SCHEME OF EXAMINATION FOR
B. TECH. (Chemical Technology)
SEVENTH SEMESTER B.TECH (CHEMICAL TECHNOLOGY)

Sr. No.	Code (Board) Theo./Pract	Subject	Workload				Credit				MARKS				Total Marks
											Theory		Practical		
			L	P	T	Total	L	P	T	Total	Sessional	University	Sessional	University	
1.	BTCHT 701T (BCHT)	Mass Transfer Operations	3	-	1	4	3	-	1	4	20	80	-	-	100
2.	BTCHT 702T (BCHT)	Chemical Reaction Engineering	3	-	1	4	3	-	1	4	20	80	-	-	100
3.	BTCHT 703T (BCHT)	*Special Technology V	3	-	1	4	3	-	1	4	20	80	-	-	100
4.	BTCHT 704T (BCHT)	*Special Technology VI	3	-	1	4	3	-	1	4	20	80	-	-	100
5.	BTCHT 705P (BCHT)	Mass Transfer Operations	-	3	-	3	-	2	-	2	-	-	25	25	50
6.	BTCHT 706P (BCHT)	*Special Technology III	-	6	-	6	-	4	-	4	-	-	50	50	100
7.	BTCHT 707P (BCHT)	Seminar and Industrial Training	-	3	-	3	-	2	-	2	-	-	100	-	100
Total			12	12	4	28	12	8	4	24	80	320	175	75	650

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- Food Technology
- Technology of Oils, Fats and Surfactants
- Petroleum Refining and Petrochemical Technology
- Pulp & Paper Technology
- Plastics & Polymer Technology
- Surface Coating Technology

SCHEME OF EXAMINATION FOR
B. TECH. (Chemical Technology)
EIGHTH SEMESTER B.TECH (CHEMICAL TECHNOLOGY)

Sr. No.	Code (Board) Theo./Pract	Subject	Workload				Credit				MARKS				Total Marks
											Theory		Practical		
			L	P	T	Total	L	P	T	Total	Sessional	University	Sessional	University	
1.	BTCHT 801T (BCHT)	Mathematical Modelling & Computer Aided Design	3	-	-	3	3	-	-	3	20	80	-	-	100
2.	BTCHT 802T (BCHT)	Project Management	3	-	-	3	3	-	-	3	20	80	-	-	100
3.	BTCHT 803T (BCHT)	*Special Technology VII	3	-	1	4	3	-	1	4	20	80	-	-	100
4.	BTCHT 804T (BCHT)	*Special Technology VIII	3	-	1	4	3	-	1	4	20	80	-	-	100
5.	BTCHT 805P (BCHT)	*Special Technology IV	-	6	-	6	-	4	-	4	-	-	50	50	100
6.	BTCHT 806P (BCHT)	*Project work/ Dissertation	-	6	-	6	-	4	-	4	-	-	100	100	200
Total			12	12	2	26	12	8	2	22	80	320	150	150	700

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- Food Technology
- Technology of Oils, Fats and Surfactants
- Petroleum Refining and Petrochemical Technology
- Pulp & Paper Technology
- Plastics & Polymer Technology
- Surface Coating Technology

Scheme of Absorption for Old Pattern to Semester Pattern of Fourth Year B. Tech. (Chemical Technology)

As Per Rashtrasant Tukadoji Maharaj Nagpur University (Old Pattern) Seventh Semester B. Tech (Chemical Technology)					As Per Rashtrasant Tukadoji Maharaj Nagpur University Credit Based Semester Pattern Scheme Seventh Semester B. Tech (Chemical Technology)		
Sr. No	**Sub Code Theory/ Practical**	**Subject**	**Theory Practical**		**Sub Code Theory/ Practical**	**Subject**	**Theory Practical**
1	7S.CT.1 (BChE)	#Process Control	Theory		--------	--------	--------
2	7S.CT.2 (BChE)	$Mathematical Methods & Computer Aided Design in Chemical Technology	Theory		--------	--------	--------
3	7S.CT.3 (BCT)	Special Technology V	Theory		BTCHT 703T (BCHT)	Special Technology V	Theory
4	7S.CT.4 (BCT)	Special Technology VI	Theory		BTCHT 704T (BCHT)	Special Technology VI	Theory
5	7S.CT.5 (BCT)	Special Technology III	Practical		BTCHT 706P (BCHT)	Special Technology III	Practical
6	7S.CT.6 (BChE)	@Process Equipment Drawing	Practical		--------	--------	--------
7	(BCT)	Seminar, Industrial Training and Tour Report	Practical		BTCHT 707P (BCHT)	Seminar and Industrial Training	--------
8	(BCT)	$Project Work / Dissertation	Practical		--------	--------	--------
9	--------	--------	--------		BTCHT 701T (BCHT)	*Mass Transfer Operations	Theory
10	--------	--------	--------		BTCHT 702T (BCHT)	Chemical Reaction Engineering	Theory
11	--------	--------	--------		BTCHT 705P (BCHT)	**Mass Transfer Operations	Practical

As per CBS scheme the subject is covered in sixth semester. So the students of absorption scheme shall have to appear for the examination of subject no. (BTCHT603T) Chemical Process Control (Theory).

@ As per CBS scheme the subject is covered in fifth semester. So the students of absorption scheme shall have to appear for the examination of subject no. (BTCHT508P) Chemical Equipment Design (Practical).

*Subject is covered in Sixth Semester according to Old Pattern subject no. (6S.CT.2) Mass Transfer (Theory). They may be exempted.

** Subject is covered in Sixth Semester according to Old Pattern subject no. (6S.CT.6) Mass Transfer (Practical). They may be exempted.

$ Subject will be covered in eighth semester as per the CBS scheme.

Scheme of Absorption for Old Pattern to Semester Pattern of Fourth Year B. Tech. (Chemical Technology)

As Per Rashtrasant Tukadoji Maharaj Nagpur University (Old Pattern)				As Per Rashtrasant Tukadoji Maharaj Nagpur University Credit Based Semester Pattern Scheme		
Eighth Semester B. Tech (Chemical Technology)				**Eighth Semester B. Tech (Chemical Technology)**		
Sr. No	**Sub Code Theory/ Practical**	**Subject**	**Theory Practical**	**Sub Code Theory/ Practical**	**Subject**	**Theory Practical**
1	8S.CT.1 (BChE)	*Chemical Reaction Engineering	Theory	--------	--------	--------
2	8S.CT.2 (BChE)	Project Management & Industrial Econimics	Theory	BTCHT 802T (BCHT)	Project Management	Theory
3	8S.CT.3 (BCT)	Special Technology VII	Theory	BTCHT 803T (BCHT)	Special Technology VII	Theory
4	8S.CT.4 (BCT)	Special Technology VIII	Theory	BTCHT 804T (BCHT)	Special Technology VIII	Theory
5	8S.CT.5 (BCT)	Special Technology IV	Practical	BTCHT 805P (BCHT)	Special Technology IV	Practical
6	8S.CT.6 (BCT)	*Seminar, Industrial Training and Tour Report	Practical	--------	--------	--------
7	8S.CT.7 (BCT)	Project Work / Dissertation	Theory	BTCHT 806P (BCHT)	Project Work / Dissertation	Practical
8	------	--------	--------	BTCHT 801T (BCHT)	Mathematical Modelling & Computer Aided Design	Theory

*The subject is covered in seventh semester according to CBS scheme.

SYLLABUS FOR SEVENTH SEMESTER

Subject: BCHT701T(BCHT) **Mass Transfer Operations (Theory)**
Lecture: 3 Hours No. of Credits: 4
Tutorial: 1 Hour University: 80 Marks
Duration of Examination: 3 Hours College Assessment: 20 Marks

Unit 1: Molecular diffusion in fluids, Diffusion in solids. Interphase Mass Transfer. Mass transfer coefficients and their correlations / H T U and N T U, concept of Jd factor. Mass transfer in packed and fluidized beds.Concept of effective diffusivity.Diffusion through membranes and applications.

Unit 2: Distillation – Vapor liquid equilibrium for ideal and non-ideal binary systems, T-x, y and P-x, y diagrams, estimation of VLE using vapor pressure data and relative volatility. Vapor liquid equilibrium for multicomponent mixtures. Differential Simple distillation, equilibrium distillation.

Unit 3: Gas Absorption – Equilibrium relationship, mass transfer theories, concept of driving force, individual and over all mass transfer coefficients. Plate column for absorption, analytical, and graphical calculation of number of plates.Humidity and air conditioning. Cooling towers and spray ponds.

Unit 4: Liquid Liquid Extraction – Equilibrium for immiscible and partially miscible systems. Use of triangular diagram.Calculation of number of stages for cocurent and countercurrent contacting.

Unit 5: Drying- Drying characteristics of the materials. Theory and mechanism of drying.Evaluation of drying rates, design and performance of continuous and batch dryers.Industrial drying equipments.Crystallisation, Miers theory, Nuclei formation, crystal growth.Theory of crystallization.Batch and continuous crystallization.Fractional crystallization.

Unit 6: Adsorption – Gas Solid isotherms for one and more sorbates, chemisorption, liquid solid isotherms. Adsorption Unit – Fixed bed equations, isothermal operation, non isothermal operation, pressure swing adsorption. Solid liquid Extraction.

Books Recommended:

1. Chemical Engineering by Coulson and Richardson
2. Mass Transfer Operation by Treybal
3. Unit Operation by G. G. Brown
4. Absorption and Extraction by Sherwood and Pigford
5. Elements of Fractional Distillation by Robinson and Gilliand

Subject: BCHT702T(BCHT) **Chemical Reaction Engineering (Theory)**

Lecture: 3 Hours
Tutorial: 1 Hour
Duration of Examination: 3 Hours

No. of Credits: 4
University: 80 Marks
College Assessment: 20 Marks

Unit 1: Conversion and Reactor Sizing

Definition of conversion, Batch Reactor Design Equations, Design Equations for Flow Reactors, Applications of the Design Equations for Continuous-Flow Reactors, Reactors in Series, Some further Definitions

Unit 2:Rate Laws and Stoichiometry

Basic definitions, The Reaction order and the rate law, The Reaction Rate Constant, Present Status of our Approach to Reactor Sizing and Design, Batch systems, Flow Systems

Unit 3:Isothermal Reactor Design

Design structure for isothermal reactors, Scale up of liquid phase batch reactor data to the design of CSTR, Tubular reactors, Pressure drops in reactors, Synthesizing the Design of a Chemical Plant, Mole Balances on CSTRs, PFRs, PBRs and Batch Reactors, Micro reactors, Membrane Reactors, Unsteady-State Operation of Stirred Reactors, Practical Side

Unit 4:Collection and Analysis of Rate Data

The Algorithm for Data Analysis, Batch reactor data, Method of initial rates, method of half-lives, Differential reactors, Experimental Planning, Evaluation of Laboratory Reactors

Unit 5: Multiple Reactions

Definitions, Parallel Reactors, Maximizing the Desired Product in Series Reactions, Algorithm for solution for complex Reactions, Multiple Reactions in a PFR/PBR, Multiple Reactions in a CSTR, Membrane Reactors to Improve Selectivity in multiple Reactions, Complex Reactions of Ammonia Oxidations.

