

B.TECH. LEATHER TECHNOLOGY

CURRICULUM

❖ Third Semester

3A. Theoretical Papers:						
COURSE NO.	COURSE TITLE	L	T	P	C	
LT 301	Biochemistry of Proteins	4	0	0	4	
LT 302	Principles of Pre-Tannage	4	0	0	4	
LT 303	Theory of Pre-Tanning Materials	4	0	0	4	
LT 304	Analytical Chemistry of Pre-Tanning Materials	3	0	0	3	
LT 305	Biotechnology of Leather Manufacture	4	0	0	3	
LT 306	Chemical Engineering	3	0	0	3	
TOTAL OF THEORETICAL PAPERS		22	0	0	21	
3B. Practical Papers:						
LT 391	Analytical Chemistry of Pre-Tanning Materials	0	0	3	2	
LT 392	Biotechnology of Leather Manufacture	0	0	3	2	
LT 393	Chemical Engineering	0	0	3	2	
LT 394	Applied Information Technology	0	0	3	2	
TOTAL OF PRACTICAL PAPERS		0	0	12	8	
TOTAL OF SEMESTER		22	0	12	29	

❖ Fourth Semester

4A. Theoretical Papers:						
COURSE NO.	COURSE TITLE	L	T	P	C	
LT 401	Principles of Inorganic Tannage	4	0	0	4	
LT 402	Methods of Leather Manufacture-I	3	0	0	4	
LT 403	Analytical Chemistry of Tanning Agents	4	0	0	4	
LT 404	Environmental Science of Tannery Effluent	3	0	0	3	
LT 405	Principles of Organic Tannage	4	0	0	3	
LT 406	Mechanics of Leather Machines-I	3	0	0	3	
TOTAL OF THEORETICAL PAPERS		21	0	0	21	
4B. Practical Papers:						
LT 491	Waste Water Analysis-I	0	0	3	2	
LT 492	Analytical Chemistry of Tanning Agents	0	0	3	2	
LT 493	Methods of Leather Manufacture-I	0	0	3	2	
LT 494	Mechanics of Leather Machines-I	0	0	3	2	
TOTAL OF PRACTICAL PAPERS		0	0	12	8	
TOTAL OF SEMESTER		21	0	12	29	

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❖ Fifth Semester

5A. Theoretical Papers:					
COURSE NO.	COURSE TITLE	L	T	P	C
LT 501	Principles of Post-Tanning Operations	4	0	0	4
LT 502	Methods of Leather Manufacture-II	4	0	0	4
LT 503	Analytical Chemistry of Post Tanning & Finishing agents	3	0	0	3
LT 504	Theory of Accountancy and Costing	3	0	0	3
LT 505	Instrumental Methods of Chemical Analysis	3	0	0	3
LT 506	Waste Water Engineering	3	0	0	3
TOTAL OF THEORETICAL PAPERS		20	0	0	20
5B. Practical Papers:					
LT 591	Analytical Chemistry of Post Tanning & finishing agents	0	0	3	2
LT592	Instrumental Methods of Chemical Analysis	0	0	3	2
LT 593	Waste Water Analysis-II	0	0	3	2
LT 594	Methods of Leather Manufacture-II	0	0	3	2
LT 595	Methods of Leather Manufacture-III	0	0	3	2
TOTAL OF PRACTICAL PAPERS		0	0	15	10
5C. Sessionals:					
LT 591	Industrial Training	0	0	0	2
TOTAL OF SEMESTER		20	0	15	32

❖ Sixth Semester

6A. Theoretical Papers:					
COURSE NO.	COURSE TITLE	L	T	P	C
LT 601	Principles of Leather Finishing	4	0	0	4
LT 602	Methods of Leather Manufacture-III	3	0	0	3
LT 603	Analytical Chemistry of Leather	3	0	0	3
LT 604	Footwear and Leather Goods Technology	3	0	0	3
LT 605	Exotic Leather & By-products Manufacture	4	0	0	4
LT 606	Computer Aided Engineering Graphics	3	0	0	3
	Elective-I	3	0	0	3
TOTAL OF THEORETICAL PAPERS		23	0	0	23
6B. Practical Papers (Project Oriented):					
LT 691	Computer Aided Engineering Graphics	0	0	3	2
LT 692	Analytical Chemistry of Leather	0	0	3	2
LT 693	Footwear and Leather Goods Technology	0	0	3	2
LT 694	Fashion Designing	0	0	3	2
TOTAL OF PRACTICAL PAPERS		0	0	12	8

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6C. Sessionals:					
LT 691	Seminar	0	3	0	2
TOTAL OF SEMESTER		23	3	12	33

❖ Seventh Semester

7A. Theoretical Papers:					
COURSE NO.	COURSE TITLE	L	T	P	C
LT 701	Economics of Leather Industry	3	0	0	3
LT 702	Applied Statistics and Quality Control	3	0	0	3
LT 703	Physical Testing of Leather	3	0	0	3
LT 704	Mechanics of Leather Machines-II	3	0	0	3
LT 705	Thermodynamics	3	0	0	3
	Elective-II	3	0	0	3
TOTAL OF THEORETICAL PAPERS		18	0	0	18
7B. Practical Papers (Project Oriented):					
LT 791	Physical Testing of Leather	0	0	3	2
LT792	Mechanics of Leather Machines-II	0	0	3	2
LT793	Exotic Leather Manufacturing Methods-I	0	0	3	2
LT794	Exotic Leather Manufacturing Methods-II	0	0	3	2
TOTAL OF PRACTICAL PAPERS		0	0	12	8
7C. Sessionals:					
LT 791	Technical Seminar	0	3	0	2
LT792	Industrial Training	0	0	0	3
TOTAL OF SESSIONALS		0	3	0	5
TOTAL OF SEMESTER		18	3	12	31

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❖ Eighth Semester

8A. Theoretical Papers:					
COURSE NO.	COURSE TITLE	L	T	P	C
LT 801	Polymer Science & Technology	3	0	0	3
LT 802	Industrial Management & Accreditation planning	3	0	0	3
LT 803	Plant Layout and Project Formulation of Tannery	3	0	0	3
TOTAL OF THEORETICAL PAPERS		9	0	0	9
8B. Practical Papers:					
LT 891	Major Project	0	0	18	12
LT 892	Open Seminar on Industrial Activities	0	0	0	6
LT 893	Comprehensive <i>Viva Voce</i>	0	0	0	6
TOTAL OF PRACTICAL PAPERS		0	0	18	24
TOTAL OF SEMESTER		9	0	18	33

❖ List of Elective Subjects

COURSE NO.	COURSE TITLE	L	T	P	C
For Sixth Semester:					
Elective I					
LT 607	Quantum Mechanics	3	0	0	3
LT 608	Photochemistry of Leather Auxiliaries	3	0	0	3
LT 609	Safety & Occupational Health Hazard of Leather Industry	3	0	0	3
For Seventh Semester:					
Elective II					
LT 706	Industrial Sociology	3	0	0	3

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LT 707	Industrial Psychology & Organisational Behaviour	3	0	0	3
LT 708	Ecological Engineering & Eco-audit	3	0	0	3
LT 709	Advanced Bio-Technology of Leather	3	0	0	3

LT 301

BIOCHEMISTRY OF PROTEINS

4 - 0 - 0 - 4

- 01. Fundamentals of Biochemistry:** The molecular logic of life, strong and weak interactions, introductory concept of cell, bio-molecules and water.
- 02. Chemistry of Bio-molecules:** Chemical composition and bonding, 3-D structure – configuration and conformation, chemical reactivity, macromolecules and their monomeric subunits, prebiotic evaluation.
- 03. Water:** Electronic structure, weak interactions in aqueous system, ionisation of water – weak acid – weak bases, Buffering against pH changes.
- 04. Amino acids, peptides and proteins:** Chemistry, classification, determination of amino acids, qualitative test and quantitative determination, structure of various amino acids, formation of polypeptides, purification and separation of proteins, covalent structure of proteins.
- 05. Three dimensional structure of proteins:** Fundamentals of protein structure, amino acid sequencing of protein, hierarchy in protein structure, primary, secondary, super-secondary, tertiary, quaternary and domain structure of protein, protein folding and denaturation.
- 06. Types of proteins:** Functional role of various proteins, structure of fibrous and globular proteins of connective tissues like keratin, reticulin and elastin; albumin, globulin, mucine etc.
- 07. Biosynthesis of protein:** Central dogma, structure of DNA, RNA, DNA replication, transcription and translation (elementary introduction only).
- 08. Molecular Biology of Collagen:** Introduction of collagen, proteoglycan network, level of orders in collagen, primary, secondary, tertiary and quaternary structure of collagen, genes of collagen, collagen biosynthesis, physiological disorders for inappropriate biosynthesis, reactivity of collagen, cursory look on the interaction of collagen network with leather auxiliary.
- 09. Origin of cutaneous structure:** Origin of epidermal cells, cutaneous appendages, epithelial – mesenchymal interaction.
- 10. Physical Chemistry:** Polarity of amino acids and ionisation of proteins, electrophoresis, hydration, solubility of proteins, dielectric properties, intermolecular forces of proteins, crosslinks in collagen and elastin – isoelectric point of collagen and its manipulation in various stages of leather manufacture, acid and base binding capacity of collagen, reversible and irreversible acid and base binding, effects of anions, swelling (osmotic and lyotropic) and phase transition of collagen, helix-coil transition, denaturation and melting of collagen, glass transition of collagen, denaturation and optical birefringence of collagen.

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Suggested Books:

1. Nelson, D.L. and Cox, M.M. (2000), *Lehninger principles of biochemistry*, 3rd Edn. Worth Publishers, N.Y.
2. Gilbert, F.G. (1997) *Development Biology*, 5th Edn. Sinauer Associates, Massachusetts.
3. Kleinsmith, L.J. and Kish, V.M. (1998), *Principles of cell biology*, Harpar & Row publishers, N.Y.
4. Gustavson, K.H. (1956), *The chemistry and reactivity of collagen*, Academic press, N.Y.
5. Hames, B.D., Hooper, N.M. and Houghton, J.D. (1999), *Instant notes on Biochemistry*, Viva Books Pvt. Ltd. N.D.
6. Turner, P.C., McLennan, A.G., Bates, A.D. and White, M.R.H. (1999), *Instant notes on Molecular Biology*, Viva Books Pvt. Ltd. N.D.
7. Elden, H.R. *Biophysical properties of skins*, vol.1 of treatise of skin, Wiley Interscience a divn. of John Wiley & sons. N.Y.
8. Dutta, S.S. (2000), *An introduction to the principles of leather manufacture*, 4th Edn. Indian Leather Technologists Association, Calcutta.

