study contents.

Laboratory Work:
Laboratory work will be based on above syllabus with minimum 12 experiments to be incorporated.

References:

1. R. K. Sinnott, Coulson and Richardson's Chemical Engineering Series, Chemical Engineering Design, 4th Edition, VI volume, Elsevier Publication.
1. Ernest E. Ludwig, Applied Process Design for Chemical and Petrochemical Plants, Vol. 2, Gulf Professional Publishing.
2. Suchen B. Thakore and Bharat I. Bhatt, Introduction to Process Engineering and Design, Tata McGraw-Hill.
3. M.V. Joshi, Process Equipment Design, McMillan.

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CH611 Food Technology [3 0 0 3]

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

- imbibe the basic knowledge of food processing
- understand food laws and regulations governing the quality of foods
- appreciate the modern techniques and recent developments for food processing, preservation and storage
- identify various types of food adulteration and simple methods to detect adulteration of food
- identify the wide variety of parameters affecting food quality

Syllabus:
Introduction to Food Science and Technology: Importance of food processing, constituents of food, process industries based on raw materials.
Food Colours and Flavours: Natural food colourants, artificial food colorants, flavours, food additives.
Food Spoilage: Food fit for consumption, deterioration of food quality, causes of food spoilage, food borne diseases.
Food Conversion Operations: Emulsification, membrane separation, centrifugation, crystallization, refrigeration, heat processing.
Food Preservation: Principles of food preservation, dehydration and sun drying, salting, picking, fermentation, thermal processing methods.
Food Processing: Milk and dairy products, vegetable and fruits, cereals, legumes and nuts, meat and meat products, fats and oils, beverages, sugar, confectionery, biscuits and cookies, seafood's.
Semi Processed and Ready to Eat Foods
Food Adulteration and Estimation Methods
Food Laws and Regulations Governing the Quality of Foods

Self Study:
The self-study contents will be declared at the commencement of semester. Around 10% of the questions will be asked from self-study contents.

References:
1. B.Sivasankar, Food Processing and preservation, PHI Learning Pvt. Limited.
2. D.G.Rao, Fundamentals of Food Engineering, PHI Learning Pvt. Limited.
3. Dennis R.Heldman, Daryl B.Lund, Christina Sabliov, Hand book of Food Engineering, CRC Press.
4.

CH631 Nanoscience and Nanotechnology [3 0 0 3]

Course Outcomes:

After successful completion of the course, students will be able to

- understand the key concepts in materials science, chemistry, physics, biology and engineering to the field of nanotechnology
- distinguish various approaches for synthesis of nanomaterials
- demonstrate a conceptual knowledge of instrumentation for the characterization of nanomaterials
- identify applications of nanotechnology and societal issues that may impede the adoption of nanotechnology

Syllabus:

Introduction: Nanoscience and nanotechnology- the distinction, significances, historical perspectives, natural and man-made nanomaterials, properties of nanomaterials.

Synthesis of nanomaterials: Top-down and bottom-up synthesis methods, self-assembly and sol-gel process, synthesis of carbon based and metallic nanomaterials.

Characterization tools for Nanomaterials: Electron microscopy methods, spectroscopic methods, other important characterization methods.

Applications of Nanomaterials: Nanobiotechnology, micro/nano electromechanical systems, medical applications, nanomaterials for catalysis.

Societal implications of nanotechnology: Nanotoxicology, potential health and safety concerns of nanomaterials.

Self Study:

The self study contents will be declared at the commencement of semester. Around 10% of the questions will be asked from self study contents.

References:

1. Gabor L Hornyak, Harry F Tibbals, Joydeep Dutta, John J Moore, Introduction to Nanoscience and Nanotechnology, CRC Press.
2. T. Pradeep, Nano: The Essentials-Understanding Nanoscience and Nanotechnology, McGraw-Hill Education.
3. Challa Kumar, Nanomaterials for Biosensors, Wiley-VCH.
4. Tuan Vo-Dinh, Nanotechnology in Biology and Medicine: Methods, Devices and Application, CRC Press.
5. Jo Anne Shatkin, Nanotechnlogy: Health and Environmental Risk, CRC press.
6. M.H. Fulekar, Nanotechnology: Importance and Application, IK International.

CH632 Process Integration [3 0 0 3]

Course Outcomes:

After successful completion of the course, student will be able to

- calculate minimum hot and cold utilities and develop heat exchanger networks
- apply the principles of appropriate placement of reactors and distillation columns with respect to heat integration
- evaluate various alternatives for heat integration of distillation columns for energy savings
- apply principles of mass exchanger networking to develop mass exchanger network
- calculate the batch cycle time required for a single/multi product plant
- use different software for heat exchanger network and water networking

Syllabus:

General Aspects of Process Integration

Targeting Methodology: Construction of hot composite curve, cold composite curve, problem table algorithm, grand composite curve, obtaining minimum hot and cold utility.

Network Design: Heuristics for pinch design, application of pinch design method for maximum energy recovery, evolution of network.

Energy Savings in Distillation: Heuristic for the sequencing separation columns, methods to sequence simple distillation columns, operational improvements for energy savings in distillation columns, heat integration of distillation columns, appropriate placements of distillation columns, grand composite curves, heat integration characteristics of distillation, various alternatives for heat integrations of distillation columns.

Reactor Integration: Heat integration characteristics of reactors, appropriate placement of reactors.

Mass Exchanger Networking: Fresh water & waste water minimization for fixed contaminant processes and fixed flow rate processes, hydrogen network synthesis.

Introduction to Scheduling of Batch Processes: GANTT charts, production schedule for single products, production schedule for multiple products.

Introduction to software for Heat Exchanger Networks and Water Networking

Self Study:

The self study contents will be declared at the commencement of semester. Around 10% of the questions will be asked from self study contents

References:

1. Robin Smith, Chemical Process Design and Integration, John Wiley and Sons.
2. U. V. Shenoy, Heat Exchanger Network Synthesis Gulf Publication.
3. Warren D. Seider, J. D. Seader, Daniel R. Lewin, Product & Process Design Principles, Wiley Publication.
4. Ian C Kamp, Pinch Analysis and Process Integration, Butterworth-Heinemann.

CH622 Advances in Chemical Process Control [3 0 0 3]

Course Outcomes:

After successful completion of the course, student will be able to

- analyse and evaluate a feedback control system
- understand and analyse advanced control systems
- design control systems for multivariable processes
- apply digital control system in chemical plant

Syllabus:

Introduction to Chemical Process Dynamics and Control

Feedback Control System: Introduction, dynamic behavior, stability analysis, frequency response.

Advanced Control Systems: Feedback control of systems with large dead time or inverse response, cascade control, selective control system, split-range control, feedforward control, feedforward – feedback control, ratio control, adaptive and inferential control system.

Introduction to Plant Control: Multiple input multiple output (MIMO) control system, degrees of freedom, controlled and manipulated variables, generation of alternative loop configurations, interaction of control loops, relative-gain array, selection of loops, design of non-interacting control systems.

Process Control using Computers: Digital computer control loops, discrete-time systems, z-transforms, discrete-time response of dynamic systems, design of digital feedback controllers, process identification and adaptive control.

Digital Control System: Programmable logic controller (PLC), distributed control system (DCS), supervisory control and data acquisition systems (SCADA).

Self Study:

The self study contents will be declared at the commencement of semester. Around 10% of the questions will be asked from self study contents.

References:

3. George Stephanopoulos, Chemical Process Control: An Introduction to Theory and Practice, PHI Learning.
4. William L. Luyben, Process Modeling, Simulation and Control for Chemical Engineers, McGraw-Hill.
5. Dale E. Seborg, Duncan A. Mellichamp, Thomas F. Edgar, Francis J. Doyle, Process Dynamics and Control, John Wiley & Sons.
6. Willis Harmon Ray, Advanced Process Control, McGraw-Hill.

2CH438 AIR POLLUTION CONTROL TECHNIQUES

Introduction:
History, The Atmosphere; Unpolluted Air; Particulate Matter; Concepts; Industrial sources of air emissions.
Air Quality: Averaging Time; Cycles; Primary and Secondary Pollutants; Measurement Systems; Air Quality Levels; Indoor Air Quality; Factors Influencing Indoor Air Quality; Indoor Air Pollutants; Effects of Indoor Air Pollutants; Control of Indoor Pollutants.
Sources of Air Pollution:
General; Combustion; Stationary Sources; Mobile Sources; Emission Inventory. Ambient Air Sampling:
Elements of a Sampling System; Sampling Systems for Gaseous Pollutants; Sampling Systems for Particulate Pollutants and PM10; Static Sampling Systems; Sampler Siting Requirements; Sampling for Air Toxics; Source Sampling; The Source Test; Source Monitoring.
Ambient Air Pollutants : Analysis and Measurement:
Principles of measurements of emissions for pm, SO2, NOX etc., Analysis and Measurement of Gaseous Pollutants; Analysis and Measurement of Particulate Pollutants; Analysis and Measurement of Odors; Analysis and Measurement of Visibility; Analysis and Measurement of Acidic Deposition.
Air Quality Criteria and Standards:
Air Quality Criteria; Conversion of Effects Data and Criteria to Standards; Conversion of Physical Data and Criteria to Standards; Conversion of Biological Data and Criteria to standards.
Emission Standards:
Subjective Standards; Objective Standards; Types of Emission Standards; Variant Forms of Emission Standards; Means for Implementing Emission Standards.
Air Pollution Control:
Strategy and Tactics – The Air Pollution System; Episode Control; Air Quality Management Control Strategy; Alternative Control Strategies; Economic Considerations
Engineering Control Concepts:
Introduction; Process Change; Fuel Change; Pollution Removal; Disposal of Pollutants; Pollution Prevention.
Control Devices and Systems: Introduction; Removal of Dry Particulate Matter and Control Technologies for particulate emission control cyclones, ESP, Bag Filters, Scrubbers; Removal of Liquid Droplets and Mists, and Control Technologies for gaseous emissions – Scrubbers , Absorption and Adsorption.; Removal of Gaseous Pollutants; Removal of Odors.
Control of Stationary Sources: Introduction; Energy, Power and Incineration; Chemical and Metallurgical Industries; Agriculture and Forest Products Industries; Other Industrial Processes
Control of Mobile Sources: Introduction; Gasoline-powered vehicles; Diesel-Powered Vehicles; Gas Turbines and Jet Engines; Alternatives to Existing Mobile Sources.
Case studies of the:
Control Technologies for SO2 emission control; Control Technologies for NOX emission control; Control Technologies for VOC emission control; Emissions from Thermal Power plant & its control; Emissions from Petroleum Refinery & its control.

Text Books:- 1.Fundamentals of air pollution control Techniques by Richard W Boubel, Donald L. Fox, D. Bruce Turner,

2CH448 BIO-CHEMICAL ENGINEERING L T P C 4 - - 4

Introduction To Bio-chemical Engineering
Essentials of Micro-biology for Bioprocess Engineers, Cell construction, Important cell types, Cell Nutrients and growth and its applications.

Study and Kinetics of One and Two Substrate Enzymes Catalyzed Reactions
Introduction to Enzymes, Mechanism of working, Enzyme kinetics, Large scale production of enzymes, Medical & industrial utilization of enzymes, Summary & suggested readings, Enzyme Deactivation & Immobilization, Immobilized-Enzyme Systems Design, Selection Scale-Up, Operation and Control of Bioreactors

Introduction, Ideal bioreactors, Scale-up & its difficulties, Bioreactor instrumentation & control. Sterilization of process fluids, Summary & suggestive further reading.

Recovery & Purification of Products
Strategy to recover & purify products, Separation of insoluble products: Filtration, Centrifugation, Coagulation and Flocculation, Separation of soluble products: Extraction, Precipitation, Adsorption, Dialysis, Reverse Osmosis, Ultra filtration & micro filtrations, Chromatography, Electrophoresis, Electrolysis's, Finishing steps for purification: Crystallization, Drying, Summary and suggested readings.

Application of Mixed Microbial Population
Introduction to mixed cultures, Industrial uses of mixed cultures, Biological waste water treatment: Overview, Biological waste treatment processes, Advanced Waste water treatment systems, Conversion of waste water to useful products, Summary and suggested readings.

Text-books:
1. "Biochemical Engineering Fundamentals" by James E. Bailey and David F. Ollis, McGraw Hill Publications.
"Bioprocess Engineering: Basic Concepts" by Michael L. Shuler and Fikret Kargi Prentice-Hall of India Pvt. Ltd.

CH723 Bioprocess Engineering [3 0 0 3]

Course Learning Outcome:
After successful completion of the course, student will be able to

- apply knowledge of biological science and engineering to bio-catalyzed reaction systems
- understand mechanism and kinetics of enzyme/microbial catalyzed reactions
- select suitable bioreactor for desired application
- select suitable separation system for downstream processing

Syllabus:
Introduction to Bioprocess Engineering
Overview of Microbiology: Cell construction, growth and its applications, overview of microbial growth kinetics, comparison of microbial and conventional reactions, fermentation technology.
Introduction to Enzymes and Kinetics of Enzyme Catalysed Reactions: **Introduction to enzymes, mechanism and kinetics of enzymatic reactions, large scale production of enzymes, industrial utilization of enzymes, enzyme immobilization and deactivation.**
Bioreactors: Introduction to bioreactors, sterilization of process fluids, selection of suitable bioreactor, bioreactor design considerations.
Recovery and Purification of Products: **Strategy to recover & purify products using suitable separation techniques.**
Mixed Microbial Cultures: **Introduction to mixed microbial cultures, industrial uses of mixed microbial cultures, biological wastewater treatment, solid waste treatment.**

Self Study:
The self-study contents will be declared at the commencement of semester. Around 10% of the questions will be asked from self-study contents.

References:

1. James E. Bailey, David F. Ollis, Biochemical Engineering Fundamentals, Tata McGraw Hill.
2. Michael L. Shuler, Fikret Kargi, Bioprocess Engineering: Basic Concepts, Prentice-Hall, Inc.
3. D G Rao, Introduction to Biochemical Engineering, Tata McGraw Hill.
4. Harvey W. Blanch, Douglas S. Clark, Biochemical Engineering, Marcel Dekker, Inc.

