B.Tech.(Chem.Tech.)
V to VIII Semester

Prospectus No. 11175

संत गाडगे बाबा अमरावती विद्यापीठ

SANT GADGE BABA AMRAVATI UNIVERSITY

(FACULTY OF ENGINEERING & TECHNOLOGY)

PROSPECTUS
OF

FOUR YEAR DEGREE COURSE

BACHELOR OF TECHNOLOGY

(CHEMICAL TECHNOLOGY)

(FOOD, PULP & PAPER, OIL & PAINT

AND PETROCHEMICAL)TECHNOLOGY

V TO VIII SEMESTER

EXAMINATIONS, 2010-11

(SEMESTER PATTERN)

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SYLLABUS PRESCRIBED
FOR BACHELOR OF TECHNOLOGY
(CHEMICAL TECHNOLOGY)
FOOD TECHNOLOGY, PULP & PAPER TECHNOLOGY,
OIL & PAINT TECHNOLOGY AND
PETROCHEMICAL TECHNOLOGY
SEMESTER PATTERN
FIFTH SEMESTER

5 SCECT 1 HEAT TRANSFER

SECTION-A

Unit I : Importance of heat transfer in chemical process industries. Modes of heat transfer, steady state conduction in one dimension.

Fourier's law.

Heat transfer through plane, cyclindrical and spherical walls, compound resistance in series, thermal insulation, critical and economic thickness. Extended surface equipments, types, their design & operation, introduction to unsteady state heat transfer.

Unit II : Heat transfer by convection, film concept, individual and overall coefficients and factors affecting them. Natural and forced convection dimensional analysis applied to heat transfer. Dittus-Boelter equation. Limitations and application.

Unit III : Heat transfer by parallel and counter current flow, concept of log mean tempeature difference, rate of heat transfer. Heat transfer by film wise and dropwise condensation in horizontal & vertical tube.

SECTION-B

Unit IV : Heat exchange equipments and their design, double pipe, parallel, counter current, shell and tube heat exchangers, condensers, fouling factors, concepts of transfer units in heat exchangers, NTU concept for heat exchangers.

Unit V : Boiling & Evaporators : Classification of types and field applications of evaporators single and multiple effect evaporators.

Heat transfer through submerged coils, jacketted vessels.

Unit VI : Heat transfer by radiation, concept of black body, Kirchoff's law, Stefan's law, Black and gray body radiation, view factors luminous and non-luminous gases. Heat transfer in packed and fluidised beds.

Recent developments in heat transfer.

PRACTICALS : Based on above syllabus.

BOOKS RECOMMENDED :

1)	Heat Trasnfer	:	Mc Adams
2)	Heat Transfer	:	Sukhatme
3)	Basic Heat Transfer	:	Necati Orisik, McGraw Hill Co., Kogakusha.
4)	Heat Transfer	:	J.P.Hokman, McGraw Hill Co., Kogakusha.
5)	Unit Operations of Chemical Engg.	:	McCab and Smith.
6)	Introduction to Chemical Engg.	:	Bedger and Banchero.
7)	Chemical Engg.	:	Coulson & Richardson, Vol. I (ELBS, Pergamon Press, Latest Edition)
8)	Heat Transfer	:	Gebhart, McGraw Hill, 2nd edition, Latest Edition
9)	Fundamentals of Engg.	:	R.C.Sachdeva, Wiley Eastern.
10)	Heat Transfer	:	R.C.Sachdeva.
11)	Heat & Mass Transfer	:	S.D.Dawande,Central Techno Pub., Nagpur

5 SCE(FPOPC)T2 CHEMICAL ENGINEERING
(MECHANICAL OPERATIONS)
SECTION - A

Unit I Relevance of mechanical operations in industry.
I. Size reduction, stages of reduction, Equipments operating variables, laws of energies, energy requirements.
2 Screening: Screen analysis, particle size distribution.

Unit II 1. Classification: Equal falling particals, equipments, jigging, tabling.
2 Gravity settling, drag force, terminal settling velocity.
3. Sedimentation : Continous thickners.

Unit III 1. Storage and handling of solids, transporation
2 Mixing, Mixers, agitation, types of equipments.

SECTION - B

UnitIV 1. Filtration : Theory, operation, types, Flotation agents, flotation cells.
2. Filter Calculations, filtration equation for compressible and non-compressible cakes, specific cake resistance.
3. Filtration - Constant pressure and constant rate and their equipments.

Unit V 1. Centrifuges: Theory, Equipments, types and calculations.
2. Cyclones: Hydrocyclones, liquid scrubbers and electronic precipitators.

Unit VI 1. Adsorption, theory, type and application, Langmuir's Freundlich's equation, nature of adsorbents, industrial adsorbents.
2. Adsorption on fixed bed, fluidised beds. Adsorption equilibria calculations for vapour, gas & liquid adsorption. Adsorption, operation such as single stage, multi stage, cross current & multistage counter current operation & equipments.
3. Recent developments in mechanical operation equipments.

PRACTICALS: based on above syllaubs.

BOOKRECOMMENDED:

1. Momentum Transfer Operation:S.K.Gupta, TMC, Latest edition.
2 Unit Operations of Chemical Engineering: McCabe and Smith, TMC 3. Chemical Engineering Vol. I : Coulson & Richardson, Pergamon, Latest edition.
4. Principles of Unit Operations: A.S.Foust, et-al.
5. Unit Operations: C.G.Brown.
6. Introduction to Chemical Engg. : Beder & Bachero.
7. Mass Transfer Operations: R.E. Treybal
8. Mechanical Operations Vol-I : R.S.Hiremath & A.P.Kulkami.

5 SCE (FPOPC) T3 CHEMICAL ENGINEERING THERMODYNAMICS

SECTION-A

Unit I : Scope of thermodynamics and its importances to chemical Engineers, Basic concepts, extensive & intensive properties. state function & chemical systems. Definition, symbols & interrelation, concepts of Entropy, Enthalpy & internal energy. First law of thermodynamics, Equations of state, critical properties, Vander Wall's constants, Virial expansions, Redlich-Kwong equation, Beattie-Bridgeman equation.

Unit II : First law applied to thermodynamic processes & calculation of Workdone, free energy & heat changes. Maxwell relation equation, second law and third law of thermodynamics. Thermodynamics relations based on second law. Relation between Cp & Cv, compressibility factor & coefficient of thermal expansion, concept of residual entropy & entropy of equilibrium.

Unit III : Partial molar and apparent molar properties, Gibbs Duhem equation, Chemical potential, effect of temperature and pressure fugacity, excess thermodynamic properties and

thermodynamic properties of mixing. Gibbs-Duhem-Morgules equation, Konovalov laws. Colligative properties. Ebulliometric constant. Determination of Molecular Weight of unknown chemical substances. Solubility law.

SECTION-B

Unit IV : Vapour liquid equilibrium, T-X-Y diagrams & X-Y diagram for ideal & non ideal system. Raoult's law and Henry's law. Deviations from Raoult's law. Comparision of ideal & non-ideal systems. Phase equilibria in non reaching multi-comonents, Binary, ternary systems. Graphical representation of L/L, L/S & G/S systems. Right angled triangular diagrams. Equilateral triangular diagrams, Janecke diagram, Effect of temp. & pressure on ternary equilibrium, Phenol-Wafer systems. auiline-water-chlorobenzene systems.

Unit V : Statistical thermodynamics, thermodynamics probability, its relation with Entropy, partition function and its relation with termodynamics functions, the Boltzman distribution law, Distribution law for chemically reactive system. Thermodynamics charts & their uses. Searching of thermodynamics data.

Unit VI : Chemical Equilibrium, feasibility of chemical reaction, free energy change, Reaction co-ordinate, equilibrium constant, Effect of temp. & pressure, Relation between Kp, Kc & Kv, Le-Chatelier's principle, Endo-Exothermic relations, Heterrogeneous equilibria, various methods of calculating free energy charge. Equilibrium conversions, case study of feasibility report for manufacture of industrial chemicals.

Practicals :- based on above syllabus.

BOOKS :

1)	An Introduction to Chemical Thermodynamics	:	R.P.Rastogi, R.R.Misra.
2)	Chemical Engineering Process	:	Houghen-Watson.
3)	Introduction to Chemical Engg. Thermodynamics	:	J.M.Smith, H.C.Vauhess
4)	Thermodynamics for Chemical Engg.	:	H.C.Weber, J.P.Meissner
5)	Engineering Thermodynamics	:	P.K.Nag.
6)	Chemical Thermodynamic	:	M.R.Awode, Dattson, Nagpur.

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5S(F/P/O/PC)T4 SPECIAL TECHNOLOGY-ll

(RELATED TO CONCERNING TECHNOLOGY)

CHEMIS1RY AND BIOCHEMISTRY OF FATS (OIL TECHNOLOGY)

Techniques of separation of fats and fatty acids : Low temperature crystallization, esterification, urea adducts, counter distribution, chromatographic methods of separation with special reference to thin-layer chromatography and gas-liquid chromatography.

Methods for quantitative investigation on the component, fatty acids of natural fats and processed fats.

Lipase hydrolysis, X-ray diffraction and polymorphism of glycerides and other fatty acids and their derivatives. Dilatimetric measurements and their significance.

Infrared (IR), Ultraviolet (UV), Unclear Magnetic Resonance (NMR) and mass spectroscopy for the analysis of fatty materials.

Reichert-Missel and Polanske and Krischner values. Advanced method of analysis of fats, fatty acids and glycerides. .

Chemical reactions pertaining to the manufacture of fatty acid derivatives including metal salts other than alkali metals.

Quantitative investigation of component triglycerides of natural fats. Theories of fatty acid distribution in natural fats. Effect of fatty acid distribution on the physical properties. Polymorphism of fats and fatty acids. Biosynthesis of fatty acids, phosphlipids and triglycerides in plants and animals. Elongation and desaturation of acyl chains. Biological utilization of fats. Fat assimilation;

Essential fatty acids.

Recent advances in the field.

Books Recommended :

1. Industrial Oil and Fat Products: A.E.Bailey : Interscience Publishers, New York, Latest Edition.
2. Fatty Acids: K.S. Markley (5 Volumes),lnterscience Publishers, New York, Edn., Latest Edition.
3. Structure and Utilization of Oil Seeds : J.G.Vaughon.
4. Melting and Solidification of Fats : A.E.Bailey, Interscience Publishers, New York, Latest Edition..
5. The Analysis of Fats and Oils: V.C.Mehlenbacher : The Garrard Press Champing, Edn., Latest Edition..
6. Progress on the Chemistry of Fats and other Lipids: T.T.Homan, W.O. Lundberg and T.Malkia, Pergamon Press, New York, Latest Edition (7 Vols.)

7. The Chemical Constitution Natural Fats: Wiley Books Publishers, New York, Latest Edition..
8. Vegetable Fats and Oils: G.S.Jamiesan, Renehold Publishers, New York, Latest Edition..
9. Vegetable Fats and Oils: E. W.Eckey : Renehold Publishers, New York, Latest Edition..
10. Gas-Liquid Chromatography - Theory and Practice: S.Dal Nagore and R.SJuvent; Interscience Publishers, New York, Latest Edition.
11. Lipid Chromatographic Analysis: C.V.Marinelt.
12. Fatty Acid Synthesis and Application: N.E.Bednareyk & W.L.Erickson.
13. The Lipids: H.D.Dauel : Interscience Publishers, New York, Latest Edition.
14. Analysis and Characterization of Oil, Fats Products : H.A.Bookenoogen.
15. Thin-layer Chromatography: Babbit.

SPECIAL TECHNOLOGY - II(PRACTICAL)

OIL TECHNOLOGY

Analysis of nickel catalyst and acids oils, Preparation of mixed fatty acids and determination of composition.Analysis of commercial fatty acids. Preparation of pure fatty acids. Determination of mono, di and tri-glycerides. Analysis of soaps and detergents. Detection of Adulteration. Analysis of Oils by thin layer and column chromatography.

5S(F/P/O/P C)T4 SPECIAL TECHNOLOGY-II

(RELATED TO CONCERNING TECHNOLOGY)

FOOD TECHNOLOGY-II

BIO-CHEMISfRY AND NUTRITION

Organisation cell and cellular constituents. Introduction and classification of enzymes, specificity, enzymes Kinetics,

activnetrs and inhabitors. Assay techniques, Isolation of enzymes trom sources and their application.

Bio-energetics, Digestion and metabolism of carbohydrates, proteins and fats. Photosynthesis, Nucleic acids and their functions.

Vitamins: Classification, sources, Chemistry, functions and deficiency symptoms. Assay of vitamins.

Minerals: Macro and micro-minerals, sources, functions and efficiency symptoms.

Nutrition: Functions of foods Energy, value of foods. BMR and its measurement, Energy requirement of individuals.

Recommended dietary allowances of proteins, fats, carbohydrates, vitamins and minerals. Nutritional evaluation of proteins. Factors influencing nutritive value of foods. Loss of nutrients during processing. Enrichment and fortification of foods. Formulation of diets and foods for specific needs.

Antinutritional Factors of Foods :

Toxic compounds, enzyme inhabitors, alkaloids etc.

Techniques of biochemical analysis like spectrophotometry Chromatography, electro-phoresis Light and electro microscopy. Histochemical techniques, isotopic methods.

Recent Advances in the field.

Books Recommended :

1. Outlines of Biochemistry by E.E.Conn & P.K.Stump, Wiley Eastern Pvt.Ltd., New DeIhi.
2. Biochemistry of Foods by Eskin, N., A.M.Handerson, H.M. & Town End RJ., Academic Press, New York.
3. Cell Physiology by A.C.Giese, Sanders & Company, Toppan, Japan.
4. Integrated Biology by L.Hill, D.Bellamy, I Chester, Jones Chapman & Hall Ltd., London, EC4.
5. Principles of Enzymology for the Food Science by Whitaker J.R., Marcel Dekker, INC, New York.
6. Applied Nutrition by R.Rajalaxmi, Oxford & IBH Publishing Co., New York.
7. Heinz Handbook of Nutrition by Benzamin T. Burton, McGraw Hill . Book Company, New York.
8. Nutrition - An Integrated Approach by R.C.Pyke & M.L. Brown, Wiley Eastern Pvt.Ltd., New Delhi.
9. Hawk's Physiological Chemistry, Edited by Bernard L.Oser, Tata McGraw Hill Publishing Co. Ltd., New Delhi.
10. Biochemistry: White A. Handler P., Smit E.L., McGraw Hill, Tokyo.
11. Text Book of Biochemistry : H.R.Mahler and E.H.Chordes, Harper & Row Publisher, New York.