LT 302

PRINCIPLES OF PRE-TANNAGE

4 – 0 – 0 – 4

1. **Curing**:- Definition; necessity; principles and different state of cured hides and skins.
2. **Soaking**:- Physico-Chemical explanation of wetting; objectives and different controls in soaking operation .
3. **Liming**:- Chemistry of unhairing; unhairing by different methods; objectives of liming; effects of liming on collagen; controls in liming operation to achieve different physical properties of leather.
4. **Deliming and Drenching**:- Objectives, principles and controls of deliming and drenching.
5. **Bating**:- Chemistry of Proteolytic enzymes used for bating; necessity of bating ; its preparation and controls for desired properties of leather.
6. **Pickling**:- Acid binding capacity of collagen; use of organic acids or salts in pickling; its necessity and controls; concept of Depickling.
7. **Degreasing**:- Objectives and necessity of Degreasing; different degreasing systems and methods.

Suggested Books:

1. Introduction to the Principles of Leather Manufacture- S. S. Dutta, 4th Edn. I. L. T. A., Calcutta.
2. Chemistry & Technology of Leather-Roddy, O` Flaherty & Lollar, Vol. 2 & 3. Robert E. Kreiger Publishing Co., N. Y.
3. Chemistry of Tanning Processes – K. H. Gustavson, Academic Press N. Y.
4. Chemistry of Vegetable Tannins –E. Haslam, Academic Press, N. Y.
5. Fundamentals of Leather Manufacture – Eckhart Hidemann.
6. Theory and Practice of Leather Manufacture –K. T. Sarkar, Macmillan India Press, Madras.
7. Leather Technician`s Handbook –J. H. Sharphouse, Vernon Lock Ltd., 125 High Holborn, London W-C1.

LT 303

THEORY OF PRE-TANNING MATERIALS

4 – 0 – 0 – 4

1. **Curing agents**: Name of different Curing agents, their Manufacturing Methods and use in curing,
2. **Soaking agents**:- Theory of wetting and its application to soaking agents chemistry. Nature and classification of soaking agents--action of different types of soaking agents on a polar substrate like collagen- HLB value as a determinant of

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surface active Phenomenon - Method of preparation of different soaking agents and uses. Function and uses of preservatives in soaking.

3. **Lime**:-Classification and manufacture of lime—Chemical composition of Indian limes and their suitabilities.
4. **Depilants**:-Manufacture and properties of sodium sulphide, unhairing mechanism of sodium sulphide. Other unhairing agents—sodium sulfhydrate, Arsenic sulphides, Cyanides. etc.
5. **Organic Depilating Agents**:-Their unhairing chemistry. Enzyme depilants, Oxidative depilants.
6. **Chemistry of Deliming Agents**:-Boric acid, Ammonium salts, Sodium bisulfite. Organic deliming agents. Proprietary deliming agents. Merits of proprietary deliming agents over conventional deliming chemicals.
7. **Bating Agents**:-Manufacture, properties and uses of Bating agents. Functions of different components in synthetic bates in bating operation. Acid bates vs alkaline bates.
8. **Pickling Agents**:-Pickle liquor materials and composition—effect of different pickle acids and salts on leather quality. Use of acidic syntans in pickling. Their difference with inorganic acid as pickling agent. Pickling without salt.

Suggested Books:

- 1) Introduction to the principles of Leather Manufacture by Prof. S. S. Dutta 4th Edition, I.L.T.A. Publication.
- 2) Theory and Practice of Leather Manufacture by K.T. Sarkar, Latest Edition Published by Ajoy Sorcar, Chennai-41.
- 3) The Chemistry and Technology of Leather (Vol-1,2) by Fred O'Flaherty William T. Roddy and Robert M. Iollar. Published by Robert E. Krieger Publishing Company Huntington, New York (1978)

LT 304

ANALYTICAL CHEMISTRY OF PRE-TANNING MATERIALS

3-0-0-3

01. Analysis of water:

Principles underlying determination in water of

- a) Chlorine by silver nitrate method
- b) Iron by colorimetric method
- c) Sulphates by gravimetric method
- d) Temporary Hardness by Hehner's method.
- e) Permanent and Magnesia hardness by Alkali precipitation method
- f) Total hardness by EDTA method.
- g) Effect of hardness of water on different stages of leather manufacture.

02. Analysis of lime:

Principles underlying determination of following in lime

- a) Available lime
- b) Total bases by titration method
- c) Iron by colorimetric method

03. Analysis of sodium sulphide:

Principles underlying analysis of sodium sulphide by official International method.

04. Analysis of lime liquor (Fresh & Used):

Principles followed to determine

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- i) total alkalinity by boric acid method
 - ii) total lime by precipitation method
 - iii) total nitrogen by kjeldahl's method
- 05. Analysis of deliming agents:**
Principles underlying analysis of
- i) Ammonium salts
 - ii) Organic & inorganic acids
- 06. Analysis pickle liquor (used & fresh):**
Principles followed for determination of acid and salt content in used and fresh pickle liquor.
- 07. Principles underlying analysis of bates for the following:**
- 1. Enzymatic Activity
 - 2. Ammonium salt content

Suggested Books :

- 01. Analytical Chemistry of Leather Manufacture – P.K.Sarkar, 2nd edition, I.L.T.A., Calcutta, 1982.
- 02. The Chemistry & Technology of Leather, Vol. – IV – F.O' Flaherty, W.T.Roddy & R.M.Lollar, original edition, Krieger Publishing Co. Florida, U.S.A. Co., 1956.
- 03. Official Methods of Analysis, S. L. T. C., U.K, 1965.
- 04. Different Standards issued by B.I.S. from time to time.

LT 305

BIOTECHNOLOGY OF LEATHER MANUFACTURE

3 – 0 – 0 – 3

Histological characteristics of different hides and skins –

Buffalo, Cow, Goat and Sheep. Histological characteristics of Hair
Histological processes for preparation of hides and Skins for observation under microscope.
Photomicrography and its utility in leather science.

Microbiology:

Bacteria -

Morphology & fine structure of bacteria- The size, shape & arrangement of bacterial cells, Bacterial structures-structures external to the cell wall- flagella & motility, pili, capsules, sheaths, prosthecae & stalks.

The cell wall – structure & chemical composition, Structures internal to the cell wall- the cytoplasmic membranes, protoplasts, spheroplasts, membranous intrusions & intracellular membrane system, the cytoplasmic inclusion & vacuoles, nuclear material, spores & cysts.

The cultivation, reproduction & growth – Nutritional requirements, nutritional types of bacteria – Phototrophs, chemotrophs autotrophs & heterotrophs, obligate parasites.

Bacteriological media – types of media , preparation of media. Physical conditions required for growth.

Reproduction – modes of cell division, new cell formation.

Growth – normal growth cycle (growth curve) , transitional periods between growth phases, synchronous growth, continuous culture.

Quantitative measurement of bacterial growth- Direct microscopic count, electronic enumeration of cell numbers, the plate count method, membrane filter count, turbidimetric methods, determination of nitrogen content, determination of dry weight of cells, measurements of a specific chemical change produced on a constituent of a medium.
Importance of quantitative measurement of growth.

Methods of isolating pure cultures- the streak plate technique, the pour plate and spread techniques, micro manipulator techniques, the maintenance & preservation of pure cultures. Culture collections, cultural characteristics, colony characteristics, characteristics of broth culture.

Characteristics, classification of Mold.

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**Role of bacteria & mold in leather. Uses of Bactericides and Fungicides in Leather.
Role of enzymes in different stages of leather processing (with a regular provision of upgradation.**

Suggested Books:

- 1)Microbiologys- Michel J . Pelczar, JR, E.C.S. Chan, Noel R. Krieg (Fifth Edition)
- 2)Molecular Biology of the gene-walson, Hopkins, Roberts, Steitz Weiner (Fourth Edition)
- 3)Standard Methods –Examination of water and wastewater-20th Edition Lenove S. Clesceri, Arnold E. Greenberg,Andrew D. Eaton
- 4)Biological wastewater treatment-Theory and applications-C.P.Lesline, Grady,Jr.Henry C. Lim.
- 5)The Science of Ecologys- Second Edition-Richard Brew

LT 306

CHEMICAL ENGINEERING

0 – 0 – 3 – 2

Introduction :

Concept of Chemical Engineering & Chemical Technology – Unit Operation & Unit Process – Material and Energy Balance – Units And Dimensions – Dimensional Analysis.

Fluid mechanics : fluid properties :

Hydrostatics – buoyancy – manometry – Metacentre – Control Volume Analysis for Mass Momentum and Energy Conservation – Differential Equation of Continuity & Momentum (Euler's & Navier – Stokes Equation), Concepts of Substantial Derivatives for Fluid Acceleration ; Relation between Stress and Strain Rate for Newtonian & Non-Newtonian Fluids ; Bernoulli's Equation ; Qualitative Ideas of Boundary Layers & Separation – Streamlined & Bluff Bodies of Fully Developed Laminar Pipe Flow – Friction Factor & Pipe Flows – Losses in Bends , Tees ,Sudden Expansion – Flow Measurement using Venturimeter – Orifice Plates.

Heat transfer :

Heat Transfer by Conduction, Convection & Radiation , Conducting through Multiple Resistances – Natural & Forced Convection – Radiation Heat Transfer by Black, Non-Black and Grey Bodies – Design of Heat Exchangers – Single & Multiple Effect Heat Exchangers – Evaporators.

Crystallization :

Theory Of Crystallization – Mechanism – Operation of Industrial Crystallizers.

Mechanical operations :

Transportation Of Fluids : Pipes – Fittings – Pumps – Compressors – Characterization of Solid Particles – Size Reduction – Crushers – Grinders – Ultrafine Grinders – Size Separation – Screening – Settling Process -- Sedimentation – Mixing & Agitation – Filtration.

Mass transfer & its application :

Classification of the Mass Transfer Operations, Principles of Diffusion, Local & Overall Mass Transfer Coefficient, Interface Mass Transfer, Material Balances in Steady State, Counter Current & Cross Flow Process/ Cascades, Number of Theoretical Stages Calculation by Kremser Equation , Stage efficiency, Tray Tower- General characteristic, Packed Tower General characteristic, Number of Transfer Unit, Height of Transfer Unit.

Humidity & air conditioning:

Humidity Its Measurement, Adiabatic Saturation Temperature, Dry Bulb & Wet Bulb Temperature, Humidity Charts, humidification & Dehumidification Air Conditioning, Cooling tower.

Distillation:

Vapour-Liquid Equilibria, Relative Volatility, Flash Vaporization, Batch Distillation, Raleigh Equation, Fractional Distillation, Design & Operation characteristic of plate columns by McCabe-Thiele Method for binary mixture, Steam Distillation, Azeotropic & Extractive Distillation.

Drying :

Drying Characteristics of Materials – Theory & Mechanism of Drying – Rate of Drying – Operation of Industrial Dryers.

Extraction :

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Liquid – Liquid & Liquid – Solid Extraction (Leaching) – Operation of Stagewise & Differential Contact Extractors & Leaching Equipment.

Adsorption :

Adsorption Processes -- Adsorption Isotherms – Adsorption Equipment.

Application in leather auxiliaries industry :

Vegetable Tanning Extraction, Polymer Processing – Oils – Fats – Soap – Detergent – Dyes – Sodium Sulphide – Sodium Dichromate – Potassium Dichromate – Lime – Soda Ash – Basic Chrome Sulphate.