CH724 Chemical Engineering Economics and Plant Design [3 0 0 3]

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

- understand the project evolution and evaluation techniques
- manage the project, plant and process requirements
- carry out detail discussion in industry in all aspects of plant design and its requirement
- carry out economic and profitability analysis, alternative investments, planning and scheduling at various level

Syllabus:
Introduction: Basic considerations in chemical engineering plant design and techno-economic feasibility, role of chemical engineer.
Process Design Development: Product design, types of process designs, selection of process, laboratory, bench and pilot plant scale process design, scale up methods, safety factors.
Basics of Flow Diagrams: Block flow diagrams (BFD), process flow diagrams (PFD), piping & instrumentation diagrams (P&ID).
Structure and Synthesis of Process Flow Diagrams: Hierarchy of process design, batch versus continuous process, input/output structure of the process, recycle structure of the process, general structure of the separation system, mass and heat-exchanger network, heuristics.
Selection of Process Equipment: Standard versus special equipment, material of construction, selection criteria, specification sheets.
Plant Location and Layout: Factors affecting plant location, types of plant layout, plant layout factors.
Optimum Design: General production rates in plant operation, optimum conditions, optimum production rates in plant operation, optimum conditions in cyclic operations.
Cost Estimation: Cash flow diagrams, factors affecting investment and production costs, total capital investment, fixed capital and working capital, types and methods for estimation of total capital investment, estimation of equipment cost, estimation of total products cost, present worth, annuities, capitalized costs, taxes.
Depreciation: Types and methods of determining depreciation, evaluation of depreciation methods.
Profitability, Alternative Investments and Replacement: Methods of profitability evaluation, alternative investment and replacement studies.

Self Study:
The self-study contents will be declared at the commencement of semester. Around 10% of the questions will be asked from self-study contents.

References:

1. Max S. Peters, Klaus D. Timmerhaus, Plant design and Economics for Chemical Engineers, McGraw Hill.
2. F.C. Vibrandt, C.E. Dryden, Chemical Engineering Plant Design, McGraw Hill.
3. Richard Turton, Richard C. Bailie, Wallace B. Whiting, Joseph A. Shaeiwitz, Analysis, Synthesis and Design of Chemical Processes, PHI.
4. S. B. Thakore, B. I. Bhatt, Introduction to Process Engineering and Design, Tata McGraw Hill.
5. Willia D. Baasel, Preliminary Chemical Engineering Plant Design, Elsevier.
6. Warren D. Seider, J. D. Seader, Daniel R. Lewin, Product & Process Design Principles: Synthesis, Analysis & Evaluation, Jhon Wile and Sons.

CH701 Chemical Reaction Engineering - II [3 0 2 4]

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

- identify non-ideality present and predict its effects on performance of reactor
- understand the behaviour of various types of contacting patterns and phases involved in the reaction
- develop rate expression, select and design suitable reactor for heterogeneous reaction
- prepare and characterize various supported catalysts

Syllabus:
Introduction: Introduction to heterogeneous reactions and contacting patterns for two phase systems.
Models for Non-ideal Flow: Basics of non-ideality present in the reactor, compartment model, dispersion model, tanks in series model.
Kinetics and Design for Non-Catalytic Systems: Kinetics and design for fluid-fluid and fluid-solid (non-catalytic) reactions.
Solid Catalysed Reactions: Overview of physicochemical properties of catalyst, rate equation for surface kinetics, pore diffusion resistance combined with surface kinetics, experimental methods for finding rates. The packed bed catalytic reactor – types and design of isothermal and non-isothermal packed bed reactor.
Fluidized Bed Reactors: Introduction and types of fluidized bed reactors.
Multiphase Reactors: Introduction to solid catalysed multiphase reactors, trickle bed reactor, slurry reactor, pressure swing reactor, temperature swing reactor etc.
Catalysis: Preparation of various bulk and supported catalysts and their characterization.

Self Study:
The self study contents will be declared at the commencement of semester. Around 10% of the questions will be asked from self study contents.

Laboratory Work:
Laboratory work will be based on above syllabus with minimum 12 experiments to be incorporated.

References:
1. Octave Levenspiel, Chemical Reaction Engineering, Wiley Eastern Pvt. Ltd.
2. *D. Kunii, Octave Levenspiel and Howard Brenner, Fluidization Engineering,* Butterworth-Heinemann.
3. H. Scott Fogler, Elements of Chemical Reaction Engineering, Prentice Hall.
4. G.F. Froment and K.B. Bischoff, Chemical Reactor Analysis and Design, Jhon Wiley & Sons.
5. C.H. Bartholomew and R. J. Farrauto, Fundamentals of Catalytic Processes, Wiley Interscience

CH704 **Minor Project** **[0 0 4 2]**

Course Outcomes:

After successful completion of the course, student will be able to

- practice acquired knowledge within the chosen area of technology for project development
- identify, discuss and justify the technical aspects of the chosen project with a comprehensive and systematic approach
- reproduce, improve and refine technical aspects for engineering projects
- work as an individual or in a team in development of technical projects
- report project related activities effectively to peers and mentors

Syllabus:

The student(s) shall carry out project based on one or more of the following aspects: prototype design, product preparations, working models, fabrication of set-ups, laboratory experiments, process modification/development, simulation, software development, integration of software and hardware, data analysis, survey etc.

The student is required to submit project report based on the work.

2CH402 MODELING AND SIMULATION **L T P C**
3 - 2 4

Introduction
Introduction to modelling and simulation, Process synthesis and Process Analysis, Process plant Simulation
Mathematical Models of Chemical Engineering Systems
Uses of mathematical models, Principles of formulations, Study of fundamental laws like Continuity equations, energy equations, equation of motion, transport equations, equation of state, equilibrium, chemical kinetics.
Examples of Modelling & Simulation of Chemical Engineering Systems
Unit Operation Equipments like Heat Exchangers, Evaporators, Flash Drum, Distillation, Extraction, Absorption.
Reactors like CSTRs' with different operating conditions, Batch reactors and Plug Flow Reactors
Simulation using Numerical Methods:
Introduction to computer programming, Iterative convergence methods like Internal Halving, Newton – Raphson Method, False Position, Explicit convergence methods, Wegstein, Muller Method. Numerical integration of ODEs including explicit and implicit methods of numerical integration. Finite Difference Methods
Modular Approaches & Equation Solving Approaches
Modular Approaches to Process Simulation, The Equation-solving approach, Precedence-ordering of Equation Sets, Disjointing, Tearing a System of Equations, The SWS Algorithm
Decomposition of Networks Tearing Algorithms, Algorithms Based on the Signal Flow Graph, The Barkley and
Motard Algorithm, The Basic Tearing Algorithm, Algorithm Based on Reduced Digraph, Kehat and Shacham Algorithm
Introduction to professional simulation softwares like Hysys.Plant and Mathematical tools like MATLAB and Poly Math etc.
Laboratory Work – Minimum eight experiments based on the course

Text-Book: 1.Process Modelling, Simulation and Control for Chemical Engineers by William L. Luyben, McGraw Hill International Editions. 2.Process Plant Simulation, B.V.Babu, Oxford Publication. 3.Systematic Methods of Chemical Process Design, Lorenz T. Biegler, Ignacio E. Grossman and Arthur W. Westerberg, Prentice Hall Publication

CH713 Non-Conventional Energy Sources [3 0 0 3]

Course Outcomes:

After successful completion of the course, student will be able to

- understand the basic principles and fundamentals of energies behind the non-conventional sources
- compare the various methodologies of tapping energy from non-conventional sources
- devise application strategies by converting non-conventional energy sources into usable form

Syllabus:

Introduction to Non-Conventional Energy Sources: Energy fundamental concepts, sources and utilization

Solar Energy: solar radiation geometry, measurement and estimation, diffuse and beam radiation on horizontal and inclined surfaces, solar thermal: liquid flat plate solar collectors, flat plate air heating collectors, focusing-type solar collectors, storage of solar energy, solar pond, solar water heating, solar heating and cooling of buildings, solar desalination, solar driers, solar photovoltaics: semiconductor principles, photovoltaic principles, types of solar cells, solar cell modules, applications.

Wind Energy: Basic principles, power content in wind and utilization, wind energy conversion system, horizontal and vertical axis wind mills, applications.

Geothermal Energy: Geothermal field, geothermal power plant.

Ocean Energy: Ocean thermal energy conversion, wave energy, tidal energy.

Biomass Energy: Potential of biomass energy, biomass processing through gasification and fermentation, biogas production and utilization.

Fuel Cells: Principle and operation, types and applications, hydrogen storage, production and transportation.

Recent Advances in Renewable Energy Technologies

Self Study:

The self study contents will be declared at the commencement of semester. Around 10% of the questions will be asked from self study contents.

References:

1. G.D. Rai, Non-Conventional Energy Sources, Khanna Publishers
2. Anjaneyulu Yerramilli, Francis Tuluri, Energy Resources: Utilization and Technologies, BS Publication.
3. B.H. Khan, Non-Conventional Energy Sources, Tata McGraw Hill.
4. Anne Maczulak, Renewable Energy Sources and Methods, Infobase Publishing.

SS701 Organizational Behaviour [2 0 0 2]

Course Learning Outcomes (CLO):

After studying the course the students will be able to:

- Analyze and evaluate performance behavior at individual, group and organizational levels.
- Develop the ability to lead and motivate others to succeed.
- Develop critical analytical skills that will help them diagnose situations pertaining to human behavior and generate effective solutions for the same.
- Understand and apply principles of organizational dynamics relating to systems, culture, structure and change processes

Syllabus

I. Introduction to Organizational Behaviour

- Concept of Organizational Behaviour (OB)
- History , Nature and scope of OB
- Key elements in OB
- Inter-disciplinary contribution to OB
- Managerial Roles

II. Individual Behaviour, Values & Personality

- Concept of Individual Differences
- Values commonly studied across culture
- Fundamentals and Determinants of Personality
- Big Five Dimensions
- Personality Traits

III. Learning & Perception

- Fundamentals of Learning
- Learning Theories - Classical Conditioning Theory, Operant Conditioning Theory, Social Learning Theory
- Behavior Modification
- Definition of Perception, Perceptual Process, Common Perceptual Errors

IV. Motivation

- Basic concept of Motivation
- Theories of Motivation – Maslow,Herzberg's Two Factor Theory, ERG, McClelland , Equity and Vroom's Expectancy Theory

V. Leadership

- Introduction
- Leadership Theories - Trait Theories, Behavioral Theories and Situational Theories

VI. Group Dynamics

- Defining and classifying groups
- Stages of group development
- Group Properties – Roles, Norms, Status, Size and Cohesiveness
- Group Decision making

VII. Managing Change in Organization

- Definition, Forces of Change,
- Causes for Resistance to Change, Overcoming Resistance to change
- Lewin's Change Model

VIII Organizational Culture

- Meaning, Strong Culture vs. Weak Culture
- Creating & sustaining Culture
- Socialization

IX. Conflict, Power & Politics

- Nature & types of conflict, Causes and outcome of conflict
- Responses to conflict
- Bases of Individual Power
- Organizational Politics

Self-study content will be declared at the commencement of the course. Approximately 10% of the assessment will be upon this content.

References:

1. Robbins, S.P.Judge, T.A. &, Sanghi, Seema. (2010). *Organizational Behavior*, Pearson.
2. Pareek, U.(2011).*Understanding Organizational Behavior*, Oxford University Press.
3. Luthans,F.(2006).*Organizational Behaviour*, Tata McGraw Hill.
4. Sekaran,U. (1989).*Organizational Behaviour: Text and Cases*, Tata Mc Graw Hill
5. Kreitner, R. &Kinicki, A.(2012). *Organizational Behavior*, McGrawHill/Irwin
6. Davis,K. &Newstorm, J.W. (1989).*Organizational Behaviour*, Tata McGraw Hill
7. Slocum,J.W&Hellreigal, D. (2010).*Fundamentals of Organizational Behaviour*, Cengage Learning.

2CH403 PROCESS EQUIPMENT DESIGN-II L T P C 3 - 2 4

Introduction to mechanical design considerations for process equipments.
Selection of Material:
Selection of material of fabrication (MOC) and Protective coating.
Material Behaviour and Design:
Material behaviour under stresses and theories of failure, introduction to various fabrication methods.
Mechanical Design of following equipment:
a. Unfired pressure vessels subjected to internal and external pressure. Pressure vessel design.
b. Reactors.
c. Storage vessel design.
d. Distillation & Fractionation Equipments
e. High Pressure vessels.
f. Supports for pressure vessels.
g. Agitators.
h. Heat Exchangers
Recent developments:
Practical and Term-work:
Sketches of various equipment accessories and Drawing based on design calculations of above type of equipments.
Laboratory Work – Minimum eight experiments based on the course

Text book

1. M.V. Joshi, Process Equipment Design, McMillan, India.
2. L.E. Brownell and E.H. Young, Process Equipment Design, John Wiley and Sons, New York

2CH458 SOLID WASTE TREATMENT TECHNIQUES

Introduction:

The development of solid waste management awareness; Waste generation in a technological society; Operation of solid waste management; Major legislations and their impacts; Government agencies; Future trends.

Municipal Solid Wastes: Sources, Types, Composition, Physical, chemical and biological properties, Types of materials recovered, Hazardous waste, recycling Handling and separation, storage, and processing at the source:

Residential dwelling, commercial and industrial facilities

Collection of solid waste:

Waste collection, Types of collection systems, equipments, and personnel requirements, analysis of collection systems, collection routes

Separation, Processing and Transformation of Solid Waste:

Opportunities for reuse and recycling of the solid waste, Materials recovered at drop-off and buy-back centres, Facilities for handling, moving and storing solid wastes, Options for separation of waste materials, Introduction to unit operations used for the separation and processing of waste materials, Waste transformation techniques and selection of techniques.

State of the art technology-Pyrolysis

Plasma reactor for burning medical waste in absence of oxygen

Disposal of Solid Wastes and Residual Matter:

Landfill methods, landfill classification, types and methods, Landfill siting considerations, Composition, characteristics, generation, movement, and control of landfill gases and also of leachate in landfills, Surface water management, Structural and settlement characteristics of landfills, Environmental quality monitoring at landfills, Layout and preliminary design of landfills, Landfill operation, Landfill closure and postclosure care, Landfill process calculations.