Unit 6: Distribution of Residence Times for Chemical Reactors

General characteristics, Measurement of RTD, Characteristics of the RTD, the RTD in ideal reactors, Diagnostics and Troubleshooting, Reactor modelling with the RTD, Zero parameter models, Using software Packages, RTD and Multiple Reactions

Books Recommended

1. Elements of Chemical Reaction Engineering by H. Scott Fogler, published by Prentice Hall Fourth Edition
2. Chemical Reaction Engineering by O.Levenspiel, published by Wiley Eastern
3. Chemical Engineering Kinetics by J.M. Smith, published by McGraw-Hill
4. Chemical Reactor Design, Vol.1 & 2 by H.W. Rao
5. Principles of Reaction Engineering by S.D. Dawande (Second Edition) published by Central Techno Publication, 2003.

Subject: BCHT703T(BCHT) **Special Technology- V (Theory)**
Lecture: 3 Hours No. of Credits: 4
Tutorial: 1 Hour University: 80 Marks
Duration of Examination: 3 Hours College Assessment: 20 Marks

BCHT703T/1 FOOD TECHNOLOGY - V
(BCHT) (FOOD PROCESSING I)

UNIT 1:PROCESS TECHNOLOGY 0F CEREALS:

Composition of cereal grains & their fractions.Process technology of milling of wheat, rice & corn.Isolation, processing and applications of starch from different cereal sources.By products of milling industry.Processing of malt.

UNIT 2:PROCESS TECHNOLOGY OF LEGUMES & OILSEEDS:

Milling of legumes.Processing of oilseeds.Oil extraction, refining & hydrogenation. Manufacture of margarine, shortening agents, Lecithin & GMS. Edible oilseed flour, Protein concentrate and Protein isolate.

UNIT 3:PROCESS TECHNOLOGY OF BAKED FOODS:

Role and quality parameters of raw materials, Rheology of dough.Changes during dough formation, fermentation & baking.

Manufacture of bread, biscuits, cookies, crackers, cakes, wafers and other bakery products.

UNIT 4:PROCESS TECHNOLOGY OF TEA & COFFEE:

Composition & processing of tea &coffee.Flavour& aroma development & evaluation.

PROCESS TECHNOLOGY OF COCOA & CHOCOLATE:

Processing of cocoa beans, and production of cocoa powder.Types of chocolates, Production of Milk crumb and chocolates.Quality control in chocolates.

UNIT 5: PROCESS TECHNOLOGY OF SUGAR CONFECTIONARY:

Sugar crystallisation& its control.Types of confectionary products. Production of fondant, fudge, toffee, pulled confections, lozenges.

Standardization and processing of traditional sweets, such as batasha, pedha, sandesh, Rasogolla, chikki and flour based sweets.

UNIT 6:CONVINIENCE FOODS

Manufacture of breakfast cereals, puffed cereals. Extrusion process & extruded products, meat analogue.Fast foods & ready mixes.Agglomeration technique &instantised foods.

SPECIALITY FOODS: Weaning & baby food, space foods, probiotic foods, neutraceuticals

Reference books

1. Cereal technology by Matz Samuel A, AVI publishing co. Inc Westport Connecticut 1970
2. Modern Cereal Chemistry by Kent Jones W.D. & Amos A.J., Food Trade Press Ltd. London 1976
3. Snack food technology Matz S.A, AVI publishing Co.1976.
4. Bakery technology Matz Samuel
5. Sugar confectionary &chocalate manufacture by E.B Jackson & Lees R, Leonard Hill Books 24, market sqareAylesbury.
7. Processed plant protein food stuff edited by Aultschul A.M., Academic press London 1958
8. Wheat chemistry & technology, edited by Pomeranz Y. American Association of cereal chemists, Minnesota 1978
9. Bakery materials & methods by Daniel A.R., Mc Larene& sons Ltd.London 1947
10. Manufacture of biscuits cakes & wafers by Fritsch J. &Grosspicrre, London 1932.

BTCHT703T/2 Oil Technology V (Theory)
(BCHT)(Technology of Fat Splitting, Essential Oils and Other Fat Products)

Unit 1: Technology of fat splitting:

Chemistry of fat splitting, Hydrolysis of oils and fats, composition of partially split fats, Effect of temperature, pressure, catalyst and ratio of reactants in hydrolysis of fats; Degree of splitting, Plants and processes employed for fat splitting, Twitchell process, enzymatic fat splitting. Semi, continuous and modern processes of fat splitting

Unit 2: Separation and purification of fatty acid mixtures:

Fractional distillation, Solvent crystallization, analysis and purification of reaction products of fat splitting, Recent advances in the field.

Unit 3: Essential oils:

Chemistry, Classification and chemical constituents of essential oils, Raw materials, general methods of manufacture from roots, stems, leaves, flowers and seeds. Production of important oils viz., rose, jasmine, khus, sandal wood, palmarosa, lemongrass, lemon, clove, eucalyptus oils.

Unit 4: Properties and composition of Essential oils:

Analysis for physico-chemical characteristics such as specific gravity, refractive index, optical rotation, solubility, acid value, total alcohols, aldehydes and ketones. Industrial uses of essential oils

Unit 5: Natural and Synthetic perfumery materials:

Important isolates, synthesis perfumery materials and fixatives e.g., menthol, camphor, thymol, geraniol, citral, eugenol, terpeniol, vanillin, coumarins, musks, benzyl acetate, benzyl benzoate etc. perfumes.their blending and industrial uses.

Unit 6: Technology of other fat products:

Mechanism and industrial utilization of important chemical reactions of fats and fatty acids such as esterification, inter-esterification, Epoxidation, Pyrolysis, Halogenations, Hydroxylation, Ozonalysis, polymerization.

LIST OF REFERENCE BOOKS

1. Bailey's Industrial Oil and Fat Products, Edible Oil and Fat Products: Chemistry, Properties, and Health Effects, 6th Edition, John Wiley & Sons, USA.

2. The production of essential oils,Guenther, E. Krieger Publ. Co., Malabar, FL.

3.The Chemistry of Essential Oils and Artificial Perfumes. Parry, E.J.,D. Vannostrand Co.,NewYork.

4.Hand Book of Oils, Fats and Derivatives with Refining and Packaging Technology, Published by Indian Institute of Consultants, Engineers India Research Institute, New Delhi

5.Essential Oils and Culinary Herbs*James E. Simon

6. Industrial Fatty Acids and their Applications," edited by E. Scott Pattison, Reinhold Publ. Corp. New York.

BTCHT703T/3 Petroleum Refining and Petrochemical Technology – V
(BCHT) (Petroleum Refinery Engineering)

Unit 1: Multicomponent vapor liquid equilibrium, application of Raoult's law and Dalton's law in multicomponent flash equilibrium calculations, ideal and non ideal systems, Concept of K, Methods of successive approximations, Lockhart-Mc Henry method, Bubble point and Dew point calculations, and their applications.

Unit 2: Petroleum Refinery distillations, TBP, ASTM and EFV. Experimental details, their comparison and inter relations by Nelson and Edmister correlations. Analysis of TBP products, mid percent curves and yield curves, blending, phase behavior of petroleum systems, construction of phase diagrams, Cox charts and successive flash vaporization.

Unit 3: Multicomponent distillation, (MCD), concept of key components, distribution of non key components and their estimation, non key components influence in design of MCD. Calculation of minimum reflux and number of plates, feed plate location. Estimation by short cut and longer methods, temperature and pressure estimations, components influence in design of MCD.

Unit 4: Complex system (Petroleum) fractionation, their comparison with MCD, Topping tower design concepts by Nelson and Watkins, types of refluxes used in crude topping towers and their calculations, concept of over flash, Estimation of tower top, bottom and side draw temperatures. Pseudo multicomponent design by Van Winkle for simple tower operation. Tube still heaters, important features and types, Radiation from flames, design of convection and radiant sections, Wilson, Lobo and Hottel equation, their limitations, Lobo and Evans method, Pipe Still design.

Unit 5: Multicomponent liquid - liquid equilibrium relations, estimation of number of stages by triangular and rectangular diagrams for complex petroleum oils. Multicomponent absorption and stripping in refinery operations, absorption and stripping factors and their significance.Mathematical analysis of multi- component absorbers and strippers, Kremser-Brown absorption factor methods.

Unit 6: Adsorption, Breakthrough phenomena, concept of adsorption zone height, Unsteady state fixed bed operation, LUB concept, design of adsorbers using above concepts. Sorbex technologies and its concepts.Isosive process.

Books Recommended

1. Petroleum Refinery Engineering, W.L.Nelson, 4thed, Mac Graw Hill Book Co, 1958.
2. Petroleum Refinery Distillation, R.N.Watkins, 2nded, Gulf Publishing Co, 1979.
3. Data Book on Hydrocarbons, J.B.Maxwell, Princeton, N.J; D.vanNostrand Co, 1965.
4. Distillation, Van Winkle, Mac Graw Hill Book Co, 1967.
5. Petroleum Processing, Principles and Applications, R.J.Hengstebeck, Mc Graw Hill Book Co, 1959.
6. Applied Hydrocarbon Thermodynamics, W.C.Edmister, Gulf Publishing Co, 1961.
7. Hand Book of Petroleum Refining Process, Robert. A.Meyers, 2nded, Mac Graw Hill Book Co, 1997.

BTCHT703T/4 (BCHT) **Pulp and Paper Technology-V (Bleaching & Stock Preparation)**

Unit 1: Bleaching of wood pulp, basic principles of chlorination and alkali extraction, oxidation bleaching agents- hypochlorite, chlorine dioxide, peroxide and other bleaching agents, reducing agents, acidification and combination stages, determination of bleach requirements.

Unit 2: Modern bleaching processes with following agents Chlorine–di-oxide, Oxygen, Ozone,Peroxide per acids, enzyme and chelating agents. Their reactions, process variables, pulp properties, advantages disadvantages and equipment selections.Bio-bleaching, fundamentals and economics. Bleaching of post-consumer office waste and deinked newspaper.

Unit 3: Stock preparation, beating and refining, effect on fiber structure, theory of beating, factors affecting beating, stock preparation systems

Unit 4: Internal sizing of paper, rosin size and synthetic sizes, wax emulsions, asphalt emulsions, theory of internal sizing, various precipitants, alkaline sizing, fortified sizing

Unit 5: Filling and loading: objectives, survey of filler properties, manufacture of fillers, preparation and addition of fillers, filler retention, adverse effects of fillers, commercial filling and loading materials, refractive index and scattering coefficient

Unit 6: Special additives for wet and dry strength, general considerations and properties, coloring, theory, terms used, dyes and pigments, fastness test, methods of coloring, coloring of special papers.

Books recommended:

1. Pulp and Paper Science & Technology Vol. I & II by C.E.Libby
2. Pulp & Paper Manufacture Vol. I, II, III by Mac Donald
3. Hand Book of Pulp and Paper Technology by K.W. Britt 2nd edition

BTCHT703T/5 Plastics & Polymer Technology V
(BCHT) (Polymer Processing)

UNIT 1: Extrusion

Introduction, design features of extruders, Zones in extruders, mechanism of extrusion, compression ratios, screen changers, single screw and twin screw extruder, effect of material properties, process parameters and their effect on product quality, process control in extrusion, extrusion dies for tapes, filaments, blow film, cast film, wire coating ,rods and simple profiles, thermoplastic foams, coating and lamination.

UNIT 2: Injection Molding

Introduction, shot capacity, process parameters, molding cycle, injection moulding of thermoplastics and thermosets, gas assisted and water assisted injection moulding, instrumentation and process control in injection moulding, trouble shooting of injection molding.