Suggested Books :

1. Unit Operations – Mc Cobe & Smith -- Mcgraw Hill.
2. Chemical Engineering – Coulson & Richardson -- Pergamon Press.
3. Heat Transmission – McAdams, W.H. – McGraw Hill.
4. Mass Transfer Operations – Treybal -- McGraw Hill.
5. Shreve's Chemical Process Industries – George T. Austin – McGraw Hill.
6. Introduction to Chemical Engineering – Ghoshal, Sanyal, Dutta – Tata McGraw Hill.
7. Introduction to Chemical Engineering – Badger & Bancharo – McGraw Hill.

LT 391 ANALYTICAL CHEMISTRY OF PRE-TANNING MATERIALS

0 – 0 – 3 – 2

01. Analysis of Water :

- a) Determination of hardness
 - i) Conventional method
 - ii) E.D.T.A. method

Determination of

- b) Iron content
- c) Chloride content

02. Analysis of lime :

Determination of

- i) Available lime
- ii) Total base
- iii) Iron Content

03. Analysis of Sodium Sulphide - Determination of Available sulphide by official method

04. Analysis of Pickle Liquor (used & fresh)

Determination of acid and salt content

Suggested Books :

04. Analytical Chemistry of Leather Manufacture – P.K.Sarkar, 2nd edition, I.L.T.A., Calcutta, 1982.
05. The Chemistry & Technology of Leather, Vol. – IV – F.O' Flaherty, W.T.Roddy & R.M.Lollar, original edition, Krieger Publishing Co. Florida, U.S.A. Co., 1956.
06. Official Methods of Analysis, S. L. T. C., U.K, 1965.
05. Different Standards issued by B.I.S. from time to time.

LP 392 BIOTECHNOLOGY OF LEATHER MANUFACTURE

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0 – 0 – 3 – 2

1. Identification of bacterial shape from effluent of leather.
2. Study of colony characteristics of bacteria in different media.
3. Test of different biochemical reaction of bacteria-proteolytic activity, sugar fermentation, indole formation and production of H₂S, isolation of bacteria from tannery effluent.
4. Counting of bacteria from tannery effluent.
5. Test of mould proof of leather.
6. Determination of strength of enzymes for leather manufacturing.

Suggested Books :

- 1) Microbiology- Michel J . Pelczar, JR, E.C.S. Chan,
Noel R. Krieg (Fifth Edition)
- 2) Molecular Biology of the gene-walson, Hopkins, Roberts, Steitz
Weiner (Fourth Edition)
- 3) Standard Methods –Examination of water and wastewater-20th Edition
Lenove S. Clesceri, Arnold E. Greenberg, Andrew D. Eaton
- 4) Biological wastewater treatment-Theory and applications-C.P. Lesline,
Grady, Jr. Henry C. Lim.
- 5) The Science of Ecology- Second Edition-Richard Brewer.

LP 393

CHEMICAL ENGINEERING

0 – 0 – 3 – 2

Mechanical Features of Different Types of Pumps & Valves, Pipe Fittings – Characteristics of Pumps – Resistances Across Fittings, Valves etc. Calibration of Different Flow Meters for Gases & Liquids – Pressure Drop for Flow Through Packed & Fluidized Bed – Viscosity – Gas Analysis.

Operating Characteristics for Various Crushers & Grinders like Jaw Crusher, Rill Crushers, Ball Mill Disc Crushers etc. Size Analysis by Screen & Sedimentation Method.

Experiment on Filtration – Froth Flotation Cell – Determination of Specific Surfaces by Water Permeability & Air Permeability Methods.

Determination of Different Heat Transfer Co-efficients -- Unsteady State Heating in Jacketted Vessels – Heat Balance in Evaporators – Determination of Thermal Conductivity of Insulating Materials – Calorific Value of a Fuel – Calibration of a ThermoCouple.

Estimation of Diffusion Co-efficient -- Rayleigh Distillation – Othmer Still Mass Transfer in Packed Bed & Wetted Well Column – Experiment on Drying & Determination Of Drying Characteristics Curve.

Determination of Different Heat Transfer Co-efficients -- Unsteady State Heating in Jacketted Vessels – Heat Balance in Evaporators – Determination of Thermal Conductivity of Insulating Materials – Calorific Value of a Fuel – Calibration of a ThermoCouple.

Estimation of Diffusion Co-efficient -- Rayleigh Distillation – Othmer Still Mass Transfer in Packed Bed & Wetted Well Column – Experiment on Drying & Determination Of Drying Characteristics Curve.

Suggested Books :

1. Unit Operations – McCabe & Smith – McGraw Hill in Chemical Engineering.
2. Chemical Engineering – Coulson & Richardson – Pergamon Press.
3. Heat Transmission – McAdams, W.H. – McGraw Hill.
4. Chemical Engineering Handbook -- Perry.

LP 394

APPLIED INFORMATION TECHNOLOGY

0 – 0 – 3 – 2

- 1) Overview of Computer Parts and its Application.
- 2) Computer Application for Documentation:-
 - a) Word,

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- b) Excel,
- 3) Computer Application for Presentation:-
 - a) Power Point Applications,
 - b) Project using Power Point Applications,
- 4) Computer Application for Database:-
 - a) Access,
 - b) SQL / Oracle,
- 5) Internet Application,
- 6) *Project (mini) software on process cost. e.g. finishing chemicals- stock inventory, identification of the course while admission to an institution-three/four disciplines.*

Suggested Books :

1. Operating systems - William Stallings (TMH)
2. DOS guide - Peter Norton (PHI)
3. Windows Operating System - Teach yourself Windows 98 (Techmedia)
4. UNIX concepts & applications - S.DAS (TMH)

LT401

PRINCIPLES OF INORGANIC TANNAGE

4 - 0 - 0 - 4

Tanning:- Theory, chemistry, factors and objectives of following Inorganic Tanning operations:

- (A) Chrome Tannage,
- (B) Aluminium Tannage,
- (C) Iron Tannage,
- (D) Zirconium Tannage,
- (E) Titanium Tannage,

Ligands available in Collagen – Their suitability in practical conditions – Stability of Metal-Ligand Bonds in Collagen – Characteristics of a Tanning Agent -- Specificity of a metal Tanning agent in Tanning of leather – Cross linking and Tanning – Helix Coil transition – Shrinkage phenomenon – Degree of Tannage, the most important phenomena for leather properties – Background of Chrome tanning -- Aqueous Chemistry and Ligand Substitution reactions of Transition and non-transition metal Complexes – Protolysis and Formation of Basic Chrome Complexes –Tanning Processes & Principles – Effect of Neutral salts like sodium chloride and sodium sulfate on chrome liquor and on chrome tanning – Effect of Alkalies on the Basicity of chrome complexes – Effect of Complexing Agents on Tanning Faculty of Chromium. Factors governing Tanning effect – Nature of anion – basicity of chromium salt – concentration of chromium salt – effect of pH – effect of temperature – influence of tan liquor volume -- influence of Previous History of collagen viz. effect of lyotropic agents – effect of weak acids – effect of liming – effect of swelling pretreatments – effect of detergents. Isoelectric point of chrome tanned leather.

Masking agents – their requirements for use in chrome tanning – effect of masking on chrome tanned leather & on chrome liquor – evaluation of masking agent in practical tanning – recycling of chrome tan liquor – detanning of chrome tanned leather.

Classical theories of Metal-Ligand Complexes – Their Limitations – Crystal Field & Ligand field Theories of the Co-ordination Complexes – Magnetic Properties of complexes – Ligand Field Stabilization Energy & Stereochemistry of Complexes – Thermodynamic & Kinetic Effects on Stability of Complexes – Ligand Substitution Reaction of Octahedral Complexes & their Mechanisms of Substitution – Factors Affecting Rate of Reactions – Trans Effect Theories of Ligand substitution reactions -- Manufacturing Principles & Methods of Basic Chrome Sulfate for Leather Tanning.

Stability of complexes and their quantitative evaluation – Stability correlations – Chelate effect – Theory of Hard and Soft Acids and Bases – Valence Shell Electron Pair Repulsion model for structural aspects of compound.

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Ionization potential – Electron Affinity – Electronegativity – Lattice Energy and Solvation Energy – Variable valency – structure of complex ionic crystals – Absorption spectra of complexes.

Suggested Books :

1. Introduction to the Principles of Leather Manufacture- S. S. Dutta, 4th. Edn. I. L. T. A., Calcutta.
2. Chemistry & Technology of Leather-Roddy, O' Flaherty & Lollar, Vol. 3. Robert E. Kreiger Publishing Co., N. Y.
3. Chemistry of Tanning Processes – K. H. Gustavson, Academic Press N. Y.
4. Fundamentals of Leather Manufacture – Eckhart Hidemann
5. Leather Technician's Handbook –J. H. Sharphouse, Vernon Lock Ltd., 125 High Holborn, London W-C1.
6. Theory and Practice of Leather Manufacture – K. T. Sarkar, Macmillan India Press, Madras.
7. Practical Leather Technology – Thomas C. Thorstenson, Robert E. Krieger Publishing Co. INC. N.Y.
8. Advanced Inorganic chemistry -- F A Cotton & G Wilkinson Wiley – Interscience
9. Fundamental principles of inorganic chemistry -- D. Banerjee. Sultan Chand & Co., New Publication.

LT 402

METHODS OF LEATHER MANUFACTURE – I

4 – 0 – 0 - 4

1. **Preservation of hides & skins** - Different methods of preservation e. g . saturation of the system with salt - water removal - freeze drying .
2. **Soaking** - Different methods of soaking - controls of soaking .
3. **Depilation** - Different methods - Amines in lime liquors - thermal unhairing - enzymatic unhairing - controls of liming .
4. **Deliming** - Different methods of deliming - controls .
5. **Bating** - Different types of bating - controls in bating operation for different end characteristics of leather .
6. **Pickling** - Methods of Pickling - Controls Pickling .
7. **Degreasing** - Different methods - Difference with Currying .
8. **Tanning** - Identifiable tanning characteristics - Measurement of shrinkage temperature - Degree of tannage - Action different masking acids in practical Chrome tanning - High Chrome exhaustion tannage - Recycling of Chrome tanning liquors - Detanning of Chrome tanned leather - Tannage with Aluminium salts - Zirconium tannage - Titanium tannage - Iron tannage - Formaldehyde tannage - Gluteraldehyde tannage - - Practical aspects Vegetable tannage -Tanning of vegetable tanned leather- Tannins with reduced tanning capacity- *Metallo -Syntan* as pretanning agent - Retanning of Chrome tanned leather - Semichroming of Vegetable tanned leather.
9. **Mechanical Operations:** Drumming, Paddling, fleshing, Scudding.