SPECIAL TECHNOLOGY-II (PRACTICAL)
FOOD TECHNOLOGY
A.BIOCHEMISTRY

1. Estimation of carbohydrates and proteins by various methods.
2. Estimation of minerals, Phosphorus, Iron, Calcium.
3. Estimation of vitamin C and effect of heat.
4. Qualitative demostration of enzyme with salivary amylase.
5. Study of rate of enzyme reaction, effect of environmental factors on rate of enzyme action.

6. Detection of trypsin inhibitor.
7. Chromatographic separation of carbohydrates and aminoacids.
8. Simple histological studies on plant tissue.

B. MICROBIOLOGY

1. Preparation and sterilisation of nutrient media.
2. Cultivation and morphological study of common species of bacteria yeasts and moulds.
3. Isolation of pure culture from natural sources.
4. Imunelation of bacteria Haemoeytometer, standard plate count MBRT tests for milk.
5. Bacteriological analysis of water.
6. Microbial spoilage of various foods and effect of extrinsic and intrinsic factors on food spilage.

BOOKS RECOMMENDED:

1. Microbiological Methods, C.H.Collins & P.M. Lyme. Butterworth Co.Ltd., London.
2. Microbes in Action - A Laboratory Manual of Microbiology; H.W.Seeley (JR.) and P.J.Von. Denmark - Taraporewala I.,W. Pvt. Ltd., Bombay.
3. Introduction to Practical Biochemistry: D.T.Plummer, Tata McGraw Hill Co., New Dellii.
4. Hawk's Physiological Chemistry Edited by Bernard L.Oser, Tata McGraw Hill Pub. Co. Ltd., New Delhi.

SPECIAL TECHNOLOGY-II
5S(F/P/O/PC)T4 PETRO CHEMICAL TECHNOLOGY-II
PETROLEUM REFINING TECHNOLOGY

Petroleum refining industry in India, practice and prospectus : Commercial petroleum products, quality requirements.Indian specifications.

Testing methods and their significance: crude assay, refining processes, integration of these processes:. typical refining schemes in India. Descriptive account of atmosphere , vaccum distillations, use of process steam, steam stripping vaccum producing systems.etc.

Industrial practice of various conversion processes, such as catalytic cracking, hydro-cracking,cooking visbreaking, polymerization, alkylation, hydro- desulphurisation etc. and their role and place in Indian refineries.

Production of cube base stocks, solvent extraction, dewazing, finishing and blending; Finishing processes in a modem refinery.

Petroleum speciality products.

Descriptive account of various aspects of a refinery such as instrumentation and automatic control, refinery utilities off site facilities refinery layout, corrosion, safety, energy saving, environmental aspects etc; conservation of petroleum products, Techno-economic aspects of optimum refining schemes.

Recent Advances in the field.

Books Recommended :

1. Petroleum Refinery Engg., W.L. Nelson : Mc Graw Hill Kogakusha, 4th Edn., Latest Ed.
2. Modem Petroleum Technology, Applied Science. G.D.Hobson and W.Pol Publisher 4th Edn., Latest Ed.
3. Petroleum Processing, Principles and Applications, RJ .Hengatabes, McGraw Hill, Latest Ed.
4. Petroleum Refiing, Technology and Economics: J.H.Gary and G.E., Hand-work, Merceidekker, New York, Latest Ed.
5. Petroleum Processing Handbook : W.E.Bland and P.L.Daviason. McGraw Hill, Latest Ed.
6. Petroleum Refinery Manual : M.M.Noel, Rinebold, New York, 1959.
7. V.B.Guthrie, Petroleum Products Handbook, McGraw Hill, 1960.

SPECIAL TECHNOLOGY-II (PRACTICAL)
PETRO-CHEMICAL TECHNOLOGY-II

Analysis and testing of petroleum and petroleum products.

ASTM distillation of motor gasoline, kerosene and high speed diesel, viscosity index. demulsification number and forming characteristics of lubricating oils; Existent gum in motor gasoline; oxidation tests for lubricating oils, oxidation stability of gasoline, water washout characteristics and roll stability of grease. Ductility of bitumen; Electric strength-transfoer oil, PONA analysis by FIA method, aniline point method liquid vapour pressure, Heat of combustion of liquid hydrocarbon fuels, calorific value of' gases, mercaptan sulphur content, salt content, Sulphur by lamp and bomb methods, P,Ca and Cl lubricating oils, study of Vapour-Liquid equilibrium for binary systems using Othmer still study of ternary equilibrium systems and representation triangular diagrams.

5S (F/P/O/PC)T4 SPECIAL TECHNOLOGY-ll
(RELATED TO CONCERNING TECHNOLOGY)
PULP & PAPER TECHNOLOGY TECHNOLOGY
OF PULPING PROCESSFS

Collection grading and storage of various raw material, wood

preparation for pulping, units for measuring wood handling wood barking chipping. screening. chip. handling and storage. relationship between wood and quality.

Introduction to pulping. Fiber separation commercial processes. types of pulping processes. advances and trends in pulping.

Manufacture of mechanical pulp: Types. grades and uses of mechanical pulp stone ground wood process, types of grinders. theory of grinders. theory of grinding. variable in ground wood process, characteristics of groundwood pulp, pulp mill operations control, practice and testing methods, whole wood fiber manufacture. ground wood from pretreated wood, refiner mechanical pulping scheme, thermomechanical pulping.

Semichemical pulping and Semimechanical pulping; Neutral sulfite semichemical pulping, bisulfite semichemical pulping, craft semichemical pulping. cold soda semichemical pulping, hot sulfite chemomechanical semichemical pulp.

Sulfite pulpinp. Description of various sulfite processes, sulfite liquor preparation. variables in sulfite pulping. mechanics and kinetics of sulfite pulping. delignification, digestion in sulfite process. characteristics of sulfite pulp.

Alkaline pulping: General description of alkaline pulping process. alkaline digestion. chemical reactions during alkaline digestion. Variables in alkaline pulping process, digester operation. material and heat balance bamboo. reeds. hemp. jute, etc.

Recent advances in the field.

BOOKS RECOMMENDED :

1. Pulping processes by A.Rydholm. Interscience Pub., John Wiley & Sons Inc., New York. London. Sydney.
2. Pulp & Paper: Chemistry & Chemical Technology, 3rd Edn., Vol I by James P.Casey, John Wiley & Sons, New York.
3. Pulp and Paper Manufacture, 2nd Edn., Vol I by Ronald G.McDonald.
4. Pulp and Paper Science Technology. Vol. I by C.E.Libby. McGraw Hill Co.
5. Hand book of Pulp & Paper Technology. 2nd Edn.. by Bitt Van Nostrad. Reinhold Co.. New York, London.

SPECIAL TECHNOLOGY -II (PRACTICAL)
PULP& PAPER TECHNOLOGY

Analysis of fibrous materials; Pulp analysis: Determination of moisture ash content, permaganate number, copper

number, kappa number of pulps 2, B, V, cellulose, solubility of pulp in alkali.

Analysis of non-fibrous materials: Analysis of black, green and white liquors, bleaching powder, soda ash, caustic soda, lime stone etc.

Books Recommended :

I. Technology of Textile Properties by M.A.Taylor,
2. Textile Analysis by S.K.
3. Identification of Textile Materials, 7th Edn., Textile Inc., Manchester,7.
4. Analytical methods for a Textile Lab., 2nd Edn., AATCC monog No.3 Research Triangle Park. North Carolina, Printed in U.sA
5. ISI Standards for Textile Testing
6. Textile Testing by Sinkale.

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5 SCECT 5 ECONOMICS AND MANAGEMENT

SECTION-A

Unit I : Nature and Scope of Economics, introduction to managerial economics.

Demand concepts : Demand specification, types of demand.

Demand analysis : law of diminishing utility, Consumer's surplus.

Demand forecasting : Concept of forecasting, types of forecasts (8)

Unit II : Production Concept, production function, Laws of return, scales of production, factors of production, production planning and control : Its meaning, essential factors for the success of production planning and control. (8)

Unit III : Meaning of Management, Principles of management, meaning and principles of scientific management, levels of management, delegation and authority,

Organisation, forms of organisation. (8)

SECTION-B

Unit IV : Sources of Finance Banking and Credit structure in India : Financial institutions, promotional polices and programmes of industrialisation, functions of Commercial Banks, functions of Central Bank. (8)

Unit V : Economic and Social Environment : Brief idea about economic environment of business, socio-cultural environment, Health hazards of chemical industries, awareness about AIDS & other diseases.

Brief idea about economic recession & its effect.

Introduction to World Trade,

Globalisation, Libertion and their effects.

Introduction to Patenting & intelleatual property protection (8)

Unit VI : Entrepreneur and Entrepreneurship :

Entrepreneurial competencies, institutional interface for small scale enterprises, opportunity scanning and identification.

Market assessment for SSE, choice of technology and selection of site, Ownership structure and organisational framework, preparation of business plan, main features of Indian factories act & minimum wage act.

Brief idea of Taxation in India. (8)

BOOKS RECOMMENDED :

1) Managerial Economics : K.K.Seo, Richard D. Irwin Inc.
2) Engineering Economics : J.L.Riggs, McGraw Hill, New York, Latest Edition.
3) Managerial Economics : Adhikary M., Khosla Pub. House, New Delhi.
4) Small Business Management Fundamentals : Dan Strenhoff and J.F.Burgess, McGraw Hill Book Company.
5) Effective Small Business Management : Richard M.Hodgills, Academic Press Incorporated, Harcourt, Brace Jovanovich.
6) Marketing Management for Small Units : Jain Vijay K., Management Publishing Co., Latest Edition.
7) Marketing Management :- Analysis, Planning, Implementation and Control : Kotler, Phillip, Prentice Hall of India Pvt. Ltd., Latest Edition.
8) Modern Economics Theory : K.K.Dewett.

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5 SRNCECT 6 COMMUNICATION SKILLS

Unit I : Comprehension over an unseen passage.

Comprehension - A - word study :-

Synonym, antonym, meanings, matching words, adjectives, adverbs, prefix and suffix, correct forms of commonly mis-spelled words, understanding of the given passage.

Comprehension - B - Structure study :-

Simple and compound sentences, types of conjunctions, singular and plural, tenses and their effect on verb forms. Use of - not only - but also, if clause, since, may, can, could, would, too etc.

Active and passive forms, negative and interrogative, punc-

tuation and capitalization. (10 Hours)

Unit II : Theoretical background - importance of communication, its process, model of communication its components & barriers.

Verbal communication, its significance, types of written communication, organization of a text (Titles, summaries, headings, sequencing, signaling, cueing etc.), Important text factors (length of paragraph, sentences, words, clarification and text difficulty). Evaluation of written communication for its effectivity and subject content.

Non-verbal communication, types of graphics and pictoral devices. (10 Hours)

Unit III : Specific formats for written communication like - business correspondence, formal reports, technical proposals, research papers and articles, advertising and graphics. Format for day-to-day written communication like applications, notices, minutes, quotations, orders, enquiries etc.

Oral communications - Important objectives of interpersonal skills, (verbal and non-verbal), face to face communications, group discussion and personal interviews.

Methodology of conduction of meetings, seminars, symposia, conference and workshop. (10 Hours)

BOOKS RECOMMENDED :

1) Krishna Mohan, Meera Banerjee : Developing Communication Skills, MacMillan India Limited.
2) Chrissie Wright (Editor) : Handbook of Practical Communication Skills, Jaico Publishing House.
3) Curriculum Development Centre, TTTI WR, Bhopal : A Course in Technical English, Somaiya Publication Pvt. Ltd.
4) F.Frank Candlin : General English for Technical Students, University of London Press Ltd.

COMMUNICATION SKILLS LABORATORY

Objective :

On completion of this laboratory the candidate should be able to demonstrate adequate skills in oral and written communication for technical English language, actively participate in group discussions and interviews and exhibit the evidence of vocabulary building. Candidates should be assessed through continuous monitoring and evaluation.

The sample list of experiments is given below. This list can be used as guideline for problem statements but the scope of the laboratory should not be limited to the same. Aim of the

list is to inform about minimum expected outcomes.

1. Assignments and tests for vocabulary building
2. Technical report writing
3. Group discussions
4. Interview techniques
5. Projects and tasks such as class news letter
6. Writing daily diaries and letters
7. Interactive language laboratory experiments.

TEXT BOOK : Norman Lewis : Word Power Made Easy

http://www.teachingenglish.org.uk

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SIXTH SEMESTER

6S(FPOPC)T1 CHEMICAL TECHNOLOGY

Study of the following proccsscs :

1. Nitration: Nitrating agensts. Kinetics and mechanism of aromatic nitration. Thennodynamics of nitrations. Equipments for nitration. Mixed acids for nitration and typical industrial nitration processes e.g. preparation of nitrabenzene, chloronitronapthalene and acetafiline.
2. Sulphonation and Sulfation : Sulphonation and sulfating agents:Kinetics, mechanism and thermodynamics. Industrial equipment and techniques. Technical preparation of sulphonates and sulphates. Sulphation of lauryl alcohol, dimethyl ether etc.
3. Hydrogenation: Catalytic Hydrogenation. Kinetics and thermodynamics of hydrogenation reactions. Apparatus and material of construction, hydrogenation of fatty oils. Synthesis of methanol. Hydroforming of naptha. Hydrogenation of heavy oils.
4. Halogenation: Thermodynamics and Kinetics of halogen. Pathohalogenation. Equipment and design for halogenation. Technical preparation or halogen compounds e.g. allyl chloride. D.D.T...B.H.C....Chlorobenzene dichlorodifluromethane. vinyl chloride etc.
5. Oxidation : Liquid and Vapour phase oxidation. kinetics and thermochemistry. apparatus for oxidation. Technical oxidation of isoeurenol. acetaldchyde. Cyclohexane Iso-propylbenzene. napthaleum refinary, electro-plating, tanning, coat mining and radio waste.
6. Wastewater Treatment : Classification of wastewater. Methods of treatment. sludge treatment and disposal. treatmcnt of effluent water from textiles rayon. pulp. dairy, distillery Petroleum refinary, electro-plating, tanning, coal mining and radio active waste.
7. Water : Source of water. Impurities in water. Requirements of water by different industrics. treatment of water for industrial and domestic

purpose. boiler feed water treatment. reuse of water. Water conservation.