UNIT 3: Blow Molding and Rotational Molding

Blow moulding: extrusion blow moulding, injection blow moulding, stretch blow moulding, perform, parison, parison programming, Single and multi layer injection blow molding, single and multi layer extrusion blow molding, process controls for blow molding machine, trouble shooting in blow molding.

Rotational molding: Basic process, materials and products parameters, cycle time, temperature, speed, cooling effect on product quality, control system, multilayer rotational molding, batch type and continuous type machines, trouble shooting in rotational molding.

UNIT 4: Compression Molding and Transfer Molding

Compression Molding: Introduction, compressing molding process, types of moulds-flash, positive and semipositive, compression molding cycle, process parameters of compression moulding, troubleshooting, molding of thermosets and rubber, types of compression molding.

Transfer molding: Introduction, transfer molding cycle, types of transfer molding, resin transfer molding, advantages, limitations, troubleshooting.

UNIT 5: Thermoforming

Definition, methods of forming, thermoforming machinery, heating of sheet, heating cycle, thermoforming machines and plants, thermoforming materials, analysis of sheet heating, stretching and wall thickness distribution, simple vacuum forming, drape forming, air-slip forming, pressure forming, drape forming, blister forming, solid-phase pressure forming, plug-assist forming. Advantages and limitation of thermoforming. Process factors in thermoforming, defects in thermoformed articles and remedies, hot strength, blistering, sags, cooling and trimming the parts, heat balance, shrinkage, trimming operations, finishing and machining of plastics.

UNIT 6: Calendaring and Casting

Calendaring: Introduction to calendaring, types of calendar units, 2, 3, 4 roll calendars, Z type calender, L type calender, heating systems, temperature control and process control parameters, roll bending, calendaring lines- film and sheet lines, laminating and embossing lines, applications and advances in calendaring.

Casting: Introduction, types of castings, solvent casting of PVC film.

Cellular Plastics: Expandable polystyrene foam moulding, structural foam moulding.

References:

1. SPI Plastics Engineering Handbook, Michel L. Berins, Chapman & Hall
2. Polymer Extrusion, Chris Rauwandaal, Hanser
3. Plastic Extrusion Technology, Hensen, Hanser
4. Extrusion of Plastics, E. G. Fisher, Newness Butterworths, London, 1974
5. Injection Molding Handbook, Dominick V. Rosato and D. V. Rosato, CBS Publisher, 2000
6. Polymer Processing by Morton and Jones, Chapman & Hall, 2007
7. Plastic Processing Data Handbook by D. V. Rosato, Springer, 2001
8. Blow Moulding Handbook, Rosato, John welley& sons
9. Blow Moulding Plastics, Illuffee Books, London 1979
10. Compression & transfer molding, J. Butler, McMillan India
11. Handbook of Thermoforming, Throne, Hanser
12. Basic Principles of Thermoforning, P. F. Bruins, gorden and Beach Science Pub, New York, 1972
13. Basic Principle of Thermoforming, Bruins, SPC

BTCHT703T/6 Surface Coating Technology – V
(BCHT) (Miscellaneous constituents and formulations of Coatings)

Unit 1: Plasticizers, general uses, requirement of plasticizers and desirable characteristics, Types of plasticizers and their evaluation Solvents, their types and chemical structure, effect of volatile solvent on film properties, solvent characteristics, true and latent solvents, types of volatile solvents and their use in surface coatings, Toxicity of solvents.

Unit 2: Test methods for film forming compositions, percentage solids, viscosity, colour, acid number and bulk density. Measurement of film thickness, Performance tests for varnishes and resins, namely drying, skinning, gasproofing, hardness, flexibility, cold check, impact resistance, abrasion resistance, adhesion, exterior durability, water resistance, permeability to water, soap and alkali solutions, alcohol and chemical resistance, electrical resistance.

Unit 3: Performance testing of coatings: Resistance to heat, light, drying, skinning gasproffing, hardness, flexibility, cold check, impact resistance, abrasion resistance, adhesion, exterior durability, water resistance, permeability to water, soap and alkali solutions, alcohol and chemical resistance, electrical resistance, Weatherometer tests, Outdoor exposure tests.

Unit 4: Principles of formulations, Four steps formulation, production, application, drying and aging. Formula calculations, concept, Binder properties and performance, Effect of binder properties and vehicle characteristics on the performance of the coatings, Effect of pigment characteristics like particle size, shape, oil absorption and bulking value on the performance of the coating, pigment volume concentration (PVC), use of additives in paints and coatings.

Unit 5: Fundamentals of pigmented coatings, Appearance of coatings, colour, hiding power, spreading power, critical pigment concentration, consistency and flow properties, effect of vehicle on consistency. Rheology of Coatings, Newtonian and Non Newtonian flow, Thixotropy, Chemicals for inducing thixotropy in paints.

Unit 6: Colour, Nature of light, Light sources, the vision, Trichromatic colour system, Munsellcolour system, Colour measuring instruments, practical applications of colour measurement, Colour standardization, metamerism, Colour aesthetics.

Books Recommended:

1. Payne, H.F., "Organic Coating Technology" Volume one, John Wiley & Sons, New York, 1954.
2. Payne, H.F., "Organic Coating Technology" Volume Two, John Wiley & Sons, New York, 1954.
3. Matellio, J.J., "Protective and Decorative Coatings" Volume Two, John Wiley & Sons.
4. Matellio, J.J., "Protective and Decorative Coatings" Volume Three, John Wiley & Sons.
5. Durrans, T.H., "Solvents" D. Van Nostrand Co., New York, 1950.
6. Oil, Colour Chemists; Association, "Paint Technology Mannuals", Vol 1.
7. Oil, Colour Chemists; Association, "Paint Technology Mannuals", Vol 2.
8. Oil, Colour Chemists; Association, "Paint Technology Mannuals", Vol 3.
9. Oil, Colour Chemists; Association, "Paint Technology Mannuals", Vol 4.
10. Oil, Colour Chemists; Association, "Surface Coatings-Vol 1-Raw materials and their usage", OCCA, Australia, 1983.
11. Long J. S. and Myers R. R., "Treatise on Coatings Vol 4 – Formulations", Marcle& Dekker, N. Y. 1975.
12. GerritsonFrans, "Theory and Practice of Colour", Studio vista, N. Y., 1975.
13. Billmeyer F. W. (Jr), and Satzzman Max, "Principles of Colour Technology", Second Edition, John Wiley & Sons, N. Y., 1981.

Subject: BCHT703T(BCHT) **Special Technology- V (Theory)**
Lecture: 3 Hours No. of Credits: 4
Tutorial: 1 Hour University: 80 Marks
Duration of Examination: 3 Hours College Assessment: 20 Marks

BTCHT704T/1 FOOD TECHNOLOGY VI
(BCHT) (FOOD PROCESSING II)

UNIT 1: PHYSIOLOGY OF FRUITS & VEGETABLES:

Quality assessment of fruits & vegetables Structure, chemistry & physiology of plant tissues.Texture of fruits & vegetables. Plant pigments. Effect of processing on colour and texture.

Post harvest changes in Climacteric and nonclimacteric fruits.CA and MA storage. Dehydration of fruits & vegetables.

UNIT 2: PROCESS TECHNOLOGY OF FRUITS & VEGETABLES:

Processing & canning of fruits & vegetables and their products. Process technology of fruits & vegetable products such as purees, concentrates, jams, jellies marmalades, preserves, candied fruits, pickles, chutnies. RTS beverages, carbonated beverages.

UNIT 3: CHEMISTRY & PHYSIOLOGY OF ANIMAL MUSCLES:

Structure & chemical composition of muscle proteins, haemoglobin, myoglobin, collagen &gelatine. Post mortem changes in muscles, rigor mortis. Live stock& poultry preparation.Various cuts of meats.Texture of meat.Effect of cooking & processing on texture, palatability & tenderness of meat.

UNIT 4: PROCESS TECHNOLOGY OF MEAT FISH & POULTRY:

Preservation & packing of meat, poultry & their products, Processing of fish.Quality control & microbiological standards of meat, fish & poultry products.Processing of eggs.

By products in meat, poultry& fish processing industry.

UNIT 5: PROCESS TECHNOLOGY OF MILK & MILK PRODUCTS:

Composition of milk.Processing, storage & distribution of milk. Manufacture of cream, butter, ghee, evaporated, condensed & skimmed milk, cheese, yoghurt. Whole & skimmed milk powder.Preparation of Indian milk products like Khoa, Channa, Curd, & their products.Simulated milk products.

UNIT 6: FOOD ADDITIVES AND FOOD LAWS

Classification and importance of food additives. Various food additives such as preservatives, antioxidants, colours, flavours, emulsifiers, sequesterants, humectants, stabilizers, acidulants, etc. with respect to chemistry, functions and limitations in formulations. Processing of Spices.

Food Laws such as FSSAI, Agmark, ISO, BIS, and Codex alimentaris. Quality assuarance in Food industry.TQM, GMP, hygiene and sanitation.

Reference books

1. Preservation of fruits & vegetables by Girdharilal&Sidappa G.S.,ICAR. New Delhi.
2. Fruits & vegetables juice processing technology edited by Tressler D.K. & Joslyn M.A., AVI publishing Co. Westport, Connecticut 1971
3. The meat handbook by Levie A. AVI publishing Co. Connecticut 1970
4. The science of meat & meat products by Price J.F. &SchweigertB.s., W.H. Freeman, San Francisco, 1970
5. Poultry products technology by Moutney G.J., AVI publishing Co. Inc. Westport Connecticut, 1976

6. Fishery Byproducts technology by Brody J., AVI publishing Co Inc Westport, Connecticut, 1965.
7. Fish as Food Vol 1, 2, 3, & 4 edited by Borgstrom G., Academic press, New york& London, 1961.
8. Drying of milk & milk products by Hall C.W. & Hedrick T.I., AVI publishing Co., Westport,Connecticut, 1966.
9. Modern dairy products by Lampert I.M., Eurasia publishing House Ramnagar New Delhi, 1970.
10. Byproducts from milk by Webb B.H. & Whittier E.O., AVI publishing Co., Connecticut, 1970.
11. Meat Technology by Gerrard F., Leonard Hill London, 1971.
12. The chemistry & testing of dairy products by Newlander J.A. &Artherton H.V., Olsen publishing Co., MilwalieWisconsis, 1964.
13. Food Adulteration by Jacob T., Mc Millan & Co. India Ltd 1976.

BTCHT704T/2 (BCHT) **Oil Technology VI (Theory) (Technology of Cosmetics)**

Unit 1: Classification of cosmetics and cosmetic preparations:

Cosmetic preparations such as Shampoos and Conditioners, their Ingredients, types, Functions, formulation, Production techniques, evaluation and safety considerations,

Unit 2:Face care products:

Beauty Masks , face creams, Cleansing and Emollient Creams and Lotions, Vanishing Creams, Foundation Makeup., face/body Formulation,Hand Creams and Lotions , Skin Lighteners and Bleach Creams ,sun care cosmetics, Rouge, Moisturizing Creams etc.

Unit 3:Face care products:

Lipsticks,face powders, talcum powders, Eye makeup cosmetics, Hormone Creams,Bath and shower products

Unit 4: Shaving soaps and creams:

After shave products, hair oils, hair dyes, Hair Conditioners, brilliantine's.

Unit 5: Dentifrices:

Toothpaste, tooth powders, Mouthwashes, teeth whiteners, evaluation of cosmetic preparations, Plant and Machinery used in cosmetic manufacture. Lay out and Hygiene aspect of cosmetic.