Biological and Chemical conversion technologies:

Aerobic composting, anaerobic digestion, energy production from biological conversion Planning, Siting and Permitting of Waste anagement Facilities: Text-

Book: 1. Integrated Solid Waste Management-Engineering Principles and Management issues by George Tchobanoglous, Hilary Theisen and Samual A. Vigil ,McGraw Hill International Editions

CH703 **Transport Phenomena** **[3 0 0 3]**

Course Outcomes:

After successful completion of the course, student will be able to

- understand the fundamentals of transport phenomena and analogy between different transport phenomena
- predict transport properties for gases, liquids, solids, and mixtures
- apply shell balance for energy, mass and momentum transport for various systems and develop mathematical expressions for transport of energy, mass and momentum
- interpret transport property distribution for various systems

Syllabus:

Introduction to Transport Phenomena: Concept and industrial relevance, analogy between different transport phenomena, equations of change for isothermal systems, equations of continuity and motion.

Momentum Transport: Molecular momentum transport, pressure and temperature dependence of viscosity, viscosity prediction for gases, liquids and mixtures, convective momentum transport.

Shell Momentum Balances and Velocity Distributions in Laminar Flow: Shell momentum balances and boundary conditions, flow of a falling film, flow through circular tube, flow through annulus, flow of two adjacent immiscible fluids.

Energy Transport: Molecular energy transport, temperature and pressure dependence of thermal conductivity, thermal conductivity prediction for gases, liquids, solids and mixtures.

Shell Energy Balances and Temperature Distributions in Solids and Laminar Flow: Shell energy balances and boundary conditions, heat conduction with an electrical heat source, nuclear heat source, viscous heat source, composite walls, cooling fin, forced and free convection.

Mass Transport: Molecular mass transport, temperature and pressure dependence of diffusivity, diffusivity prediction for gases and liquids.

Concentration Distributions in Solids and in Laminar Flow: Shell mass balances and boundary conditions, diffusion through a stagnant gas film, diffusion with a homogeneous chemical reaction, diffusion with heterogeneous slow and instantaneous chemical reactions.

Self Study:

The self study contents will be declared at the commencement of semester. Around 10% of the questions will be asked from self study contents.

References:

1. R. Byron Bird, Warren E. Stewart, Edwin N. Lightfoot, Transport Phenomena, John Wiley & Sons, Inc.
2. Bodh Raj, Introduction to Transport Phenomena: Momentum, Heat & Mass, PHI Learning Private Limited.

Christie John Geankoplis, Transport Processes and Separation Process Principles, PHI Learning Private Limited.

CH744 Unit Processes [3 0 0 3]

Course Outcomes:

After successful completion of the course, student will be able to

- understand the concepts of kinetics and thermodynamics of unit processes
- acquire knowledge of various organic reactions and their mechanisms
- understand the applications and major engineering problems associated with unit processes
- appreciate the advancements in unit processes

Syllabus:

Introduction to Various Unit Processes: Introduction to mechanisms, applications of thermodynamics and chemical kinetics in unit processes.

Nitration: Aromatic nitration, industrial nitration processes and products, production of nitro paraffin's, major engineering problems.

Sulfonation and Sulfation: Sulfonating and sulfating agents and their applications, chemical and physical factors, sulfonation of aromatic compounds, preparation of sulfonates and sulfates.

Halogenation: Chlorination of ethane and propane, ethylene dichloride, bromination, iodination.

Amination by Reduction: Methods of reduction, aniline, nitroaniline, electrolytic reductions, metal and alkali reductions.

Amination by Ammonolysis: Physical and chemical factors affecting ammonolysis, manufacture of amino compounds.

Oxidation: Types of oxidative reactions, vapor-phase oxidation of aromatic hydrocarbons.

Esterification: Esterification of organic acids, carboxylic acid derivatives and amides.

Hydrolysis: Hydrolyzing agents, operations involving hydrolysis, hydrolysis of alkylchlorides and esters.

Alkylation: Types of Alkylation, factors controlling alkylation.

For above all processes exothermicity, endothermicity and safety aspects to be covered.

Self Study:

The self-study contents will be declared at the commencement of semester. Around 10% of the questions will be asked from self-study contents.

References:

5. P. H. Groggins, Unit Processes in Organic Synthesis, Tata McGraw-Hill Edition.
6. Arun Bahl, B.S.Bahl, Advanced Organic Chemistry, S. Chand & Company Ltd.
7. Jonathan Clayden, Nick Greeves, and Stuart Warren, Organic Chemistry, Oxford University Press.

HS016 Applied Literature [3 0 0 3]

Course Learning Outcome

Students completing this subject will:

- be able to explore the importance of textual traditions in shaping responses to other places, peoples, cultures;
- gain a knowledge and understanding of the social, political and intellectual forces contributing to imperial, third world and migrant writing;
- develop a knowledge and appreciation of the subject matter, styles and narrative conventions

Syllabus

Non-fictional Prose Works (Excerpts)

New Branded World by Naomi Klein
From the Gutenberg Elegies: The Fate of Reading in the Electronic Age by Sven Birkets
Decolonising the Mind by Ngugi wa Thiong'o
Idea of India by Sunil Khilnani
Wings of Fire by APJ Kalam

Poems

Night of the Scorpion by Nissim Ezekiel
Little Red-Cap, by Carol Ann Duffy
Hunger by Jayanta Mahapatra
The Dacca Gauzes by Agha Shahid Ali
The Howl by Allen Ginsberg
If you forget me by Pablo Neruda
Still I rise by Maya Angelou
If by Rudyard Kipling
"Hope" is the thing with feathers by Emily Dickinson
All You who Sleep Tonight by Vikram Seth
The Unknown Citizen by W. H Auden
Song of Myself, I, II, VI & LII by Walt Whitman

Short Stories

Short Story: "Seventeen Syllables" by Hisaye Yamamoto
Short Story: "The Gift of the Magi" by O. Henry

Criticism

Towards a Feminist Poetics by Elaine Showalter

Movies

The Prestige
To Sir, With Love
The Namesake
Sherlock – TV series
Troy
Jobs

References:

1. Widdowson, Peter. *Literature*. London: Routledge, 1999.
2. Miller, J. Hillis. *On Literature: Thinking in Action*. London: Routledge, 2002.
3. Mulhern, Francis, *Culture/Metaculture*. London: Routledge, 2000.
4. During, Simon, *The Cultural Studies Reader*. London: Routledge, 1993.

5. Leitch, Vincent B. *The Norton Anthology of Theory and Criticism*. Norton: New York, 2001.
6. Stam, Robert; Alessandra Raengo, *A Companioin to Literature and Film*. Blackwell: Oxford, 2004.

2ME004 Cryogenics [3 0 0 3]

Course Learning Outcome:
After successful completion of the course, student will be able to

- describe various methods to produce low temperature and phenomena at cryogenic temperature.
- understand the working principle of different cryogenic refrigeration and liquefaction system.
- understand the functions and working principles of insulations and various low temperature measuring and storage devices.
- understand the application of cryogenic technology in engineering research and industry.

Syllabus:
Low Temperature Properties – Mechanical, thermal, electrical and magnetic properties of engineering materials, properties of cryogenic fluids.
Gas Liquefaction Systems – Thermodynamically ideal system, Joule Thomson effect adiabatic expansion, simple, pre-cooled and dual pressure Linde Hampson systems, Claude system, Kapitza system, Heylandt system, other liquefaction system using expanders, comparison of liquefaction systems, liquefaction systems for hydrogen and helium
Cryogenic Refrigeration Systems – Ideal isothermal and isobaric source systems, Joule Thomson systems, pre-cooled Joule Thomson system, expansion engine system, Philips refrigerator, G M refrigerator, Pulse Tube refrigerator.
Measurement Systems for Low Temperatures – Temperature, pressure flowrate and liquid level measurement at low temperatures.
Cryogenic Fluid Storage – Basic storage vessel, construction of storage vessels for oxygen, hydrogen, nitrogen, helium, safe devices, drawing of the vessel.
Insulations – Gas filled powder and fibrous, vacuum, evacuated powder and fibrous, multiplayer insulations, mechanism of thermal insulation, apparent thermal conductivity, and selection of insulation
Cryogenic Fluid Transfer Systems – Different types of transfer lines, process of cryogenic transfer, components of transfer lines.
Application of Cryogenic Systems – Super-conducting bearing, motors, super-conducting magnets, space technology, blood and tissue preservation, cryo probes used in cryo surgery.

Self Study:
The self study contents will be declared at the commencement of semester. Around 10% of the questions will be asked from self study contents.

References:
1. R.F. Barron,Cryogenics systems, Mc Graw Hill Publication.
2. T.Flynn, Cryogenic Engineering, Springer Publication

Course Code	CE003
Course Title	Data Structures

Course Learning Outcome (CLO):
At the end of the course, students will be able to -

- understand various data structures and applications associated with them
- analyse efficiency and effectiveness of various data structures
- apply appropriate data structures for time and space optimization

Syllabus:	**Teaching Hours:**
Unit I Introduction to Data Structures: Types of Data Structures, Linear & non-linear Data Structures. Linear Data Structures & their sequential storage representation: Storage Structures for arrays, stack definitions & concepts, operations on stacks, double stack, applications of Stacks-Recursion, Polish Expressions and their compilation, Queue-Representation of queue, operations on queue, priority queues, linked list-linked linear list-operation on linear list using singly linked storage structures, circularly linked list, doubly linked linear list, applications of linked linear list-polynomial manipulation.	10
Unit II Non Linear Data Structures: Trees-Definitions and concepts, operations on Binary Trees, Storage Representation and Manipulation of Binary Trees-Linked & Threaded, Conversion Of General Trees To Binary Trees, Sequential and other representations of trees, applications of Trees-the Manipulation of Arithmetic Expressions, Multi Linked Structures-Sparse Matrices.	6
Unit III Graphs-Matrix: Graphs-Matrix representation of graphs, Breadth First Search, Depth First Search, Spanning Trees. Searching: Searching-Sequential & Binary Searching, Search Trees-Height Balanced, Weight Balance, 2-3 Trees, Tree Structures	5
Unit IV Sorting: Sorting-Notation and Concepts, Time and Space Complexity, Asymptotic behavior, Sorting: Insertion Sort, Selection Sort, Bubble Sort, Merge Sort, Tree Sort, Quick Sort, Shell Sort, Radix Sort, Address Calculation Sort, Summary of Sorting	4
Unit V Hashing: Hash Table Methods-Introduction, Hashing Functions, and Collision-Resolution Techniques. File Structure: Definition of Record, File, Blocking, Compaction and Database, introductory overview of Database Management System, Implementation and Traders of Sequential Access, Index Sequential Access, Random Access, B-Trees, Inverted List and Multi list.	5

Self-Study:
The self-study contents will be declared at the commencement of semester. Around 10% of the questions will be asked from self-study contents.

Laboratory Work:

Laboratory work will be based on above syllabus with minimum 10 experiments to be incorporated.

Suggested Readings^:1. Jean-Paul Tremblay and Paul G. Sorenson, An Introduction to Data Structures with Applications, Tata McGraw Hill Edition

L= Lecture, T= Tutorial, P= Practical, C= Credit[2]

2

CL001 **Disaster Risk Management** **[3 0 0 3]**

Course Learning Outcome:
After successful completion of the course, student will be able to

- develop understanding about concept of risk, vulnerbility and disasters
- select and apply tools & techniques for disaster risk assessment
- comprehend role of Engineers from various Engineering branches for disaster risk management
- develop ability for contributing to resilient societies through skills, methods and tools pertaining to disaster risk management

Syllabus:
Introduction to Disaster Risk Management (DRM): Concept, Types of Disasters, Linkages between Disasters and Development, Importance & Significance of DRM.
Risk and Vulnerability: Risk, Vulnerability, Risk Assessment, Disaster Risk Modelling; Emerging Risks due to Development, Climate Change Adaptation, etc.
Disaster Risk Management: Phases, Mitigation, Preparedness, Prevention, Response, Relief and Recovery, Humanitarian Assistance, DM Institutional Framework, Incident Command System, Disaster Management Plan,
Community Based Disaster Management (CBDM): Concept of CBDM, Community Health and Safety, Do's and Don'ts before, during and after disasters.
Disaster Communication: Disaster Communication, Early Warning and Disaster Monitoring, Role of GIS and Remote Sensing in Disaster Risk Management.
Role of Enginners from various branches in Disaster Risk Management: Use of Skills, Methods, Tools and Techniques for understanding the challenges and determining solutions for DRM and Climate Change Adaptation.
Disaster Risk Management Programmes: DRM Programmes, Practices and Case Studies.

Self Study:
The self study contents will be declared at the commencement of semester. Around 10% of the questions will be asked from self study contents.

References:

(xvii) Sahni Pradeep, Ariyabandhu Madhavi Malalgoda, Disaster Risk Reduction in South Asia, PHI Learning Pvt.Ltd.
(xviii) Sinha Prabhas C., Disaster Relief: Rehabilitation and Emergency Humanitarian Assistance, SBS Publishers.
(xix) Wisner Ben, Blaikie Piers, Cannon, Terry & Davis, Ian, At risk natural hazards, people's vulnerability and disasters, Routledge.
(xx) Singh R.B. (Ed.), Natural Hazards and Disaster Management Vulnerability & Mitigation, Rawat Publications.
(xxi) Blodgett Robert & Keller Edwards, Natural Hazards: Earth's processes as hazards disasters and catastrophe, Pearson Prentice Hall

2EE002 Electrical Power Utilization and Safety [3 0 0 3]

Course Learning Outcome:

After successful completion of this course, students will be able to

- understand the importance of power factor and suggest a suitable method for improving it
- suggest and apply suitable electric heating, welding, refrigeration and air conditioning for a system
- analyze and design illumination scheme, electrification, earthing system and protection system for an application

Syllabus:

Electric Heating and Electric Welding: Advantages of electric heating, Resistance heating, Types of furnaces, Induction heating, Types of induction furnaces, Dielectric heating, Types of welding- arc and resistance.