8. Industrial gases : CO, CO_2, CO_3, H_2, O_2, N_2, SO_2, C_2, H_2 synthesis gas, rare gases : Helium nitrous oxides.
9. Industrial Acids : Sulphuric, Nitric and hydrochloric acid.
10. Marine Chemicals : Salt from sea water. by product of salt industry viz, Bromine and Iodine.
11. Fertilizers: Ammonia Nitrogenious of fertilizers. Phosphatic fertilizers. Potassic fertilizers. Compound and complex fertilizers. Miscellanceous fertilizers,
12. Electrolytic and Electro-chemical Industries: Chlorates, perchlorates. Primary and Secondary cells, artificial abrasives. Calcium carbide Refractory carbides. borides, silicides and nitrides.

BOOKS RECOMMENDED:

1. Unit Processes in Organic Synthesis by P.H.Groggins. Vth Edn.. International Students Edn.. McGraw Hill Co.
2. Chemical Technology -Vols I, II, III by D.Venkateswarlu, Chemical Engg. Education Development Centre. I.I.T. Madras, Latest Edition.
3. Chemical Process Industries by R. N. Sherve and J. A. Brink. McGraw Hill, Co., Latest Edition.
4. Chemical Technology in two parts. Edited by I.P.Mukhlyanov, Mir Publishers Moscow, Latest Edition.

6 SCE (FPOPC) T 2 PROCESS EQUIPMENT DESIGN & DRAWING

SECTION-A

Unit I : Material behaviour under stresses, theories of failures. (8)

Unit II : Fabrication methods and their effects : Design method for atmospheric storage vessels, unfired pressure vessel subjected to internal and external pressure. (8)

Unit III : Vessels for high pressure operations, Agitated vessels. Tail columns, internals of the reactors. (8)

SECTION-B

Unit IV : Design of proess equipment accessories and support systems. (8)

Unit V : Complete design and preparation of working drawing for typical process equipment, such as large storage vessels, thick wall pressure vessels. Self supported tall columns, agitated pressure vessels with heat transfer requirements etc. (8)

Unit VI : Design and layout of piping system and preparation of piping

diagram for a typical process. Material selection and piping coding. (8)

PRACTICALS : Based on the above syllabus.

BOOKS RECOMMENDED :

1) Process Equipment Design : I.E.Brownell, E.H.Young, John Wiley, Latest Edition.
2) Process Equipment Design : M.V.Joshi, McMillan, Latest Edition.
3) Introduction to Chemical Engg. Design, Mechanical Aspects
4) I.S.Code for Unfired Pressure : IS No. 2825 - 1969 pressure vessel.
5) Process Equipement Design & Drawing : S.D.Dawande.
6) International & Indian Standard codes for Piping.
7) Process Design of Equipments, 3rd Ed, S.D. Dawande, Vol I & II, Central Techno Pub., Nagpur

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6 SCECT 3 INSTRUMENTATION & CONTROL

SECTION-A

Unit I : Measuring Instruments : Qualities of measurement, elements of instrument, static & dynamic characteristics, measurements of temperature and levels.

Unit II : Measurement of pressure, vacuum, humidity & pH in process industry.

Unit III : Methods for composition analysis. Principle and techniques of instruments for composition analysis in process industry, such as chromatography, spectroscopy, refractrometry etc.

SECTION-B

Unit IV : Flow measuring instruments : Flow measuring devices for incompressible and compressible fluids. Electro-hydraulic valves, hydraulic servomotors, electro-pneumatic valves. Pneumatic actuators.

Unit V : Introduction to Simple system analysis : Laplace Transformation. Block diagrams, linearization. First and higher order system.

Unit VI : Frequency response, distributed parameter system, dead time.

Feed back control, servo and regulator control. Time domain closed loop responses, closed loop frequency response.

BOOKS RECOMMENDED :

1) Industrial Instrumentation : Eckman, Wiley Eastern
2) Instrumental Methods of Chemical Analysis : Erwing, McGraw Hill.
3) Instrumentation & Process Measurements : W.Bottom, Orient Longman.
4) Industrial Control & Instrumentation : W.Bottom, Orient Longman.
5) Outlines of Chemical Instrumentation & Process Control : A. Suryanarayan, Khanna Pub., New Delhi.
6) Donald R. Cougha Nowr : Process Systems Analysis and Control, McGraw Hill Pub., New York.
7) Vyas R.P. : Process Control and Instrumentation, Central Techno Pub., Nagpur.
8) Patranabis D. : Principles of Industrial Instrumentation, 2nd ed., Tata McGraw Hill Pub. Co., New Delhi.
9) Patranabis D. : Principles of Process Control, Tata McGraw Hill Pub. Co., New Delhi.
10) Gaikwad R.W., Misal S.A. : Process Dynamics & Control, Central Techno Pub., Nagpur.
11) Stephanopoulos G. : Chemical Process Control and Introduction to Theory & Practice, PHI, Latest Edition.
12) Considine D.N. : Process Instrumentation & Control Handbook, McGraw Hill.

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6S(F/P/O/P C)T4 SPECIAL TECHNOLOGY-III

(REIATED TO THE CONCERNING TECHNOWGY)

TECHNOLOGY OF OIL BEARING MATERIAI:S

Domestic and World production of oil seeds and oils, storage, sampling, Grading of oil seeds and oils. Pre-Extraction treatments of oil seeds. Mechanical expression, solvent extraction and other methods of recovery of oils and fats. Economic aspects of these processes, processes and plants employed for refining, bleaching, deororisation and hydrogenation of oils and fats.

Manufacture of butter, Ghee, margarine, vanaspati and confectionary fats. Transesterified oils, fats, winterization of oils. Manufacture and evaluation of ancillary materials such as activated earths, activated carbons, nickel catalyst for hydrogenation. Cooking and salad oils, plastic shortening agents.

Environmental aspects in Oils seeds and oil processing units. Effective control according to Indian Standard specification.

Non Glyceride Constituents, general method of upgrading

and utilization of oils and fats, oil-cakes and other products. Synthetic fatty acids and glycerides.

Recent advances in the field.

BOOKS RECOMMENDED :

1. Cottonseed and Cottonseed Products : A.B.Bailey, Interscience Publishers, New York, Latest Edition.
2. Industrial Oil and Fat Products: A.E.Bailey, Interscience Publishers, NewYork, Latest Edition.
3. Soyabeans and Soyabean Products: K.B.NarkIev, Interscience Publishers, New York, Latest Edition.
4. Hydrogenation of Fatty Oilseeds : Waterman, Lquosevier Publishers, New York, Latest Edition.
5. Fatty Acids: K.S.Markely (5 Vols.), Interscience Publishers, New York.
6. Continuous Processing of Fats : M.K.Schwitzer, Latest Edition.
7. Refining of Oils and Fats for Edible Purposes: A.J.C. Anderson, Academic Press, New York.
8. Vanaspati Industry: G.S.Hattangadi
9. Practical Treaties on Vegetable Ghee Manufacture: Varma & Jaidev.
10. Solvent extraction of Vegetable Oils: H.Y.Parkb.
11. Refining and Technology of Oils and Fats: T.N.Mahatte, Small Business Publication, New Delhi.
12. Food Oils and their Uses: TJ.Weiss, Latest Edition.
13. Bleaching Earths: M.K.H.Siddiqui, Latest Edition.
14. Progress in the Chemistry of Fats and other Liquids: R.T.Holman, M.O.Luadberg & T.Malkin, Pergamon Press, New York (7Vols.)
15. Vegatable Fats and Oils: E. W.Eckay, Rinehold Publishers, New York, Latest Edition.
16. The Chemistry, Flavouring and Manufacture in Chocolate, Confectionary and Cocoa: H.PJenson, Blackiston Publishers, Philadelphia, Latest Edition.
17. The Butter Industry: O.F.Huzoker, Latest Edition.
18. Margarine: A.J.C.Anderson, Academic Press, New York, Latest Edition.

6S(F/P/O/P C)T4 SPECIAL TECHNOLOGY-III

(RELATED TO THE CONCERNING TECHNOLOGY)

FOOD TECHNOLOGY-III

MICROBIOLOGY AND PRINCIPLES OF FOOD PRESERVATION

Brief historical background, classification and terminology of micro-organisms. Study of morphology and physiology of bacteri-yeasts moulds and actinomicetes, introduction to viruses and bacteria. Methods of isolation, cultivation and enumeration of micro-organisms, Nutrition,

reproduction and metabolism. Synchronised and balanced growth and continuous cultivation of microorganisms.

Control of microorganisms by physical and chemical methods, Sterilisation and disinfection, inadiation antibiotics, evaluation of antimicrobial agents, Microbiology of air, water and sewage. Immunological methods. Bacteriological analysis of foods, Role of microorganisms in food spoilage.

Principles of food preservation. Preservation of food by means of low temperature. Freozedrying thermal processing irradiation, dehydration chemicals antibiotics and C.A.storage. Sources and prevention of contamination. Food Production and Microbial toxins, Principles of a amitation in food technology and safety of foods. Fermented food like bread, cheese, yogurt, vinegar, alcohol, pickles.

Recent advances in the field.

BOOKS RECOMMENDED:

I. Food Microbiology: W.C.Frazier, Tata McGraw Hill Pub., Co., Bombay.
2. Microbiology: MJ.Pelkzar, Ried R.D., E.C.S.Chan, Tata McGraw Pub., Co. Ltd., New Delhi.
3. Fundamentals of Microbiology: M.Frobisher, W.B.Saunders Co., Philadelphia.
4. Microbiology: P.L.Carpenter, W.B.Saunders Co., Philadelphia.
5. Microbiological Methods: C.H.Collins & P.M.Lyne, Butterworth and Co., London.
6. Food Processing Operations: M.A.Goslyn & J.Hold, The AVI Pub. Co., INC, Westport.
7. Principles of Food Science, Vol. II : G.Borgestrom the MacMilIan Co. Ltd., London.
8. Technology of Food Preservation: Destosier, Norman W., AVI Pub. Co., INC, London.
9. Practical Food Microbiology and Technology: H.H. Weiser, The AVI Pub. Co., Westport (Coun.)

6S(F/P/O/P C)T4 SPECIAL TECHNOLOGY-III

(RELATED TO THE CONCERNING TECHNOLOGY)

PETROCHEMICAL TECHNOLOGY-Ill

PETROLEUM REFINERY ENGINEERING CALCULATIONS

ASTM, TBP, EFV distilIation curves, computation of the curves from any one type by methods such as those or Nelson, Simister etc. Computation of various properties of petroleum fractions such as VABP,MABP, thermophysical

properteis from refinery engineering chart. Phase behaviour of multicomponent hydrocarbon systems retrograde phenomena, K values and their estimate for complex mixtures K values corelations; Flash equilibrium calculation for multi component system by method of successive approximations and simple methods such as that of McHenry; Calculation of bubbic and dew points for complex mixtures, construction of phase diagram, successive flash for complex mixtures, multicomponent fractionation.

Separation criteria in crude oil fractionation, comparison with the simplest light hydrocarbon fractionation. Watkins method of covering crude TBP to product TBP curve, concept of overflash.

Energy balance in a topping tower, types of reflexes and calculations involved, estimation of top side draw bottom and stripper temperatures. Brief account of topping tower design procedures: according to Nelson, Watkins, Van Winkle (psudeo component design method), tray design.

Entrainers and solvents for hydrocarbon separation by azeotropic and extractive distillations. Types of pipe still heaters, calculation of radiant absorption rates, Wilson Lobo, Hetel equation, Labo Evans method piple still design.

Problems illustrating the use of solvent extraction, absorption and stripping in refinery operations and natural and refinery gas processing; multicomponent absorbers and strippers, calculation by Kremser-Brown absorption factor procedure.

Heat exchangers in refinery design and operational problems, fluid mechanics and refinery applications. Use of combustion charts.

Recent advances in the field.

(The subject has to be covemed entirely by Numerical)

Books Recommended:

1. Petroleum Refinery Engineering : W.L.Nelson, McGraw Hill, Kogakusha, 4th Edn., Latest Edition.
2. Petroleum Refinery Distillation: R.N. Watkins, Gulf Pub. Co., Texas, Latest Edition.
3. Data Book on Hydrocarbons: J.B.Maxwall, K.E.Kriegar Pub. Co., New York, Latest Edition.
4. Distillation: M. Van Winkle, McGraw Hill, Latest Edition.
5. Handbook of Natural Gas Engineering: D.L.Katz & Others, McGraw Hill, Latest Edition.
6. Applied Hydrocarbon Thermodynamics: W.C.Edmister, Gulf Pub. Co., Latest Edition, Vol. I & II.

7. Surface Operations in Petroleum Production: G.Y.Chilingar & C.M.Beeson, Elsevier, New York, Latest Edition.
8. Petroleum Processing Handbook: W.F.Bland & R.L.Davidson, McGraw Hill, Latest Edition.
9. Chemical Engg. : J.M.Coulson and J.F.Richardson, Pergamon Press 3rd Edn., Vols. I & II, Latest Edition.
10. Equipment Design Handbook for Refineries and Chemical Plants: Frank L.Evans, Jr., Gulf Pub. Co., Houston, Texas, Latest Edition.