Unit 6: Miscellaneous Cosmetics:

Anti per spirants and deodorants, depilatories, Baby Toiletries, nail lacquers and polishes,recent trends and other miscellaneous cosmetic preparations

LIST OF REFERENCE BOOKS:

1. Handbook of Cosmetic Science and Technology, Barel,A.. Paye,M.,Howard I. and Maibach,H. I. Marcel Dekker, Inc.270 Madison Avenue, New York.
2.Cosmetics Formulations, Technology & Project Estimations, Institute of Natural & Modern Cosmetech,USA.
3. Cosmetic Formulation of Skin Care Products, Series EditorEricJungermann ,Jungermann Associates, Inc. New York.
4. Cosmetics-Science and Technology, Vol-2, 2nd Ed,Sagarin, E. andBalsam, M,Wiley India Pvt. Ltd,New Delhi.
5.Analysis of Cosmetic Products,Salvador,E.,Elsevier, New York.

BTCHT704T/3 Petroleum Refining and Petrochemical Technology - VI
(BCHT) (Petrochemical Processes)

Unit 1: Starting materials for Petrochemicals and their preparation, principal reactions of Methane, ethane, propane and butane. Preparation of gaseous hydrocarbons, separation of Liquid hydrocarbons by fractionation, adsorption and crystallization etc.

Unit 2: Derivatives of ethylene and acetylene, polyethylene, ethylene oxide, ethyl alcohol and ethyl benzene. Vinyl chloride, acrylonitrile, neoprene and vinyl acetate.

Unit 3: Propylene and C_4 hydrocarbon derivatives, polypropylene, isoprene, propylene oxide, Iso-propyl alcohol, cumene. Butadiene by oxidative dehydogenation

Unit 4: Chemicals from synthesis gas (and also from olefins), ammonia, methanol and higher alcohols. Petroleum aromatics, styrene, phenol, cyclohexane, caprolactum and naphthalene.

Unit 5: Polymerization fundamentals, Ziegler Natta catalysts, polymerization of simple olefins such as ethylene and propylene. Synthetic rubbers, manufacture, general characteristics, raw materials for synthesis, Range of synthetic rubbers, PBR, SBR, NBR, Butyl rubber.

Unit 6: Synthetic detergents from petroleum, field of application of Surface-active agents, classification, alkylarylsulphonates, linear alkyl benzenes, sulphonal. Engineering plastics, PTFE, polyacrylonitrile, polycarbonates, PVC, epoxy polymers,polyurethanes and silicones.

The subject is to be taught with increase in order of depth, different routes, flow schems for the most favored route, future trends, physico-chemical and chemical engineering principles and engineering problems encountered, unit operations and unit process involved.

Books Recommended

1. Acetylene, vol I and II, S.A.Miller,
2. Ethylene and its Indutrial Derivatives, S.A.Miller.
3. Propylene and its Industrial Derivatives, E.G.Hancock.
4. Benzene and its Industrial Derivatives, E.G.Hancock.
5. Oxidation of Hydrocarbons, S.B.Chandalia.
6. Oxidation of Petrochemicals,T.Dumas and W.Bulani.
7. Production of Polymers and Plastic Iintermediates from Petroleum, R,Long
8. A Text Book on Petrochemicals, B.K.Bhaskara Rao.
9. Toluene, Xylenes and their Industrial Derivatives, E.G.Hancock.
10. Fundamentals of Petroleum Chemicals Technology, P.Belov.

BTCHT704T/4 Pulp & Paper Technology-VI
(BCHT) (Paper & Board Manufacture-I)

Unit 1: Flow behaviour of pulp suspension, equation of continuity, mechanical energy balance and frictional losses in mixing of pulp suspensions, role of viscosity, critical consistency, network strength, flocculation

Unit 2: Introduction to types of paper machines, history and development of Fourdrinier paper machine, birds eye view, auxiliary equipments-stock chests, stock proportionars, consistancy regulators, approach flow systems, head box and slices, different types

Unit 3: Drainage and sheet formation on Fourdrinier, breast roll, table rolls, forming boards, wire, suction boxes, dandy rolls, couch rolls, wire pit, miscellaneous equipments, twin wire formers, ventri formers

Unit 4: Pick up and press section, concept of suction pick up, plain and suction presses, mechanism of water removal, factors affecting water removal and moisture distribution, paper machine felts, felt conditioning and treatment

Unit 5: Drying of paper, need, means, major characteristics, theory, mechanism of water removal, drying rate curves, critical and equilibrium moisture contents, multi-cylinder drying, different phases of drying, Mechanism of heat and mass transfer.

Unit 6: Cyclic nature of paper drying, Yankie and MG drying, factors affecting heat and mass transfer uniformity, effect of drying on sheet properties, methods of expressing the moisture content of a wet sheet and their inter relationship. Performance calculations, determination of centre line temperature distribution, air drying, radiant drying, psychrometry, heat requirements, ventilation, cost economics

Books recommended:

1. Pulp and Paper Science & Technology Vol. I & II by C. E. Libby
2. Pulp & Paper Manufacture Vol. I, II, III by Mac Donald
3. Hand Book of Pulp and Paper Technology by K.W. Britt 2nd edition.

BTCHT704T/5 Plastics & Polymer Technology VI

UNIT 1: Mould Design

Introduction to mould design, mould making materials, design of positive, semi positive and flash type moulds, single and multi cavitymoulds, calculation of number of cavities, allowance for shrinkage etc, transfer moulds, injection moulds, design of ejection system, design of sprue, runner and gate system, hot runner moulds, runnerless injection moulds, mould defects, mould cooling system.

UNIT 2: Spinning

Introduction to spinning technology, essential properties of fibres, characteristics of fibre forming polymers, fundamentals of fibre formation, melt spinning, dry spinning and wet spinning of fibres, spinnerets for wet spinning. Drawing and stretching of synthetic fibres, high speed spin drawn, formation and arrangement of crystallites in fibres, preparation of viscose rayon, high tenacity nylon fibre and high oriented nylon fibre.

UNIT 3: Polymer Rheology

Basic rheological concept, Newtonian fluids, Non-Newtonian and its types, Rheological Models, Power law relationship, power law index, shift factor, expression for shear rate, Carreau equation, effect of temperature, pressure and molecular weight on viscosity, Viscoelastic behaviour of polymer solutions and melts, mathematical models of viscoelasticity, Viscosity change during extrusion, weissenberg effect, Extrudate effect, Draw resonance, Melt fracture, Capillary entry flow patterns, Abnormal fringe patterns in calendaring, Pressure hole error, Parallel plate separation, Tubeless siphon, Uebler effect.

UNIT 4: Viscometers

Capillary tube viscometer, cone and plate viscometer, brook field viscometer Sandwich or parallel plate viscometer, Rotating cylinder viscometer, Concentric cylinder rotary viscometer, Mooney viscometer.

UNIT 5: Biopolymers

Introduction, classification, applications, advantages and disadvantages, Biopolymers vs polymers, Biopolymers vs Biodegradable polymers, introduction of different types of biopolymers like polypeptides, nucleic acid, sugar based, poly lactic acid, PHBV , biodegradation and its classification, degradation - Intracellular biodegradation , extra cellular biodegradation , thermal degradation , hydrolytic degradation ,environmental degradation , criteria used in the evaluation of biodegradable polymers.

UNIT 6: Plastics Waste Management

Sorting and segregation of waste, Plastics identification, Plastics waste: Composition, quantities and disposal, Four R's of plastics waste management, Need for recycling, alternative types of recycle methods, recycling of plastics from urban waste, Waste management of plastics packaging

References:

1. Plastics Mould Engineering, J. H. Dubois
2. Injection mould&moulding, Dym
3. Injection mould Design, R.G.W.Pye, Longman Scientific and Technical, 4th Edition, 1989
4. Design of Plastics Moulds& Dies, Sors
5. Injection Mould Design, 4th edition, Pie
6. Text Book of fibre Technology, S. P. Mishtra
7. Rheometry, K. Walters, Chapman and Hall, Londan, 1975
8. Rheology of Polymers, G. V. Vinogradov, A. Ya. Malkin, Mir Publications, 1980

9. Introduction to Polymer Viscoelasticity, J. J. Alkonics, W. J. Macknight, Wiley Inter Science, New York, 1982
10. Melt Rheoloy and it role in Plastics Processing, Dealy
11. Chemistry & Technology of Biodegradable Polymers, G.J.L.Griffin Blackie(ed.), Academic & Professional London, 1st Edition,1994
12. Biodegradable Plastics & Polymers, Yoshiharu Doi , Kazuhiko Fukuda(ed.), Elsevier, 1st Edition, 1994
13. Polymeric Biomaterials, Piskin and A S Hoffmann, MartinusNijhoff Publishers. (Dordrecht.), 2nd Edition, 1986
14. Biomaterials - An introduction, J.B. Park, Plenum Press, 2nd Edition, 1979

BTCHT704T/6 Surface coating Technology – VI
(Manufacturing Methods and application of Surface Coatings)

Unit 1: Paint manufacture, steps in manufacture, mixing, grinding, letting down, tinting, straining, filling. Types of coatings, primers, topcoats, corrosion resistant finishes, clear finishes.

Unit 2: Types of machinery required for various steps and their working, construction, designing and function of various parts. Details of machinery for Mixing, edge runners, paint mills (single, twin, three and four roll mills), Ball and pebble mills, sand grinders, attritors, kadymillk, high speed impellers, Filling and labeling machines.

Unit 3: Varnish manufacture Oleoresinous varnishes, constituents of varnishes and their function, film properties of varnishes, Types of furnaces and their design, types of kettles and their advantages and disadvantages, design of resin kettle, thinning and cooling tanks, storage of raw materials and finished products, filling and labeling machines.

Unit 4: Coating/printing inks/varnish industry plant layout, flow of material and finishing schedule, sampling of coatings for testing, recording, costing of coatings, Paint Film Defects, their causes and remedies.

Unit 5: Surface preparation for coating, solvent vipeoff, vapour degreasing, alkali cleaning, chemical cleaning, burn off and flame cleaning, mechanical cleaning with hand and power tools, sand blasting, phosphate treatment, treatments for alluminium and magnesium.

Unit 6: Application of coat/paint, brush and roller coating, spray painting (ordinary, Electrostatic, power, airless, two component, hot spray), dipping, flow coating, fluidised bed coating, pressure curtain coating, knife and roller coating, tumbling barrel, silk screen coating, centrifugal coating, design of spray booths.