Refrigeration and Air conditioning: Introduction to refrigeration and air-conditioning, Principles of a refrigerator, Domestic refrigerator, Electrical circuit of refrigerator, Need of voltage regulator, Water cooler, Air conditioner, Thermo-electric refrigeration, Air purification, Central air conditioning systems.

Illumination Scheme: Basic terms used in illumination scheme, Electric lamps, Recommended levels of illumination, Types of lighting schemes, Design of lighting schemes, Factory lighting, Street lighting, Flood lighting.

Electrical Installation, Estimating and Costing: Types of load, Load assessment, Electrical supply systems, Wiring systems, Permissible voltage drops and conductor size calculations, Estimating and costing for residential and commercial service connections (single phase and three phase).

Power Factor: Effects of power factor, Causes of low power factor, Disadvantages of low power factor, Methods of improving power factor.

Electrical Safety Concepts and Criteria: Electrical shock mechanisms, Factors influencing the electric shock, Body current thresholds (tolerable body current limit), Thevenin's concepts and accidental equivalent circuits (step and touch potentials), Protection against electric shock.

Earthing Systems: Purpose of earthing, IS rules for earthing of electrical installations, Factors governing the resistance of earth electrode, Methods of earthing, Measurement of earth resistance, Methods of reducing earth resistance.

Protective Devices: Fuse, Miniature circuit breakers (MCB) and Earth leakage circuit breakers (ELCB).

Self Study:

The self-study contents will be declared at the commencement of semester. Around 10% of the questions will be asked from self-study contents.

References:

1. E. Openshaw Taylor, Utilisation of Electrical Energy, Universities Press.
2. H. Partab, Art and Science of Utilisation of Electrical Energy, Dhanpat Rai & Co.
3. J. B. Gupta, Utilization of Electric Power and Electric Traction, S. K. Kataria & Sons, New Delhi.
4. G. C. Garg, Utilization of Electric Power and Electric Traction, Khanna Publishers, Delhi.
5. R. K. Rajput, Utilisation of Electrical Power, Laxmi Publications (P) Ltd., New Delhi.
6. N. V. Suyranarayana, Utilisation of Electric Power Including Electric Drives and Electric Traction, New Age Publishers, New Delhi.
7. J. B. Gupta, A Course in Electrical Installation Estimating and Costing, S. K. Kataria & Sons, New Delhi.
8. Dr. J. G. Jamnani, Elements of Electrical Design, Mahajan Publishing House.

HS006/2HS006, Element of Marketing Management

[3 0 0 3]

Objective: To acquaint the engineering students with the basic concept of marketing management.

Marketing: Concept of marketing, core marketing concepts, importance and scope of marketing, company orientation towards market place

Product: Product and product mix, importance of product, product objective, product strategy planning for new product

Market Environment: Demographic, Economic natural, Technical, Political, legal, social cultural Consumer Buying Behaviour: Influences on buyer behaviour, buying decision process,
Market segmentation – levels, pattern and procedure

Distribution channels : Importance and factors of distribution channels, typs of channels, channels of distribution – consumption good, industrial goods, nature and type of retailers Function and type of wholesalers, selecting distribution, channels

Pricing: Nature and Importance of pricing, objectives of pricing. Considerations in price determination approaches to pricing.

Promotion: Promotion and its elements, objectives of promotion, promotion mix

Market research: Nature and scope, process of market research, uses and limitations

Text/Reference Books:

Marketing Management – Philip Kotler, PHI
Marketing Management – Rajan Saxena, TMH
Organization and management – R.D. Agrawal, TMH

2EC002 Embedded Systems [3 0 0 3]

Course Learning Outcomes:

After successful completion of the course, the students will be able to

- understand the structure of an embedded systems, their characteristics, design requirements and applications
- ability to identify the tools and techniques for embedded system hardware design
- ability to identify tools and techniques for software of embedded system
- understand operation of Real Time Operating System
- understand Device Drivers and their role in Embedded System design

Syllabus:

Introduction: Embedded Systems overview, characteristics of embedded systems, applications, common design metrics, design challenges, Processor technology, IC technology, Design Technology, Types of Embedded systems, Hardware and software units of embedded systems, examples of embedded systems

Processors: General purpose processors, their basic architecture, operations, Superscalar and VLIW architectures, application specific system processors, digital signal processors, ARM processor, selecting a microprocessor

Embedded Programming: Embedded software development Tools and Languages

Real Time Operating Systems: Operating System introduction, Real Time Operating System (RTOS), RTOS functions, RTOS processor scheduling models, task prioritization, context switching, multitasking, inter task communication, event management, locking mechanism, interrupt handling, case study: RTx51 tiny RTOS

Device Drivers: Introduction, their functions, architecture, types, and implementations

Networks for Embedded Systems: Distributed embedded architecture, I2C, CAN, SPI, USB Bus

Embedded System Design: System design techniques, design methodologies, requirement analysis, specifications, system analysis and architecture design, Quality assurance, design example

Self Study:

The self study contents will be declared at the commencement of semester. Around 10% of the questions will be asked from self study contents.

References:

1. Raj Kamal, Embedded systems Architecture, Programming and Design, TMH
2. Wayne Wolf, Computers as components Principles of embedded computing system design, Morgan Kaufmann
3. Frank Vahid, Tony Givargis, Embedded system design: A unified Hardware/Software introduction, Wiley publishers
4. Shibu K V, Introduction to Embedded Systems, TMH

Course Code	CE002
Course Title	Internet and Web Technologies

Course Learning Outcome (CLO):

At the end of the course, students will be able to -

- understand the architecture of web based applications and underlying technologies
- design an efficient web based applications using appropriate web technologies
- develop web based application using appropriate scripting languages

Syllabus:	Teaching Hours:
Unit I Internet Structure, Protocols and Access: Internet Protocol Model overview, Internet Addresses, Internet Protocol, Transport Layer, Upper layer Protocols, Internet Access, Internet Applications, About World Wide Web ,Future of Internet and Internet related applications WWW and Web Servers, IIS Configurations and settings, Apache Configuration, Introduction to PWS, Planning a Website. XHTML: Introduction, Forms, Internal Linking, Image Maps, meta, frameset	7
Unit II Cascaded Style Sheet: Inline styles, Embedded Style Sheets, Linking Style Sheets, Text Flow and Box Model. JavaScript: Introduction, Control Structures, Functions, Arrays, Objects.	8
Unit III Dynamic HTML: Object Model and Collection, Event Model, Filters and Transitions, Data binding and Tabular Data Control. XML: XML namespaces, DTDs and schemas, DOM , SAX, XSL, SOAP.	5
Unit IV ASP: Introduction, ASP Objects, FSO, Data Access Object. Building Interactive Animation: Working with Flash and Dream Weaver	6
Unit V Wireless Internet and m-business: Introduction to Wireless Internet, WAP, m-business. e- business and e-commerce. E- Business Models, Building an e-business Application, e-marketing, Security	4

Self-Study:

The self-study contents will be declared at the commencement of semester. Around 10% of the questions will be asked from self-study contents.

Laboratory Work:

Laboratory work will be based on above syllabus with minimum 10 experiments to be incorporated.

Suggested Readings^:

1. Deitel Deitel Nieto, Internet and World Wide Web: How to Program, Pearson Education

2. Minoli, Internet and Intranet Engineering, McGraw Hill Education

Course Code	CE002
Course Title	Internet and Web Technologies

Course Learning Outcome (CLO):

At the end of the course, students will be able to -

- understand the architecture of web based applications and underlying technologies
- design an efficient web based applications using appropriate web technologies
- develop web based application using appropriate scripting languages

Syllabus:	Teaching Hours:
Unit I Internet Structure, Protocols and Access: Internet Protocol Model overview, Internet Addresses, Internet Protocol, Transport Layer, Upper layer Protocols, Internet Access, Internet Applications, About World Wide Web ,Future of Internet and Internet related applications WWW and Web Servers, IIS Configurations and settings, Apache Configuration, Introduction to PWS, Planning a Website. XHTML: Introduction, Forms, Internal Linking, Image Maps, meta, frameset	7
Unit II Cascaded Style Sheet: Inline styles, Embedded Style Sheets, Linking Style Sheets, Text Flow and Box Model. JavaScript: Introduction, Control Structures, Functions, Arrays, Objects.	8
Unit III Dynamic HTML: Object Model and Collection, Event Model, Filters and Transitions, Data binding and Tabular Data Control. XML: XML namespaces, DTDs and schemas, DOM , SAX, XSL, SOAP.	5
Unit IV ASP: Introduction, ASP Objects, FSO, Data Access Object. Building Interactive Animation: Working with Flash and Dream Weaver	6
Unit V Wireless Internet and m-business: Introduction to Wireless Internet, WAP, m-business. e- business and e-commerce. E- Business Models, Building an e-business Application, e-marketing, Security	4

Self-Study:

The self-study contents will be declared at the commencement of semester. Around 10% of the questions will be asked from self-study contents.

Laboratory Work:

Laboratory work will be based on above syllabus with minimum 10 experiments to be incorporated.

Suggested Readings^:

3. Deitel Deitel Nieto, Internet and World Wide Web: How to Program, Pearson Education

4. Minoli, Internet and Intranet Engineering, McGraw Hill Education

L	T	P	C
2	0	2	3

Course Code	CE006
Course Title	Operating Systems

Course Learning Outcome (CLO):
At the end of the course, students will be able to -

- understand the components and functionalities of a typical operating system
- identify synchronization needs of various system resources for optimal utilization
- experiment with various control and scheduling activities of operating system components

Syllabus:	**Teaching Hours:**
Unit I	
Introduction: Evolution of operating systems, operating system services, types of operating system, different view of operating system, Review of types of I/O polled, interrupt driven and DMA. Process Scheduling: Concepts of Process, attributes of process, process control block, data structures. Processes and threads, process status, scheduler: long term, medium term, short term scheduler, matrix of evaluation, scheduling algorithms.	7
Unit II	
Inter process Communication(IPC):Need of IPC, concurrency, Race conditions, critical section, mutual exclusion problem, solution approaches, algorithmic approaches, critical region, condition for critical region, semaphore : Binary ,counting, the queuing implementation. Monitors, message passing: synchronous vs asynchronous message exchange. Classical IPC Problems: Dinning Philosopher Problem, Sleeping Barber Problem, Reader's & Writer Problem, procedure control.	6
Unit III	
Deadlock - Deadlock problem, deadlock characterization, dealing with dead lock, deadlock prevention, deadlock avoidance. Memory Management - Paging: Principle of operation, page allocation, h/w support for paging, multiprogramming with fixed no. of task, multiprogramming with variable no. of task, segmentation, virtual memory : concept of demand paging, page replacement algorithms, thrashing.	7
Unit IV	
Input Output Management-Principles of input/output: Input / Output devices, device controllers, direct memory access, principles of input/output s/w : goals of the input/output s/w, concepts of interrupt handler and device driver, devices as files, the inode structure and organization.	5
Unit V	
File Systems: file structure, file types, file access, file attributes, file operations, memory mapped files and directories: hierarchical directory system, pathnames, directory operations, contiguous allocation, linked list allocation, linked list using index, Inodes, Concepts of Shared files.	5

Self-Study: The self-study contents will be declared at the commencement of semester. Around 10% of the questions will be asked from self-study contents.

Laboratory Work:
Laboratory work will be based on above syllabus with minimum 10 experiments to be incorporated.

Suggested Readings^:

1. William Stalling, Operating System – Internals, Prantice Hall
2. Andrew S. Tanenbaum, Modern Operating Systems, Prentice Hall
3. Peterson, Operating System Concepts, Addition-Wesley Longman Publishing Co
4. Milan Milenkovic, Operating System – Design & Concepts, Mc Graw Hill
5. Stephen Prata, Advanced Unix - A Programmer's Guide, BPB Publications
6. Yashwant Kanitkar, Unix Shell Programming, BPB Publications
7. Sumitabha Das , Unix System V.4 Concepts & Applications, Pub. TMH
8. Maurice Bach, The Unix Operating System, Prentice Hall

L= Lecture, T= Tutorial, P= Practical, C= Credit[3]
^This is not an exhaustive list

3

IC002 Programmable Logic Controller [3 0 0 3]

Course Learning Outcome:

After successful completion of the course, student will be able to

- understand the fundamental principles of Programmable logic controller, I/O modules
- develop the ability to design program using standard programming technique
- develop and design an application orientated project using PLC

Syllabus:

Introduction: Definition, advantages and Importance of PLC, Evolution history of PLC, Architecture and block diagram.

PLC hardware : Types of PLC, CPU unit architecture, Input/Output devices and interfacing, Hand held programming terminals, Industrial computer and monitors,

PLC operation: Ladder logic, Logic functions, Wiring diagaram

PLC Programming: Basic relay instructions, timer-counter instructions, comparison, data handling, input-output instructions, sequencer instruction

PLC applications and case studies.

Self Study:

The self study contents will be declared at the commencement of semester.Around 10% of the questions will be asked from self study

References:

1. Webb and Reis, Programmable Logic Controllers, Principles and Applications.
2. Mitra and Gupta, Programmable Logic Controllers and Industrial Automation an Introduction.
3.

CL002 **Project Management** **[3 0 0 3]**

Course Learning Outcome:
After successful completion of the course, student will be able to

- understand project, management functions, planning, monitoring and controlling techniques
- develop network, calculate project duration and optimize time and cost
- implement resource allocation and control techniques
- identify, analyze and apply suitable planning and management techniques for project management

Syllabus

Introduction to Management: History, concept, need for scientific management, scope, functions, engineer as manager.

Organizational Structure: Need, types, principle, functions of various personnel, organization as resource.

Material Management: Objectives, scope, functions, stages of material management, inventory control.

Personnel Management: Special characteristics, man power planning, recruitment, placement, training and induction, motivation, performance appraisal, industrial relation, aspect of administration, motivation, public relation, welfare measures.

Project Planning and Control: Project life cycle, identification, budget planning, appraisal, negotiation, approval, detailed planning, implementation, monitoring and control, evaluation, planning techniques and their merits and demerits.