6S(F/P/O/P C)T4 SPECIAL TECHNOLOGY PAPER-Ill
(RELATED TO THE CONCERNING TECHNOLOGY)
PULP & PAPER TECHNOWGY
PULPING PROCESSES-II

Pulp Washing, Bleaching and Recovery of Spent Chemicals : Washing of Pulp : Delibration of sulphate pulp, brown stock washing, screening and clearing of sulphate pulp, washing of sulphite pulp, screening and clearing of sulphite pulp, screening and clearing of other pulps.

Recovery of spent chemical : Liquor recovery in alkaline pulping, evaporation of kraft liquors, recovery furnance, recausticizing treatment to digester and evaporator condensates, recovery of alkalining sulphate, turpentine, tall oil and other alkaline pulping by products.

Recovery process in sulfite pulping, Calcium, Magnesium, Amonia and Sodium bases recovery, other sulfitex recovery methods, recovery of by-products from sulfite process, whole spent liquor and ligoo sulfonates. Vaniline and alcohol from sulfite spent liquor, fermentation of sulfite spent liquor to produce proteins.

Bleaching: History of Bleaching, bleaching of mechanical pulps, semichemical pulps, chemi-mechanical and chemical pulps, multistage bleaching, control procedures in bleaching process, colour reversion of bleaching pulps, environmental aspects of Bleaching chemicals.

Recent advances inthe field.

Books Recommended:

1. Pulping Processes by S.A.Rydholm.
2. Pulp & Paper : Chemistry and Chemical Technology, 3rd Edn., Vol. I by James P.Casay
3. Pulp & Paper Manufacture, 2nd Edn., Vol.-I by R.P.Mc Donald.
4. Hand Book of Pulp & Paper Technology, 2nd Edn., by K. W. Britt.

6 SCECT 5 COMPUTER PROGRAMMING AND APPLICATIONS

Note : Application of the following techniques for problems of interest in chemical engineering, writing and testing of programs written in C Language.

SECTION-A

Unit I : Numerical solution of first order differential equations with initial condition, Euler's method, Runge-Kutta method.

Unit II : Systems of linear equations, solution by the method of determinants, matrix inversion for the solution of linear equations, Gauss elimination method.

Unit III : Roots of algebric and transcendental equation, iteration methods, Regula-Falsi method, Newton-Raphson method, roots of simultaneous and solution set of transcendental and algebric equations. Development of equations for heat transfer, fluid mechanics and reaction engineering problems.

SECTION-B

Unit IV : Regression analysis - Least Square, error approach, approximation by Chebychev orthogonal polynomial.

Unit V : Elements of optimization techniques, single variable function, optimization-direct search, with and without acceleration, method of regular intervals and fibonacci search method, gradient methods.

Unit VI : Computer programming in modular form, use of subroutine libraries, Block diagrams of preliminary aids in programming, capacity optimization.

PRACTICALS : Based on above theory.

TEXT BOOK : Digital Computation for Chemical Engineering by Leon Lapidas, McGraw Hill, Latest Edition.

6 SCECT 6 MINI PROJECT

Students are required to prepare and submit report on mini project on Software Development / Market Survey / Design / Fabrication / Site Visit / Some Experimental Investigation / Validation in the relevant field under the guidence of teacher.

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SEVENTH SEMESTER

7S(FPOPC)T1 MASS TRANSFER

SECTION A

Unit I : Diffusion - molecular diffusion in gases & liquids, diffusivities of gases & liquids, application of molecular diffusion, mass-transfer coefficients in laminar flow, Eddy diffusion, Mass-transfer in turbulent flow. Analogies of transfer Process.

Models of Mass-Transfer analogies. Theories of mass transfer.

Interphase mass transfer Diffusion between phases, two phase mass transfer coefficients, individual & overall coefficients:

Stagewise processes co-current & countercurrent processes.

Equipment : Tray towers, general characteristics of tray towers, efficiencies Wetted Wall towers, packed towers characteristics of packed towers. Mass transfer coefficients in packed towers.

Gas absorption: Equilibra relationships, Material balance for co-current and counter current multistage equipment. Approach for dilute systems.

Calculation of HETP & HTU in continuous equipment for absorption and stripping, - Individuals & overall coefficients, Transfer units.

Unit II : Distillation : Various liquid equilibria for ideal & non ideal systems. Relative valtility, Azeotropes, Enthalphy concentration diagram, single flash vaporization. Partial condensation. Differential distillation for binary systems.

Fractionation McCabe - Thiele & Panchon- Savarit methods for multistage operations. Reflux, Reflux ratio & optimum reflux ratio. Reboilers, Total and partial condensers. Tray efficiencies, azeotropic & extractive distillation. Introduction of multicomonent distillation.

Unit III : Extraction - Liquid Liquid Ternary liquid equilibria, Different co-ordinate systems. Classification of equipment.

Single Stage and Multistage Co-current & counter current extraction. Calculation of number of stages analytically and graphically continuous Extraction. N. T. U. and H. T. U.

Ion exchange & Membrane separation techniques.

Unit-IV : Leaching, Principles, Equilibria calculation of single stage & multistage leaching- process equipment.

Unit V : Crystallization & Principles, Calculation of Yield, Heat effects, equipments.

Unit VI : Humidification, Fundamental concepts, General Theorems, Cycometric chart, Dehumidification and drying theory and

mechanism, drying rates, Design and performance and continuous and Batch Dryers, Industrial Dryers.

PRACTICALS : Based on above syllabus.

BOOKS RECOMMENDED:

1. Unit operations in Chemical Engg. 3 Ed. W.L.McCabe & J. C.Smith, McGraw Hill & Kogakusha, Latest Edition.
2. Mass-Transfer RE.Trebal3 ed. McGraw Hill, Latest Edition.
3. Mass-Transfer 3-ed. T.K.Sherwood, RI.Pigford;C.R, McGraw Hill, Latest Edition.
4. Mass-Transfer Operation: RE. Treybal.
5. Design of equilibrium stage Process: B.D.Smith
6. Chemical Engineering, Vol II : Couslson Richardson.

7SCE (FPOPC) T2 CHEMICAL REACTION ENGINEERING-I

(KINETICS)

SECTION - A

Unit-I : Classification of chemical reactions. Variables affecting the rates of reaction. Kinetics & Thermodynamics. Thermodynamics of chemical reactions. Classification of reactors. Order of reaction & rate constant.

Unit-II : Rates of Homogeneous reactions. Fundamentals of rate equation. Rate equations from proposed mechanism Analysis of simple & complex rate equation. Evaluation of rate equation from laboratory data.

Unit-III : Interpretation of rate data, Scaleupard Design. Constant volume batch reactor. Variable volume Batch reactor. Temperature and reaction rate.

SECTION - B

Unit-IV : Single ideal reactors. Ideal Batch Reactor. space time and space velocity, steady state mixed flow reactors, steady state plug flow reactor, Holding-time & space time for flow system.

Unit-V : Design for single reactions

Size comparison of single reactors Batch reactor, Mixed verses plug flow reactors Variation of reactant rates. General Graphical comparison. Autocatalytic reactions.

Unit-VI : Design for multiple reactor system. Reactions in parallel & in series, series-parallel reactions. Batch recycle reactor, Flow-recycle reactor. Temperature & pressure effects in single and multiple reactions. Optimum temperature profile.

Practicals : based on above syllabus.

BOOKS RECOMMENDED:

1) Chemical Reaction Engg. : Octane Levenspiel, Wiley Eastern LId

2) Chemical Engg. Kinetics: Smith J.M., Mc Graw Hil:
3) Reaction Kinetics for Chemical Engineers: Waas. McGraw Hill.
4) Elements of Chemical Reaction Engg: Scott H., Fogler, Prentice Hall India.
5) Principles of Reaction Engg : S.D.Dawande, Central Techno., Pub., Nagpur.
6) Chemical Reaction Engineering : Gavhane K.A., Nirali Pub.
7) Chemical Kinetics and Dynamics : Stein feld, Allied Pub. Ltd., Chennai.
8) An Introduction to Chemical Engg. Kinetics and Reactor Design : Hill C.G., Jr., John Wiley.

7S(F/P/O/PC)T3 SPECIAL TECHNOLOGY PAPER-IV

(RELATED TO CONCERNED TECHNOLOGY)

OIL TECHNOLOGY

TECHNOLOGY OF SOAPS, DETERGENTS, ESSENTIAL OILS AND GLYCERINE

Surfactants : Concepts of surface activity. structure of surfactant molecules, Hydrophil - Lipophil balance. Methods for measurement surface activity, mechanism of detergency.

Typc of Surfactants : Anionic, Cationic, nonionic and amphoteric. Biodegradation of surfactants. Application of Surfactants.

Soaps: Raw materials for soap. industry classification and selection of raw materials. Properties of soap and soap solutions. Phase seperation in soap boiling. Plants and process employed in soap manufacture. Various types of soaps and cleaning preparation. Analysis of soaps.

Detergcnts: Classification. raw materials. plants and process employed in manufacture of detergents, analysis of detergents. LS.I.methods of testing of soaps and detergents.

Essential oils : Classification and chemical constituents of essential oils. Methods of extraction. Analysis of essential oils. Natural and synthetic perfumery. materials for industrial uses.

Glycerine : Manufacture of Glycerine from natural sources, sweet waters, propeties spent lyes. Synthetic glycerine.: Properties. analysis and utilization of glycerine.

Recent advances in the field

BOOKS RECOMMENDED :

1. Soap: Their Chemistry and Technology: J.G.Khane.
2. Soap Manufacture: J.Davidson.lnerscience Publishers. New York. Latest Edition.
3. Sulphated Oils and Allied Products: D.Burton and G.F.Robertshaw.

Chemical Publishing Co., New York, Latest Edition.
4. Surface active agents and'Detergents : A.M.Schwarttz. J.W.Perry and J.Berch, Interscience Publishers, New York. Latest Edition.
5. Industrial oil and fat products: A.P.Bailley, Interscience Publishers. New York. Latest Edition.
6. Technology of Laundry Soap Manufacture: Small Business Publications, New Delhi
7. House Hold & Industrial Surfactants : Small Business Publications, New Delhi.
8. The Technology of synthetic Detergent : Small Business. Publications, New Delhi.
9. Textiles Chemicals & Auxilaries : H.C.Speed and E. W.K.Schwartz, Reinhold Publications, New York, Latest Edition.
10. The Manufacture of Glycerol : G.Martin
11. The Modern Soap Detergent Industries: G.Martin
12. Textile Auxiliaries: Shenoy

SPECIAL TECHNOLOGY -IV
PRACTICAL- III
OIL TECHNOLOGY

Producing fats and fat based products, Mechanical expression of Oil from Oil seeds, Refining and hydrogenation of Oils. Evaluation of Bleaching Earths. Activated carbon and charcoal. Preparation of soaps and detergents. Preparation of various types of detergents. Refining of commercial waxes. Preparation and evaluation *of* wax formulations. Preparation of metallic soaps. preparation of boiled oil. blown oils and stand oils and their evaluation. Preparation of ester gum. monoglycerides. sulphated and sulphonated oils, varnishes, lime and zinc harden resin and product evaluation. Fat splitting and separation of fatty acids. Preparation of paints and its analysis for wa ablity. drying lime. gloss and shade matching. Preparation of cosmetics. Analysis of pigment. Oil absorption. hiding power etc.

7S(F/P/O/PC)T3 SPECIAL TECHNOLOGY PAPER-IV
(RELATED TO CONCERNED TECHNOLOGY)
THEORY
FOOD TECHNOLOGY-IV
FOOD PROCESSING(I)

Unit Operation in Food Processing: Equipment for various operations like clearing. sorting. grading. size reduction and separation, mixing. filtration. expression, centrifugation, crystallisation etc. Application of heat in concentration. chilling and refrigeration. Thermal processing of foods.

preliminary operations, methods of heat sterilisation and process time calculations. Food irradiation. Plant hygiene and water supply.

Process Technology of Cereals, Legumes and Oil Seeds: Post-harvest storage and handling. Insect infection and its control. Mycotoxins in cereals, Oilseeds and their products. Milling of cereals and legumes. By-products of milling industry Oil extraction. refining and hyderogeneration. Manufacture of margarine, salad Oils, cooking oils, shortening agents, lecithin CMS etc. Processing of Oil seeds for food uses.

Process Technology of Baking and Baked Products: Selection of raw materials, Rheology of dough and dough testing methods. Changes during fermentation of dough. Manufacture of bread, Biscuits, crakers, cookies, cakes and other bakery products. Manufacture of breakfast cereals, puffed cereals, fortified and enriched products. Extrusion cooked products. Quality control.

Process Technology of Tea & Coffee: Composition and Processing. Flavour and aroma, Methods of evaluation of quality. Process technology of Cocoa, Chocolate, Candy and Confectionary Products.

Raw materials, use of additives, tech. of processing of cocoa, Manufacture of chocolate candies and confectionary products. Quality control and standards.

Special Foods: Weaning and baby foods, processed protein and cereal foods textured proteins, synthetic foods, space foods. I.M.Foods, Simulated milk products, Pro-cooked and instantised foods. Quality food management.

Recent advances in the field.

BOOKS RECOMMENDED :

1. Fundamentals of Food Processing Operations by Jonslyn. M.A. and Heid, J.L., Published by AVI Publishing Co., Inc Westport, Connecticutt, Latest Edition.
2. Food Processing Operations, Vols.l,2 and 3 by Jonslyn, M.A. and Heid, J .L.,Publ. by A VI Publ. Co., INC, Westport Connecticut, Latest Edition.
3. The Freezing Preservation of Foods, Vols., 1,2,3 & 4 Edited by Eople, MJ.and Tressler, D.K.,Published by AVI Publ. Co., INC, Westport Connecticut, Latest Edition.
4. The Fundamentals of Food Engineering by Charu, S.E., Published by AVI Publ. Co., INC, Westport Connecticut, Latest Edition.
5. Grain storage part of System. Edited by Sinha, R.N. and Muir WE., Published by AVI Publ. Co., Inc, Westport Connecticut, Latest Edition.