Books Recommended

1. Payne, H.F., "Organic Coating Technology" Volume one, John Wiley & Sons, New York, 1954.
2. Payne, H.F., "Organic Coating Technology" Volume Two, John Wiley & Sons, New York, 1954.
3. Matellio, J.J., "Protective and Decorative Coatings" Volume Two, John Wiley & Sons.
4. Matellio, J.J., "Protective and Decorative Coatings" Volume Three, John Wiley & Sons.
5. Durrans, T.H., "Solvents" D. Van Nostrand Co., New York, 1950.
6. Oil, Colour Chemists; Association, "Paint Technology Mannuals", Vol 1.
7. Oil, Colour Chemists; Association, "Paint Technology Mannuals", Vol 2.
8. Oil, Colour Chemists; Association, "Paint Technology Mannuals", Vol 3.
9. Oil, Colour Chemists; Association, "Paint Technology Mannuals", Vol 4.
10. Oil, Colour Chemists; Association, "Surface Coatings-Vol 1-Raw materials and their usage", OCCA, Australia, 1983.
11. Tank, G. F., "Industrial Paint Finishing Techniques and Processes", Ellis Horwood Ltd., 1991.
12. Bigos Joseph, "Steel Structure Painting Mannual, Vol. I and Vol. II", Steel Structures Painting Council, Pittsburg, USA, 1955

Subject : BCHT705P **Mass Transfer Operations (Practical)**
Practical : 3 Hours No. of Credits : 2
University : 25 Marks College Assessment : 25 Marks
Duration of Examination: 3 Hours

LIST OF EXPERIMENTS

Required to perform minimum 8 practical from the list given below:

1. Winkelmann's method – To find the diffusion Coefficient of vapour in still air
2. Liquid Diffusion – To find the Diffusion Coefficient for a liquid –liquid system
3. To calculate rate of Drying.
4. Studies ofcrystallization phenomenain Batch Crystallization
5. To evaluate the performanceof Cooling Tower.
6. To find the mass transfer coefficient in a wetted wall Column
7. Determination of solid-liquid mass transfer coefficient.
8. Evaporation from free surface.
9. Determination of HTU in packed bed.
10. Study of Ion exchange process.
11. Removal of impurities by use of adsorption techniques.
12. To verify Rayleigh's Equation for Simple Distillation
13. To construct the boiling point diagram for binary – miscible system
14. Distillation using Sieve Plate, Bubble Cap Column
15. To determine the thermal and vaporization efficiencies in Steam Distillation
16. Single/multiple stage extraction studies
17. To prepare the ternary phase diagram.
18. Soxhlet Extraction
19. Absorption studies in packed column
20. Absorption studies in bubble column
21. Batch/ Continuous Leaching
22. Membrane separation
23. Liquid Liquid Extraction.

Subject : BCHT706P **Special Technology III (Practical)**
Practical : 6 Hours No. of Credits : 4
University : 50 Marks College Assessment : 50 Marks
Duration of Examination: 6 Hours

BCHT706P/1 FOOD TECHNOLOGY PRACTICAL III
(FOOD PROCESSING)

Preparation of fruit juices, squashes, jam, jellies, concentrates, pickles, pastes, ketchup, canning of fruits & vegetables. Preparation of bakery products like bread, biscuits, cakes, crackers. Preparation of confectionary products like soft & hard boiled candies, fruit candies, chikki etc. Processing of meat, fish & poultry products & dairy products like ice cream, paneer etc.

BOOKS RECOMMENDED:

1. Practical baking by Sultan W.J., AVI publishing Co. Inc. 1969.
2. Manufacture of confectionary by an industrialist, industry publishers Ltd., 22. R.G. Kar Road, Shyam Bazaar, Calcutta.
3. Preservation of fruits &vegetabbles by Girdharilal&Sidappa, ICAR, New Delhi, 1967.

BCHT706P/2 OIL TECHNOLOGY-III
(Processing)

1. To prepare the red oxide metal primer and evaluation of its properties
2. To prepare synthetic enamel and evaluation of its properties.
3. To prepare universal strainer and evaluation of its properties.
4. To prepare cleansing creams and lotions.
5. To prepare and analyze metallic Soaps
6. To prepare lubricating grease
7. To prepare detergent powder
8. To prepare liquid detergent
9. To prepare shaving soaps
10. To prepare shampoos
11. To prepare biodiesel

BTCHT706P/3 Petroleum Refining and Petrochemical Technology - III
(Petroleum Refinery Operations)

1. To study TBP distillation of a petroleum fraction
   - 1.1 Verification of ASTM and TBP correlations
   - 1.2 Distillate blending of TBP fractions
   - 1.3 Residue blending of TBP fractions
   - 1.4 Construction of Mid-Percent curves
   - 1.5 Determination of Yield curves
2. To study Liquid-Liquid extraction
   - 2.1 Extraction of acid from kerosene fraction in a Bubble column.

2.2 Extraction of acid from kerosene fraction in a Packed column.
2.3 Extraction of acid from kerosene fraction in a Mixer-Settler.
2.4 Determination of tie line data for three component L-L system.
2.5 Determination of tie-line data in L-L extraction for a petroleum fraction.

3. Study of adsorption isotherm for a solid - liquid system
   3.1 Adsorption of acetic acid from acetic acid-water system using Granular Activated Carbon as a adsorbent.
   3.2 Adsorption of toluene from toluene-heptane system using Silica gel as a adsorbent.
4. To study the acid refining of lubricating oil stock using concentrated sulphuric acid at fixed set of parameters & observe the improvement in indices.
5. Extractive distillation
6. Azeotropic distillation
7. Merox treating
8. Vapor liquid equilibrium

BTCHT706P/4 Pulp & Paper Technology – III
(Analysis of Fibrous raw material: Pulp & Paper)

1. Determination of moisture content of pulp and paper
2. Determination ash content of pulp and paper
3. Determination of cold and hot water solubility of the a pulp and paper
4. Determination of 1%, 10%, and 18% NaOH solution solubility of a sample of pulp and paper
5. Determination of Permanganate number of a sample of pulp and paper
6. Determination of Kappa number of a sample of pulp and paper
7. Determination of Copper number of a sample of pulp and paper
8. Determination of viscosity of a pulp
9. Determination of rosin size in a sample of paper
10. Determination of hot water extractable alkalinity or acidity of paper

BTCHT706P/5 Plastics& Polymer Technology III

1. Preparation of articles by injection moulding process.
2. Preparation of Polymer strands by Hand injection moulding process.
3. To prepare fibre reinforced composites by Hand Layup technique.
4. To prepare chopped strands reinforced composites by hand layup process.
5. Determination of viscosity of polymer solution/emulsion by Brookfield viscometer.
6. To study compression moulding process.
7. To study the rotational moulding machine.
8. To study the blow moulding process.
9. To study the laboratory Extruder.
10. To study the Filament winding process.

BTCHT706P/6 Surface Coating Technology-III

Processing of Pigments, Paints, Enamels and Varnishes

1. Preparation and analysis of pigments.
2. Preparation and analysis of extenders
3. Preparation of Industrial paints like Stoving, Automotive, Marine and Epoxy paints and preliminary analysis of these products.
4. Preparation of primers,
5. Preparation of synthetic enamels,
6. Preparation of wall finishes.
7. Preparation of varnishes and preliminary analysis of products.

Subject : BCHT707P **Seminar and Industrial Training**
Practical : 3 Hours No. of Credits : 2
University : ----- College Assessment : 100 Marks
Duration of Examination: 6 Hours

The seminar work shall consist of preferably study of certain phenomenon, system, equipment, process design in depth, review of certain research work, compilation and analysis of certain engineering/ management activity including costing, safety, administration, market study, field study, etc. on any topic which may have importance in respective technology.

Students are expected to work individually on the seminar and the report shall be a bound journal written in technical format with illustrations by graphs, charts, tables, photographs etc. about the specific work undertaken by the student.

Students are expected to undergo Industrial Training at the end of sixth semester and submit the training report in the department. The report shall be a bound journal written in technical format with the certificate provided after successful completion of training.

The number of copies of the report shall be such that the examiner, departmental library and the concerned student shall have one copy each.

SYLLABUS FOR EIGHTH SEMESTER

Subject: BCHT801T **Mathematical Methods and Computer Aided Design (Theory)**

Lecture : 3 Hours
University : 80 Marks
Duration of Examination: 3 Hours
No. of Credits : 3
College Assessment : 20 Marks

BTCHT 801T Mathematical Methods and Computer Aided Design (BTCHT)

Unit 1: Principles of modeling, mathematical formulation of the problem. Numerical methods of solution of nonlinear algebraic and transcendental equations applied to chemical process systems.

Unit 2: Methods of solution of simultaneous linear & nonlinear algebraic equations and curve fitting techniques in Chemical Technology.

Unit 3: Formulation and numerical solution of ordinary and/or partial differential equations with emphasis on chemical process systems and computer applications.

Unit 4: Strategies for computer aided balances, Steady state simulation, sequential modular approach, equation based approach, dynamic simulation, commercial CAD packages etc.

Unit 5: Computer aided application in simulation and/or design aspects of chemical process engineering systems/operations in mass transfer, fluid flow.

Unit 6: Computer aided application in simulation and/or design aspects of chemical process engineering systems/operations in reaction engineering, heat transfer.

Books recommended

1.Mathematical Methods in Chemical Engineering by V.G.Jenson, G.V. Jeffreys, Academic Press Inc, (London).
2.Applied Mathematics for Chemical Engineers by H.S.Mickley, T.S. Sherwood, C.E. Reed, McGraw Hill
3.Chemical Process Simulation byAsgharHussian, Wiley Easrern,New Delhi.
4.Numerical methods for engineers, S.C.Chapra,&R.P.Canale,Tata McGraw Hill, New Delhi.
5.Computer Aided Process Plant Design by M.E. Leesley, Editor, published by Gulf Publishing company, Houston, Texas.
6. Computer aided design of chemical process equipment, B.C.Bhattacharyya& C.M. Narayanan, New central book agency (P) Ltd. Calcutta.

Subject : BCHT802T **Project Management (Theory)**
Lecture : 3 Hours No. of Credits : 3
University : 80 Marks College Assessment : 20 Marks
Duration of Examination: 3 Hours

BTCHT 802T Project Management
(BTCHT)

Unit 1: Nature and purpose of process economics-requirement of project proposals & methods of economic analysis conceptual background for economic analysis such time value of money, description accounting, cash flow profitability. Principle of accounting analysis of financial statement- problem situations for economic decision making.

Unit 2: Developing economic data for economic analysis- estimating capital requirement or total investment for industrial projects- estimating product costs, costs, revenues,
Profits & earning for process plants, problem situation for estimation.

Unit 3: Evaluation and selection of industrial projects various modern methods of projects evaluation, economic selection of alternatives on the basis of annual costs, present worthy, rate of return and payout period etc. problem situation for selection of alternative profile, replacement problem.

Unit 4: Entrepreneurship decision about plant/company operation, plant layout, basic principle and function of management, management thought and scientific management,
Management movement, organization principle and patterns, step in building organization.

Unit 5: Material, management and control, production planning and control, manpower planning, employment and utilization, main function of person administration, financial planning and control. Inventory management.

Unit 6: Modern concept of marketing.Marketing, planning and implementation.Scales organization and sales management.Public relations.Industrial enterprises and environmental safety.

Books Recommended:

1) Handbook of Chemical Engineering J.H.Perry, Section25 on process economics, 1974
2) Fundamentals of cost engineering M.C.Bourman
3) Chemical economics Happel and Jourdon.
4) Applied project Management, Ludwig
5) Plant Design and economics for Chemical Engineers, Peter and mmerhouse

Subject: BCHT803T(BCHT) **Special Technology- VII (Theory)**
Lecture: 3 Hours No. of Credits: 4
Tutorial: 1 Hour University: 80 Marks
Duration of Examination: 3 Hours College Assessment: 20 Marks

BCHT803T/1 (BCHT) FOOD TECHNOLOGY VII (BIOCHEMICAL ENGINEERING)

UNIT 1: Thermodynamics of biosystem. Mass & energy balance. Microbial growth Dynamics.kinetics of substrate utilisation, Biomass production & product formation in microbial cultures.

UNIT 2: Design, Preparation &sterilisation of fermentation media. Batch and continuous sterilisationSterilisation of air supply.

UNIT 3: Oxygen transfer & microbial respiration. Oxygen Transfer Coefficient, and it's determination. Oxygen transfer in gassed & agitated systems and non Newtonian fermentation broth.