Network Analysis: History, Bar chart, CPM and PERT: development of network, time estimates and computation, analysis of network, time-cost trade off, updating and resource allocation.

Accounting and Financial Management: Accounting: Concept, objectives, types, principles. Finance Management: Finance as resource, functions, control, cost analysis. Financial statements: Balance sheet, profit and loss account, fund and cash flow statement. Financial Analysis**:** Financial ratio, types, significance Methods, factors, purpose, financial analysis, cost-benefit ratio. C-V-P analysis: concept, assumption, fixed and variable cost, breakeven point, margin of safety, utility.

- Project Information System: Need, components, use of computer, implementation, monitoring, reports, schedule and budget, updating, cost and time control.
-
- **Self Study:**
- The self study contents will be declared at the commencement of semester. Around 10% of the questions will be asked from self study contents.

References:

1. Nagarajan, Project Management, New Age International Publishers
2. Harold Kerzner, Project Management: A System Approach to Planning, Scheduling and Controlling, John Wiley and Sons
3. Burke and Rory, Project Management: Planning and Control Techniques, John Wiley and Sons
4. Prasanna Chandra, Financial Management: Theory and Practice, Tata McGraw Hill
5. P Gopalakrishnan, Materials Management, Prentice Hall
6. K. Aswathappa, Human Resource Management: Text and Cases, Tata McGraw Hill

HS005 **Technical Writing** **[3 0 0 3]**

Course Learning Outcome

After successful completion of the course, student will be able to

1. Participate actively in writing activities (individually and in collaboration) that model effective scientific and technical communication in the workplace.
2. Understand how to apply technical information and knowledge in practical documents for a variety of a.) professional audiences (including peers and colleagues or management) and b) public audiences.
3. Practice the unique qualities of professional writing style, including sentence conciseness, readability, clarity, accuracy, honesty, avoiding wordiness or ambiguity, previewing, using direct order organization, objectivity, unbiased analyzing, summarizing, coherence and transitional devices.

An introduction to technical writing

- Technical writing vs. General writing b. Purpose, importance and characteristics of technical writing.
- Objectives of technical writing: Clarity, conciseness, accuracy, organization, ethics.
- Audience recognition and involvement: High tech audience, low-tech. audience, gender neutral language.

Memorandum:

- Objectives, difference between memos, letters and emails. Criteria and format for writing and memos.

Technical description:

- Criteria and process.
- Technical instructions for user's manual

Report Writing:

- Characteristics, types and writing of various reports: feasibility reports, inventory report, mishap report, progress report, laboratory report.

Letter- writing:

- Business letters, Job-applications, Resume.

Business Proposals:

- Types & formats

Graphic representation of Technical Data

SOP writing

Promotional Writings

- Technical Brochure designing
- Content writing for Websites (For promotional and troubleshooting purposes)
- Writing Fliers and Newsletters

Academic Writing

- Summaries, abstracts and instructions

Case studies on Technical Writing.

Reference Books:

1. Sharon J. Gerson and Steven M. Gerson, , Technical writing – process and product ,Person Education Asia .
2. Andrea J. Ratherford ,Basic Communication Skills for Technology,Person Education Asia
3. Pfeiffer, W.S. and T.V.S. Padmaja. Technical Communication. Pearson
4. Muralikrishna and Sunita Mishra. Communication Skills for Engineers. Pearson

HS003 **Introduction of Accounts** **[3 0 0 3]**

Objective To understand the various concepts of financial and cost accounting

Financial Accounts : Accounting equation, Journal, Cash book, Ledger, Trial Balance, Profit & Loss Account, balance Sheet

Cost Accounts : Cost classification (direct cost, indirect cost, variable cost, fixed cost) Prime cost, conversion cost, full cost, Cost - Volume – Profit Analysis, Absorption costing, activity based costing, budgetary control, standard costing.

Reference Books:

1. Accounting for Managers by Jawaharlal TMH
2. Accounting Principles by Anthony &bn . Reece, AITB

HS001 **Entrepreneurship Development** **[3 0 0 3]**

Objective:	To acquaint the engineering students with the basic concepts of Entrepreneurship with an effort to develop entrepreneurial skill amongst the students.
Entrepreneurship :	Definition and structure. Entrepreneurial culture, the concept of Entrepreneurship. Entrepreneurial Traits: Entrepreneurial Skills, Qualities and Characteristics of an Entrepreneur, Nature and Importance of entrepreneurs. Entrepreneurship as a career choice. Contribution of entrepreneurs to the Development of the Nation.
Entrepreneurial Development :	entrepreneurial Environment, Meaning and Process of entrepreneurial Development. Entrepreneurial Development Training, Importance, Objectives and Methods of Training.
Project Management :	Search for Business Idea, Concept of Project and classification. Project Identification and Formulation. Project Design & Network Analysis. Project Report, Project Appraisal.
Financial Analysis :	Investment Process, Break even analysis, Budget and Planning Process.
Sources of Finance :	Sources of Development Finance, Financial Institutions.
Establishing a small scale Industry:	Location, Steps of Setting up a Small Scale Industry, Selection of Organization.
Marketing Environment :	Marketing Segmentation, Market Research, Market Planning.

Text/Reference Books:

1. A handbook for New entrepreneurs by EDI, Published by Oxford University Press.
2. Dynamics of Entrepreneurial Development and Management – Vasant Desai, Himalaya Publishing House
3. Entrepreneurship Development – Dr. Y.P. Hathi, Dr. Rupesh Vasani, Mahajan Publishing

HS014 **Banking & Finance** **[3 0 0 3]**

Objective: To understand the various concepts of banking and financial system

Indian Financial System: The Financial System, Nature, Evolution and Structure, the Functions of Financial Intermediaries, Financial Instruments, the Role of Financial System in Economic Development, the Indian Financial System. The Origin and Growth of Banking of Banking, Functions of Commercial Banks,, Banking in the New Millennium.

Banker Customer Relationship: Types of Accounts, Types of Relations, KYC Norms, Banker – Customer relationship, Rights and Duties of Banker/ Customer, Importance provisions of NI Act

Sources &Uses of Funds: Bank Balance sheet, Sources & Uses of Funds in a Bank. Form of Balance Sheet of Banking Companies. Different Schedule under Banking Regulation Act. – Provisioning norms of CRR & SLR

Deposit Management: Importance of Deposit, Types of Deposit in India, USA & Europe. NRI Deposits, Cost of Deposit & its impact on Profitability, concepts of Fixed & Floating Rate of Interest, Deposit Insurance.

Cheques: Special Features Negotiability, Validity, Crossing & Endorsement.

Cash Management: Importance of Cash Management issues, Cash at Counter, Vault & Currency Chest.

Lending Activities : Lending activity, Basic requirements for lending.

Credit Policy: Need for Credit Policy, Components of Credit Policy, Credit Policy Pursued by the Government, Bench Marks Exposure Norms, Credit Culture.

Retail Banking: Basics of Retail Banking, Forms of Retail Banking and Emerging issues

Corporate Banking: The nature of corporate banking, Developments in corporate banking, Consortium finance, Multiple banking arrangements, and Loan syndication

Feebased Services: Feebased Services L/C,B/G, Subsidary services, Bancassurance, Demat Account, Safe Deposit Locker , Mutual Funds, Merchant Banking Activities – Management of Public issues, Reasons, Eligibility norms, Regulatory framework, Marketing of issues, Post issue activities

Plastic Money: Different types of plastic money, Concept of a credit card, Distinction between Credit card, Charge card and Debit card, Mechanics of a credit card transaction, Credit card as an augmented retail financial product, Credit card business in India, The merging scenario CRM, (AWB, ATM, Mobile Banking Internet Banking) Delivery Channels (Payment & settlement services)

Reference Books:

1. Management of Banking & Financial Services - Paul, Justin / Suresh, Padmalatha. Pearson – 2007
2. Financial Institutions and Markets, 4th e Bhole, LM. Tata McGraw Hill 2004
3. Indian Financial System, Theory and Practice, 4th e, Khan, M Y. Tata McGraw Hill 2004

CH801 **Major Project** **[0 0 0 26]**

Course Outcomes:

After successful completion of the course, student will be able to

- use various tools and techniques to study existing systems
- critically analyse existing systems, thereby select and justify parameters to be improved
- start and manipulate proposed engineering solution as per industry / research / societal need
- achieve precision in uses of the tools related to their experiments/fabrication
- reorganize and refine various components of technology to optimize the resources at large
- appraise the potential of technology for scalability and wide spectrum of applications
- report project related activities effectively to peers, mentors and society
- follow and value health, safety and ethical practices during project

Syllabus:

The major project shall be based on the recent trends in technology, system/process analysis, construction/fabrication/production techniques, design methodologies etc. The student(s) shall carry out a comprehensive project at relevant Academic/R&D/Industrial organization based on one or more of the following aspects: prototype design, product preparations, working models, fabrication of set-ups, laboratory experiments, process modification/development, simulation, software development, integration of software and hardware, data analysis, survey etc.

The student is required to submit comprehensive project report based on the work.

L	T	P	C
3	-	-	3

Course Code	UEIP007
Course Title	Advanced Instrumental Techniques

Scope:

This subject deals with the application of instrumental methods in qualitative and quantitative analysis of drugs. This subject is designed to impart a fundamental knowledge on the principles and instrumentation of spectroscopic and chromatographic technique. This also emphasizes on theoretical and practical knowledge on modern analytical instruments that are used for drug testing.

Objectives:

Upon completion of the course, the student shall be able to-

1. Understand the interaction of matter with electromagnetic radiations and its applications in drug analysis
2. Understand the chromatographic separation and analysis of drugs.
3. Perform quantitative & qualitative analysis of drugs using various analytical instruments.

Course Learning Outcomes (CLO):

At the end of the course, students will be able to -

1. Recall the fundamental theory of different spectroscopic techniques. E-1
2. Recognize the fundamentals, instrumentation and application of various chromatographic methods S-17
3. Discuss the instrumentation and application of various spectroscopic techniques S-19
4. Describe various X-ray methods E-1
5. Apply the knowledge of chromatographic techniques for the separation of the component. ENT-13

UEIP001 **COSMETIC TECHNOLOGY**

Learning Outcomes:

After successful completion of the course student will be able to :

- Acquire comprehensive knowledge about the various raw materials used in cosmetic formulations
- Create and develop cosmetic formulations
- Analyze the cosmetic formulations for evaluating its efficacy and safety
- Understand the regulatory guidelines related to cosmetic formulations

Theory (Detailed Syllabus)

L	P	C
3	-	3

1. Introduction: The scope, historical background and present status of herbal cosmetics.
2. Classification of Cosmetics.
3. Raw materials used for formulation of skin care and hair care cosmetics: Source and description of raw materials of natural origin like fixed oils, waxes, gums, hydrophilic colloids, colours, perfumes, protective agents, bleaching agents, preservatives, antioxidants and other ancillary agents used in the cosmetic formulations.
4. Formulation and analysis of cosmetics: hair care, skin care and oral care products.
5. In vitro and in vivo models for efficacy testing for various cosmetic products.
6. Regulatory guidelines:

   Complaince of Drug & Cosmetic Act 1940 with reference to provisions for packaging and labelling (Rule 150 A, schedule S), permitted colors, flavors etc.

   BIS guidelines for cosmetic products and raw materials.

Total Lectures: **45**

Books Recommended:

1. Sagarin Edward, Cosmetic Science and Technology Vol. I, II, III , Wiley India Pvt. Ltd., Canada, 1992
2. Sharma P.P., Cosmetic Formulation, Management and Quality Control, Vandana Publications Pvt. Ltd., Vandana Publications, Delhi, 2010
3. Paye M, Barel A.O., Maibach H.I., Handbook of Cosmetic Sciences, Informa Press, Tylor and Fransis, LLC, 2006
4. Panda H., Herbal Cosmetics Handbook, Asia pacific Business press, 2004
5. Veermeer B.J., Cosmeceuticals: Drugs vs. Cosmetics, Marcel Dekker, Editors: Peter Elsener, Howard I. Maibach, Marcel Dekker Inc., New York, 2000.

UNIT I **10 Hours**

- **Spectroscopic Techniques**
  UV-Visible spectrophotometry: Theory of electronic spectroscopy absorption by organic molecules, choice of solvent and solvent effect, applications of UV-Visible spectroscopy.
- **Infra-red spectrophotometry:** Absorption in the infrared region, factors influencing molecular vibrations, applications, interpretation of infra-red spectra, FTIR- Theory, Instrumentation.

UNIT II **10 Hours**

- **Nuclear Magnetic Resonance Spectroscopy:** Basic principles, the theory of PMR spectroscopy, Instrumentation, Chemical shift, spin-spin coupling, factors affecting chemical shift and spin coupling, applications, ^{13}C NMR spectroscopy, interpretation of NMR spectra.
- **Mass spectroscopy:** Basic principles, ion formation and types, Fragmentation rules, recognition of molecular ion peak, interpretation of spectra and applications.

UNIT III **10 Hours**

- **Raman Spectroscopy**: Basic principle, instrumentation, applications.
- **Atomic absorption and atomic emission spectroscopy**: Basic principles, instrumentation, applications.
- **X-ray diffraction methods:** Introduction, Bragg's law, X-ray absorption and X-ray diffraction methods and applications.

UNIT IV **15 Hours**

- **Separation techniques**
  Classification of chromatographic methods based upon the mechanism of separation and mode of separation with its fundamental principle, instrumentation and application
  High-Pressure Liquid Chromatography
  Gas chromatography
  High-Performance Thin Layer Chromatography

Suggested Readings^: (Latest edition)

1. Silverstein, R. M., Bassler, G. C., & Morrill, T. C. Spectrometric Identification of Organic Compounds, John Wiley& Sons. Inc., New York.
2. Kalsi, P. S., Spectroscopy of organic compounds. Place of publication not identified: New Age International Pvt
3. Skoog, D. A. H., James, F., & Nieman, T. A. Principles of Instrumental Analysis. Eastern press.
4. Lindsay, S. High performance liquid chromatography. Chichester: Wiley.