6. Technology of cereals with Special reference to Wheat by Kent, N .L., Publishing by Pergamon Press, Oxford, Latest Edition.
7. Cereal Technology by Matz, Samuel, A., Published by the AVI Publishing Co., INC, Westport Connecticut, Latest Edition.
8. Coffee Processing Technology, Vols.1 and 2 by Sivetz M.,Published by AVI Publ.Co., INC, Westport Connecticut, Latest Edition.
9. Food Dehyderation, Vols, I and 2 by Copley, MJ. and Van Arsdel, WB., Published by the AVI Publ. Co., INC, Westport Connecticut, Latest Edition.
10. Modern Methods of Cocoa and Chocolate manufacture by Waters,H. W.,Published by J. & A. Churchill, 40, Glouceter Place, Portman Square, Latest Edition.
11. Wheat Chemistry and Technology, Edited by Pomeranz, Y.,PiJblished by the American Association of Cereal Chemists, Incorporated St.Paul, Mannesota, Latest Edition.
12. Modem Cereal Chemistry by Kent Jenos. D. WAmos, AJ .,Published by Foods Trade Press Ltd., 7, Garrick Street, WC.London, Latest Edition.
13. Snack Food Technology by Matz, S.A., Published by AVI Publ.Co., INC, Westport Connecticut. Latest Edition.
14. Bailey Industrial. Oil and Fat Products, Edited by Deniel Swern, Published by Interscience Publishers, A division of John Wiley and Sons, New York, Latest Edition.
15. Bakery Materials and Methods by Daniel, A.R., Published by Mac, Laren & Sons, Ltd., London,Latest Edition.
16. The Manufacture of Biscuits, Cakes and Waffer's by Fritsch,J. and Grospicrre, Published by Sir. Issac Pitman and Sons Ltd., London, Latest Edition.
17. Surgar Confectionary and Chocolate Manufacture by E.BJackson and Less, R.,Published by Leonard Hills Books, 24, Market Square, Aylesburry, Books.

SPECIAL TECHNOLOGY -IV
FOOD TECHNOLOGY-III
PRACTICAL-III
FOOD ANALYSIS

Chemical and Instrumental Methods for the analysis of foods and their constituents like fruits, bakery foods, honey, tea, coffee, vinegar, glucose, syrup. Spices and condiments, confectionary products and dairy products. Analysis of cereals and cereal products. Determination of maltose No., sedimentation value etc. Identification and determination of food aditives, poisonous and toxic materials. Estimation of Aresenic and lead in processed foods.

BOOKSRECOMMENDED:

1. Modern foods Analysis by Hart, F.L. and Fisher, MJ.,Published by Springer Verlag, Berling, Heidelberg, New York,Latest Edition.
2. Official Methods of Analysis of the Association of Official Analytical Chemists, Edited by William Horwitz, Published by Association of Official Analytical Chemists, P.O.Box, 540, Benjamin Frankin Station, Washington, D.C. 20044, Latest Edition.
3. The Chemical Analysis of Foods and Food Products by Jacobs, MR, Published by D. Van Nostrand Company, INC, Prinoonton New Jorsey, New York Latest Edition.
4. Food Analysis by Less, R.,Published by Leonard Hill Books 450 Road, London, W2, LEG Latest Edition.
5. The Chemical Analysis of Foods, by Pearson, D., Published by lEA, Churchill, 104, Cloucester Place, London, Sixth Edition, Latest Edition.
6. Manual of Analysis of Fruit and Vegetable Products by Ranganna, S.,Published by Tata McGraw Hill Publishing Co., Ltd., New Delhi. Latest Edition.

7S (F/P/O/PC)T3 SPECIAL TECHNOLOGY-IV
PAPER-IV
(REIATED TO CONCERN ED TECHNOLOCY)
THEORY
PETROCHEMICAL TEOINOLOGY-IV

Reactor Design in Petrochemical Processes

Unit I : Design aspects of pipe still heaters. Radiant and convection sections. calculation of heat flux. radius and number of pipes. band allowance.

Capacity. number of plates. shell thickness. reflux ratio. pressure. temp. and composition calculations.

Unit II : Capacity. role of fccd stocks. desi red product pattern. process variables. raw material of visbreaker. coker and catalytic crackcr. Deactivation in catalylic cracking, types, mechanism and kinetics.

Unit III : Details of loading capacities of different reactors in series for cata l ytic reforming. catalyst properties and composition. space time variation. variation of rates and extents of diff. reactions in diff. reforming, hydrocrdcking and isomerization reactors. problems associated with pressure and corrosion.

Unit IV : Trickel bed reactors for HDS, mass. transfer effects. ,'arious reactions. role of pressure characteristics of fluidised bed reactors, paramcters. Kunni Lcva model, role of emmission phase. wake. diameter of bubble. application of FBR for acrylonitrile production.

Unit V : Packed bed reactors, multibed reactors. phathalic anhydride production in multi tubuler bed reactor. Details of slurry bed reactor, heat and mass transfer. effects in slurry reactors. problems of catalyst and product separation.

Unit VI : Reactor design aspects for production of PP.PE, Styrene. Problems of agitation. viscosity rise, mass transfer and heat transfer, power requirement.

Reactor design for alkylator. cooling systems. agitation and product separation.

Recent development in the field.

Practicals : Based upon the Theory

BOOKS RECOMMENDED (FOR REFERENCES):

1. J.M.Smith : Chemical Engineering Kinetics. 2nd Edn.. McGraw Hill. Latest Edition. .
2. Octave Levenspiel : Chemical Reaction Engineering, Wiley Eastern. Latest Edition. .
3. C. G.Hill. Jr. : An Introduction to Chemical Engineering and Kinetjcs and Reactor Design. John Wiley; Latest Edition.
4. J.J.Carbery : Chemical and Catalytic Reaction Engineering. McGraw Hill. Latest Edition.
5. A. R. Cooper and G. V. Jeffreys: Chemical Kinetics and Reactor Design Oliver and Boyd. Edinburgh. Latest Edition.
6. J.M.Coulson. J.F.Richardson & D.G.Peacock: Chemical Engineering. Vol III, ElBS, Latest Edition.
7. K.B.Denbig & IC.Turner: Chemical Reactor Theory. 2nd Edition, Cambridge University Press, Latest Edition.
8. O.A.Houghen and K.M Watson: Chemical Process Principles. Part-III Kinetics and Catalyst: John Wiley - Latest Edition.

7S(F/P/O/PC)T3 SPECIAL TECHNOLOGY -IV
(RE1ATED TO CONCERNED TECHNOLOGY)
PULP AND PAPER TECHNOLOGY-IV
STOCK PREPARATION

Introduction. beating. refining. factors afecting bealing. equipments used in stock preparation such as peaters.,refiners, pulpers etc. consistency regulaters, stock proportioners, chest and agitators. pums stock preparation systems for main grades of paper. board and tissue.

Internal Sizing of Paper : Introduction. application of internal sized papers, chemistry of intemal sizing, wettability and contact angle materials used for internal sizing. size requirements for different pulps, factors deterimental to internal sizing.

Filling and loading: Definations. influence of loading. on physical properties of paper. adverse effects of fillers. properties of fillers. preparation of fillers. theories of fillers retention.

Colouring of Paper : Colour measuring instrument. shades of colour, colouring materials. dyes and pigments and fluoroscent brightening agents. dyeing of paper, colour selection and dye fonnula.

Special Additives: Introduction wet end adhessives. use of starches, gums, and synthetic resins in paper making, wet strength, papers, chemistry of wet strength process, mechanism of wet strength, retention of resins, curring of wet strength resin, Water and water reuse.

Recent development in the field.

BOOKS RECOMMENDED :

1. Pulp and Paper: Science and Technology Vol- II by C.E.Libby
2. Pulp and Paper Manufacture, 2nd Edn., Vol.-II by Mac Donald McGraw HilL
3. Pulp & Paper: Chemistry and Chemical Technology Erd, Edn. Vol-III by James Casey.
4. "Hand Book of Pulp and Paper Technology" by K.N.Britt

SPECIAL TECHNOLOGY-IV
PRACTICALS- III
PULP AND PAPER TECHNOLOGY - PRACTICAL- III

Analysis of Paper-Moisture content, ash content, cold water and hot water extractibles, determination of copper number, Determination of rosin size, Alpha Cellulose content etc.

7SCE (FPOPC) T4 INDUSTRIAL WASTE TREATMENT
SECTION A

Unit-I : Environment, pollution, pollutant, Zero pollution, production waste, consumption waste, by product waste salvageb!e waste, types of pollution causes by wastes, greenhouse effect, Acid rains, Causes of acid rains, effects. Chloroflurocarbon, application of CFC's in industry, role of CFC's in depletion atmospheric ozone. Other effects of air pollution. Agencies working on pollution control, their constitution, ageing of lakes and resvoirs, thermal stratification of lakes and reservoirs. example of wasteless processing.

Unit-II : Legislations of Environment protection, Indian standards for drinking water, effluent discharge, Indian Standard Codes for disposal of Wastes, Micro-organisms present in water,

water borne diseases, determination of the dissolved solids, suspended solids, turbidity, pH, conductivity, DO, BOD by direct method & dilution method, COD sampling methods, Sampling procedures and precaution.

Unit-III : General Treatment: Screening and grease removal, Neutralization, Proportioniry, Chemical Coagulation, Sedimentation, filtration.

Biological Treatment: Kinetics of Biological growth, various suspended and attached grouth processes for the treatment of industrial effluent.

Advanced Waste Water Treatment : Ion exchange, Activated carbon adsorption, Electro dialysis, Reverse Osmosis. Disinfection of Water: Sterlization and methods for disinfection.

Sludge Disposal: Various alternatives for Sludge disposal.

SECTION-B

Unit-IV : Solid waste management, land pollution, composting, land filling, incineration, types of hazardous waste, treatment of hazardous waste, sources of radioactive wastes, treatment of radioactive waste. effects of radiations. Rewashable and recyclable solid waste, recycling in chemical industries.

Unit-V : Removal of particlated matter, comparative study of method employed e.g. cyclones, bag filters, precipitators, scrubbers, collectors etc., Pollutions control for fly ash, combustion and gasification plants. Various process for reducing SOx, NOx emissions.

Unit-VI : Waste management for industries like Food Industry Dairy Industry, Sugar Mill, Fertilizer, Pulp and Paper. Sulphonic acid, Cement, Tanneries.

Case studies and corrective measures taken in inaustry to prevent environmental hazards.

PRACTICALS : Based on above syllabus.

BOOKS RECOMMENDED:

1) Dr.S.P.Mahajan : Environmental Pollution Control
2) Matcaff and Eddy : Waste Water Treatment
3) Rao & Datta : Waste Water Treatment
3) V. V. Kafarov : Wasteless Chemical Processing

7S(F/P/O/PC)T5 SPECIAL TECHNOLOGY PAPER-V

OIL TECHNOLOGY

TECHNOLOGY OF SURFACE COATINGS

Convertible and non-convertible coatings: Chemical nature of coatings and their properties. Natural synthetic resin.

Chemistry of drying, Semi-drying and non-drying oils, chemistry and mechanism of heat and drying. Manufacture of synthetic drying oils, Processes and Plants employed in refining of drying oils.

Their manufacture and properties. Vents, diluents and thinners: Definition types of solvants and their properties.

Chemistry and tech.of resins: Natural and synthetic resins.

Pigment and extenders: Pigmentary properties and evaluation of pigments. General outlines of the methods of the manufacture of pigments. Properties and uses of important pigments. Organic pigments and colours.

Formulation of paints: Printing inks, leaquers, varnishes and linoleum. Methods of manufacture of paints, printing inks, and leaquers,I.S.1. methods for evaluation of paints and printing inks.

Recent development in the field.

BOOKS RECOMMENDED:

l. Outline of Paint Tech. - H.Hea
2 Organic Coating Tech. - H.R.Payne
3. Introduction to Drying Oil Tech. - A.R.MiIls
4. Paint and Varnish Manufacture - H. W. Chatfiels
5. Treatise on Coatings - Myas and Long.
6. Printing Inks - C.Ellis, Rainhold PbI., New York, Latest Edition.
7. Nitrocellulose Ester Leaquers - F.Zimmer
8. Paint Film Defects - M.Hers
9. Paint and Varnishes - A.S.Khanna
10. O.C.C.I. Paint Technology Manual (5 Volumes)
11. Tech.of Writting and Printing Inks, Small Business Publ.

7S(F/P/O/P C) T5 SPECIAL TECHNOLOGY PAPER-V

(RELATED TO CONCERNED TECHNOLOGY)

THEORY

FOOD TECHNOLOGY-V

FOOD PROCESSING-II

Process Technology of Fruits and Vegetables - Pre and Post harvest changes in fruits and Vegetables, Storage, handing,and canning of fruits and

Vegetables and their products. Technology of fruits and Vegetables Juices, purees, concentrates, jams, jellies, marmalades, preserves fruit butters, candied fruits, pickles etc.

Process Technology of Meat and Poultry : Live stock and poultry preparations, slaughter, cutting dressing and gradding, Various cuts of meat. Post-mortem changes. Preservation and packing of meat, poultry and their products.

Quality control in processed meat and poultry products, Microbiological standards. By products of meat and poultry processing industries. Process technology of eggs and their products.

Process Technology of Fish and other Aquatic Foods: Sources, methods of fishing, handling and storage processing of fish and fish products. By products of fish processing. Fish oils, Standards of fish and fish products. Processing of other aquatic foods like crabs, frogs, moiluses etc.

Process Technology of Milk and Milk products: Composition of milk, processing, storage and distribution of milk, manufacture of cream, butter, ghee, evaporated, condensed and skimmed milk, whole and skimmed milk powder and other fermented milk products. Manufacture of cheese. Preparation of Indian milk products like Khoa Channa, curd and their products, Standards for milk products.

Process Technology of Beverages: Carbonated Beverages. Fruit Juices, and R.T.S. beverages. Alcoholic Beverages. Quality control.

Packaging: Functions of packaging materials, Rigid and flexible packages, Metallic, glass and plastic containers. Laminated packaging. Requirement of packaging for specific products. Testing of packaging materials. Biodegradable packaging. Quality Attributes of Foods and their Evaluation.

Flavour, armoa and texture of foods. Food additives. Spices and condiments. Contamination in foods.

Food Adulteration and Food Laws: PFA and FPO rules, ISI and Agmark standards.