Suggested Books :

1. An Introduction To The Principles Of Leather Manufacture - S . S .Dutta .
2. Physical Chemistry Of Leather Making - Krzysztof Bienkiewicz .
3. Fundamentals Of Leather Manufacture - Eckhart Hidemann .
4. Chemistry And Technology Of Leather - Vol . II & III - Lollar , Roddy .
5. Theory And Practice Of Leather Manufacture . - K . T . SARKAR
6. Leather Tchnician's Handbook - J . H . Sharphouse .
7. Chemistry Of Tanning Process - K . H . Gustavson .

LT 403

ANALYTICAL CHEMISTRY OF TANNING AGENTS

4 – 0 – 0 – 4

01. **Analysis of Metal Tanning Agents;**

B.TECH. LEATHER TECHNOLOGY

- a) **Analysis of Chrome liquor/ Chrome Tanning Agents:**
Principles underlying determination of acidity and basic chromium in single bath chrome liquor, Calculation of Basicity Figures and changes of basicity, Principles followed for the determination of degree ofolation of basic chromium salt.
- b) **Analysis of Zirconium Tanning Agents:**
- c) **Analysis of Alum Tanning Agents:**
- d) **Analysis of Iron Tanning Agents:**
- 02. Analysis of Vegetable Tannin:**
Principles underlying estimation of tannin in vegetable tanstuffs, extracts, liquors etc. by ----
- a) lead acetate method
- b) Hide powder method
- 03 Principles underlying analysis of Synthetic Tanning Agents**

Suggested Books :

07. Analytical Chemistry of Leather Manufacture – P.K.Sarkar, 2nd edition, I.L.T.A., Calcutta, 1982.
08. The Chemistry & Technology of Leather, Vol. – IV – F.O' Flaherty, W.T.Roddy & R.M.Lollar, original edition, Krieger Publishing Co. Florida, U.S.A. Co., 1956.
09. Official Methods of Analysis, S. L. T. C., U.K, 1965.
- 04 Different Standards issued by B.I.S. from time to time.

LT 404 ENVIRONMENTAL SCIENCE OF TANNERY EFFLUENT

3 – 0 – 0 – 3

1. WATER POLLUTION IN GENERAL:

Principal industries attributed for water pollution. Types of water pollution – physical, chemical & biological pollution. Hazardous effects of water pollution on land, ground water, surface water, aquatic life and sea. Ecological system and water pollution.

2. TANNERY EFFLUENT:

Types of tannery effluent, characteristics of effluent from beam house processes, tan yard processes and finishing processes, their nature and pre-treatment before disposal, Most toxic ingredients- hazards of tannery effluent, principles involved in removing their toxic effect from tannery effluent.

Principles for estimation of DO, COD, BOD, Sulphides, chromium and non-biodegradable aromatic substances in waste water.

3. PRIMARY TREATMENT:

Main objects of primary treatment- primary Treatment units- Collection system of discharged waste water in tanneries- screening- equalisation of waste water.

4. SECONDARY TREATMENT:

Principles of secondary treatment- Different processes involved in secondary treatment system- Lagoon treatment- aeration system- trickling filter- systematic design of these systems- bio-technology in effluent treatment.

5. STANDARDS AND SPECIFICATIONS:

Indian standards- international standards specifications for industrial effluent discharge- Types of effluent disposal.

6. RECOVERY OF WASTE WATER:

Different processes in recovery and reuse of wastewater in tanning industry- economic feasibility of different processes.

Suggested Books :

- 1.Environment & Tannery- M.C.C. Carre et.al. Center technique du cuir, Lyon, France.

B.TECH. LEATHER TECHNOLOGY

2.Waste water engineering, treatment, disposal reuse- Metcalf & Eddy- Tata Mcgraw Hill Publishing Co. Ltd. New Delhi.

3.Standard Methods for the Examination of Water & Waster Water- American Public Health Association, Washington, D.C.

4.An Introduction to the Principles of Leather Manufacture, 3rd edition- S.S.Dutta, Chap.XXVI, I.L.T.A., Kolkata.

LT 405

PRINCIPLES OF ORGANIC TANNAGE

3 – 0 – 0 – 3

Vegetable tannins –

Classification of Vegetable Tannins – Structural Aspects, Analysis and Chemistry of Hydrolysable and Condensed Tannins – Manufacture of Vegetable Tannin Extract – Use of Additives for Product Modification -- Reaction of Vegetable Tannins with Collagen. Principles of Vegetable Tanning. Factors affecting Tannin Diffusion and Factors affecting Tannin Fixation with Collagen – Principles of Rapid Tanning methods – Principles of Heavy Leather And Industrial Leather Manufacture – Vegetable Tanning Principles from Skins.

Synthetic tannins –

Chemistry and Multifunctional Properties of Syntans –Non Tans in Synthetic Tannins – General Manufacturing Methods of Phenol – Formaldehyde, Naphthalene – Formaldehyde and Naphthol – Formaldehyde Condensates – Supra Syntans – Use of Syntans For the Manufacture of Various Leathers and for Various Objectives. Use of Lignosulfonic acids in Leather processing.

Resin syntans –

Urea – formaldehyde and Melamine – Formaldehyde condensates as Tanning Agents for Leather – Their Chemistry and structure, property, relationship – Polyacrylates and Polyurethanes as Resin Tanning Agent – Principles of their Use.

Aldehydes as tannins --

Formaldehyde and other mono and difunctional aldehydes – their chemistry, structure and general properties – Investigation of their tanning faculty. Reaction of aldehydes with different functional groups of protein. Tanning faculty at different pHs – Ewald reaction.

Suggested Books :

1. Chemistry Of Vegetable Tannins -- E. Haslam Academic Press.
2. Vegetable Tannage -- Tanning Extract Producers Federation Limited, England.
3. An Introduction To The Principles Of Leather Manufacture -- S S Dutta, Indian Leather Technologists Association, Calcutta. India

LT 406

MECHANICS OF LEATHER MACHINES – I

3 – 0 – 0 – 3

Mechanics of Leather Machinery:

Wood- Characteristics/ specification/ requirement matching use.

Rubber- Quality requirement at different stages of leather machines; specification and testing; maintenance.

Knives used, their characteristics, their constituents, their preparation and optimum usages, their varied functioning.

Variation of speeds of different rollers and their justification matching requirement of leather making.

Electronics as applied and devices in different leather machinery, timer device.

Surface coating devices.

Insulation.

B.TECH. LEATHER TECHNOLOGY

Different heating systems and economic usage depending upon the final results; thermostatic controls.

Varieties of pumps used in tannery, effluent treatment system.

Driving systems- varied load factors, economic system.

Conveyors.

Lubrications and lubricants.

Clutch mechanism, Crank slider, lever mechanism, Balancing and vibration – their application in high speed bladed cylinder and machines, Mechanism of cutting and slicking action of helical bladed cylinder, Bush, ball and roller bearings, cam, springs and their application and function in tannery machines.

Hydraulic & Pneumatic Systems:

Hydraulic & pneumatic steering mechanism for leather machinery. Air compressors, blowers and dust control equipment used in tannery, Drying mechanism and dryers used in tannery.

Suggested Books :

01. Leather Technician's HandBook – J. H. Sharpouse, Leather Producers' Association, Northampton, 1971.
02. Lecture Notes on Leather – P. S. Venkatchalam, CLRI, Chennai, 1964.
03. Different Catalogues issued by different Leather Machinery producers.

LP 491 WASTE WATER ANALYSIS – I

0 - 0 - 3 - 2

- 1) Determination of I) Total solids
 - 2) Total dissolved solids
 - 3) Total suspended solids
 - 4) Total volatile solids
 - 5) Total non volatile solids content in waste water.
- 2) Determination of the Acidity / Alkalinity of the given sample of waste water.
- 3) Determination of the Salinity of waste water.
- 4) Determination of the lime content in terms of Calcium content in spent lime liquor.
- 5) Determination of the total chromium content in spent chrome liquor by perchloric acid oxidation method.
- 6) Detection and Determination of the hexavalent chromium present, if any, in spent chrome liquor.
- 7) Determination of the Dissolved Oxygen content in a given sample of water.
- 8) Determination of the Sulphide content in spent lime liquor.

Suggested Books :

LP 492 ANALYTICAL CHEMISTRY OF TANNING AGENTS

0 - 0 - 3 - 2

01. **Analysis Chrome tanning agents and liquors :**

Determination of

 - i) Moisture
 - ii) Chromic oxide content
 - iii) Acid combined with chromium
 - iv) Percentage basicity
 - v) Change of basicity
 - vi) Degree of olation

B.TECH. LEATHER TECHNOLOGY

- 02. Analysis of Tannin :**
Determination of
- i) Moisture
 - ii) Tannins
 - iii) Non-tannins
 - iv) Colour by Lovibond tintometer
 - v) pH of extract
 - vi) Total solubles & solids
- 03. Analysis of Synthetic Tanning agents :**
Determination of
- i) Moisture
 - ii) Total soluble & solids
 - iii) Non-tannins
 - iv) Tannins
 - v) Colour by Lovibond Tintometer &
 - vi) pH of extract

Suggested Books :

1. Analytical Chemistry of Leather Manufacture – P.K.Sarkar, 2nd edition, I.L.T.A., Calcutta, 1982.
2. The Chemistry & Technology of Leather, Vol. – IV – F.O' Flaherty, W.T.Roddy & R.M.Lollar, original edition, Krieger Publishing Co. Florida, U.S.A. Co., 1956.
3. Official Methods of Analysis, S. L. T. C., U.K, 1965.
Different Standards issued by B.I.S. from time to time.

LP 493 METHODS OF LEATHER MANUFACTURE - I

0 - 0 - 3 - 2

Manufacture of different types wet blue/ wet white from raw Cow / Goat / Sheep / Buffalo hides & skins - Tanning with different metal e.g . Chrome , Aluminium , Zirconium, Iron etc.- estimation of shrinkage temperature leathers of different tannage - cost evaluation of the prepared leather.

Suggested Books :

- 1) Introduction to the Principles of Leather Manufacture - S . S . Dutta , 4th edition , ILTA , Calcutta .
- 2) Chemistry & Technology of Leather - Roddy , O' Flaherty & Lollar – Robert E . Krieger Publishing Co . N . Y .
- 3) Fundamentals Of Leather Manufacture - Eckhart Hidemann .
- 4) Theory & Practice Of Leather manufacture - K . T . Sarkar , Macmillan India Press , Madras .
- 5) Leather technician's Hand Book - J . H . Sharphouse , Vernon Lock Ltd . 125 , High Holborn , London Wcl .

LP 494 MECHANICS OF LEATHER MACHINES – I

0 – 0 – 3 – 2

Free hand sketch and drawing of tannery drums and paddle.

B.TECH. LEATHER TECHNOLOGY

Calculation of the pitch, contact angle, lead angles of helical blades, Fixing of blades in bladed cylinder.

Free hand sketch of different parts of Fleshing, shaving, staking, buffing, glazing, setting & measuring machines.

Suggested Books :

1. Leather Technician's HandBook – J. H. Sharpouse, Leather Producers' Association, Northampton, 1971.
2. Lecture Notes on Leather – P. S. Venkatchalam, CLRI, Chennai, 1964.
3. Different Catalogues issued by different Leather Machinery producers.