UNIT 4: Classification, Design & Analysis of bioreactors. Scale up of bioreactor systems. Bioprocess simulation & control.

UNIT 5: Downstream processing &bioseparation.Modelling& design of effluent management.New trends in bioproject Engineering.

UNIT 6: Immoblilsation of cells &enzymes.Co-immobilisation of biocatalysts. Kinetics of immobilised enzymes/ Cell system. Industrial Application.

BOOKS RECOMMENDED:

Text Books:

1. Biochemical Engineering fundamentals by Bailey James E. &Ollis D.F., McGraw Hill Book Co., 1977.
2. Principles of Fermentation Technology by Whitaker

Reference Books:

1. Bioprocess Computations in Biotechnology edited by Ghose T.K., Published by Ellis Horwood Ltd. 1990.
2. Advances in biochemical Engineering vol 1 to 6 edited by Ghose T.K. &Fietcher A., Springer verlag Berlin, Heidelberg, Newyork, 1971.
3. Biochemical Engineering science vol1 & 2 edited by Blakebrough, Academic press London, 1968.
4. Immobilised enzymes, Antigens, antibodies & Peptides vol 1, 2, 3, & 4 edited by Weetal H.H., Marcel Dekkar Inc. Co., New York, 1975.

BCHT803T/2 Oil Technology VII (Theory)
(BCHT) (Technology of Waxes, Drying oil, Castor oil and Misc, Uses)

Unit 1: Natural Waxes:

Natural sources, their occurrence, composition, classification, extraction, refining and processing of waxes, general properties and uses of bees wax, shellac wax, carnauba wax, sugarcane wax, Montana wax, ceresin wax, paraffin wax, sperm-oil and spermaceti. Vegetal waxes, Animal waxes, specifications

Unit 2:Synthetic waxes:

Esters, Paraffin Wax, properties,specifications composition, properties, testing, evaluation and Industrial applications, Candle-making, Microcrystalline waxes - properties, specifications Industrial and Applications, compounded waxes.

Unit 3: Technology of Drying oils:

Chemistry, Thermal and chemical modification methods; Properties and uses, drying, semi drying oils, yellowing of oils : modified oils like heat treated oils, Malenized oils, Co-polymerized oils, dehydration, isomerised oils, segregated, reconstituted oils.

Unit 4: Castor oil Derivatives:

Processing, Formulation and Testing, DCO- Synthesis, Manufacturing and Purification of Sebacic acid and 2- octanol, use as Plasticizer. Polyester Lubricants based on Sebacic acid, Manufacturing and Applications. Hydrogenated castor oil, it's uses, Castor oil based urethanes – synthesis and uses, Acetylated castor oil and Miscellaneous derivatives, Sulphated castor oil, Turkey red oil, Manufacturing, Derivatives, Applications.

Unit 5:Fat Based Products:

Industrial lubricants. Bio Lubricants,Lubricant additives, Plasticizers, biodiesel, Lubricating Greases, Manufacture, Properties, types, ingredients, additives, analysis.Fatty Alcohols and Amines.

Unit 6: Uses of Fats and Oils:

Leather, Textiles , linoleum, rubber, Factices, protective coatings , food , pharmaceutical, explosives, paper, cosmetics surfactants , water proofing and water repellant industries,

LIST OF REFERENCE BOOKS

1. Paint Technology Manuals. Oil and color chemists Association, Vol-I – Vol. VIII,Chapman and Hall – 1972.
2. Outline of paint technology, W.M. Morgans, Edward Arnold Publishers, London – 1990
3.Mills, M. R., "An Introduction to Drying 0il Technology,"Interscienee Publishers Inc., New York,
4. Introduction to paint chemistry – Principles of paint technology,Turner GPA, Chapman and Hall ,
5.Paint and surface coatings, theory and practice, LambourneR.EllisHorwood Ltd. Publisher – 1987.
6.American Oil Chemists' Soc. "Drying Oils," ShortCourse Lectures, American Oil Chemists' Soc. Chicago,Ill.USA.
7. Castor oil Derivatives, SBP Publications, New Delhi

BTCHT803T/3 Petroleum Refining and Petrochemical Technology- VII
(BCHT) (Petrochemical Process Design)

Unit 1: Oxidation of naphthalene to phthalic anhydride, parametric sensitivity, kinetics, thermodynamics, simple and complex models, and fluidized bed reactor vs fixed bed operations.

Unit 2: Parallel and consecutive reactions, Chlorination of paraffins and aromatics, Acetylene Manufacture, kinetic models, thermodynamics, manufacture of glycols and amines in CSTR and plug flow reactors, their comparison, effect of reactant ratio on product distribution in different reactors.

Unit 3: Oxo reaction, economic justification, kinetic models with different catalysts, control of straight chain to branched chain olefins, effect of olefin structure on reaction rate, engineering problems in reactor design, process design aspects with a flow scheme.

Unit 4: Reversible exothermic reactions, their important features, manufacture of ammonia, types of commercial reactors used for ammonia synthesis, kinetics and thermodynamics of ammonia formation, optimum temperature profiles achieved in industrial reactors.

Unit 5: Alternative energy sources, coal, biogas, biomass, alcohol. Synthetic fuels from coal by hydrogenation, solvation & coal oil processing.

Unit 6: Integrated coal-oil refinery, coal based hydrocarbons upgraded to suit as petroleum fuels; Incineration to produce energy.

The paper is to be taught with necessary mathematical treatment and numerical problems illustrating the physico chemical and chemical engineering principles, process equipment design etc, Pertaining to the topics in petrochemical industries.

Books Recommended:

1. Chemical Engineering Process Analysis, A.M.Mearns.
2. Chemistry of catalytic processes,B.C.Gates,J.R.Katzer and G.C.A.Schuit.
3. Chemical Reactor Design and Process Plants, vol I and II, H.F.Rase.
4. Equipment Design hand book for Refineries and Chemical Plants,F.L.Evans.
5. Applied Process Design for Chemical and Petrochemical Plants vol I, II and III, E.E.Ludwig.
6. Hand Book of Petroleum Refining Process, Robert. A.Meyers,2nded, Mc Graw Hill Book Co,1997.
7. Non Conventional Energy Sources, G. D. Rai.
8. Fuels, W. Francis & M. C. Peters.

BTCHT803T/4 Pulp and Paper Technology-VII
(BCHT) (Paper & Board manufacture-II)

Unit 1: Cylinder mold type paper making machine, Sheet forming mechanism, different types of vats, cylinder and Fourdrinier machines comparison, combination of cylinder and Fourdrinier machines, cylinder machine products, single cylinder wet board making machine, multicylinder paper board making machine

Unit 2: Vat stock entry, web formation, factors affecting the quality of web, drainage through cylinder mold, machine head box, cylinder vacuum, modern web forming devices

Unit 3: Process utilities in pulp and paper industry, steam, power, air, water, energy management, utilization and conservation, application of humidity saturation, paper machine drives

Unit 4: Comparison of a chemical recovery furnace with that of a standby furnace in pulp and paper mill, use of different fuels and their combustion techniques, flue gas utilization, black liquor gasification

Unit 5: Use and application of pumps, compressors, blowers ventilators, refrigerating units in pulp and paper industries. Stock chests, overall economical considerations of pulp and paper mills.

Unit 6: Process control and instrumentation in mills, maintenance, instruments specifications, on line measurement and control of parameters computer applications in pulp and paper industries, Total Quality Management

Books recommended:

1. Pulp and Paper Science & Technology Vol. I & II by C. E. Libby
2. Pulp & Paper Manufacture Vol. I, II, III by Mac Donald
3. Hand Book of Pulp and Paper Technology by K.W. Britt 2nd edition.

BTCHT 803T/5 Plastics & Polymer Technology VII
(BCHT)

Unit 1: Functions of packaging, advantages of plastic packaging, special requirements of polymeric materials and their selection for medical and food packaging specially for raw and processed foods, Meat, Fish, Poultry, Eggs, Milk and Dairy products, Fruits and vegetables, Cereal grains and Baked food products, Beverages, Snacks, Ready to eat food. Prevention of Food Adulteration Act (PFA)

Unit 2: Packaging legislations and regulations, distribution hazards, Economics of packaging, Specialty packages-Bottle, Strip, Skin, Blister, Shrink, Stand up pouch, Box, Tetra. Flexible packaging: Evaluation of seals in flexible packages, advantages of flexible packaging, flexible packaging products. Rigid packaging: Skin Packaging, Blister packaging, Thermoforming fill-seal.

Unit 3: Coating - definitions and general classifications, paints, varnishes and lacquers, mechanism of film formation, classification of oils, semi drying and non-drying oils, chemical properties of oils, introduction to pigments & dyes, organic and inorganic

pigments, pigment volume concentration, critical pigment volume concentration, objectives of paints , basic formulations of various types of paints.

Unit 4: Additives - dispersing agent, emulsifier, anti settling agent, biocides, antifoams, corrosion inhibitors, U.V. and light stabilizers, antioxidants, driers - constitution, active & auxiliary, primary and secondary; surface & through driers, solvents - properties of solvents, solvent (cutting) power, rate of evaporation, water as coating solvent, various steps in paint manufacture, phenomenon of mixing, soaking, wetting, grinding, dispersion and stabilization.

Unit 5: Standard specifications and test methods, test on liquid paints, density, dispersion, viscosity, consistency, application of films, spreading capacity, wet opacity, dry hiding, spreading time, drying time, wet and dry film thickness, optical properties, color, gloss, haze & clarity, opacity, orange peel, transparency, hiding power, mechanical properties, electrical resistance properties, environmental resistance and ageing properties of coatings, analysis of paints and varnishes.

Unit 6: Adhesives: Theories of adhesion, wettability, pressure sensitive adhesives, hot melt adhesives, solvent & emulsion based adhesives, guidelines for good adhesion, advantages & disadvantages of using adhesive bonding over conventional joining techniques, basic principle of adhesives formulation, techniques for evaluation of adhesives, mechanical testing of adhesive bonding, chemistry and uses of adhesives, properties and testing of adhesives. (as per ASTM standards), tack, viscosity, cure time, etc.

Reference Books

1. Understanding Plastic Packaging Technology, Susan E.M. Seleke, Hanser publications – Munich, 1st Edition, 1997.
2. Plastics in Packaging, A.S. Althalye, Tata McGraw–Hill publishing Co. Ltd., New Delhi, 1st Edition, 1992.
3. Food Packaging Technology Hand Book, NIIR, Asia-Pacific publication, 1st Edition, 2012
4. Package Engineering, Honlon J F, McGraw Hill, 1st Edition, 1984
5. Plastics Packaging, Turtle Ivor, Pira International, 1st Edition, 1990.
6. Handbook of Packaging-Plastics, A.S. Altalye, multi-tech publishing co.Mumbai, 1st Edition, 2013
7. Organic Coating Technology, Volume I, by Henry Fleming Payne, John Wiley & Sons, 1954.
8. Surface Coatings, Volume I, by OCCA Australia (Prepd.), Chapman and Hall, 1983.
9. Outlines of Paint Technology, III Ed. By W. M. Morgans, Edward Arnold, 1969
10. Surface coatings: Science and Technology, by Swaraj Paul, John Wiley and Sons, 1985
11. Organic Coatings: Science and Technology, Volume I, by Z. W. Wicks, F. N. Jones and S. P. Pappas, Wiley-Interscience, 2007.
12. Basics of Paint Technology, Part I & II, by V. C. Malshe&MeenalSikchi, 2002.
13. Datta P.K. &Gray J.S. Surface Engineering Vol. I Fundamentals of coatings. Royal Society of London, 1993.
14. Datta P.K. &Gray J.S. Surface Engineering Vol. II Fundamentals of coatings. Royal Society of London, 1993.
15. Datta P.K. &Gray J.S. Surface Engineering Vol. III Fundamentals of coatings. Royal Society of London, 1993.
16. Skeist, Irving, Handbook of Adhesives, Van Nostrand, New York, 3rd edition, 1990.