Recent development in the field.

BOOKS RECOMMENDED:

1. Preservation of Fruits and Vegetables by Girdharilal and Siddappa, G.S.Published by Indian Council and Agricultural Research, New Delhi, Latest Edition.
2. Fruits and Vegetable Juice Processing Technology Edited by Treassler, D.K. and Jonslyn, M.A., Published by the AVI Publishing Co., Inc. Westport, Connecticut, Latest Edition.

3. Practical Canning by Lock *A.,* Published by Foods Trade Press Ltd., 7 Garrick Street, W.C.2, London Latest Edition.
4. The Meat Hand book by Levie A, Published by the AVI Publishing Co., Inc. Westport, Connecticut, Latest Edition.
5. The Science of Meat and Meat Product, Edited by Price, J.F. and Schweigert, B..S.Pub1ished by W.H. Freeman and Company, San Francisco, Latest Edition.
6. Poultry Products. Technology by Mountney, GJ., Published by the A VI Publishing Co., Inc. Westport, Connecticut, Latest Edition.
7. Fishery By-products Technology by Brody, J., Published by the A VI Publishing Co., Inc. Westport, Connecticut, Latest Edition.
8. Fish and Food Vols. 1,11,11I & IV Edited by Brog traom. G., Published by Academic Press, New York and London, Latest Edition.
9. Processed Cheese Manufacture by Dr. Meyer A.. Published by Food Trade Press, London, Latest Edition.
10. Drying of Milk and Milk Products by Hall. C. W. and Hendrick, T.I., Published by the AVI Publishing Co., Inc.Westport, Connecticut, Latest Edition.
11.. Modern Dairy Products by Lampert, I.M.,Published by Eurasia Publishing House, (P) (Ltd.), Ram Nagar, New Delhi - 110055, Latest Edition.
12. By products from Milk by Webb,B.H. and Whittier, E.O., Published by the A VI Publishing Co., Inc. Westport, Connecticut, Latest Edition.
13. The Chemistry and Testing of Dairy Products by New Lander, J.H. and Atherton, H. V., Published by Olsen Publishing Co., Milwakee Wisconsis, Latest Edition.
14. Food Adultration by Jacob, T., Published by the Mac-Millan & Co. of lndia, Ltd., Latest Edition.
15. The Spice Handbook of Parry, J. W., Published by Chemical Publishing Co., New York, Latest Edition.
16. Meat Technology by Gerrard F., Published by Deonord Hill, London Latest Edition.
17. Radiation Technology by Desrosier, N. W., Published by the AVI, Publishing Co., INC, (1960)
18. Symposium: Processing Agricultural and Municipal Wastes, Edited by Inglett, C.E., Published by the AVI Publishing Co., Inc., Latest Edition.
19. Introduction of Waste Water Treatment Processes by Ramalho, R.S., Published by Academic Press, New York, Latest Edition.
20. Processed Plant Protein Food Stuffs, Edited by Aultschul, A.M., Published by Academic Press, London, Latest Edition.
21. Chemistry of Food Packaging by Swalam, C.M., Published by American Chemical Society, Washington D.C., Latest Edition.

22. Packaging by Newbaner, R.G., Published by Van Nostrand, Reinhold Co., New York, Latest Edition.

7S(F/P/O/P C)T5 SPECIAL TECHNOLOGY PAPER-V
(RELATED TO CONCERNED TECHNOLOGY)
THEORY PETROCHEMICAL TECHNOLOGY-V
PETROCHEMICAL INDUSIRY

A state of the art account typically of the following with emphasis in increasing order of depth, wherever possible on 1) routes possible, 2) Stochiometry reaction, mechanism and flow sheet, 3) history, economics and future trends, 4) qualitative discussion of physico-chemical and chemical engineering principles involved and engineering problems encountered in the more favoured route.

Defination of a petrochemical; source materials for manufacture of chemicals from hydrocarbons individual compounds and mixtures; Manufacture of major olefin building block -ethylene, propylene, butadience etc. Manufactures of BTX aromatics, naphathalene etc.

Production of acetylene, synthesis gas, hydrogen, sulphur, carbon block, Oxosynthesis.

Production of specific Hydrocarbon derivatives by hydrogenation, oxidation, hydration, alkylation, halogenation, sulphonation etc. As illustrated by benzene from cyclohexane; ethylene oxide, vinyl chlorides, acrylonitrile, phenol, DMT caprolatum, etc. Comparison of routes starting from paraffins, olefine, acetylene etc. Wherever possible.

Polymerisation - polyetheylene, polypropylene, piktestersm bikibsm, acrylic fibres, synthetic rubbers etc.

Safety aspects, pollution control, energy saving etc. in a petrochemical plants, The petrochemical Industry in India.

Recent development in the field

BOOKS RECOMMENDED :

I. R.N.Shreve, J.A. Brink: Chemical Process Industries, 4th edition Mc Graw Hill, Kogakusha 1977, Chapter-38, Page 687.
2. J .A.Kent : Riegal's Handbook ofIndustrial Chemistry, 7th edn., Van. Nostrand Reinhold Co., 1974, Chapter 14, Page 402.

FOR REFERENCE :

1. Books 4 and 9 recommended under *Special Tech-III,* Petrochemical Technology
2. S.A.Miller : Acetylene, Vols. I & II, Ernest Benn. Latest Edition.
3. S.A.Miller : Ethylene and its industrial Derivatives, Ernest Benn., Latest Edition.
4. E.G.Nancock: Prophylene and its Derivatives, Ernest, Bean, Latest Edition.
5. E.G.Nancock: Benzene and its Derivatives, Ernest Bean, Latest Edition.
6. S.B.Chandlia : Oxidation of Hydrocarbons, Sevak Publication, Latest Edition.
7. T.Dumas, W.Bulani : Oxidation of Petrochemicals, Chemistry and Technology, Applied Science, Latest Edition.
8. R.Long : Production of Polymer and Plastic Intermediates from Petroleum, Butterworths, Latest Edition.
9. Articles in Hydrocarbon Processing, Chemical Engineer, Oil & Gas Journal Etc. as recommended furthering the academic session.

7S(F/P/O/PC)T5 SPECIAL TECHNOLOGY - V
PULP & PAPER TECHNOLOGY
THEORY

1. Paper and paper board Manufacture : Introduction auxiliary equipments, Centric leaners, Sand traps, centrifugal separators and various screens.
2. Paper making machines : Fourdrinier machine, history and development of fourdrinier, modern fourdrinier machine appraoch flow system, head box slice, types of slices, drainage and formation on fourdrinier machine.
3. Fourdrinier design and construction, miscellaneous equipments, twinwire formation of paper,Informer, various types of former.
4. Cylinder mold machine: Introduction, History of cylinder machine, Vat, stock entries, and priliminary press, rolls and ripples, cylinder machine felts.
5. Pick-up and press section: Section picks-up, pressing theory, felts press section arrangements, suction rolls, crow ling and open draw.
6. Dryer section: Function of dryer section, theories of drying, cylinder drying. air drying, radiant drying, auxilliary equipment, operations and control, performance calculations. cost and economics.

Recent development in the field.

BOOKS RECOMMENDED :

1. Pulp and Paper Manufacture, 2nd edn., VoI.II, by B.Mac. Donald, Mc Graw-Hill.
2 Pulp and Paper, Science and Technology Vol-II, by C.E.Libby.
3. Handbook of Pulp and Paper Technology, by K. W.Britt.

EIGHT SEMESTER

8S(F/P/O/PC)TI SPECIAL TECHNOLOGY PAPER-VI
(RELATED TO CONCERNED TECHNOLOGY)
OIL TECHNOLOGY

Technology of Waxes, Cosmetics and other Fat Based Products.

Waxes : Natural sources classification, Chemical composition, Extraction refining and processing of waxes, their modification and formulation. Synthetic waxes, properties, utilization, testing and evaluation of waxes.

Cosmetics. : Classification, manufacture and evaluation of cosmetic, preparation such as shampoos, shaving creams, lotions, toileteries and perfumery materials.

Other Fat based Products: Manufacture and utilization of nitrogen, phosphorous and sulphu containing compounds. Core oils, cutting oils, lubricants greases, plasticizers and products obtained by inter-exterification hydrogenation, oxidation and pyrolysis.

Fatty acids: Theory and practice of fat spliting and purification of products, Separation of fats and fatty acids and their applications in foods, pharmaceuticals, textile, plastics, leather and other industries.

Recent development in the field.

BOOKS RECOMMENDED :

1) The Chemistry and Technology of Waxes - A.H. Warth
2) Industrial Waxes - H.Benet (2 Volumes)
3) Fatty Acids and their Industrial Applications - E.S.Pattison
4) Industrial Oil and Fat Products - A.E.Bailey
5) Industrial Chemistry of Fats and Waxes - T.P.Hilditech.
6) Cosmetics Science and Tech. - W.Saggarin
7) Perfumes, Cosmetics and Soaps - W.A.Poucher (Vol.-I ,II, III)
8) Chemistry and Biochemistry of Natural Waxes - P.E.Kolattukudy.
9) Basics of Paint Technology, Part-I, V.C.Malshe, Meenal Sikchi, VICT, Mumbai.

PRACTICAL-IV
OIL TECHNOLOGY

Analysis of butter, ghee, margarine, vanaspati, soap stock, sulphonated and oil spent lyes. Commercial fatty acids and glycerine. Evaluations of detergents. Analysis of fatty material by column thinlayer and gas liquid chromatography techniques. Analysis of mixture of oils and fats. Analysis of bye products and wastes. Preparation and, analysis of some industrially important fatty acids. Derivatives. Analysis of printing inks.

BOOKS RECOMMENDED FOR PRACTICALS:

1) Technical hand book of Oils, Fats and Waxes - PJ.Frayar and F.E. Weston (2 Volumes)
2) Analysis of Fats and Oils - V.C.Mehlenbacher.
3) Lab.handbook of Oils and Fat Analysis - D. V.Cock & c. Van Rede.
4) Analysis and Characterization of Oils, Fats and Fat Products : H.A.Boekenoogen.
5) Oils, Fat and Fatty Acids - Their Practical Exams: K.A. Williams
6) Synthetic Detergents, - A. Davidson
7) I.S.I.Method of Analysis of -
   i) Oils and Fats No. - IS-548-1964.
   ii) Soaps IS-286-195 I
   iii) Oil Seeds and Oil Cakes -IS-I 714-1970,IS-4 I 15-1967
   iv) Surface Active Agents - IS-5785-1970
   v) Printing Inks - IS-693 1-1972
   vi) Paints, Varnishes, and Pigments - IS-I 17-1964.
8) B.S.I. Methods of Analysis of Oils and Fats
9) Official and Tentative Methods of the American Oil Chemists Society, A.C.C.S.Publication.
10) Waxes - Natural and Synthetic - H.Bennet.
11) An Introduction to Drying Oil Technology- A.R.Mills
12) Thin layer Chromatography - Babbit.
13) Bleaching Earths - M.K.H.Siddiqui
14) O.C.C.I.Paint Tech. manuals, Vol. V, the Testing of Paint
15) Cosmetics Science and Technology - W.Sassauin.

8S(F/P/O/PC)T1 SPECIAL TECHNOLOGY PAPER-VI
(RELATED TO CONCERNED TECHNOLOGY)
THFORY
FOOD TECHNOLOGY-VI

Biochemical Engineering and Fermentation Technology : Metabolic pathways of micro organisms. Parameters for growth energy, carbon and nitrogen. Sources requirements and biomass, estimation, surface, sub-merged and solid state cultures. Kinetics of growth and structured growth models. Measurement of dissolved oxygen, mass transfer coefficient. Effect of aeration and agitation, Kinetics of substrate utilisation. Product yield and biomass production, batch, plugflow and chemostat cultures, Scale up in fermenter design.

Types of fermenters. Designing and operation of fermentation equipment. Methods of aeration, agitation and sterilisation. Control of contamination in fermentors. Antifoam devices, auxiliary equipment an instrumentation,

Product recovery.

Fermentation technology of alcohol, alcoholic beverages, vitamins, antibiotics, vinegar, organic acis, solvents. SCP, enzymes and other miscelleneous products. Specific metabolic transformation Hydrocarbon fermentations. Cultivation of algae, mushrooms and the starter culture.

Immobilised enzymes, methods of immoblisation, properties an applications of immobilized enzymes. Reactor design for immoblilised enzyme Systems. Waste treatment, New special in fermentation technology.

Recent development in the field.

BOOKSRECOMMENDED:

1. Biochemical Engineering Fundamentals by Bailey, lame, E., Published by McGraw HiII Book Co., Latest Edition.
2. Advances in Biochemical Engineering. Vols. 1 to 6 Edited by Bhose, T.K. and Ficchter, A , Published by Springer Vorlag, Berlin, LLcid elberg NewYork, Latest Edition.
3. Biochemical and Biochemical Engineering, Science Vols. 1 to 2 Edited by Blakebrough, Published by Academic Press, London and New York, Latest Edition.
4. Industrial Fermentation, Vols. 1 & 2 By Under Kofler, L.A., Published by Chemical Publishing Co., INC, 212, Fifth Avenue, New York, Latest Edition.
5. Immobilized Enzymes, Antigens, Antibodies and Peptides, Vols. 1 & 2, 3 & 4 Edited by Weetal, H.H., Published by Marcel Decker, INC New York, Latest Edition.
6. Industrial Microbiology by Presscot and Dunn, Published by Me Graw Hill Book Co., INC, New York, Latest Edition.
7. Industrial Microbiology by Cas ida, L.E., Published by John Wiley and Sons, INC, New York, Latest Edition.

FOOD TECHNOLOGY
PRACTICAL-IV
FOOD PROCESSING

Preparation of fruit juices, squash, jam, jelies, concentrates, pickles etc. Canning of fruits and vegatable and their evaluation. Processing of meat, fish and dairy products. Dehydration of fruits and vegetables and their evaluation. Preparation of bakery products like bread, biscuits, cakes. crackers etc. Preparation and evaluation of confectionery products like hard and soft boiled candies, fruit candies, chikki, etc. Preparation of beverages.