LT501

PRINCIPLES OF POST-TANNING OPERATIONS

4 – 0 – 0 – 4

1. **Neutralisation**:- Its objectives, necessities and controls to achieve desired up-take of dyes and fatliquors.
2. **Bleaching**:- Definition; theory; mechanism of chemical bleaching; classification and application of different methods of bleaching to leathers . Theory of optical bleaching and possibilities of its' application to leather bleaching .
3. **Dyeing** :- Theory and mechanism of dyeing ; concept of colour ; manual colour matching. Colour and Chemical Constitution of Dyes – Classification of Dyes – Different Dyes – Azo – Azoic – Sulfur Dyes – Anthraquinone Dyes – Acridine – Azine – Methine – Nitro – Nitroso – Oxazine – Quinoline Dyes – Phthalocyanine Dyes & Pigments – Organic Pigments – Basic Dyes – Cationic Dyes – Photochemistry of Dyes.
4. **Retanning**: Objectives of retanning- Effect of different retanning agents on properties of leather- Principles of bondage of retanning materials as special reinforcing agent.
5. **Retanning Syntans**: Chemistry and classification- tanning power- role of hydroxyl group- role of and molecular size of syntans- electron affinity and chemical structure- mechanism of synthetic tannage- general method of manufacture of aromatic syntans-their general properties- different types of syntan- chromium and aluminium containing syntans- syntan for retanning purpose- bleaching action and neutralisation.
6. **Fatliquoring** :- Physical chemistry Of Colloids – Interfaces & Interfacial tension – Surface / Interfacial tension of solutions – Particle size Distribution – Viscosity – Concentration – Dielectric Constant – Theories of Stability of Emulsion (Surface theories and Electrical theories) – Inversion & Deemulsification – Chemistry of emulsifying agents – Emulsifier efficiency – HLB Method – Emulsification Techniques - Principles and objectives of fatliquoring ; difference between natural and synthetic fats & oils ; controls to achieve desired properties of leather .Concept of currying .
7. **Synthetic fatliquor**:Fischer – Tropsch synthesis – Mechanism of optical Dissociation – Mechanism of Photochemical Chlorination of Methane – Control of extent of Chlorination – Collision Theory _ Transitional State Theory – Comparison between Photochemical Chlorination, Fluorination, Bromination & Iodination of Methane – Photochemical Chlorination of Higher Alkanes – Prediction of yield of Positional Isomers – Mechanism of Sensitization – Mechanism of Photochemical Sulfochlorination of Mepasin – Raw Material Control – process Control – Mechanisms of Substitution Reaction – Manufacture of Anionic, Non-ionic, Cationic & Amphoteric Synthetic Fatliquor from Marsol, Advantages & Disadvantages of Synthetic Fatliquors.
8. **Water proofing** :- Definition , theory and need of water barrier characteristics in leather . Difference among water repellent, water resistant and water proof leather . Principles involved in different methods of water proofing followed in leather industry.
9. **Theory Of Leather Drying**:- Principles of energy and mass transfers ; physico- chemical aspects of leather drying ; different methods of drying followed in leather industry.

Suggested Books :

- 1.Introduction to the Principles of Leather Manufacture- S. S. Dutta, 4th. Edn. I. L. T. A.,Calcutta.

B.TECH. LEATHER TECHNOLOGY

2. Chemistry & Technology of Leather-Roddy, O` Flaherty & Lollar, Vol. 3. Robert E. Kreiger Publishing Co., N. Y.
3. Chemistry of Tanning Processes – K. H. Gustavson, Academic Press N. Y.
4. Fundamentals of Leather Manufacture – Eckhart Hidemann
5. Leather Technician`s Handbook –J. H. Sharpouse, Vernon Lock Ltd., 125 High Holborn, London W-C1.
6. Theory and Practice of Leather Manufacture – K. T . Sarkar , Macmillan India Press , Madras.
7. Practical Leather Technology – Thomas C. Thorstenson , Robert E. Krieger Publishing Co. INC. N.Y.

LT 502 METHODS OF LEATHER MANUFACTURE – II

4 – 0 – 0 – 4

1. **Neutralization:** Controls of neutralisation, choice of neutralising agents, degree of neutralisation for different types of leather, efficacy of neutralising syntans.
2. **Dyeing:** Choice of dyestuffs for leather, checking of affinity of dyestuffs for a particular leather, influence of retanning on dyeing property of leather, leveling of dyestuffs for uniform coloration, different methods of dyeing techniques, fixation of dyestuffs, penetration of dyestuffs, practical aspects in the dyehouse, fastness properties in respect to a color, manual color matching
3. **Retanning:** Objectives of retannage, effects of different retanning agents e.g. vegetable tanning agent, synthetic tanning agents, resin tanning agents, aldehyde tanning agents etc. on a particular leather (chrome/vegetable/aldehyde- tanned), choice of combination of retanning agents with a view to the ultimate leather,
4. **Fatliquoring:** Stuffing, currying, dubbing, types of oil, fat raw stock, methods of modification of fat compounds, practical fatliquoring methods followed in leather houses, properties of different types of basic technical fatliquor, choice of fatliquor for specific leather, hydrophobisation of leather, degreasing of pelts and leathers.
5. **Drying of leather:** Influence of drying conditions on properties of leather e.g. influence of humidity, influence of temperature, technical drying methods e.g. vacuum drying, paste drying etc.
6. **Mechanical Treatment:** Samming, Splitting, Shaving, Setting, Staking, Toggling, Buffing, different drying systems of leather in wet conditions.

Suggested Books:

1. An Introduction To The Principles Of Leather Manufacture - S . S .Dutta .
2. Physical Chemistry Of Leather Making - Krzysztof Bienkiewicz .
3. Fundamentals Of Leather Manufacture - Eckhart Hidemann .
4. Chemistry And Technology Of Leather - Vol . II & III - Lollar , Roddy .
5. Theory And Practice Of Leather Manufacture . - K . T . SARKAR
6. Leather Tchnician`s Handbook - J . H . Sharpouse .
7. Chemistry Of Tanning Process - K . H . Gustavson .

LT 503 ANALYTICAL CHEMISTRY OF POST- TANNING & FINISHING AGENTS

4 – 0 – 0 – 4

01. **Analysis of lipids** :
Principles underlying determination of
 - i) Acid value
 - ii) Saponification value by Reflux method
 - iii) Iodine value by Hanus method
 - iv) Unsaponifiables by extraction Method.
02. **Principles underlying examination & analysis of sulphated oils and readymade**

B.TECH. LEATHER TECHNOLOGY

fatliquors .

03. Principles underlying examination & analysis of dyes used in leather manufacture.
04. Principles underlying examination & analysis of readymade finishes and finishing materials used in leather manufacture.

Suggested Books :

03. Analytical Chemistry of Leather Manufacture – P.K.Sarkar, 2nd edition, I.L.T.A., Calcutta, 1982.
04. The Chemistry & Technology of Leather, Vol. – IV – F.O' Flaherty, W.T.Roddy & R.M.Lollar, original edition, Krieger Publishing Co. Florida, U.S.A. Co., 1956.
05. Official Methods of Analysis, S. L. T. C., U.K, 1965.
06. Different Standards issued by B.I.S. from time to time.

LT 504

THEORY OF ACCOUNTANCY AND COSTING

4 – 0 – 0 – 4

ACCOUNTANCY:

Book-Keeping-Double Entry System, advantages and objects of double entry system. Different classes of accounts. Rules for debit and credit for each class of accounts. Posting of transactions from Principal and subsidiary book to ledger. Balancing of accounts in the ledger. Different types of cash book, writing and balancing of cash books. Trade discount and cash discount, distinction between them and how they are accounted in Cash Book. Recording of Bank Transactions in Cash book, Trial Balance, Rectification of errors in Trial Balance through journal proper. Correction of wrongly prepared Trial Balance. Final accounts of Proprietorship and Partnership business. Gross profit and loss. Net profit and net loss. Distinction between Trading Manufacturing Account and Trading Account and Profit and Loss Account. Distinction between Trial Balance and Balance sheet. Different kinds of assets and liabilities. Marshalling of assets and liabilities, Adjustments before final accounts. Outstanding and prepaid expenses. Accrued income and income received in advance. Depreciation of bad debts and Reserve for Bad and Doubtful debts. Reserve for discounts on debtors and creditors Re-drafting of wrongly prepared accounts. Manufacturing, Trading accounts, Profit & Loss accounts. Definition of consignments and difference from Sale Consignor, Consignee Proforma Invoice, sales accounts and remittances. Entries in the book of Consignors and Consignees. Valuation of closing stock. Definition and classification of Bills of Exchange. Valuation of Closing Stock. Definition and classification of Bills of Exchange. Inland and Foreign Bills, Promissory Notes of Hundies, entries of bills of exchanges at different stages i.e. on payment on due date, on endorsement to creditor or dishonoured or Renewing and Retiring of bills.

COSTING:

Fundamental principles, advantages and disadvantages. Different methods of cost accountancy and their application to manufacturing industry. Elements and division of costs. Direct and indirect expenditures. Books used in cost accountancy. Purchase and receipt of materials, their records. Order books, bin card, store ledger, Issue of materials, bill of materials and material abstract. Return and transfer of surplus materials, Entries in cost accounts. Wastage of materials- normal and abnormal. Pricing of materials. Stock taking, perpetual and periodical inventory. Causes of difference with physical verification of stores. Definition and classification of overheads. Determination and allocation of overheads. Items of chargeable expenses. Distinction between chargeable expenses and overheads. Time recording system in production. Methods of remunerating labour e.g. time basis and piece work basis. Preparation of pay roll. Idle time, normal and abnormal- how they are treated in cost accounts. Production on time basis.

B.TECH. LEATHER TECHNOLOGY

STATISTICS:

Probability concepts, Bayer theorem, Binomial distribution, Poison distribution, Normal distribution, Index numbers & time series, Introduction to Statistics, Correlation and regression, curve fitting.

Suggested Books :

LT 505 INSTRUMENTAL METHODS OF CHEMICAL ANALYSIS

4 - 0 - 0 - 4

General Study: - Relationship between wavelength, frequency & energy of radiation, wave-particle duality, Schrödinger's wave equation, normalisation & orthogonality of wave function. Molecular orbital theory, Valence bond theory, Particle-in-box theory, Chemistry of excited states, Vibrational energies of a diatomic molecule, molecular electronic energy levels.