BTCHT 803T/6 Surface Coating Technology – VII
(BCHT) (Technology of Powder Coatings & Industrial Paints)

Unit 1: Architecture finishes, formulation and methods for manufacture of paints for exterior and interior house design, paints for wood interior and exterior, formulation for plaster and wallboard coatings, exterior emulsion paints for masonry, interior and exterior enamels.

Unit 2: Industrial finishes, formulation and methods of manufacture for clear finishes for wood, furniture, metal goods, overprint finishes, automotive finishes, Lacquers for wood, metal and decorative finishes.

Unit 3: History of powder coatings, Comparison of powder coatings with solvent based coatings. Pretreatment equipment and power application equipments, Manufacture of powder coatings, Working of Buss Extruder.

Unit 4: Raw materials for powder coatings composition based on Epoxy, Polyester, Urathane and Acrylics, Flow agents and other additives for powder coatings, Selection of pigments and extenders for powder coatings, Causes and remedies for paint film defects.

Unit 5: Marine paints, formulation and methods of manufacture of coatings for ships, ship bottoms, seaside structures, hulls, Water thinnable coatings, Their importance and comparison with solvent based paints.

Unit 6: Speciality coatings, wrinkle finishes, hammer finishes, multicolour finishes, flock finishes, paper coatings, textile coatings, coatings for plastics, Traffic paints, formulation and method of manufacture of paints for traffic signs, bituminous coatings.

Books Recommended:

1. Payne, H.F., "Organic Coating Technology" Volume one, John Wiley & Sons, New York, 1954.
2. Payne, H.F., "Organic Coating Technology" Volume Two, John Wiley & Sons, New York, 1954.
3. Matellio, J.J., "Protective and Decorative Coatings" Volume Three, John Wiley & Sons.
4. Durrans, T.H., "Solvents" D. Van Nostrand Co., New York, 1950.
5. Oil, Colour Chemists; Association, "Paint Technology Mannuals", Vol 2.
6. Oil, Colour Chemists; Association, "Paint Technology Mannuals", Vol 3.
7. Oil, Colour Chemists; Association, "Paint Technology Mannuals", Vol 4.
8. Lehr, W.D., "Powder Coating Systems", McGraw Hill Inc., N. Y. 1991.

Subject: BCHT803T(BCHT) **Special Technology- VIII (Theory)**
Lecture: 3 Hours No. of Credits: 4
Tutorial: 1 Hour University: 80 Marks
Duration of Examination: 3 Hours College Assessment: 20 Marks

BCHT 803T/1 FOOD TECHNOLOGY VIII
(BCHT) (BIOTECHNOLOGY)

Unit1: Screening of microorganisms for biotechnological processes. Introduction to r-DNA technology, and its applications.G M foods.and biotech crops.

Unit 2: PRODUCTION OF BIOMASS: Production of bakers yeast, starter cultures, algae, mushrooms & single cell proteins from different substrates.

Unit3: PRODUCTION OF ORGANIC CHEMICALS: Production of industrial alcohol, acetic acid, citric acid, vinegar and Acetone Butanol by fermentation.

Unit 4: PRODUCTION OF SECONDARY METABOLITES: Production of antibiotics, enzymes, polysaccharides, flavours& fragrances, Introduction to tissue culture.

Unit 5: FERMENTED FOODS: Types of food fermentations.

PROCESS TECHNOLOGY OF ALCOHOLIC BEVERAGES: Types of alcoholic beverages. Raw material, fermentation & processing of alcoholic beverages. Modern brewing technology

ORIENTAL FERMENTED FOODS: Soya sauce, Tofu, Tempeh, Idli, dosa, etc.

Unit6: INDUSTRIAL WASTE MANAGEMENT: Waste utilisation& disposal in food industry. Aerobic treatment of wastewater.Biomethanation.Byproduct recovery and value addition to the food industry waste.

BOOKS RECOMMENDED:

1. Industrial Microbiolgy by Casida L.E., John Wiley & Sons Inc New york, 1964.
2. Industrial Microbiology by Presscot& Dunn, McGraw Hill Book Co. Inc. New york, 1940.
3.BiotechnologyB.D.SinghKalyani Publishers ,Ludhiana,1999

Reference

1. Industrial fermentation vol 1&2 by Underkoffler L.A., Chemical publishing Co. Inc. 212, Fifth Avenue, New york, 1954.
2. Microbial Technology vol 1 & 2 by Peppler.
3. Biotechnology : Food Fermentations Ed. VK Joshi , Ashok Pandey Educational Publishers and Distributors , New Delhi 1999

BCHT 803T/2 Oil Technology VIII (Theory)
(BCHT) (Technology of Paint, Resin and Inks)

Unit 1:Technology of Paints: Definition, ingredients, Formulation,manufacture,machinery. Principles of paint formulations and testing, varnishes and lacquers,primers, undercoats and finish coats. Manufacture, classification and types of powder coating.Sketches of the machinery used. Manufacture of different types of wall finishes.

Unit 2: Technology of Pigments and Extenders : Definition, classification ,Sources, properties, manufacture, testing and evaluation of pigments, preparation and uses of important pigments such as White,yellow,black, blue, green and red pigments, Metallic pigments, Natural organic pigments, comparison of organic pigments,Extenders:- Sources, manufacture, properties and uses,, recent developments.

Unit 3: Convertible and Non-convertible coatings: Natural Resins -Classification, composition, Rosin and shellac, properties, Processing and application in surface coatings.Oleoresins,Recovery of resin and turpen tine,

Unit 4: Convertible and Non-convertible coatings: Synthetic Resins - Chemistry and manufacture of Alkydresins , raw materials, chemistry, formulation and its application. amino resins, urea formaldehyde, epoxy resins, various epoxy modified resin and their application, water soluble epoxies, polyamide resin, amino resins, chlorinated rubber, vinyl resins with special reference to acrylics. Polyurethanes, classification, properties and application

Unit 5: Solvents and General Paint Properties: Hazards and precautions. Diluents, thinners, lacquers-Types, general properties, classification, evaluation of solvents, solubility parameters. Safety measures for coatings, ISI methods of testing of paints, specialty paints, paint film defects, recent developments. Industrial Formulation and Applications of paints

Unit 6: Technology of Printing Inks: Classification, raw materials, manufacture, machinery, formulations and evaluation.Plants and processes employed. Driers,types , functions, and mechanism.

LIST OF REFERENCE BOOKS

1. Protective and Decorative Coatings, Paint, Varnishes, Lacquers, and Inks, Mattiello, J. J., John Wiley and Sons, New York.
2. Organic Coating Technology Vol, 1 & 11 by, Payne, H.Y.
3. Paint Technology Manuals., Oil and color chemists Association, Vol-I – Vol. VIII, Chapman and Hall , London
4. Pigment Hand book Vol. 1 – Vol. VIII,. Patton, T. C., Wiley-Inter science Publications,New York.
5. The Testing of Paints, Vol – V, Paint Technology Manual,.Dunkley F.G. and Collier, C.W., Chapman and Hall.London
6. Paint film defects and their remedies, Manfred, H., Chapman and Hall Ltd. London.
7. Introduction to paint chemistry – Principles of paint technology, Turner G.P.A.,, Chapman and Hall , London
8. Outline of paint technology, Morgans, W.M. Edward Arnold Publishers, ,London
9. OCCA Surface Coating Technology Vol, 1 & 11
10. Printing inks: their chemistry and technology - Ellis, C. ,New York

BTCHT804T/3 Petroleum Refining and Petrochemical Technology- VIII
(BCHT) (Reactor Design & Catalysis)

Unit 1: Solid catalysts used in petroleum refining and petrochemical processes, methods of preparation, important properties and their evaluation, theories of heterogeneous catalysis, bifunctional and phase transfer catalysts. Role of adsorption in catalysis and its rates, development of kinetic models for rate processes.

Unit 2: Theories of deactivation, role of catalyst deactivation, the chemical nature of deactivation, deactivation of a pellet, effect on selectivity, time on stream theory, regeneration kinetics of catalyst deactivation. Performance of catalytic reactors under conditions of deactivation.

Unit 3: Heat and mass transfer effects in packed bed catalytic reactors; concept of effectiveness factor and its determination; effective thermal conductivity; role of diffusion and allied problems in catalysis.

Unit 4: Concept of fluidization, properties of fluidized bed, use of fluidized bed as a chemical reactor Design of fluidized bed reactor, basic considerations, bubble phase, emulsion phase, gas mixing in the phase, different models, heat and mass transfer effects, design of distributer and entrainment.

Unit 5: Fluidized bed reactor design for a deactivation catalyst (with complex reactions), bubble diameter and reactor internals, practical considerations and strategy for reactor design and development, variations in designs in fluidized bed reactors, multi stage, packed and fast fluidized bed reactors, transport reactors and moving bed reactors, circulating fluidized bed reactors.

Unit 6: Basic concepts and characteristics of slurry bed and trickle bed reactors, different flow regimes, Heat and mass transfer effects, catalyst ageing and fluid flow problems, applications to design of Hydrodesulphurization and Hydrocracking reactors used in Petroleum refining industry.

Books Recommended:

1. Heterogeneous Reactions, Analysis, Examples and Reactor Design, L. K. Doraiswamy and M. M. Sharma.
2. Catalysis and Chemical Processes, R. Pears and W. R. Patterson.
3. Chemical Reactor Design Practice, I.M.Rose.
4. Chemical and Catalytic Reaction Engineering, C.C.Carberry.
5. Catalyst Deactivation, Eugene E.Peterson and A.T.Bell.
6. Deactivation and Poisoning of catalysts, Jacques Oudar and Henry Wise.
7. Catalyst Poisoning, L. L. Hegedus and R.W.Mccabe.
8. Chemical Reactor Design and Process Plants, Vol I and II, H.F.Rase.

BTCHT804T/4 Pulp and Paper Technology – VIII
(BCHT) (Surface treatment, finishing, Analysis, Testing, Pollution abatement)

Unit 1: Surface treatment of paper, objective, process for surface sizing and treatment, surface sizing materials, coating, calendering, winding, reeling, wrapping and rewinding, supercalendering and embossing

Unit 2: Specialty papers, hand made papers, insulating board, hard board, recent developments in paper and board manufacture,

Unit 3: Analysis and testing, test requirements, equipments, analysis of pulp wood, wood pulp, paper and converted products,

Unit 4: Pollution abatement in Pulp and paper mills, sources of pollution, soli waste treatment and disposal

Unit 5: Water treatment in pulp and paper mills, water for process streams, boiler feed water, water from different parts of the mill, white water reclamation, physical, chemical and biochemical methods of treatment of waste water

Unit 6: Air pollution, sources, methods of treatment, control, pollution free pulping, Microbiology of wood, pulp, wet felts, water & stream pollution, slime, sulfite spent liquor, food packaging.