Evaluation of Michaelis - menten constant. Determination of BOD, COD and dissolved oxygen by chemical and instrumental methods; potting of Do Sag profiles, Determination of Kla.

Production, recovery and control tests of the fermentation products like alcohols, organic acids, enzymes and antibiotics.

BOOKS RECOMMENDED :

1. Practical Baking by Sultan, W.J.,The AVI Publishing Co., INC, Latest Edition.
2. Manufacture of Confectionary by an Industrialists, Industry Publishers Ltd., 22, R.G.Kar Road, Sham bazar, Calcutta.
3. The Chemical Anslysis of Foods by Pemson, J.& A. Chutchill Ltd., 404 Gloucester Place, London, w.L., Latest Edition.
4. Cannd Foods by Baumgartner, L. & A. Churchill Ltd., 104, Gloucester place, Portman Square Latest Edition.
5. Preservation of Fruits and Vegetables by Girdharilal and Siddapa. Indian Council and Agricultural Research, New Delhi, Latest Edition.
6. Practical Canning by Lock, A., Food Trade Press Ltd.,
7. Garrick Street, W.C.2, London, Latest Edition.
7. Introduction to Waste Water Treatment Processess by Ramalho, R.S. Published by Academic Press, New York, Latest Edition.

8S(F/P/O/P C)Tl SPECIAL TECHNOLOGY PAPER-VI
(RELATED TO CONCFRNFD TECHNOLOGY)
THEORY
PETROCHEMICAL-VI
PETROCHEMICAL PROCESS ANALYSIS

Mathematical treatment, numerical problems etc. iIlustrating the physio-chemical and chemical engineering, principles, Process equipment design etc. pertaining to topics in the petroleum chemicals industry Petrochemical Technology- V (Theory) as exemplified by, the following.

Concept of equillibrium approach, criterion, kinetic severity, function safe conversion, etc., in liquid hydrocarbon mixture steam, cracking; calculation of number of tubes for propane cracking under operational conditions; parametric sensitivity in vapour phase catalytic reforming the simple smith model and the complete rare model; assessment of rate determining steps in oxosynthesis (liquid phase process) Naiglor, Natta catalysed Polymerisation of effylene : calculations pertaining to dynamic sorption capacity Ensorb type Processes, Hypersorption : thermal problems in polymer storage etc.

Recent development in the field.

8S(F/P/O/P C)T1

PRACTICAL-IV
PETROCHEMICAL TECHNOLOGY
REFINERYENGINEERING

TBP distiIlation of petroleum fraction and construction of property midpercent, residue yield, distillate yield curves, Vertification of ASTM, TBP, Correlations. Comparison of characteristics of buble, packed column and mixer settler for extraction of acids from petroleum fractions into water, dilute alkali etc. Quantitative study of break through phenomena in adsorption of aromatics by siIlicagel.

8S(F/P/O/PC)T1 SPECIAL TECHNOLOGY PAPER-VI
PULP AND PAPER TECHNOLOGY
PROPERTIES AND TESTING OF PAPERS
AND POLLUTION CONTROL

1. Finishing of paper and board: Calendering, realing and wrapping, winders. winding, super calendering, embossing.
2. Surface treatment of paper and board: Definitions, objectives, general approaches, typical surface treatment processes. adhesives, by products.
3. Insulating boards, hard boards, forming machines, dryers, fabrication and finishing.
4. Wastewater treatment and air pollution control
5. Analysis and testing: Introduction, test facilities. equipment. analysis and testing of pulp wood, wood pulps, paper and converted products.
6. Energy conservation and capacity utilization in pulp and industry, hand made papers and speciality papers.
   Recent deveopment in the field.

BOOKS RECOMMENDED :

1. Pulp and Paper Manufacture, 2nd edn. Vol-II. by B.Mac.Donald, McGraw Hill
2. Pulp and Paper, Science and Technology Vol-II, by C.E.Libby
3. Handbook of Pulp and Paper Technology. by K. W.Britt.

8S(FPOPC)T4 PAPER AND PULP TECHNOLOGY
PRACTICAI-IV

Processing of raw material, analysis of raw material and paper manufacturing, hand made paepr manufacturing. Testing of Paper.

8SCE(FPOPC) T2 CHEMICAL REACTION ENGINEERING-II
(REACTOR DESIGN)
SECTION B

Unit I : Residence time distribution. Models for non-ideal flow.

Unit II : Mixing concept and models: Rate equation for Heterogeneous reactions, fluid particle reactions. Determination of rate controlling step. Application to Design.

Unit III : Fluid-Fluid reaction: The rate equation for different cases and application to design. 8 design.

SECTION B

Unit IV : Heterogenous processes, catalysis and adsorptionl determination of surface area, void volumn. Pore volume distribution catalyst preparation, promoters and inhibitation catalyst reactivation.

Unit V : Rate equation for third solid catalytic, reactions. Internal External transport process in Heterogeneous Reactions.

Unit VI : Design of Heterogeneous catalytic reactors, fixed bed reactors, isothermal & adiabatic fixed bed reactor, non-isothermal & non-adabatic fixed bed rector. fludized bed, Drickle bed, slurry reactor.

BOOKS RECOMMENDED:

1. Chemical Reaction Engineering, Octove Levelspil, Wiley Eastern Ltd.
2. Chemical Engineering Kinetics, Smith J.M., Mc Graw Hill.
3. Elements of Chemical Reaction Engineering - H.Scott Fogler, Prentice Hall.
4. Chemical Reactor Analysis & Design, Gilberth F Froment & Kenneth B Bischoof, John Wiley & Sons.
5. Chemical Reactor Design, Vol I & II, M W.Rase.

8S(FPOPC)T3 PLANT DESIGN & PROJECT ENGINEERING
SECTION-A

THEORY-INTRODUCTION - Basic Considerations in Chemical Engg. plant design.

Unit I : Project identification, Preliminary teclmo economic feasibility, Process design aspects selection of process, factors affecting process selection. importance of laboratory developmcnt pilot plant, scale up methods. safety factors, Types of flow diagrams.

Unit II : Detection of process equipments - standard vs. special equipment, materials of construction for process equipments. selection criteria. specification sheets.

Unit III : Process auxilaries - piping design. layout. supports for valves,

process control & instrumentation control system design.

Process utilities - process water, Boiler feed water, water treatment, waste treatment & disposal, oils heating systems. Chilling plant. compressed air & vaccum. Plant location & layout-Factors affecting both planning of layout. principles of plant layout, Use of scale methods.

SECTION B

Unit IV : Cost estimation - factors involved in projcct cost estimation. Total capital investment, fixed capital & working capital. methods of estimation of investment.

Estimation of equipment cost production factors.

Estimation of total product cost - factors involved in estimating. Depreciation - types of methods of determination depreciation. evaluation of depreciation methods.

Unit V : Profibility, alternative investments & replacements, methods for profitability evaluation. practical factors in alternative & replacement investment.

Unit VI : Economic considerations in process & equipment design, inventory control, Scheduling a project using CPM/PERT methods, project management. Option design, general production rates in plant operation.

Optimum conditions, optimum production rates in plant operation, optimum conditions in cyclic operation.

BOOKS RECOMMENDED :

1 Plant Design & Economics for Chemical Engineering By M.S. Peters & K.D.Timmerhaus, McGraw Hill (Japan), 2nd Edition, Latest Edition.

2. Chemical Engg. Plant Design: F. C. Vibradant & C.E.Dryden, McGraw Hill (New York), Latest Edition.

8(FPOPC)T4 ELECTIVE

List of Electives :

1) Polymer Science and Engineering
2) Man Made Fiber Technology
3) Corrosion Engineering
4) Biochemical Engineering
5) Petroleum Processing Engineering
6) Oil and Paint Technology.
7) Fuel Technology
8) Cellulose Technology
9) Bio Fuels
10) Industrial Piping
11) Wine Making

8S(FPOPC)T4 ELECTIVE

1) POLYMER SCIENCE AND ENGINEERING

Basic structures and fundamentals of polymers:

Industrially important polymerse. Polymerization Reaction Kinetics. Gelation Phenomena; Morphology and Transitions in Polymers, Solution thermodynamics of polymers; Experimental techniques in polymer characterisation; Introduction to Theology and Viscoelasticity of polymers; fundamentals of polymer processing.

Books recommended:

1. Williams, L.J. Polymer Science and Engineering Prentice Hall, Inc.
2. Rofrigues, F, Principles of Polymer Systems, Tata-McGraw Hill Pub. Latest Edition.
3. Ordiam G. Pnnciples of Polymerization, McGraw Hill Latest Edition.
4. Collins E.A. Bares, J. and Billimeryer. F.W. Experiments in Polymer Science Wiley-Interscience, Latest Edition.
5. Kumar, A. and Gupta, S.K. "Fundamentals of Polymer Science and Engineering" Tata-McGraw Hill Pub. Latest Edition,
6. Middleman, S. "Fundmentals of Polymer Processing" McGrawHill New York, Latest Edition.

8S(FPOPC)T4 ELECTIVE

(2) Man Made Fiber Technology

1) Classification of fibres: Types of natural fibers. man made fiber, synthetic fibers count, denie text, staple fibers, filament fiber, physical properties of fiber.
2) Degree of polymerization, cellulose and its properties, molecular weight, preparation and properties of cellulose acetate and rayons-viscose and cuprammonium.
3) Preparation and properties of polyester, terylene, nylon and polyamide.
4) Preparation and properties of synthtic fiber carbo chain type. Polyrinyal, polypropeline and poly acrilonimile.
5) Introduction to yarn spinning and testing of man made fiber.
6) Introduction to fabric forming by weaving process related to man made fiber.

BOOKS RECOMMENDED:

I. Textile Fibre by Mancrill
2. Textile Fibre by Murthy
3. Textile Fibre and their use by Hess
4. Physical Property of Textile Fibre by Norton & Hearle

8S(FPOPC)T4 ELECTIVE

(3) CORROSION ENGINEERING

Corrosion, direct, two stage attack, electrochemical attack, Environment conditioning. Higher corrosion resistance through proper selection of material, Isolation of corrosion, prone materials from destructive environment, Technologies of anodisation. enamelling, rubber lining, glass lining, refractory lining, painting and other surface protective measures. Corrosion Engineering in special applications such as material transport, pumping, filtration, condensation, boiling, rivetting welding. high temperature environments, electrochemical environmental etc. Cost factor in competitive corrosion prevention/inhibition techniques.

BOOKS RECOMMENDED;

1. Uhilig, H.H."Corrosion and Corrosion Control", John Wiley and Sons Latest Edition.
2. Bullar G. and Ison HC. KCorrosion and its Prevention in Waters", Leonard Hill-London Latest Edition.
3. Maslov, P, "Chemical Materials for Construction" Structures Publishing Co. Latest Edition.
4. Fontane, M.G, and Greehnee. N.D. "Corrosion Engineering" Mc Graw Hill Latest Edition.
5. Payne, H.F., "Organic Coatings Technology" John Wiley and Sons.
6. Rajgopalan, K.S.Corrosion and its Prevention", Chemical Engneering Education Development Centre, I.I.T. Madras

8S(FPOPC)T4 ELECTIVE

(4) BIOCHEMICAL ENGINEERING

Scope and possibilities. characteristics and classification of biological matter, kinetics of microbial growth. balance equations for batch and cultures, kinetics of enzyme catalysed reactions. Analysis of mixed microbial populations. Design and analysis of biological reactors. Production, isolation and utilisation of enzymes. Transport phenomenas in biological systems.

BOOKS RECOMMENDED:

1. Aiba, A.E. Humpharey, N.F. Mills: Biochemical Engineering, Academic Press, New York. Latest Edition.
2. J.E. Bailey, D.F. Oltes : Biochemical Engineering Fundamentals, Mc Graw Hill, Latest Edition.
3. B.A.Tkinson : Biochemical Reactors, Pion Ltd. London, Latest Edition.

8S(FPOPC)T4 ELECTIVE

(5) PETROLEUM PROCESSING ENGINEERING

Ii Itraduction to petroleum industry. World petroleum resources,

petroleum industry in India. Origin, exploration, drilling and production of petroleum crudes, Transportation of crudes and Products. Crude pretreatment- Composition and classification of crudes. Methods of evaluation; ASTM, TBP and EFV distillation. Properties and specifications of petroleum products such as LPG, gasoline, naphtha kerosene, Diesel, oils, lubricating oils, waxes and the like.

Separation processes:

Design and operation of topping and vaccum distillation units. Tubes still furnales Solvent extraction processes for lube oil base stocks and for anomatics from naphtha and kerosene streams, solvent dewaxing Convertion Processes.

Thermal cracking, visbreaking and cooking processes. catalytic Cracking reforming, hydroprocessing alkulation, polymerisation and isomerisation, Safety and pollution considerations in refineries.

BOOKS RECOMMENDED:

1. Nelson, W.L. : Petroleum Refinery Engineering, Mc Graw Hill.
2. Hobson G.D., Phol, W. : Modern Petroleum Technology, Halsted Press, Division of Wiley Eastern.
.3. Guthrie V.B.: Petroleum Products Handbook, McGraw Hill.
4. Kobew K.A.. Mcketta. J.J. : Advances in Petroleum Chemistry and Refining, lnterscience.

8S(FPOPC)T4 ELECTIVE

(6) OIL AND PAINT TECHNOLOGY

Essential Oils: Classification and chemical constituents of essential oils. Methods of extraction. Analysis of essential oils, Natural and synthetic perfumery, materials for industrial uses.

Covertible and non convertible coatings : Chemical nature of coatings and their properties. Natural synthetic resin.

Formulation of paints: Printing inks, leaquers, varnishes and linoleum. Methods of manufacture of paints, printing inks, and leaquers, I.S.I. methods for evaluation of paints and printing inks.

Cosmetics : Classification, manufacture and evaluation of cosmetic, preparations such as shampoos, shaving creams, lotions, toileteries and perfumery materials.