L	T	P	C
3	-	-	3

Course Code	UEIP007
Course Title	Drug Discovery and Development

Course Learning Outcomes (CLO):

After successful completion of the course, student will be able to –

1. Understand the overall process for drug discovery and development.
2. Describe various methods of drug discovery.
3. Discuss different techniques of drug design and molecular modeling.
4. Explain the role of combinatorial chemistry in rational drug design.
5. Use bioinformatics, cheminformatics, genomic and proteomics knowledge for drug discovery.

Syllabus: **Teaching hours: 45 Hours**

UNIT I **10 Hours**

Introduction to Drug Discovery and Development

- Historical development, drug development pipelines, various stages and their importance, improvement of existing drugs, pre-marketing development of drugs, synthetic screening including extensive screening, random screening of intermediates and final leads, source of new drug discovery.

UNIT II **10 Hours**

Methods in Drug Discovery

- Introduction, structure activity relationships and quantitative structure activity relationships, structure toxicity relationships, various physiological properties, mathematical models, experimental and theoretical approaches of physicochemical parameters, parameter inter-dependence, case studies.

UNIT III **10 Hours**

Drug Design and Molecular Modeling

- General introduction, pharmacophore model, primary biological targets, structural determination of primary targets, introduction to docking, molecular docking, *in silico* prediction by molecular docking, methodologies with suitable case studies.

UNIT IV **10 Hours**

Combinatorial Chemistry in Drug Design

- Introduction, principle of combinatorial chemistry, synthetic methodologies including solid phase synthesis (SPS) and solution phase chemistry, high throughput screening, library preparation.

UNIT V **05 Hours**

Bioinformatics, Cheminformatics, Genomic and Proteomics

- Introduction, application, significances in new drug discovery, suitable case studies in each topic.

Suggested Readings^: (Latest edition)

1. Robert, G.C.K. ed. *Drug Action at the Molecular Level*. University Prak Press Baltimore.
2. Cohen N. C. *A Guidebook on Molecular Modeling and Drug Design*. Elsevier Publications.
3. Wilson, C. O., Beale, J. M., & Block, J. H. Wilson and Gisvold. *A textbook of organic medicinal and pharmaceutical chemistry*. Lippincott Williams & Wilkins.
4. Foye, W. O. *Foye's principles of medicinal chemistry*. Lippincott Williams & Wilkins..
5. Koro l.A. Burckhalter J.H. *Essentials of Medicinal* Chemistry. Wiley Interscience
6. Burger, A., & Abraham, D. J. *Burger's medicinal chemistry and drug discovery* (Vol. I–IV). Wiley.
7. Krogasgaard, P. *A textbook of Drug Design and Development*. Harwood Academics.
8. Smith, H. J., & Williams, H. (2016). *Introduction to the principles of drug design*. Elsevier.
9. Silverman, R. B., & Holladay, M. W. (2014). *The organic chemistry of drug design and drug action*. Academic press.

L= Lecture, T= Tutorial, P= Practical, C= Credit

^ this is not an exhaustive list

Course Title: Elements of Management

Credit Hours: 3

Course Number: UEIM004

Course Objectives

- To familiarize the students with the Management Discipline.
- To understand the role of a manager in managing people and organizational activities.

Learning Outcomes

At the end of the course, students will be able to:

1. Understand the major functions of management viz. Planning, Organizing, Leading and Controlling,
2. Describe the interrelationship among the various functions of Management
3. Develop a general management perspective, and

Syllabus

Module 1: NATURE & EVOLUTION OF MANAGEMENT
• Meaning & Scope of Management • Management a Science and/or Art? • Management Vs Administration • Management as a Profession • Evolution of Management Thought • Early Classical Approaches – Scientific Management, Administrative Management, Bureaucracy • Neo-Classical Approaches – Human Relations Movement, Behavioural Approaches • Modern Approaches – Quantitative Approach; Systems Approach; Contingency Approach • Management Process • Functional Areas of Management • Global Applications • Management Practices in India

Module 2: MANAGERIAL ROLE & EXTERNAL ENVIRONMENT

- Role of Managers
- Mintzberg's Ten Managerial Roles
- Functions of Various Levels of Management
- Managerial Skills
- External Environment of the Organization & Its Impact on Organizational Operations
- Globalization and Business Environment

Module 3: PLANNING AND ORGANIZING

Planning

- Planning: Meaning, Need & Importance
- Planning Process
- Types of Plans; Objectives,Policies, Procedures and Methods
- Nature and Type of Policies
- Types of Planning; Advantages & Limitations
- Forecasting: Need & Techniques

Organizing

- Division of Work
- Departmentation; Definition; Departmentation by Function, Territory, Product/Service, Customer Group; Matrix Organization
- Line & Staff; Span of Control
- Authority; Delegation of Authority; Centralization & Decentralization; Formal and Informal Organizations

Module 4: Coordination and Control

Coordination

- Need for Coordination
- Types and Techniques or Coordination
- Coordination Process
- Coordination Characteristics
- Coordination: Advantages and Limitations
- Distinction between Coordination and Co-operation

Controlling

- Concept of Controlling
- Types of Controls
- Design of Control Process
- Control Methods – Financial; Budgetary; Operational; Quality; Information Systems & Control
- Responsibilities of Managers

Module 5:Current Trends in Management
• Managing Diversity • Technology Management • Capability Development • Management of Family Owned Businesses • Relevance of Management to Modern Industries and Government
• Management Lessons from Indian Ethos

Suggested Readings

1. Stoner, J. A. F. & Freeman, R. E. Management, (6th Ed). Prentice Hall, 1995.
2. Prasad, L. M. Principles and Practice of Management. (7th Ed). Delhi: Sultan Chand & Sons. 2008.
3. Drucker, P. The Practice of Management. Elsevier Ltd. 1955, Reprint 2007.
4. Hampton, D. R. Contemporary Management. (2nd Ed). McGraw Hill. 1981, Reprint 2008.
5. Tripathi, P. C. & Pandey, P. N. Principles of Management . (5th Ed). New Delhi: Tata McGraw Hill. 2012.
6. Koontz,H., Weihrich, H. & Aryasri, R. Principles of Management. Tata McGraw Hill. 2004.

Course Title: Financial Management

Credit Hours: 3

Course Number: UEIM007

Course Objectives

- To provide students with the basic understanding of financial management in an organizational context
- To help them understand the working of financial markets
- To enable them to use spreadsheets to perform financial analysis

Learning Outcomes

At the end of the course, students shall be able to:

1. Understand the significance of financial management to firm performance
2. Identify the variables important to making financial decisions
3. Perform primary investment decision analysis
4. Describe sources of funds and their costs
5. Perform basic financial analysis using spreadsheets

Syllabus

Module 1: Basics of Financial Management
• Introduction to Financial Management • Role and Functions of the Finance function • Time Value of Money • Basics of Risk and Return
Module 2: Financial Markets and Instruments
• The Financial System • Introduction to Financial Markets and Instruments • Sources and Cost of Capital

Module 3: Major Financial Decisions
• The Investment Decision • The Funding Decision • The Distribution of Profit Decision • Introduction to Working Capital Management • Managing Risk
Module 4: Using Spreadsheets in Finance
• Introduction to Financial functions in Spreadsheets • Spreadsheet Application Exercises

Suggested Readings

1. Chandra, P. (2010). Fundamentals of Financial Management. New Delhi: Tata McGraw Hill.
2. Khan, M. Y. & Jain, P. K. (2012). Fundamentals of Financial Management. New Delhi: Tata McGraw Hill.
3. Pandey, I. M. (2011). Essentials of Financial Management. New Delhi: Vikas Publishing House.
4. Ross, S., Westerfield, R. & Jordan, B. (2012). Fundamentals of Corporate Finance. New Delhi: Tata McGraw Hill.
5. Rustagi, R. P. (2011). Financial Management: Problems & Solutions. New Delhi: Taxmann.
6. Wachowicz J. M. & Van Horne, J. C. (2009). Fundamentals of Financial Management. New Delhi: PHI Learning

UEIL007 **Forensic Science and Law**

Teaching Hours: 45 Credit: 3

I INTRODUCTION:

The functioning of a criminal justice system depends on the principle of proving the guilt beyond reasonable doubt. It is believed that punishment should be awarded only when there is substantial proof that the person being convicted has an established guilt in the matter concerned. For this purpose, evidence is generated that provides for the involvement of a person in a particular act. Evidence is the arena wherein the concept of forensic science comes into play. Forensic science is that branch of science which provides practical application of scientific technology to investigate criminal or legal matters. The Indian Criminal Justice system is an adversarial system which means there are two parties, and both of them present their cases and the court decides the case on the basis of evidence provided by the parties. Forensic science is resorted to for the purpose of attaining a lead as to involvement of the person in question or for that matter identification of any other person who may have been involved. This course tries to analyse involvement of forensic science in criminal justice system with relate to Quality in Forensic Science, Importance of crime scene, Preservation of crime scene. Issue of admissibility, the increasing role of scientific technique, admissibility standards for expert evidence, to name a few.

II COURSE LEARNING OUTCOME:

After the completion of the course the students will be able to:

1. Understand and describe the underlining concepts of forensic science
2. Identify and articulate the emerging issues in forensic evidence.
3. Analyse the benefit and cost of using new scientific technique in criminal investigation.
4. Evaluate the issues relating to admissibility of forensic evidence in a court of law.

III SYLLABUS:

1. **Scene of crime and sight of Law**

   This unit examines a number of critical issues associated with the collection of forensic evidence at the crime scene such as quality in Forensic-Science, importance of crime scene, preservation of crime scene. Exploring these areas by keeping in mind that the crime scene is one of the most crucial aspects of an investigation and that the scene of the crime is where collection of forensic evidence begins.

22

2. **Proved beyond doubt? Scientific Technique in Criminal Investigation**
This unit examines the science of DNA identification, Brain finger printing, Lie Detector Test, Narco Analysis Test and its use during criminal investigations and in criminal proceedings, including criminal trials, appeals and post-conviction proceedings. This unit try to analyse the main benefits and costs of the increasing role of scientific technique in the criminal justice system with special emphasis to India and the challenges of these technologies in future.
3. **Scientific Evidence in Court of Law**
Development of scientific and technical expert testimony in the complex and technical issues has flooded the judicial system, the question of its reliability and admissibility has also plagued the courts and engendered much debate. This unit try to analyse the issue of admissibility which has attracted the attention of countless commentators and the offered arguments supporting greater or lesser barriers to the admissibility of scientific expert evidence.

4. **Need for caution: Problematizing Pitfalls**
This unit discusses *Daubert*in a new context, using the Indian case of *State of Maharashtra v. Sharma* as an example of how unreliable, questionable evidence can penetrate the courtroom when admissibility standards for expert evidence do not keep it at bay. This unit also analyses *Daubert* against the backdrop of rapidly emerging technologies and highlights the fact that courts can expect to confront increasing amounts of technical expert evidence in the future.

5. **Scientific race and legal pace: struggle of catching up**
In addition to the conventional areas of study mentioned in the above units, this unit tries to explore the field of forensic science which constantly expands to include many additional areas of expertise include analyses of bloodstain pattern interpretation, forensic engineering, forensic cyber technology, and criminal personality profiling, forensic economics, forensic photography, forensic radiology, and forensic accounting. Further this unit also tries to understand emerging specialty known as forensic security with which today's loss prevention manager must become quite familiar if he or she is to successfully respond to the growing challenge of premises liability for negligent security litigation facing today's businesses, corporations, and commercial/ residential landlords from a broader perspective.

IV REFERENCES:

- Henry C. Lee, *Forensic Science and the Law*, 25 CONNECTICUTLAW REVIEW (1117-1125) (1993).
- Michael J. Saks & Jonathan Koehler, *The Individualization Fallacy in Forensic Science Evidence,* 61, VANDERBILT LAW REVIEW(pp199-219) (2008).

- John I. Thornton, *Uses and Abuses of Forensic Science*, Vol. 69 AMERICAN BAR ASSOCIATION JOURNAL(pp 289-292) (1983).
- Foster William L, *Expert Testimony- Prevalent Complaints and Proposed Remedies*, 11(3), HARVARD LAW REVIEW(pp169-186) (1897)
- Alldrige Peter, *Forensic Science and Expert Evidence*, 21(1), JOURNAL OF LAW AND SOCIETY(pp 136-150) (1994).
- Brigham John C., *What is Forensic Psychology, Anyway?* 23(3), LAW AND HUMAN BEHAVIOUR(pp 273-298) (1999).
- Diamond Bernard L., *Inherent Problems in the Use of Pre-trial Hypnosis on a Prospective Witness*, 68(2), CALIFORNIA LAW REVIEW (pp 313-349) (1980).
- Tovino Stacey A., *Imaging Body Structure and Mapping Brain Function: A Historical Approach*, Vol.33, AMERICAN JOURNAL OF LAW AND MEDICINE (pp 193-228) (2007).
- Lyndia D., Johnson, *Guilty or Innocent-Just Take a Look at My Brain: Analysing the Nexus between Traumatic Brain Injury and Criminal Responsibility.* Vol. 37 (1): SOUTHERN UNIVERSITY LAW REVIEW. (pp 25-40) (2009).
- Danielle, Andrewartha , *Lie Detection in Litigation: Science or Prejudice (article).* Vol.15(1): PSYCHIATRY PSYCHOLOGY AND LAW.(pp 88-104) (2008).
- Robbert L. Collins, *Improved Crime Scene Investigation*, ,JOURNAL OF CRIMINAL LAW, CRIMINOLOGY AND POLITICAL SCIENCE.
- Whitman Glen, Koppl Roger, *Rational Bias in Forensic Science*, 9, OXFORD JOURNAL: LAW, PROBABILITY & RISK. (pp 69-90) (2010)
- Williams John F, *Trace Evidence.* 49, THE JOURNAL OF CRIMINAL LAW, CRIMINOLOGY AND POLICE SCIENCE. (pp 285-288) (1958).
- Kingston Charles R., *Application of Probability Theory in Criminalistics,* 60, JOURNAL OF AMERICAN STATISTICAL ASSOCIATION. (pp 70-80) (1965).
- Rao Dr. G.V., *DNA Testing: Mere match is not conclusive proof unless statistics corroborate*, 118, CRIMINAL LAW JOURNAL (October 2012)
- Gupta Mohit, *Digital Forensics, Hacking and its Role in Crime Investigations,* MEDICO LEGAL UPDATE (pp98-100)
- Celine Weyermann, Olivier Ribaux, *Situating forensic traces in time*, JOURNAL OF THE FORENSIC SCIENCE SOCIETY SCIENCE AND JUSTICE, 52, (pp68-75) (June 2012).
- John W. Bond, *The value of fingerprint evidence in detecting the crime,* INTERNATIONAL JOURNAL OF POLITICAL SCIENCE AND MANAGEMENT Vol.11 (77-82)
- Stan Brown and Sheila Willis, *Complexity in Forensic Science,* Vol.(1:4), FORENSIC SCIENCE POLICY AND MANAGEMENT: AN INTERNATIONAL JOURNAL (pp 192-198) (2010).
- Roach Kent, *Forensic Science and Miscarriage of Justice: Some lessons from Comparative Experience*, Vol.50, JURIMETRICS, (pp 67-92) (2009)

Reference Books:-

- MAHENDRA SINGH ADIL, SCENE OF CRIME- CRITICAL ROLE AND USAGE OF SCENE OF OCCURRENCE IN TRIAL,(Capital Publishing House, Delhi.)