Books recommended:

1. Pulp and Paper Science & Technology Vol. I & II by C. E. Libby

2. Pulp & Paper Manufacture Vol. I, II, III by Mac Donald

3. Hand Book of Pulp and Paper Technology by K.W. Britt 2nd edition.

BTCHT 804T/5 Plastics & Polymer Technology VIII
(BCHT)

Unit 1: Polymer blends terminology, compatibility and miscibility, significances of blends over conventional polymers, difference between blends and composites, thermodynamics and characteristics of polymer blends, steps involved in designing of a blend, classification of polymer blends, compatibilizer, polymer alloys, methods of compatibilization.

Unit 2: Rheological properties of polymer blends, rheological criteria, interfacial criteria, synergy & additivity, effect of interaction parameters on properties, phase structure development in polymer blends UCST and LCST, study of factors affecting the morphology of polymer blends Introduction of IPN, Types of IPN, Methods of preparation of IPN & their Applications

Unit 3: Commercial polymer blends and their applications with case studies such as Polyolefin blends, Styrenic blends, Vinyl resin blends, Acrylic blends, Elastomeric blends, Polyamide blends, Polycarbonate blends, Polyoxymethylene blends, Polyphenyleneether (PPE) blends, Thermoplastic polyester blends, Specialty polymer blends and Thermoset blend systems.

Unit 4: Composites: Indroduction, classification, advantages & disadvantages of polymer composites, selection criteria for material, reinforcement and process. Reinforcement, glass fibre, carbon fibre, graphite fibre, aramid fibre, organic fibres, boron & silicon fibres, reinforcement/matrix interactions.

Unit 5: Manufacturing Processes: Sheet Moulding Compound (SMC), Dough Moulding Compound (DMC), Bulk Moulding Compound (BMC), Prepeg, Hand layup, Spray layup, Vacuum bagging, Filament winding, Pultrusion, Resin transfer moulding, Resin injection moulding, Sheet manufacturing, Centrifugal casting, Sandwich construction

Unit 6: Polymer Nano-Composites (PNC):Definitions, classification of nanoparticles, layered nanoparticles, (Clay), fibrillar nanoparticles (carbon nanotubes (CNTs) etc.) and other nanoparticles, polymer clay nano-composites (PCNC), preparation steps - intercalation, exfoliation**,** PNC based on CNTs for electrical conductivity, CNTs - thermoset matrix, CNTs -thermoplastic matrix, comparison of PNC with normal composites based on composition, mechanical, thermal, rheology, morphology & process parameters.

Reference books:

1. Polymer blends handbook, L. A. Utracki, Kluwer Academic Publishers, 2002.
2. Polymer Blends A Comprehensive Review; Lloyd M. Robeson; Hanser Publication, 2007.
3. Polymer Blends; D. R. Paul & Seymour Newman, Vo. 1 & 2, Academic Press, New York, 1978.
4. Advance in Polymer Blends & Alloys Technology by MalvynKohudic, Technomic® publication, 1988.
5. Plastics Materials J. A. Brydson, Butterworth Scintific, 1990.
6. Fibre Reinforced Composites, P. K. Malik, Marcel Deckar, 1988.
7. Analysis and Performance of Fiber Composites, 3rd edition, Bhagawan D. Agarwal, Lawrence J. Broutman, K. Chandrashekhara, John Wiley & Sons Inc, 2006
8. Polymer composites, Brainstrong, Sci-Tech Books.
9. Polymer Composites, Alan J. Lesser, Volume 36, 2015.

BTCHT 804T/6 Surface Coating Technology – VIII
(BCHT) (Technology of Printing Inks and Other Coatings)

Unit 1: History of printing industry, types of printing processes, introduction of printing press, lithographic process, offset and litho-offset processes, intaglio and gravuer processes, photogravure processes, single and multicolour printing processes.

Unit 2: Machinery for various printing proesses, Characteristics of inks required for various processes, types of substrate for printing, number of impressions, mode of drying, offset.

Unit 3: Manufacture of varnishes for printing inks, composition of raw materials, oils and resins used in formulation and their proportions. Additives for printing inks, driers, waxes, tack and non tack agents, solvents.Formulation of printing inks, selection of pigments and binders/vehicles, solvents, driers, resins, and additives for various process inks.

Unit 4: Formulation of letter press inks, offset press inks, lithograpghic inks, photogravure inks, screen printing inks, Flexographic inks, high gloss inks, specialty inks, inks for bank notes, Type writer and duplicating paper inks, textile inks.

Unit 5: Manufacture of Printing inks, Types of machinery used, sampling of inks for record and testing, Ink troubles and remedies, printing defects.

Unit 6: Testing of printing Inks. and Modern development in printing Inks.

Books Recommended:

1. Mertle, J.S., and Mosen, Gorden, "Photomechanics and printing", Oxford and IEH Publishing House Calcutta 1969.
2. Woulfe H. J. "Printing and Lithographic Inks", MacNair Dorland Co., N. Y.

Subject : BTCHT805P **Special Technology IV (Practical)**
Practical : 6 Hours No. of Credits : 4
University : 50 Marks College Assessment : 50 Marks
Duration of Examination: 6 Hours

BTCHT805P/1 FOOD TECHNOLOGY PRACTICAL IV (FOOD ANALYSIS)

Analysis of wheat flour, tea, coffee, cocoa, milk, honey.Analysis of pectin, shortenings, food additives. Identification of dyes

Quality control of Bread, biscuits, cake, extruded products, protein concentrates. Fruit juices, squashes, jams, jellies, concentrates, pickles, canned fruit products. Milk products like cheeses, paneer, shreekhand. Milk powder, Confectionary products, Alcholic beverages & soft drinks.

BOOKS RECOMMENDED:

1. The analysis of foods & food products by Jacob M.R., D. Van Nostrand Co. Inc. Princeton, New jersey, New york, 1958.
2. The Chemical analysis of foods by Pearson D., J.E.A. Churchill, 104, Goucester place, London, Sixth edition, 1970.
3. Manual of analysis of fruits & vegetable products by Ranganna S., Tata McGraw Hill publishing Co. New Delhi.
4. Official Methods of Analysis of the association of Official Analytical chemists, Pub. Assoc. Office, Anal chemists, Washington D.C. 11th Edition, 1970.

BTCHT805P/2 OIL TECHNOLOGY-IV (Analysis)

1. Analysis of soaps
2. Analysis of acid oils and soap stocks
3. Analysis of metallic soaps
4. Analysis of spent bleaching earths
5. Analysis of Glycerin (sweet water)
6. Analysis of detergent powders
7. Analysis of essential oils
8. Analysis of waxes
9. Analysis of paints
10. Analysis of cosmetic products
11. Analysis of lubricating greases

BTCHT805P/3 Petroleum Refining and Petrochemical Technology – IV (Chemical Reaction Kinetics)

1. Study of thermal cracking of a petroleum fraction in a tubular flow reactor.
   1.1 Calibration of Thermocouple.
   1.2 Determination of temperature profile of tubular flow reactor.
   1.3 Calibration of a flow meter.
   1.4 Feed and product characterization.
2. To study Residence Time Distribution (RTD):
   2.1 RTD in a continuous flow stirred tank reactor
   2.2 RTD in a tubular flow reactor
3. To study Kinetics of hydrolysis:
   3.1 Methyl and ethyl acetate system in a batch reactor.
   3.2 Methyl and ethyl acetate system in a Tubular Flow Reactor (TFR).
   3.3 Energy of activation of a hydrolysis reaction
4. To study Saponification Reaction:
   4.1 In a batch reaction
   4.2 In a Continuous Stirred Tank Reactor.
   4.3 In a Tubular Flow Reactor.
5. Sulphonation of Alkyl Benzene to get acid slurry and neautralisation of acid slurry to get detergent type mixture.
6. To study Chlorination reaction:
   6.1 Chlorination of benzene by photochemical reaction to observe yield versus time for definite intensity of UV light.
   6.2 Liquid phase chlorination of petroleum oil to analyze chlorine content with the extent of reaction.
7. To study coking reaction for the comparison of yield of coke & other products.
   7.1 With additive such as Iron Oxide.
   7.2 Without any additive

BTCHT805P/4 Pulp and Paper Technology – IV (Processing)

1. Collection, grading sorting, and storage of various raw materials.
2. Proximate analysis of raw materials.
3. Pulping of different fibrous materials.
4. Washing, cleaning and bleaching of pulp.
5. Stock preparation.
6. Standard sheet making and analysis.
7. Physical, optical and chemical testing of various paper and board samples.
8. Determination of BOD, COD, SS in effluents from pulp and paper mills.
9. Analysis of cooking and spent liquors usedin pulp and paper industries

Books recommended:

1. TAPPI Standards USA
2. Pulp and Paper Science & Technology Volume I & II by C.E.Libby

3. Pulp & Paper Manufacture Volume I, II, III by Mac Donald
4. Hand Book of Pulp and Paper Technology by K.W. Britt 2nd edition

BTCHT 805P/5 Special Technology IV (Practical)
(Plastics& Polymer Technology IV)

1. Preparation of Polystyrene (PS) by suspension Polymerization.
2. Preparation of Poly butyl acrylate Emulsion.
3. Preparation of copolymer of Butyl acrylate and Methyl Methacrylate by emulsion polymerization technique.
4. Preparation of Butyl acrylate, Methyl methacrylate, Ethyl acrylate and Acrylic Acid copolymer by emulsion polymerization for coating application.
5. To prepare a high glossy architectural acrylic paint.
6. To compare the preparation of polystyrene by bulk and solution polymerisation.
7. To prepare the Polyester resin terminated with – OH group.
8. To prepare the Polyester resin terminated with – COOH group.
9. Synthesis of Epoxy resin.
10. Analysis of Epoxy resin.
11. Preparation of Polyurethane resin.

BTCHT 805P/6 SURFACE COATING TECHNOLOGY – IV

Analysis of paint and allied products

1. Analysis of resins for Acid value, Hydroxy value % solids, Viscosity, Drying, Adhesion, Hardness and resistance characteristics. Molecular weight distribution of resins.
2. Analysis of Red oxide zinc chrome primer as per the IS specification.
3. Analysis of Zinc chrome primer as per the IS specification.
4. Analysis of Aluminum paint as per the IS specification.
5. Analysis of Etch primer as per the IS specification.
6. Analysis of Synthetic enamels as per the IS specification.
7. Analysis of General purpose air-drying paint as per the specification.
8. Analysis of Emulsion paint as per the IS specification.
9. Analysis of Zinc silicate primer as per the IS specification.
10. Analysis of Powder coatings as per the IS specification.
11. Analysis of Printing Ink as per the IS specification

12. Sophisticated analysis of synthetic enamels, Industrial paints and powder coatings corrosion resistance, gloss retention, salt spray test. Crosscut adhesion test and use of modern equipment in paint analysis.

Subject : BTCHT806P **Project**
Practical : 6 Hours No. of Credits : 4
University : 100 Marks College Assessment : 100 Marks
Duration of Examination: 6 Hours

BTCHT806PProject Work/Dissertation
(BCHT)

The project work shall consist of dissertation/ experimentation, fabrication, testing of equipment; process designing in depth; review of certain research work; compilation and analysis of certain engineering/ management activities, phenomenon, designing, drawing and prototype modelling of certain equipment, instrument and testing thereof, etc. on any topic which may have importance in respective technology.

The report shall be a bound journal written in technical format with illustrations by graphs, charts, photographs, etc. about the specific work undertaken by the student. Maximum two students may work on the same project.

The number of copies of the report shall be such that the examiner, the departmental library and the concerned students shall have one copy each.