BOOKSRECOMMENDED:

I. Industrial Oil & Fat products: A.P.Bailey, Interscience Pub., New York, Latest Edition.
2. Outline of Paint Tech. - H.Hea.
3. Organic Coating Technology - H.R.Payne

4. Paint and Warnishes - A.S.Khanna
5. Cosmetic Science and Technology - W.Saggarin

8S(FPOPC) T4 ELECTIVE

(7) FUELTECHNOLOGY

SECTION-A

Unit I Comparison of various sources of energy. Alternatives to non-renewal sources. Characteristics and distribution, production and total deposits of coal and petroleum in India. Classification of Fuels Classification of Coal. Formation of Coal (colification process).

Unit II Analysis of coal. Proximate and ultimate analysis. Significance of analysis. Rank of coal relation with moisture, ash, volatile matter. Reporting of coal analysis. Significance, composition of ash and mineral matter. Properties and testing of coal, Calorific value (Gross and net), Bob calorimeter, Boy's gas calorimeter, weathenng index, swelling index, craking index. Grindability Index, specific gravity. Theoretical computations of calorific value.

Unit III Testing of oils, viscosity, flash point, pour point, aniline point, carbon residue, Diesel index, octane and cetane number moisture content. Preparation of raw of mine coal. Washing of coal, washability curves. methods of coal washing, coal washeries in India, Gravity seperation, float and sink rest Efficiency of coal washing.

SECTION-B

Unit-IV Carbonisation. Physical and chemical changes, high and low temperature carbonisation. Modern developments in design of coke ovens. Recovery of by products, Tar distillation, Blending of coals. Fuel economy in steel plants. Properties of metallurgical coke. Straight run distillation of crude oil. Thermal transfer and catalytic cracking. Polymerisation alkylation and ison.

Unit-V General principles of combustion. Combustion of grates, mechanical stokers, combustion of pulverised coal, Suspenaed bed and fluridised bed combustion. Problems in combustion based on mass and heat transfer with chemical reaction..

Unit-VI Gasification of coal. First and second generation gasifiers. Design of gasifier. Fixed and fluidised bed suspended gasifiers. Koppa Totrek, Lurgi Winker Hygas process. Orsat gas analysis, Gobour gas and sewage gas. Syntheis gas and its uses. Under ground gasification of coal.

BOOKS RECOMMENDED'

1. Fuels and Combustion : Samir Sarkar
2. Fules Fumaces and Refractories : O.P.Gupta
3. An Introduction to Study of Fuel : J C Marrae.
4 Fuels: J Francis
5. Fuels and Furnaces : Brame and King
6. Fuels : Huslam & Russel

8S(FPOPC)T4 ELECTIVE

(8) CELLULOSE TECHNOLOGY

Morphological characteristics of cellulosic raw materials. Methods of pulping, washing, refining and bleaching, pulps for differern process industries like paper, rayon, derivatives, etc., principles of paper board manufacture. Regeneration of spent liquor from pulping industries, Regenerated cellulose cellulosic derivatives.

BOOKS RECOMMENDED:

1 R.C. McDonald and others: Pulp and Paper Manufacture. Vol I. II (McGraw Hill)
2. Elibby: Pulp and Paper. Science and Technology, Vol. I and II (McGraw Hill). Latest Edition
3. Emit Ott: Cellulose and Cellulose Derivatives. Vol-III (Interscience), Latest Edition

8 SCE 3/8S (FPOPC) T4 ELECTIVE

(9) BIOFUELS

History, diesel engine, diesel fuel, alternative diesel fuels, Biodiesel,definition, sources, standards.

Use of straight vegetable oil, dilution with conventional diesel, blending with esters; Structure of triglycerides, transesterification of oils, alcohols and catalysts used, mechanism of reaction, reaction conditions, process, glycerin recovery, raw materials and glycerin use, Fuel related properties of various fats, oils and their esters, comparison with petroleum diesel.

Combustion chemistry lubricity, engine performance, engine problems and deposits using biodiesel in present engines.

Tailpipe emissions using vegetable oil fuel and esters, comparison with petroleum diesel, Health hazards on use of petroleum fuel and biodiesel,

Safety and advantages of biodiesel.

Storage conditions for biodiesel.

8S (FPOPC)T4 ELECTIVE

(10) INDUS1RIAL PIPING

Importance of piping in chemical industry.

Classification of pipes: - Pipe codes and specification, Schedule numbers,BWG, NPS. Material of construction of pipes.

Pipe sizing: - Calculation of pipe diameter, thickness. Pipe fittings, advantages, calculation of frictional losses, and empirical correlations for flow of oil. Gasoline, hydrocarbons.

Criteria for selection of pipe joints, pipe joints for similar and dissimilar material, expansion effects and methods for reducing them. Piping lay-out consideration, piping diagrams, types of pipe support, erection and maintenances of supporting, restraining and braing systems. Complex pipe-lines.in series and parallel.

Calculation of equivalent lengths. Pipeline storage capacity. Fundamental considerations in piping vibrations, types of vibrations, their prevention and control. Cryogenic piping.

Single phase and two-phase flow. Piping for slurries..Insulation for piping systems.

Recommended Books:

l. Piping Design for Process Plants by H. F. Rase, John Wiley.

2 Process Piping Systems,D. J. Deutsch, CJiemical.Engineering . Magazine. McGraw Hill. .

3. Industrial Piping, C.T. Littleton, McGrawHill.

8S (FPOPC) T4 Elective

(11) WINE MAKING

History, definition, wine and wine indusuy, Wine production of selected areas, grape varieties Geographic, geological, and climatic attributes regarding wine production and quality.

Structure and composition of grapes:

Grape structure, chemical composition of grapes, e.g. sugars, acids, an thocyanins, tannins, etc., analytical techniques, fiuit ripeness. noble rot

Processing of grapes: Grape reception, grape handling strategies, e.g. de-stalking, crushing, pressing and skin contact, must treatments, temperature control.

Fermentation: Alcoholic fennentation, role of yeast, enzymes, temperature and fermentation Vessels, strategies for the extraction of colour, aroma, flavour and tannin Carbonic maceration, whole bunch fermentation and thermovinification, theory and practice of malolactic fermentation

Maturation and blending:

Maturation options, types of maturation vessel, inert storage Blending options, timing of bottling

Stabilisation, clarification, packing and labeling:

Movement of wine in bulk, methods of stabilisation and clarification, e.g. fitting, filtration, centrifugation, cold stabilization, etc., use of chemicals in

wine making and wine.handling - their function, action and application, international regulations goveming the use of chemicals, packing into bottles and other containers, ingredient labeling, closures.

Production of sparkling wines: Production techniques for sparkling wines, grape selection and pressing, temperature control, selection and blending of base wines, the second fermentation, Maturation, finishing

Production of fortified wines:

Production techniques for fortified wines, selection of base wines,timing of fortification. practice and significance of blending and maturation, fmishing

Quality assurance and quality control: Composition of wine and its faults, analysis of wine, its purpose, use and limitations, QA and QC systems and structures for wine and dry goods, practical issues of QA and QC, Effects of storage and transport on wine after packing.

Recommended Books:

Exploring Wine, 2nd Edition, by Koplan, Smith, & Weiss. Published by John Wiley & Sons, Inc. New York. Ed. Latest Edition.

8S(FPOPC)T5 PROJECT AND SEMINAR

Each student is required to prepare and submit either a typed review of about 6000 words 011 the recent literature OR a typedlhand written account of a critical study of a recent mathematical treatment pertaining to topics of current interest. in the branch of special technology choosen or related topics. The review/account press to be presented as a lecture by the student to be followed by discussion.

PROJECT WORK

A student or a group of students, not exceeding three, is required to prepare and submit typed reports of a quantitative study including material energy balances. process equipment design etc. of any modem processing unit or units in the brance, of special technology choosen. The study may be based on calculations made using literature data.

OR a student or the group has to carry out experiemental investigation of a research problem of interest in the branch of special technology chQosen under the guidance of a teacher in the special technology branch chosen and submit typed reports.

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L : Theory Lecture
T : Tutorial
P : Practical
D : Drawing / Design

APPENDIX-C
FOUR YEAR DEGREE COURSE
BACHELOR OF TECHNOLOGY (CHEMICAL TECHNOLOGY)
(FOOD/PULP & PAPER/OIL & PAINT/PETROCHEMICAL)
FIFTH SEMESTER
SEMESTER PATTERN

ABBRIVATIONS :-
S - SEMESTER PATTERN
CE - CHEMICAL ENGG.
CT - Chemical Technology including Food/Pulp & Paper/Oil & Paint/ Petrochemical and Polymer (Plastic)

Sr. No.	Sub. Code No.	SUBJECT	Teaching Scheme L	T	P/D	Total Hours/ Week (Hrs)	Examination Scheme: Theory Duration of Papers	Maximum Marks Theory	College Assessment	Total	Min. Pass Marks	Practical Maximum Marks External	Internal	Total Marks	Mininum Passing Marks
1.	5SCECT1	Heat Transfer	4	1	2	7	3	80	20	100	40	25	25	50	25
2.	5SCE(FPO-PC)T2	Chemical Engineering (Mechanical Opertion)	4	1	2	7	3	80	20	100	40	25	25	50	25
3.	5SCE(FPO-PC)T3	Chemical Engineering thermodynamics	4	1	2	7	3	80	20	100	40	25	25	50	25
4.	5S(F/P/O/PC)T4	Special Technology-II	3	1	4	8	3	80	20	100	40	25	25	50	25
5.	5SCECT5	Economics & Management	3	-	-	3	3	80	20	100	40	--	--	--	--
6.	5SRNCECT6	Communication Skills	2	1	-	3	2	40	10	50	20	15	10	25	12
		TOTAL	20	05	10	35				550				225	

GRAND TOTAL : 775

SIXTH SEMESTER

Sr. No.	Sub. Code No.	SUBJECT	Teaching Scheme L	T	P/D	Total Hours/ Week (Hrs)	Examination Scheme: Theory Duration of Papers	Maximum Marks Theory	College Assessment	Total	Min. Pass Marks	Practical Maximum Marks External	Internal	Total Marks	Mininum Passing Marks
1.	6S(FPO-PC)T1	Chemical Technology	4	1	-	5	3	80	20	100	40	--	--	--	--
2.	6S(FPO-PC)T2	Process Equipment Design & Drawing)	4	-	2	6	3	80	20	100	40	25	25	50	25
3.	6SCECT3	Instrumentation and Control	4	1	2	7	3	80	20	100	40	25	25	50	25
4.	6S(FPO-PC)T4	Special Technology-III	3	1	-	4	3	80	20	100	40	--	--	--	--
5.	6SCECT5	Computer Programming and Application	3	1	2	6	3	80	20	100	40	25	25	50	25
6.	6SCECT6	Mini Project	-	-	2	2	-	--	--	---	--	25	25	50	25
		TOTAL	18	04	8	30				500				200	

GRAND TOTAL : 700

APPENDIX-D

FOUR YEAR DEGREE COURSE

BACHELOR OF TECHNOLOGY (CHEMICAL TECHNOLOGY)

(FOOD/PULP & PAPER/OIL & PAINT/PETROCHEMICAL)

SEVENTH SEMESTER

SEMESTER PATTERN

L : Theory Lecture
T : Tutorial
P : Practical
D : Drawing / Design

ABBRIVATIONS :-
S - SEMESTER PATTERN
CE - CHEMICAL ENGG.
CT - Chemical Technology including Food/Pulp & Paper/Oil & Paint/ Petrochemical and Polymer (Plastic)

Sr. No.	Sub. Code No.	SUBJECT	Teaching Scheme L	T	P/D	Total Hours/ Week (Hrs)	Examination Scheme: Theory Duration of Papers	Maximum Marks Theory	College Assessment	Total	Min. Pass Marks	Practical Maximum Marks External	Internal	Total Marks	Mininum Passing Marks
1.	7SCE(FPOPC)T1	Mass Transfer	4	1	2	7	3	80	20	100	40	25	25	50	25
2.	7SCE(FPOPC)T2	Chemical Reaction Engineering-I(Kinetics)	3	1	2	6	3	80	20	100	40	25	25	50	25
3.	7S(FPOPC)T3	Special Technology-IV	3	1	3	7	3	80	20	100	40	25	25	50	25
4.	7SCE(FPOPC)T4	Industrial Waste Treatment	3	1	2	6	3	80	20	100	40	25	25	50	25
5.	7SC(FPOPC)T5	Special Technology-V	3	1	-	4	3	80	20	100	40	--	--	--	--
6.	8S(FPOPC)T5	Project and Seminar	-	-	2	2	-	--	--	---	--	--	--	--	--
	TOTAL		16	05	11	32				500				200	

GRAND TOTAL : 700

EIGHTH SEMESTER

Sr. No.	Sub. Code No.	SUBJECT	Teaching Scheme L	T	P/D	Total Hours/ Week (Hrs)	Examination Scheme: Theory Duration of Papers	Maximum Marks Theory	College Assessment	Total	Min. Pass Marks	Practical Maximum Marks External	Internal	Total Marks	Mininum Passing Marks
1.	8S(FPOPC)T1	Special Technology-VI	3	1	4	8	3	80	20	100	40	25	25	50	25
2.	8SCE(FPO-PC)T2	Chemical Reaction Engineeing-II (Reactor Design)	4	1	-	5	3	80	20	100	40	--	--	--	--
3.	8S(FPO-PC)T3	Plant Design & Project Engineering	4	1	-	5	3	80	20	100	40	--	--	--	--
4.	8S(FPOPC)T4	Elective	4	1	-	5	3	80	20	100	40	--	--	--	--
5.	8S(FPOPC)T5	Project and Seminar	-	-	6	6			(1) College Assessment:- (i) Project				50		
									(ii) Seminar				25	150	75
									(2) University Oral Exam.				75		
	TOTAL		15	04	10	29				400				200	

GRAND TOTAL : 600

List of electives : Note : One Subject is to be offered out of the following :

1) Polymer Science & Engineering 2) Manmade Fiber Technology 3) Corrosion Engineering 4) Biochemical Engineering 5)Petroleum Processing Engineering 6) Oil & Paint Technology 7) Fuel Technology 8) Cellulose Technology 9) Bio Fuels 10) Industrial Piping 11) Wine Making