24

- GROSS'S CRIMINAL INVESTIGATION, (5th Edition, Universal Law Publishing Co. 3rd Indian Reprint, Delhi) (2008).
- SHARMA B.R., SCIENTIFIC CRIMINAL INVESTIGATION, (Universal Law Publishing Co., Delhi) (2006).
- K. MATHIHARAN AND AMRIT K PATNAIK, MODI'S MEDICAL JURISPRUDENCE AND TOXICOLOGY, (23rd Edition, Lexis NexisButterworths).
- EDWARD HUESLE, .FIREARMS AND FINGERPRINTS, ESSENTIALS OF FORENSIC SCIENCE, (1st Indian Edition, Viva Books Private Limited, New Delhi) (2007)
- MAX M HOUCK, TRACE EVIDENCE, ESSENTIALS OF FORENSIC SCIENCE-(1st Indian Edition, Viva Books Private Limited, New Delhi) (2007).
- JYOTIRMOY ADHIKARY, DNA TECHNOLOGY IN ADMINISTRATION OF JUSTICE (Lexis NexisButterworths, New Delhi) (2007)

125

Course Title: Fundamental of International Business

Credit Hours: 3

Course Number: UEIM003

Course Objectives

- To introduce the students various concepts and issues in international business and related activities.
- To evaluate global business opportunities and develop skills to deal with various issues involved in cross-border transaction of goods, services and other resources between two or more nations.

Learning Outcomes

At the end of the course, students shall be able to:

1. understand and evaluate the basis of international trade and business.
2. explain the various methods of entry into foreign markets and assess the suitable mode for international business.
3. understand the concept of globalization and discuss the implications of GATT/WTO in international business.
4. understand the India's institutional and policy framework for international business.

Syllabus

Module 1: AN OVERVIEW TO INTERNATIONAL BUSINESS
Introduction □ Evolution Of International Business □ Stages Of Internationalization □ International Business Approaches □ Importance Of Cross Cultural Differences In International Business □ Modes Of Entry Into International Markets □ Advantages And Problems Of International Business

Module 2: CONCEPTUAL FRAMEWORK: INTERNATIONAL TRADE, INVESTMENT, BALANCE OF PAYMENT AND TERMS OF PAYMENT
▯ Mercantilism ▯ Theory Of Absolute Cost And Comparative Cost Advantage ▯ Relative Factor Endowment Theory ▯ Product Life Cycle Theory ▯ Porter's National Competitive Advantage Theory ▯ Foreign Collaboration/Technology Transfer Related Issues ▯ Factors Influencing FDI ▯ Reasons And Cost And Benefits Of FDI ▯ Concept Of Balance Of Payments And Its Components ▯ Terms Of Payment
Module 3: GLOBALISATION, WORLD TRADE ORGANISATION AND REGIONAL ECONOMIC INTEGRATION
▯ Concept Of Globalization ▯ Drivers Of Globalization ▯ Globalization Of Markets, Production, Investment, Technology ▯ Advantages And Disadvantages Of Globalization ▯ General Agreement Of Tariff And Trade ▯ Uruguay; Round, Establishment Of WTO And Various Agreement Of WTO ▯ GATS - Trade In Services ▯ Concept Of Regional Integrations And Regional Blocks
Module 4: INDIA'S INSTITUTIONAL AND POLICY FRAMEWORK FOR INTERNATIONAL BUSINESS
▯ Policy And Service Support Organizations ▯ Commodity Specialization ▯ Training And Research Institutions ▯ Trading / Service Corporations ▯ Risk Covering Institutions ▯ Financial Institutions ▯ Institutions Especially For SSIs and State Participation ▯ An Overview Of India's Foreign Trade Policy And Procedure

Suggested Readings

- Carbaugh J. R.International Economics. Bangalore: Thompson South-Western,

Latest Edition.

- Chugan, P. K. International Technology Transfer. Mumbai: Himalaya Publishing House.
- Czinkota R.M., Ronkained I.A. and Moffet, M.H. International Business. Bangalore: Thompson South-Western. Latest Edition.
- Foreign Trade Policy and Handbook of Procedures. New Delhi: Centax Publications. Latest Edition.
- Francis C. International Business Environment. New Delhi: Prentice-Hall India, Latest Edition
- Joshi, R. M. International Business. New Delhi: Oxford University Press. Latest Edition.
- Mithani, D.M. International Economics. Mumbai: Himalaya Publishing House. Latest Edition.
- Paras R. Export – What, Where and How. New Delhi: Anupam Publications. Latest Edition.
- Paul, Justin. International Business. New Delhi: PHI Learning Pvt. Ltd. Latest Edition
- Rao, S. P. International Business; Text and Cases. Mumbai: Himalaya Publishing House. Latest Edition.

Course Code	UEIA001
Course Title	GIS AND REMOTE SENSING

Course Learning Outcomes (CLO):
At the end of the course Students will be able to -

- Develop understanding about database management.
- Display data in maps.
- Acquire fundamental knowledge of Remote Sensing through Satellite imageries.
- Gain insights on application of GIS and Remote Sensing in Planning.
-

Teaching hours: 60

Syllabus:

Unit 1: Database Management and Data Analysis Hours: 12

- Fundamental concpets of Database Management System
- Query Building
- Understanding the usage of ArcTool Box
- Creating Charts and graphs
- Statistics Summary
- Using Field Calculator
- Calculate Geometry
- Buffering or Proximity Analysis
- Overlay Analysis
- 3D, spatial and statistical analysis
- Land Matrix
- Land Utilization
- Cloud Computing
- Crowd Sourcing

Unit 2: Displaying Data in Maps and Map Elements Hours: 16

- Symbology
- Labeling and Annotation
- Creating Map Layout
- Inserting Map Scale; Legend Map; Title; North Symbol; Creating Grids; Other map Elements and Saving a Layout.
- Conducting a Land Suitability Analysis using GIS, Introduction to new concepts like cloud computing, crowdsourcing etc.

Unit 3: Remote Sensing and Photo Interpretation Hours: 16

- Remote Sensing -Definition, Aerial and Satellite Remote Sensing; Aerial Photo-Interpretation, Qualitative and Quantitative Elements of Photo- Interpretation
- Satellite Remote sensing, Geo-Stationary and Sun-Synchronous Satellites, Principles of Electro-Magnetic Radiations, Resolutions
- Introduction to Digital Image Processing
- Salient Features of Popular Remote Sensing Satellites; Applications in Planning
- Laboratory Exercises

Unit 4: Photogrammetry Hours: 08

- Limitations of Traditional Surveys for Planning
- Photogrammetry as an Alternative Tool for Surveying
- Arial Photographs, Classification
- Principles of Stereoscopic Vision
- Basic instruments -Stereopair, Pocket and Mirror Stereoscopes, Parallax Bars
- Principles of Photogrammetry, Measurement of Heights and Depths
- Introduction to Digital Photogrammetry

Unit 5: Planning Information Systems in India Hours: 08

- Introduction to Spatial Data Infrastructure, NNRMS, NUIS, National Urban Observatory, Municipal Information Systems, Land Information Systems, Cadastre Systems
- Applications and Limitations
- Tools for Spatial Data Handling,
- BHUVAN
- Agencies responsible for generating spatial data.

Suggested Readings:

- "National Atlas and Thematic Mapping Organisation" (NATMO) Publications
- Andrew Skidmore et al, "*Environmental Modelling with GIS and Remote Sensing*", CRC Press
- Basdudeb Bhatta, "*Remote Sensing and GIS*", Oxford University Press
- David J Maguire et al, "*GIS, Spatial Analysis, and Modelling*", ESRI Press
- Mesfin T Bekalo et al, "*Landuse Change Detection using GIS, Remote Sensing and Spatial Matrices*", Lap Lambert Academic Publications
- Mezenzia Mengist, Vdm Verlag, "*Lans Sustainability Evaluation using GIS and Remote Sensing Technology*",
- Netzband, "*Applied Remote Sensing in Urban Planning, Governance and Sustainability*", Springer, India
- PA Longley et al, "*Geographic Information Systems and Science*", John Wiley and Sons Ltd.
- Qihao Weng, "*Remote Sensing and GIS Integration: Theories, Methods and Applications*", McGraw Hill Professional
- Satheesh Gopi, "*Advanced Surveying: Total Station, GIS and Remote Sensing*", Pearson
- Thomas M Lillesand et al, "*Remote Sensing and Image Interpretation*", John Wiley and Sons Ltd.

UEIP013 COURSE NAME: HEALTH AND NUTRITION

Learning Outcomes

After successful completion of the course student will be able to:

1. Remember the fundamentals of health and nutrition
2. Cite examples of food labelling
3. Describe significance of macronutrients and micronutrients
4. Discuss importance of functional foods
5. Explain indicators of nutritional status

Theory	**L**	**P**	**C**
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1. Introduction to the basic concepts of health and nutrition
2. Nutrition
   - Macronutrients: Carbohydrates (including dietary fibers), fats and proteins
   - Micronutrients: Vitamins, minerals, anti-oxidants, gut flora
   - Significance of macronutrients and micronutrients for optimal health
3. Meal Planning
   - Functional foods: Definition of functional foods, Role of functional ingredients and food in nutrition, Health attributes of functional foods
   - Health attributes of nutrition: Diet and disease, Diet with respect to special population (elderly, pediatric and pregnant women),
   - Indicators for maintenance of nutritional status: Nutrition Balance Indicator, Satiety Index, Fullness factor, Glycemic index and insulin index
4. Food Labelling **(Food service management)**
   - Nutrition Facts Panel
   - Serving Size
   - Calories
   - Ingredients list
   - Quantitative indications
   - Food additives
   - The percent daily value
   - Allergan labelling

Course Title: Human Resource Management

Credit Hours: 3

Course Number: UEIM006

Course Objectives

- To introduce the students to human resource management function.
- To understand the people management role in organizations.

Learning Outcomes

At the end of the course, students will:

1. acquire an insight into the role and responsibilities of the HRM function.
2. learn about the different systems within HRM viz. Recruitment and Selection, Performance Management, Compensation Management, Employee Relationship Management and recognize their strategic contribution to business and organizations
3. carry out job and role analysis and write job descriptions.

Syllabus

Module I: Introduction
An Introduction to Human Resource Management Skills and Competencies of a Human Resource Manager Corporate Strategy and Human Resource Management
Module II: Manpower Planning and Talent Acquisition
Manpower Planning and Deployment Job Analysis, Design and Redesign of Jobs Recruitment & Selection
Module III: Managing and Rewarding Employee Performance
Performance Management Compensation Management Learning & Development

Module IV: Managing Employee Relations
Employee Relationship Management Industrial Disputes & Conflicts Labour Legislation Managing Employee Exit and Separations
Module V: Contemporary issues in Human Resource Management

Suggested Readings

- Dessler, G. Varkkey, B. (2011. Human Resource Management. (12th ____ Edition). New Delhi: Pearson Education.
- Bernardin, J. H. (2007). Human Resource Management – An Experiential Approach. New Delhi: Tata McGraw Hill Publishing Company Limited.
- Singh B.D. (2004). Industrial Relations, Emerging Paradigms. New Delhi: Excel Books.
- Varkkey, B., Dutta, R. and Rao, G. P. (Eds). (2000). Value Creation: The Challenge of HR in the New Millennium. New Delhi: Tata McGraw-Hill Publishing Company Limited.
- Ramaswamy, E.A. (2000). Managing Human Resources: A Contemporary Text. New Delhi: Oxford University Press.

Pande, S. and Basak, S. (2012). Human Resource Management. (1st Edition). N

Course Title: Indian Economy

Credit Hours: 3

Course Number: UEIM001

Course Objectives

- To introduce the students to the various dimensions of the Indian Economy
- To provide a historical and current analysis of how the Indian Economy has reached its current state of affairs

Learning Outcomes

At the end of the course, students shall be able to:

1. Understand the various aspects of India's economy
2. Develop a perspective on the different problems and approaches to economic planning and development in India
3. Understand the role of the Indian Economy in the global context, and how different factors have affected this process

Syllabus

Module 1: STRUCTURE OF THE INDIAN ECONOMY
India As A Developing Economy; Indian Economy On The Eve Of Independence; National Income Of India: Trends And Levels Human Resources And Economic Development; Human Development In India; Occupational Structure And Economic Development Natural Resources, Economic Development And Environmental Degradation Infrastructure In The Indian Economy; Social Infrastructure And Social Sector
Module 2: PLANNING AND ECONOMIC DEVELOPMENT
• Objectives And Strategy Of Economic Planning In India; • Approach To The Ongoing Five Year Plan • Regional Planning In India • Financing Of The Plans • Economic Reforms In India – Main Features And Achievements.