UV-Vis Spectrophotometry:- Instrumental brief details- radiation sources, H or D discharge lamps, incandescent filament lamps, Detectors- photovoltaic cells, photoemissive tubes, photomultiplier tubes, photodiodes, Filters- Absorption filters, Monochromators, slits, thin film coatings, Monochromator performance, dispersion, resolution, light gathering power, prism as dispersive device, dispersion by diffraction grating, grating monochromator system- Elbert mounting, Czerny- Turner mounting, Littrow mounting, Seya- Namioka mounting, Rowland circle mounting, single beam spectrophotometer, scanning double-beam spectrophotometer. Beer Lambert's law, deviation from Beer's law. Quantitative methodology, character of valence shell electronic transition $\sigma \rightarrow \sigma^*$; $\pi \rightarrow \pi^*$; $n \rightarrow \sigma^*$; $n \rightarrow \pi^*$, d-d transition, charge transfer, solvent effect. Shifts of λ_{max} - hypsochromic, bathochromic, hyperchromic, hypochromic shifts, solvent effect. Signal to noise ratio, Sources of noise, S to N enhancement.

IR Spectrophotometry:- Correlation of IR spectra with molecular structure; Near infrared region, mid infrared region, far infrared region. Structural analysis instrumentation:- Detectors, Thermal detectors, photon detectors, spectrophotometers, FT interferometer. Sample handling system:- solid samples, liquid samples, films, outline of quantitative analysis.

AAS spectrophotometry:- Principles of Atomic Absorption Spectroscopy, Nebulization, flames & flame temperatures, disadvantages of flame atomisation, burners, Interference:- background absorption, spectral line interference, vaporisation interference, ionisation effects. Sources of atomic absorption, Hollow cathode lamps, Electrothermal atomisation, Chemical vaporisation.

General principles of chromatography:- Classification of chromatographic methods, Nature of partitioning forces, dispersion interaction, dipole-dipole interaction, H-bond interaction, Chromatographic behaviour of solutes, retention behaviour, partition coefficient, partition ratio, Column efficiency & resolution:- plate height & plate number, peak asymmetry, resolution, Solvent delivery system, reciprocating pumps, syringe type pumps, constant pressure pumps, applicability of pumps. Sample introduction:- syringe injection, sampling valves and loops. Detectors:- photometric detectors, IR detectors, differential refractrometers. Solvent programming, flow programming, effect of temperature,

Color measurement: Theory of colour formation, theory of instrumental gloss measurement, colour measurement, CIE XYZ, LAB system, RGH values, computer aided colour matching theory.

Suggested Books:

- 1) G.M. Barrow:- Introduction to Molecular Spectroscopy, Mc-Graw Hill Book Co. N.Y.
- 2) J.D. Graybeal:- Molecular Spectroscopy, Mc-Graw hill book Co, N.Y.
- 3) C.N. Banwell:- Fundamentals of Molecular Spectroscopy, Tata Mc-Graw Hill Co. Ltd. N.D.

B.TECH. LEATHER TECHNOLOGY

- 4) H.H. Willard, L.L. Merritt Jr., J.A. Dean and F.A. Settle Jr. Instrumental Methods of Analysis, CBS Publishers & Distributors, N.D.
- 5) D.A. Skoog & J.J. Leary, Principles of Instrumental Analysis. Harcourt Brace Joranson College Publishers, N.Y.
- 6) G.W. Ewing, Instrumental Methods of Chemical Analysis, Mc-Graw Hill Book Co. N.Y.
- 7) J.R. Dyer, Applications of Absorption Spectroscopy of Organic Compounds- Prentice- Hall of India Pvt. Ltd.
- 8) W. Kemp, Organic Spectroscopy, Macmillan, London.

LT 506

WASTE WATER ENGINEERING

4 – 0 – 0 – 4

Waste water characteristics – physical, chemical & biological. Waste water characterization studies – sampling -- location & interval of sampling – sampling equipment – preservation of sample.

Waste water composition – loading factors – analysis of waste water loading data.

Chemistry and analysis of various characteristics of waste water viz. Total Solids, Total Dissolved Solids, Volatile Matter, Fixed Solids, BOD₅, COD, ThOD, TOD, Ammon. Nitrogen, Protein content, TOC, Chlorides, Alkalinity, pH, Sulphides, Dissolved Oxygen, Total Coliform Count, Metal content.

Physical unit operations – screening – Flow Equalization – Flocculation – Settling / Sedimentation – Filtration.

Chemical Precipitation – different precipitating agents – Theoretical aspects of precipitation.

Hydraulic characteristics of different Reactors – Reaction kinetics & Reactor selection.

Important micro-organisms & waste water treatment – kinetics of biological growth – application of kinetics to biological treatment processes – Aerobic Suspended growth process – its microbiology – Process analysis for different reactors – Aerobic Attached growth process – different types – microbiology of the process – process analysis – mathematical designing of Activated Sludge process – its considerations.

Sludge disposal -- Solid waste management- Solid waste characteristics- Generation rate-component- moisture content- VOC content. Density- solid waste collection and transportation- solid waste transfer and transportation. Solid waste processing and recovery- recycling- processing for recovery of material- manufacture of solid waste product- electrical energy recovery- disposal of solid waste.

Bioremediation:

Sources of contaminants, current bioremediation practices, Ground water bioremediation, soil bioremediation (like in-situ treatment, land farming, composting, bioreactor), factors influencing bioremediation, environmental factors, physical factors and chemical factors.

Suggested Books :

- 1.S.K.Banerjee, Environmental Chemistry, 2nd edition. Prentice Hall of India (1999), New Delhi.
- 2.A.Mackenzie, A.S. Ball & S.R. Virdee -- Instant notes in Ecology, Viva Books Pvt. Ltd.(1999) New Delhi.
- 3.C.W. Sawyer, P.L.Mc Carty, Chemistry for Environmental Engineering, 3rd Edn. McGraw Hill Public Co. Ltd. (1978)
- 4.B.S.N. Raju, Water supply and waste water engineering. Tata Mc graw Hill Public Co. Ltd. (1995) New Delhi.
- 5.A.P.Sincero. G.A. Sincero- Environmental Engineering. A design approach. Prentice Hall of India (1999), New Delhi.
- 6.M.J.Hammer, M.J.Hammer Jr., Water and waste water technology, 3rd edn, Prentice Hall of India (1998), New Delhi.
- 7.S.L.Culter Edn. Environmental risk and hazard -- Prentice Hall of India (1999), New Delhi.
- 8.J.B.Enlia, S.J.Ergas, D.P.V.Chang, F.D.Schroeder -- Bioremediation Principles-WCB McGraw Hill (1998), Boston.

B.TECH. LEATHER TECHNOLOGY

9.C.M. Masters, Introduction to Environmental Engineering & Science. Prentice Hall of India (1994), New Delhi.

LP 591 ANALYTICAL CHEMISTRY OF POST TANNING & FINISHING AGENTS

4 - 0 - 0 - 4

01. **Analysis of lipids** :
Determination of
 - i) Moisture
 - ii) Acid Value
 - iii) Saponification value
 - iv) Iodine Value
 - v) Unsaponifiables
02. **Analysis of Sulphated oils** :
Determination of
 - i) Moisture
 - ii) pH
 - iii) Organically combined sulphates as sulphuric and sulphonic esters
 - iv) Total ash
03. **Examination of dyestuffs used in leather manufacture**
04. **Examination of readymade finishes and finishing materials used in leather Manufacture**

Suggested Books :

4. Analytical Chemistry of Leather Manufacture – P.K.Sarkar, 2nd edition, I.L.T.A., Calcutta, 1982.
5. The Chemistry & Technology of Leather, Vol. – IV – F.O' Flaherty, W.T.Roddy & R.M.Lollar, original edition, Krieger Publishing Co. Florida, U.S.A. Co., 1956.
6. Official Methods of Analysis, S. L. T. C., U.K, 1965.
Different Standards issued by B.I.S. from time to time.

LP 592 INSTRUMENTAL METHODS OF CHEMICAL ANALYSIS

0 - 0 - 3 - 2

1. **UV-Vis Spectrophotometry:** Determination of spectra of some known organic compounds and identification of molecular transitions and functional groups in single beam spectrophotometer, quantitative estimation of various compounds in single beam spectrophotometers by applying Beer-Lambert's Law, scan spectra of some organic compounds in dual beam spectrophotometer, estimation of Cr^{6+} , Fe^{3+} , NO_3^- , PO_4^{3-} , COD in spectrophotometer.
2. **Atomic Absorption Spectrophotometry:** Determination of some heavy metal concentrations (like total Cr, Fe, Zn, Pb, Zr etc.) from solution, leather, effluent, soil / sludge, plant and fish tissues.
3. **Fourier Transform Infra Red Spectrophotometry:** Determination and interpretation of spectra of some organic compounds, identification of group frequencies and functional groups.

B.TECH. LEATHER TECHNOLOGY

4. **CHN Analysis:** Estimation of CHN content of various known compounds in CHN analyser.
5. **UV-Vis and IR spectrophotometry and CHN analysis for structural studies:** Determination of structure of unknown compound by taking and interpreting the data obtained from those instruments.
6. **High Performance Liquid Chromatography:** Some simple separation techniques for separating simple organic compounds from their mixture.
7. **Titration using Autotitrator:** Acid-base titration, complexometric titration.

LP 593

WASTE WATER ANALYSIS – II

0 – 0 – 3 – 2

1. Determination of the Ammoniacal Nitrogen present ($\text{NH}_3\text{—N}$) in tannery effluent.
2. Determination of the protein content (Org – N) in tannery effluent.
3. Determination of the Biochemical Oxygen Demand (BOD_5) of a given waste water.
4. Determination of the Chemical Oxygen Demand of a given waste water.
5. Determination of the Total Iron Content in a given waste water.
6. Determination of the Ferrous Iron content in a given waste water.
7. Determination of the Ferric Iron content in a given sample of waste water.
8. Determination of the Phenolic substance in a given waste water.

Suggested Books :

LP594

METHODS OF LEATHER MANUFACTURE - II

0 - 0 - 3 - 2

Manufacture of different types crust from raw/ wet blue/ wet white Cow / Goat / Sheep / Buffalo hides & skins - Tanning with different metal e.g . Chrome , Aluminium, Zirconium etc . - crusting of different varieties from the prepared wet blues / wet whites - Necessary finishing of the prepared crust - cost evaluation of the prepared finished leather - Relevant physical tests of those leathers

Suggested Books :

- 6) Introduction to the Principles of Leather Manufacture - S . S . Dutta , 4th edition , ILTA , Calcutta .
- 7) Chemistry & Technology of Leather - Roddy , O' Flaharty & Lollar – Robert E . Krieger Publishing Co . N . Y .
- 8) Fundamentals Of Leather Manufacture - Eckhart Hidemann .
- 9) Theory & Practice Of Leather manufacture - K . T . Sarkar , Macmillan India Press , Madras .
- 10) Leather technician's Hand Book - J . H . Sharphouse , Vernon Lock Ltd . 125 , High Holborn , London Wc1 .

LP 595

METHODS OF LEATHER MANUFACTURE - III

0 - 0 - 3 - 2

Manufacture of different types of crust from raw Cow / Goat / Sheep / Buffalo hides & skins - Tanning with different vegetable tannins e . g . wattle , Quebracho, Chestnut, Gambier , Sumac , Babul , Myrobalan etc /Aldehydes / Different Syntans /Resins etc . - Crusting of different varieties from prepared tanned crusts - Necessary finishing of the prepared crust - Cost evaluation of the prepared finished leather - Relevant physical tests of those leathers.

