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**MS = Mid Semester, ES = End Semester; IA = Internal assessment** (like quiz, assignments etc)

**LW = Laboratory work; LE = Laboratory Exam**

**Department Elective I:** Food Technology; Nanotechnology; Pharmaceutical Engineering; Fertilizer Technology
UNIT I
Introduction to Computer Aided Design (CAD), Engineering Tools for CAD Development of simple, Introduction to AutoCAD, various tools of designing in Autocad, Steady state flow sheeting on the computer, approach to flow sheeting systems, Mathematical methods used in flow sheeting and simulation, Degree of freedom in a flow sheet for various processes, Sequential modular approach to flow sheet, Flow sheet solution by equation solving methods based on tearing

Introduction to Excel solver, Different operators in Solver, Solving linear and nonlinear algebraic equations, Simulation by linear methods and quasi-linear approach

UNIT II
Introduction to MATLAB in chemical engineering, Introduction to toolboxes in MATLAB, Control design and tuning in MATLAB, Algorithms for problems related to chemical engineering, Computerized physical property systems- physical property calculations, example of physical and thermodynamics property estimation.

Exposure to UNIFAC and other methods for distillation, Multi component distillation

UNIT III
Introduction to ASPEN, Solvers in Aspen, Heat and Power Integration of various chemical units, Heat-integrated Distillation Trains, Heat Engines and Heat Pumps, Optimum integration of energy, Threshold Approach Temperature, Optimum Approach Temperature, flash calculations

UNIT IV

Texts and References
### CH 401P  Computer Aided Process Design

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**Laboratory:** Process Simulators – Steady State Simulators, Dynamic Simulators with the help of case studies which includes energy and material recycle

Laboratory sessions: Softwares like Polymath, Chemcad, Gams, Aspentec, etc. will be covered with suitable examples from theory portion.

1. Introduction to commercial chemical engineering softwares
2. Use of MATLAB for fine tuning of controllers
3. Introduction to Polymath and simulation of chemical engineering problems in polymath
4. Introduction to GAMS and basic syntax learning
5. Formulation of chemical engineering linear and Mixed integer linear programming problems and solving them using GAMS
6. Formulation of chemical engineering non-linear and Mixed integer non-linear programming problems and solving them using GAMS
7. Introduction to ASPEN and simulation of basic equipments such as Pump, Compressor, expander, Heat exchanger and Flash separator in ASPEN
8. Simulation of different types of reactions such as conversion reaction, equilibrium reaction in ASPEN
9. Simulation of equipments such as CSTR, absorber and separation columns in ASPEN
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**UNIT I**
Introduction, Basic concepts of Polymer Science, concept of non Newtonian fluids, types of molecular weights and its distribution, determination of Molecular Weight (End group analysis, colligative property measurement, Gel Permeation Chromatography) structure property relationship, physical properties of polymers

**UNIT II**
Types of Polymerization including pre polymerization, study of polymerization mechanism, Kinetics, Effects of temperature, pressure, different types of polymerization techniques,
Polymer Analysis & Characterization (esp. thermal, physical, mechanical properties)

**UNIT III**
Production of bulk polymers like PE, PP, PVC, SBR, Polyester, Nylons etc. by different processes, their differences wrt conventional chemical manufacturing
Specialty polymers: Conducting polymers, Block copolymers, Polymer composites, special discussion on polyurethanes, Elastomers, spandex, etc.

**UNIT IV**
Polymer Processing: Molding, Extrusion, Thermoforming, calendaring, Reaction injection molding, principle and applications Additives and Compounding, composite plastics, engineering plastics
Fiber Technology: Textile and Fabric properties, Spinning, Elastomer technology: Vulcanization, Reinforcement.

**Texts and References**
UNIT I
Origin and occurrence, status of Indian petroleum industries. Onshore & off shore drilling techniques, Engineering limitations in offshore and use of robotics in deep sea exploration. Pretreatment of crude oil for refining, characterization of crude oil and product specification.

UNIT II
Reforming of naptha, thermal and catalytic cracking, thermal reforming, plat forming (Catalytic reforming), vacuum distillation, fractionation. Processing of residuum, FCC, lubricating oil processing, blending and hydro treatment processes.

UNIT III
Alkylation and isomerization, Processing of natural and associated gases.
Definition of petrochemical, source material for manufacture of chemicals from hydrocarbons, individual compounds and mixtures
Manufacture of major olefin building block- ethylene, propylene, butadiene etc

UNIT IV
Manufacture of BTX aromatics, naphthalene etc.
Current development in petrochemicals technologies – shale oil & gas extraction methods-fracturing, hazards and safety measures for fracturing, Underground natural gas storage in cravines and abandoned coal mines, methods for ensuring leak proof, testing of such facilities prior to storage, exposure to standards for shale oil/gas extraction.

Texts and References
Seminar topics can be based on the wide range of chemical engineering and its application areas including the fundamental technologies, design and development, current trends in technology, modeling, simulation, specific case studies, etc.

**Student must meet the concerned supervisor to finalize the topics**

1. Weekly/bimonthly reporting
2. Literature survey
3. Detail analysis and report writing
4. Intermittent progress evaluation
5. Final seminar presentation
### UNIT I
Introduction, general aspects of food industry, world food demand and Indian scenario, constituents of food, quality and nutritive aspects.

Food chemistry: Lipids, proteins, carbohydrates, composition of foods nutrition. Food Microbiology: Introduction growth factors, degradation and spoilage of foods epidemiology of food borne diseases, food infections.

### UNIT II
Food Biotechnology: Fermentation and enzymatic processes.

Asceptic Techniques: Food handling, food sterilization sterilization of food processing equipments.