Module 3: DOMESTIC SECTOR
• Institutional And Technological Reforms In Indian Agriculture • Agricultural Finance And Marketing • Agricultural Prices And Policy • Industrial Policy • Sources Of Industrial Finance; Role Of Small Scale And Cottage Industries In Indian Economy.
Module 4: EXTERNAL SECTOR OF THE ECONOMY
• India's Balance Of Payments – Problems And Solutions • Trends, Composition And Direction Of India's Foreign Trade • New Trade Policy • WTO And Indian Economy • Foreign Investment Inflows • India's Exchange Rate Policy
Module 5: ISSUES AND CHALLENGES OF INDIAN ECONOMY
□ Problems Of Poverty □ Inequality □ Unemployment And Inflation - Strategy And Policy Of The Government □ Food Security And Public Distribution System □ Salient Features Of The Relevant Union Budget

Suggested Readings

- Datt, R and Sundharam, K.P.M. Indian Economy. New Delhi: S. Chand & Company Ltd. (Latest Edition).
- Jalan, B. The Indian Economy: Problems and Prospects. Penguin Books.
- Misra, S.K. and Puri, V.K. Indian Economy. Himalaya Publishing House.
- Agrawal, A.N. Indian Economy: Problems of Development and Planning. New Age International Publishers.
- Economic Survey. Government of India (Latest Issue).

Relevant Business Newspapers.

UEIL002 Information Technology and Cyber Law

Teaching Hours: 45 Credit: 3

I Introduction

The rapid growth of computer technology makes our life easier and attracts us to make every transaction by using electronic sources. All of us use computer every day through personal computer, laptop, mobile phone, notebook, *etc.* On the other hand unemployed persons are attracted to involve in unethical and unsocial activities, even in some of the cases, it extend to criminal activities. This course will disseminate the knowledge of computer technology which use cyberspace to transact the text, photo, documents, videos, money, etc. The course will also develop their ability to link internet technology with legal principles in fixing the tortious liabilities of the wrongdoer to compensate the victim and criminal liabilities of the offenders after following the due process of law. The Course will create ability among the students to apply Indian Information Technology Act in regulating E-Commerce, E-Governance, E-Banking and cybercrimes.

II Course Learning Outcome:

After the completion of the course the students will be able to:

1. Understand the information technology with technical & social perspectives.
2. Analyses the critical issues in developing cyber jurisprudence & policy.

III Syllabus

Module 1: Information Technology

What is Networking and Internet? What are various Computer Technologies used in Networking? What is relation between Computer Web Technology? , Types of networks; Intra-net and internet, Understanding Internet, www, Computer Memory and Storage, What is relationship between Cyberspace, Technology and Law, Defining the Scope of Information Communication Technology

Module 2: Stakeholders in cyber world

Defining the expansion of Cyber World & IT Industry, Who are Users (subscribers), Service Providers, Intermediaries, Cyber Cafe and other stakeholders. What kind of Agreements are Regulating Stakeholders Relationships: Click Wrap, Shrink Wrap, EDI. Discussing Electronicin IPR Law, Issues relating to Biotechnology and ICT related to software copyright, software privacy, open source software.

Module 4: Regulating Information Technology

How Authentication of electronic Records is done?, what digital signature? & how it is different from electronic signature?, what are regulatory powers of Controller and Certifying authorities?, Understanding, E-governance, E-commerce, E-banking including mobile banking, What are Civil liabilities under IT Act, Who is Adjudicating officer & What is Cyber Regulation Appellate Tribunal.

Module 5: Cyber Crimes

What is Cyber Crimes & what are its various classifications?, Appraisal of Crimes targeting Commuters, Social crimes committed through internet, Cyber pornography and stalking, Personal crimes, Economic offenses and Social Networking, Terrorist activities through internet. What are various measures taken by government to prevent cybercrimes?

Module 6: Investigation of cyber crimes

How investigation of cybercrime is done? Who is responsible for Cyber Crime Investigation? What are Territorial powers and issues, Confiscation of the computer and other e-devices? What is Computer and cyber forensics, discussing the Admissibility of E-Evidence in court of Law?

Module 7: Issues and challenges to cyber law

Discussing the Relevance of Data Protection Laws & Cyber Security, Legal recognition of Digital Evidence, Recognition of liability in the digital world, deciphering the Jurisdiction Issues in Transnational Crimes, What is Cloud Computing & what is its regulatory structure, Issue of Communication Convergence, Relevance of Online Dispute Resolution in India.

Module 7: Issues and challenges to cyber law

Discussing the Relevance of Data Protection Laws & Cyber Security, Legal recognition of Digital Evidence, Recognition of liability in the digital world, deciphering the Jurisdiction Issues in Transnational Crimes,

References:

- SURYA PRAKASH TRIPATHI, RITENDRA GOEL AND PRAVEEN KUMAR SHUKLA, INTRODUCTION TO INFORMATION SECURITY AND CYBER LAWS,WILEY INDIA PRIVATE LIMITED, 2014 (Technical Approach)
- APAR GUPTA,COMMENTARY ON INFORMATION TECHNOLOGY ACT,LEXIS NEXIS INDIA; (2nd ed.) (2011).
- PAVAN DUGGAL, CYBER LAW - AN EXHAUSTIVE SECTION WISE COMMENTARY ON THE INFORMATION TECHNOLOGY ACT ALONG WITH RULES, REGULATIONS, POLICES, NOTIFICATIONS ETC., Universal Law Publishing Co. Pvt Ltd., (2014)
- CYBER LAWS, JUSTICE YATINDRA SINGH, Universal Law Publishing Co., (2010).
- PAVAN DUGGAL, TEXTBOOK ON CYBER LAW, Universal Law Publishing Co. Pvt Ltd., (2014)
- AJIT NARAYANAN AND BENNUM (ed.): LAW, COMPUTER SCIENCE AND ARTIFICIAL INTELLIGENCE.
- LINDA BRENNAN AND VICTORIA JOHNSON, SOCIAL, ETHICAL AND POLICY IMPLICATION OF INFORMATION TECHNOLOGY.
- KARNIKA SETH, COMPUTER INTERNET AND NEW TECHNOLOGY LAWS, LEXISNEXIS, (1st Edition) (2013).
- KAMATH NANDAN, LAW RELATING TO COMPUTERS INTERNET & E- COMMERCE (A GUIDE TO CYBER LAWS & THE INFORMATION TECHNOLOGY ACT, 2000 WITH RULES & NOTIFICATION), (5th Edn., Universal Book Traders), (Reprint 2004).
- ARVIND SINGHAL AND EVERETT ROGERS, INDIA'S COMMUNICATION REVOLUTION : FROM BULLOCK CARTS TO CYBER MARTS.
- MIKE GODWIN, CYBER RIGHTS DEFENCING FREE SPEECH IN THE DIGITAL AGE

Additional Sources :

- Talwant Singh Addl. Distt. & Sessions Judge, Delhi, *Cyber Law & Information Technology*http://delhicourts.nic.in/CYBER%20LAW.pdf
- *New Crimes Under The Information Technology (Amendment) Act*http://www.ijlt.in/archive/volume7/5_Mohanty.pdf
- *(A to Z of cyber crime by Asian School of cyber laws* available at http://ensaiosjuridicos.files.wordpress.com/2013/06/122592201-cybercrime.pdf)
- Louise Ellison and Yaman Akdeniz, I*nvestigating Cyber Law and Cyber Ethics:*

*Issues, Impacts, and Practices, Cyber-stalking: the Regulation of Harassment on the Internet*http://www.cyber-rights.org/documents/stalking_article.pdf

- Cyber Crimes and Information Technology
- http://www.nalsar.ac.in/pdf/Journals/Nalsar%20Law%20Review-Vol.%204.pdf
- *A Study of the Privacy Policies of Indian Service Providers and the 43A Rules*
- http://cis-india.org/internet-governance/blog/a-study-of-the-privacy-policies-of-indian-service-providers-and-the-43a-rules
- *Relationship Between Privacy and Confidentiality*
- h ttp://cis-india.org/internet-governance/blog/relationship-between-privacy-and-c onfidentiality
- *Availability and Accessibility of Government Information in Public Domain*
- h ttp://cis-india.org/accessibility/blog/availability-and-accessibility-of-government-information-in-public-domain
- ***Cloud Computing in India: The current Legal regime and the main Issues and Challenges*** :http://www.indialawjournal.com/volume7/issue-1/article3.html

UEIL014 **Intellectual Property Right**

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Course Code	
Course Title	**Intellectual Property Rights**

Course Learning Outcomes:

At the end of this course the student will able to:

1. Understand on various facets of IPR including Trade Mark, Patent, Copyright and Design Law
2. Identify various issues and challenges related to IPR.

Syllabus **Teaching Hours: 45**

Unit 1 Introduction **6 Hours**

1.1 Concept of Property
1.2 Concept of Intellectual Property
1.3 Various Justification of Property
1.4 Introduction to TRIPS Agreement

Unit 2 Patent Law **9 Hours**

2.1 Concept and basis of protection
2.2 Criteria of Patentability
2.3 Novelty, Utility and Non-obviousness
2.4 Non Patentable Inventions
2.5 Procedure for patent registration
2.6 Rights of Patentee and Infringement procedure
2.7 Green Patents
2.8 Leverage of Patents

Unit 3 Copyrights Law **8 Hours**

3.1 Introduction and justification
3.2 Subject-Matter of Copyright
3.3 Literary, Dramatic, Musical, Artistic, Cinematograph Films and Sound Recordings
3.4 Copyright and related rights
3.5. Fair use

3.6 Rights covered under copyright & remedies for infringement

Unit 4 Trademarks Law **8 Hours**

4.1 Concept and justification of trademarks protection
4.2 Types of marks - Distinctiveness, Descriptive marks, Generic marks and Well-Known Trademarks
4.3 Grounds of Refusal of Registration
4.4 Procedure for Registration
4.5 Rights of trademark owner and Infringement – passing off of trademarks
4.6 Trademarks and Geographical indication

Unit 5. Design Law **8 Hours**

5.1 Basics of Design & Justifications for protecting designs
5.2 Features of Shape, Configuration, Pattern, or Ornament or Composition of Lines or Colour
5.3 Excluded Subject-Matter
5.4 Rights of Design owner and protection against Infringements

Unit 6. Traditional Knowledge and Biodiversity **6 Hours**

6.1. Concept of Traditional knowledge
6.2 Bio-piracy and bio-prospecting
6.3 Access and benefit sharing under CBD

Suggested Readings:

- Ahuja V K. Intellectual Property Rights. Lexis Nexis- Butterworths, New Delhi, 2015
- B.L. Wadhera. Law on Intellectual Property Rights, Universal Publication, 2014
- Cornish, W R, Cases and Materials on Intellectual Property, 3rd Ed. London: Sweet & Maxwell, 1999.
- Verkey Elizabeth, Law of Patents. Second Edition, Eastern Book Company, Lucknow, 2012

UEIL011 **Introduction to Indian Constitution**

Credit: 3
Hours: 45

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Introduction:

India is a democracy and her Constitution seeks to establish its fundamental organs of government and administration, describe their structure, composition, powers and principal functions, define democracy through relationship of the organs with one another and with the people. The Constitution also guarantees certain Fundamental Rights to its citizens that are not to be infringed by the Government. A good understanding of the Constitution and the law, which has developed through constitutional amendments, judicial decisions, constitutional practice and conventions is, therefore, absolutely necessary for a student of law.

The purpose of teaching constitutional law is to highlight its never-ending growth. Constitutional interpretation is bound to be influenced by one's social, economic or political predilections. A student must, therefore, learn how various interpretations of the constitution are possible and why a significant interpretation was adopted in a particular situation. Such a critical approach is necessary requirement in the study of Constitutional law.

Course Learning Outcomes:

After the completion of the course the students will be able:

1. To understand the nature, scope and extent of the Fundamental rights
2. To understand the Composition, Role and Functions of Executive, Legislature and Judiciary.
3. To analyze and critic the interrelationship between the different organs of the Government i.e. Executive, Legislature and Judiciary.
4. To apply the knowledge of the constitutional provisions in solving the emerging challenges posed to the constitution.

Unit I: Introduction to Indian Legal System

- Constitution, Constitutionalism, Constitutional Law, Constitutional Conventions

- Historical evolution of the Constitution of India during British Raj
- Formation of Constituent Assembly
- Working of Constituent Assembly
- Salient Features of Indian Constitution

Unit II: Goal, Values, Ideals & Aspirations from the Constitution

- Objectives Resolution
- Preamble to Indian Constitution
- 42nd Amendment Act & the Preamble

Unit III: Nature of Indian Union

- Indian Union
- Formation, Creation and Establishment of new States under the Union
- Citizenship

Unit IV: Fundamental Rights

- Definition of State
- Definition of Law
- Right to Equality
- Fundamental Freedoms
- Right to Life & Personal Liberty
- Right against Exploitation
- Right to Religion
- Right to Constitutional Remedies

Unit V: Organs of the Government

- Union Executive
- Union Parliament
- Union Judiciary

Unit VI: Emergency Provisions

- National Emergency
- State Emergency
- Financial Emergency

Unit VII: Amendment to the Constitution

- Need for Amendment
- Types of Amendment
- Procedure for Amendment

Unit VIII: Constitutional Bodies

- Comptroller & Auditor General of India

- Finance Commission of India
- Election Commission of India

Unit IX: Panchayati Raj Institutions

- Committees
- 73rd & 74th Amendment Act
- Rural Local Bodies
- Urban Local Bodies
- PESA Act

Text Book:

1. M. P. Jain, Constitutional Law, 6th Edition Lexis Nexis Butterworths.
2. V. N. Shukla's, Constitution of India, 12th Edition, Eastern Book Company
3. J.N. Pandey,The Constitutional Law of India, 50th Edition, Central Law Agency

Reference:

1. H.M. Seervai, Constitutional Law of India (4th ed., Vol 1 (1991), Vol. 2 (1993), Vol.3 (1996)
2. D.D. Basu, Shorter Constitution of India (14th ed., 2009)
3. V.D. Sebastian, Indian Federalism the Legislative Conflicts (1985).
4. B. Shiva Rao, The Framing of India's Constitution – Select Documents (1967)
5. Granville Austin, Indian Constitution: Corner stone of the nation (1966)
6. Granville Austin, Working a Democratic Constitution - A History of the Indian Experience (1999)

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