Suggested Books :

B.TECH. LEATHER TECHNOLOGY

1. Introduction to the Principles of Leather Manufacture - S . S . Dutta , 4th edition , ILTA , Calcutta .
2. Chemistry & Technology of Leather - Roddy , O' Flaharty & Lollar – Robert E . Krieger Publishing Co . N . Y .
3. Fundamentals Of Leather Manufacture - Eckhart Hidemann .
4. Theory & Practice Of Leather manufacture - K . T . Sarkar , Macmillan India Press , Madras .
5. Leather technician's Hand Book - J . H . Sharpouse , Vernon Lock Ltd . 125 , High Holborn , London Wcl .

LT 601

PRINCIPLES OF LEATHER FINISHING

4 – 0 – 0 – 4

Classification of finishes. Characteristics of film. Theory of adhesion. Gloss and gloss retention. Different layers of finish coat. Theory of film formation. Nature of polymers used in finishing. Factors influencing the intermolecular forces of attraction. Plasticization and plasticizers. External and internal plasticization i.e. co-polymerisation, substitution branching. Function of different ingredients, gloss measurement.

Pigments: Its functions in leather finishing, classification, requirements in general. Insolubility, particle size and particle size distribution, determination of particle size distribution, interaction of pigments with the medium, surface properties, effect of different additives on the charge and dispersion properties of the pigment, stability properties, impact of pigment volume concentration on different properties. Method of preparation of aqueous pigments paste.

Optical properties of pigments-origin of colour in inorganic compound- opacity, Hiding power and tinting strength. Light fastness and thermal resistance. Difference between inorganic pigments and organic pigments.

General manufacturing procedure of pigments. Chemistry and properties of different pigments e.g. Titanium dioxide, Iron pigments, quinacridone pigments, Pthalocyanine pigments, Azo pigments, Carbon black.

Extender pigments- their functions in surface coatings.

Chemistry and properties of Luminescent pigments.

Binders: Theory of film formation: different types of polymeric materials and their suitability as film formers, Different factors influencing film properties, Glass transition temperature, its importance in film formation.

Chemistry & properties of leading film forming polymers- Polyacrylates, polyurethanes, polyacrylate- Butadiene copolymers, Styrene- Butadiene copolymers.

Chemistry and properties of Polyethylene, polypropylene, polystyrene, polyvinyl chloride, polyvinyl acetate, polyvinyl alcohol etc. in brief and reasons for their unsuitability in leather finishing- along with condensation resins- e.g. phenol formaldehyde, urea-formaldehyde, epoxy resins and alkyd resins.

Chemistry and properties of casein film and modified casein film, Nitrocellulose lacquer- their chemistry and properties, manufacturing process of N.C. lacquer and N.C. lacquer emulsion. Role of emulsifiers in producing a hydrophobic rough film, drawback of these top coating film formers.

Crosslinking polymers- their suitability in leather coating and merits over conventional thermoplastic polymers. Requisites of a polymer for cross linking phenomena.

Plasticization: Definition and classification- requirements of plasticization- mechanism- plasticization and glass transition temperature relationship- effect of plasticization on film forming properties- important type of plasticizer.

Solvents & Diluents: Definition- theoretical considerations of solvents- thermodynamical considerations- different important properties of solvent and diluent- other properties- Individual properties of some solvents and diluents.

Chemistry, properties and uses of other important auxiliaries in leather finishing e.g. Brightening dyes, formaldehyde, wax emulsion, silicon emulsion, other water proofing agents, matting agents, filler penetrator etc.

B.TECH. LEATHER TECHNOLOGY

Suggested Books :

1. Chemistry of Tanning Processes- K.H. Gustavson, Academic Press, N.Y.
2. Introduction to the Principles of Leather Manufacture- S.S.dutta, 3rd edition. I.L.T.A.
3. Chemistry of synthetic dyes- K.Venkatraman, Academic Press, N.Y.
4. Synthetic Detergents- A. Davidson & B.M. Milidsky.
5. Chemistry & Technology of Leather vol.2 & 3 – Roddy , Flaherty & Lollar- Robert E.Krieger Publishing co., N.Y.
6. Treatise on Coatings- Myers & Long. 5 vol. Marcel Dekher, N.Y.
7. SBP Board of Consultants and Engineers- “synthetic resins and their industrial applications” – Small Business Publication No.57.
8. Modern surface Coatings- Mylen & Sunderland.

LT602

METHODS OF LEATHER MANUFACTURE – III

4 – 0 – 0 – 4

Finishing of Leather: Aim and purpose of Leather finishing, Requirements imposed on Leather Finishes, influence of finish on the nature of the leather, its' behaviour, resistance to wear, composition of the finish, types of finish, pigment finish, water finishes, special pigment preparations, solvent based finishes, application of nitrocellulose finishes, brightening dyes for leather finishes, water- soluble brightening dyes, special use of basic dyes, color lakes, solvent soluble brightening dyes, pigmented nitrocellulose lacquers, coloured polymer dispersions, auxiliaries for leather finishing, bottoming agents- for glazed finishes , plated finishes & for nitrocellulose finishes, binders- for glazed finishes, for plated finishes, non thermoplastic binders, seasons based on organic solvents, plasticizers-for water finishes, for nitrocellulose finishes, fixing agents.

Leather finishing techniques: Preparing leather for finishing, grain clearing, wet pigmenting, buffing of grain surface, polishing, glazing, plating, printing and embossing, preparation of finishes,

Application of finishes -- pad coating, spray coating, Roller coating, design of Roller coater, curtain coating requirements, behaviour of curtain coating mixtures, drying conditions, fixation,

Testing of properties of finishes: Adhesion, rubfastness, fastness to water, elasticity, lightfastness, heat resistance, cold crack resistance, resistance to solvents, resistance to washing, cleansing and shoe dressing agents, polishability, bleeding in contact with plasticizers, resistance to ageing.

Mechanical Treatment: Buffing, Snuffing, Dedusting, Drying, Drymilling, Plating, Glazing, Spraying, Polishing, Roller coating, Polishing in Finiflex.

Suggested Books :

1. An Introduction To The Principles Of Leather Manufacture - S . S .Dutta .
2. Physical Chemistry Of Leather Making - Krzysztof Bienkiewicz .
3. Fundamentals Of Leather Manufacture - Eckhart Hidemann .
4. Chemistry And Technology Of Leather - Vol . II & III - Lollar , Roddy .
5. Theory And Practice Of Leather Manufacture . - K . T . SARKAR
6. Leather Tchnician's Handbook - J . H . Sharphouse .
7. Chemistry Of Tanning Process - K . H . Gustavson .

LT 603

ANALYTICAL CHEMISTRY OF LEATHER

4 – 0 – 0 – 4

01. Principles underlying analysis of the followings of Chrome tanned leather :

- i) moisture
- ii) Volatile matter
- iii) Total ash
- iv) Solvent extractable substances

B.TECH. LEATHER TECHNOLOGY

- v) Nitrogen and Hide substance
 - vi) Water soluble matter
 - vii) Chromic oxide content
 - viii) Difference figure of water-soluble matter.
- 02. Principles underlying analysis of the followings of vegetable tanned leather :**
- i) moisture
 - ii) volatile matter
 - iii) total ash
 - iv) solvent extractable substances
 - v) Nitrogen and Hide substance
 - vi) Water soluble matter
 - vii) Water insoluble ash
 - viii) Bound organic substances
 - ix) Degree of tannage
 - x) Difference figure of water soluble matter
 - xi) Invert sugar
 - xii) Epsom salt
- 03. Principles underlying analysis of the followings of Alum tanned leather :**
- i) moisture
 - ii) total ash
 - iii) solvent extractable substances
 - iv) Difference figure of water soluble matter
 - v) Water soluble matter
 - vi) Aluminium as Alumina
- 04. Principles underlying analysis of the followings of Combined tanned leather :**
- i) moisture
 - ii) total ash
 - iii) solvent extractable substances
 - iv) Nitrogen and Hide substance
 - v) Water soluble matter
 - vi) Chromic oxide content
 - vii) Degree of tannage
 - viii) Difference figure of water soluble matter
- 10. Principles underlying analysis of the followings of Zirconium tanned leather :**
- i) moisture
 - ii) total ash
 - iii) solvent extractable substances
 - iv) Water soluble matter
 - v) Zirconium Content
- 11. Principles underlying analysis of Formaldehyde tanned leather**
- 12. Principles underlying analysis of oil tanned leather**
- 13. Determination of iron, silicone, copper and phosphorous present in leather**

Suggested Books :

- 01. Analytical Chemistry of Leather Manufacture – P.K.Sarkar, 2nd edition, I.L.T.A. Calcutta, 1982
- 02. The Chemistry and Technology of Leather, Vol. – IV – F.O'Flaharty, W.T.Roddy & R.M.Lollar, Original edition, Krieger Publishing Co. Florida, U.S.A., 195
- 03. Official Methods of Analysis, S.L.T.C., U.K., 1965
- 04. Different Standards on leather issued by B.I.S. from time to time.

LT 604

FOOTWEAR & LEATHER GOODS TECHNOLOGY

4 – 0 – 0 – 4

Introduction:

History of footwear evolution . Nomenclature of different types of footwear. Different parts of footwear.

B.TECH. LEATHER TECHNOLOGY

Anatomy of human foot:

Bones, joints, muscles, ligaments, arches of skin of human foot. Common foot defects and their remedies. Internal & External changes of human feet from infant to adult stage. Functions of human foot. Analysis of human locomotion. Foot measurement. Foot comfort and Foot-care.

Last:

Definition, classification of last, different parts of last, methodology of seasoning of wood for wooden last; Last measurement; Comparison of last with human foot.

Designing and 'shoe sizes & fittings':

Introduction to Designing. Elements of Design. Elements of Fashion. Functions of a Designer. Design procedure related to footwear & other leather products. design documentation.

Limitations imposed by purpose, material and technical considerations. Concept of inside form, outside form and mean form. Different techniques to get these three forms. Concept of Bio-mechanical designing of shoe. . Relation between foot 'sizes & fittings' and shoe 'sizes & fittings'. English, American, French, Continental and Mondopoint shoe sizes and fittings system.

Pre-closing & closing operation:

Principle of clicking operation, different size & stitch marking system; skiving operation – its objectives & different types ;different types of edge –treatment ; lock-stitch & chain-stitch; different types of seam;

Construction :

Material selection, flow chart, methodology, advantages & disadvantages of Cemented construction, Good-year wetted construction, Veldtschoen construction, D.V.P. construction, D.I.P(PVC) construction & D.T.P(PU) construction.

Footwear materials:

Upper & Lining Materials : Different natural & synthetic materials; comparison between natural & synthetic materials.

Adhesive : Defination; different types of adhesion; different types of adhesive used in footwear industry-and their relative advantages & disadvantages.

Sole, Insole, Toe-puff, Shank, Stiffner, Heel, Thread and Needle: Required properties of these materials, different types of these material and their relatives advantages & disadvantages.