Transport Phenomena in food processing: Non newtonian flow heat transfer simultaneous heat and momentum transfer thermal time distribution mixing unit operations in food systems, evaporation.

### UNIT III
Preservation techniques: Thermal, Dehydration, microwave irradiation cold fermentation and by chemicals.

Packaging and storage: Principles, shelf life, canning, modified atmosphere packaging, refrigeration.

### UNIT IV
Post Harvesting Techniques: Grain drying and storage fruit and vegetable processing seafood and meat processing

Supercritical extraction: Flavours, spices, and essence.

### Texts and References
## CH-012 Nanotechnology

### Teaching Scheme

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### Examination Scheme

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### UNIT I

Introduction and definition, nanoscale, electromagnetic spectrum, top down and bottom up approach, particle size, chemical and physical properties of nanomaterials, opto-electronic properties and phenomenon in nanostructures, quantum effects.

Synthesis, properties, stability and characterization of nano-particles: like Iron, platinum, copper, gold, silver, nickel, fullerene and carbon nanotubes and different types of nano-oxides, (Al₂O₃, TiO₂, ZnO etc.)

### UNIT II

Sol-gel methods, chemical vapour deposition, ball milling etc. Preparation and properties of Carbon nanotubes.

Synthesis and properties of composite nano-particles, nanofillers, high performance materials, polymer nanocomposites, nanoclays, nanowires, nanotubes, nanoclusters etc. Coated nano-particles.

### UNIT III

Nanomanipulation, Micro and nanofabrication techniques, Photolithography, Nanolithography., Introduction to MEMS, NEMS and nanoelectronics.

Introduction to bionanotechnology and nanomedicines.

### UNIT IV

Application of nano-particle in catalysis and quasi homogeneous reactions, heterogeneous reaction, fuel cell catalysis, selective hydrogenations, benzene hydrogenation, environmental clean up technology

Nanoparticle characterization instruments, Safety issues with nanomaterials

### Texts and References

3. Pulikel M. Ajayan, Nanocomposite science and technology, Wiley-VCH 2005
4. David G. Bucknall, Nanolithography and patterning techniques in microelectronics, Wood head publishing 2005
### CH-013 Pharmaceutical Engineering

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#### UNIT I
Introduction to Pharmaceutics and its scope, definition of Pharmacy, Historical background and development of profession of pharmacy and pharmaceutical Industry in India, Chemical Engineering in the Pharmaceutical Industry, Unit processes and unit operations pharma industry,

#### UNIT II
The Role of Chemical Engineering in Pharmaceutical Active Pharmaceutical Ingredient (API) Process, concepts of chemical kinetics and catalysis,

Process safety and risk assessment,

#### UNIT III
Design of distillation and crystallization processes, scale up studies,

Study of novel separation techniques in pharmaceutical engineering,

#### UNIT IV
Process Modeling and simulation studies for drug design, packaging materials and concepts, design of packing units

#### Texts and References
CH-014 Fertilizer Technology

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UNIT I
Introduction and classification of fertilizers, use and applications, types of raw material and sources for plants, N-P-K values and calculations, Fertilizer Market scenario, environmental issues, Introduction to micro fertilizers, Nitrogenous Fertilizers: production of: nitrogenous fertilizer-ammonium sulphate, nitrate, granulated and prilled urea neem coated urea and calcium ammonium nitrate, ammonium chloride and their production, characteristics and specifications, packaging, storage and handling.

UNIT II
Phosphatic Fertilizers: Raw materials types and properties, synthesis of sulphuric and phosphoric acids; phosphates fertilizers - ground rock phosphate; bone meal-single superphosphate, triple superphosphate, thermal phosphates and their methods of production, characteristics and specifications.

UNIT III
Potassic Fertilizers: Methods of production of potassium chloride, potassium schoenite, their characteristics and specifications.

Complex and NPK Fertilizers: Methods of production of ammonium phosphate, sulphate, nitrophosphates, various grades of NPK fertilizers produced in the country.

UNIT IV
Miscellaneous fertilizers: Mixed fertilizers and granulated mixtures; bio fertilizers & biopesticides, nutrients, secondary nutrients and micro nutrients; liquid fertilizers, controlled release fertilizers, controlled release fertilizers.

Texts and References
4. Slack, A.V.; Chemistry and Technology of Fertilizers, Interscience, New York, 1966
7. “Handbook of fertilizer technology”, Association of India, New Delhi, 1977
UNIT I Introduction
- Provide basic understanding of economic concepts such as Demand, supply, Concept and organization of a firm; ownership, control and objectives of the firm.
- Need, importance and role of industries in economic growth and development, Industry and agriculture sector Linkages.

UNIT II Firms and Market Conduct
- Public, Private, Joint and Co-operative sectors, private corporate sector, MNCS and their Role.
- Cost behavior the firm. Types of cost, short run – long run, fixed and variable. Production function – short run and long run. Types and classification of market

UNIT III Location and Dispersion:
- Location of industries - Theories of Location, Regulations/ Recommendation for plant layout and location
- Diversification, Integration and Merger of Industrial Units, Dispersion; and Problem of Regional imbalance.

UNIT IV India’s Industrial Sector and Issues of Labour:
- Structure of Large - Scale Industries in India.
- Emerging Global competition and Indian Industry.
- Impact of Liberalization and Privatization on industrial sector.
- New Industrial Policy 1991 and recent industrial policies in India, Industrial Growth and pattern in India.
- Structure of Industrial Labour, Industrial relations exit policy and social security, Wages and problems of bonus

UNIT V Financing of Industry:
- Role and functions of IFCI, IDBI, SIDBI, MSFC, GIDC, GIIC in Industrial Finance.

Texts and References
### TP 310 INDUSTRIAL TRAINING EVALUATION

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Training evaluation based on min. 6-8 weeks of summer training