Leather goods :

Classification of Leather Goods; different types of tool used for making of footwear and Leather-goods.Designing and pattern cutting; fashion designing.

Selection criteria for manufacture of different types of articles.

Suggested Books :

1. Manual of Shoe Making - Clark.
2. Text book of Footwear Manufacture- J.H.Thronton.
3. Footwear Materials – Harvey.
4. Leather Work - I.P.Roseman ; The Manual Arts Press.

LT 605

EXOTIC LEATHER & BYE-PRODUCTS MANUFACTURE

4 – 0 – 0 – 4

Detailed manufacturing processes of the following leathers with the chemistry behind every unit operation. The processes would commence from raw hides & skins i.e. from beam house operations to finishing operations. Each unit operation should include the controlling factors and checkpoints in details.

1. Fancy Glove Leather.
2. Waterproof Glove Leather.
3. Heat resistant Glove Leather.
4. Glace Kid Leather.
5. Cow Suede Leather.
6. Goat Suede Waterproof Leather (full chrome/semi chrome).
7. Cow Nubuck Upper Leather .

B.TECH. LEATHER TECHNOLOGY

8. Cow Nubuck Garment Leather .
9. Brush – Off Upper Leather .
10. Cow Garment Nappa Leather .
11. Buffalo Garment Nappa Leather .
12. Goat Garment Leather .
13. Cow Shoe Nappa Leather .
14. Oil Pull – Up Leather .
15. Crackled Finished Split Leather .
16. Split Suede Water Proof Leather .
17. Buffalo Water Proof Leather .
18. Chrome Retanned Foot Ball Leather .
19. Stain Resistant Cow Upholstery Leather for furniture.
20. Buffalo Antifogging Upholstery Leather for automobile use..
21. Vegetable Tanned Lining Leather .
22. Chrome Tanned Goat Lining Leather .
23. Vegetable Tanned Sole Leather .
24. Chrome Tanned Sole Leather .
25. Antique Bag Leather .
26. Sheep Washable Garment Nappa .
27. Shrunken Grain Leather .
28. Drymilled Leather .
29. Drum Dyed leather .
30. Corrected Grain Leather .
31. Finished Split Leather .
32. Glaze Finish .
33. Chamois leather.
34. Harness and saddlery leather.
35. Dog chew.

Bye- Products: Types of animal bye-products from abattoirs, meat processing plants, tannery and other sources including fallen animals.

Glue and gelatine from different raw materials; difference in glue and gelatine, manufacturing process of glue and gelatine, equipments necessary for glue and gelatine manufacture, quality controls for technical, edible and pharmaceutical gelatines, difference between acid and alkali treated gelatine- their manufacturing process, properties and uses.

Assessment of quality-chemical treatments- preservation and packing for wool industry.
Bone products and their utilization.

Detanning and recovery of chromium, methods of making glue, gelatine, detergents, amino-acids from chrome shavings.

Manufacture of Leather Board.

Industrial applications of collagen other than leather industry, Manufacture of manure from unusable tannery products, recovery of chromium from effluents of tan yard.

Suggested Books :-

1. An Introduction To The Principles Of Leather Manufacture . –S . S . DUTTA .
4th edition , ILTA , Calcutta .
2. The Chemistry And Technology Of Leather . - Roddy , Lollar , Vol . II & III .
Robert . E . Krieger Publishing Co . N . Y .
3. Practical Aspects Of The Manufacture Of Upper Leathers . – J . M . DEY .

B.TECH. LEATHER TECHNOLOGY

- ILTA , Calcutta .
4. Theory And Practice Of Leather Manufacture . - K . T . SARKAR .
Mcmillan India Press , Madras .
 5. Journals Of ILTA .
 6. Leather Technician's Hand Book - J. H. Sharphouse .
Vernom Lock Road , 125 , High Holborn , London , W – C1
 7. Practical Leather Technology - Thomas C . Thorstenson , Robert . E.
Krieger Publishing Co . Inc. N. Y .
 8. Processing & Utilisation of animal bye-products- Mann. I, Food & agriculture Organisation
of the United Nations, Rome (1962)
 9. Animal Bye-products-their processing and utilisation- Scaria, K.J., Mahendra Kumar and
Divakarons, C.L.R.I. Madras-20 (1981)
 10. Animal wastes- taiganides, E.P. applied Science Publishers Ltd. Essex (1977).

LT 606

COMPUTER AIDED ENGINEERING GRAPHICS

3 – 0 – 0 – 3

Introduction to design:

Design procedure, Modeling of the design, Engineering design and analysis, Evaluation of prototype through simulation and testing, drafting & design documentation. Concepts of Limits, Fits & tollerances.

Introduction to CAD:

Reasons and application of CAD systems, Geometric modeling, benefits of CAD, Limitations of CAD, Hardware of CAD systems, concepts and application of FEM in footwear, geometrical tollerances,

Computer Hardware & Software:

Interactive display devices, CRT principle, DVST, Raster scan, Vector refresh, Flat screen, Plasma Senun, LCD, Input devices.

Digitalization:

2-D & 3D co- ordinate extraction, Principles of digital to analog conversion, digital input/output processing systems.

Image Processing:

Principle of strategies for collection data for imaging, data reduction and processing techniques with special reference to footwear design.

Suggested Books :-

- 1.Computer Graphics And Design - P. Radhakrishnan & C. P. Kothandaraman
- 2.Computer Graphics - Zhigang Xiang & Roy Palstock
- 3.Auto CAD for Dummies - Bud Smith
- 4.Groover, MP and EW Zinimers, 'CAD/CAM Computer Aided Design and Manufacturing,-
Prentice Hall of India (1986).

LP 691

COMPUTER AIDED ENGINEERING GRAPHICS

0 – 0 – 3 – 2

Principle of Computer Graphics:

B.TECH. LEATHER TECHNOLOGY

Point plotting techniques, Layout & sketching, Elements of drawing, DDA Algorithms, types of projections.

2D – Drafting:

2-D transformation- scaling, Translation, Rotation, Clipping and Windowing,

2-D Drawing, shading, dimensioning, text, continuous dimensioning, tolerances etc.

3-D transformation, 3-D modeling procedure.

Application of Image Processing Techniques and related software.

Suggested Books :-

1.Computer Graphics And Design - P. Radhakrishnan & C. P. Kothandaraman

2.Computer Graphics - Zhigang Xiang & Roy Palstock

3.Auto CAD for Dummies - Bud Smith

4.Groover, MP and EW Zinimers, 'CAD/CAM Computer Aided Design and Manufacturing,- Prentice Hall of India (1986).

LP 692

ANALYTICAL CHEMISTRY OF LEATHER

0 – 0 – 3 – 2

01. Analysis of the followings of chrome tanned leather

- i) Moisture
- ii) Ash
- iii) Chromic Oxide Content
- iv) Solvent extractable substances
- v) Water soluble matter and difference figure

02. Analysis of the followings of vegetable tanned leather

- i) Moisture
- ii) Ash
- iii) Water soluble matter & difference figure
- iv) Solvent extractable substances
- v) Hide substance
- vi) Water insoluble ash
- vii) Bound organic substances
- viii) Degree of tannage
- ix) Epsom salt
- x) Invert sugar

03. Analysis of the followings of Alum tanned leather :

- i) Moisture
- ii) Total ash
- iii) Solvent extractable substances
- iv) Aluminium as Alumina

04. Analysis of the followings of combined tanned leather :

- i) Moisture
- ii) Ash
- iii) Solvent extractable substances
- iv) Hide substance
- v) Water soluble matter & difference figure
- vi) Chromic oxide content

B.TECH. LEATHER TECHNOLOGY

- vii) Degree of tannage
- 05. Analysis of Zirconium tanned leather for the followings :**
- i) Moisture
 - ii) Ash
 - iii) Solvent extractable substances
 - iv) Zirconium Content
- 06. Analysis of formaldehyde tanned leather :**
- 07. Analysis of oil tanned leather**
- 08. Determination of iron, silicone, copper and phosphorous present in leather**

Suggested Books :-

1. Analytical Chemistry of Leather Manufacture – P.K.Sarkar, 2nd edition, I.L.T.A. Calcutta, 1982
2. The Chemistry and Technology of Leather, Vol. – IV – F.O'Flaharty, W.T.Roddy & R.M.Lollar, Original edition, Krieger Publishing Co. Florida, U.S.A., 1956
3. Official Methods of Analysis, S.L.T.C., U.K., 1965
4. Different Standards on leather issued by B.I.S. from time to time.

LP 693

FOOTWEAR AND LEATHER GOODS TECHNOLOGY

0 - 0 - 3 - 2

Different techniques of clicking. Tools and machinery for clicking. Nesting of different components.

Different steps of Pre-closing and Closing operations.

Different types of light footwear and slipper making.

Designing and pattern cutting of various leather goods. Making of Gents' & Ladies' money purses.

Suggested Books :

5. Manual of Shoe Making - Clark.
 6. Text book of Footwear Manufacture- J.H.Thronton.
 7. Footwear Materials – Harvey.
- Leather Work - I.P.Roseman ; The Manual Arts Press.

LP 694

FASHION DESIGNING

0 - 0 - 3 - 2

1. Basic styles for men's, women's and children's footwears.
2. Different methods to create Mean-forme (Paper Slotting Method; Starch Coated Cloth Method; Self Adhesive Tape Method; Vacuum Pressure method).
3. Drawing of patterns for Derby, Oxford and Court Shoes/ leather goods.
4. Modification of basic design as per modern fashion.
5. Principles of art design with related products. Pattern cutting of leather goods.
6. Pattern Generation for Chappal & other related Leather Products. Designing in the perspective of cost minimisation, waste minimisation, ergonomic designing.
7. Fashion and style trends.
8. Fashion sources.
9. Style Specification.

Suggested Books :-

1. Leather Work- Anne and Jane Lope.
2. Making Clothes in Leather- Ben and Elisabeth Morris.
3. Dictionary of Leather Working Tools c 1700-1750 and the tools of allied trades.
4. The Complete HandBook of Leather Crafting by Jane E. Garners.

B.TECH. LEATHER TECHNOLOGY

5. The Lather Craft Book - Pat Hills with Joan Wiener, Robert Hale. London.

LT 701

ECONOMIS OF LEATHER INDUSTRY

3 - 0 - 0 - 3

Introduction:

Economic importance of leather. Antiquity of leather industry. Uses of leather in different sorts of life.

Hides and Skins:

Indian livestock population over two decades – Hides and skins availability, their sizes, marketing centres, channels and prices over two decades.

Leather Industry:

Leather production - centres, prices and marketing channels. Statistics of production of leather in organised and village sector of tanning industry. Present and past condition of indigenous leather industry of India. Obstacles in the way of development of tanning in India and their possible Remedies.

Leather Products Industry:

Leather Products manufacturing centre, prices and marketing channels. Statistics of production of leather products in organised and village sector. Present and past condition of indigenous leather products industry of India.

Export Trade of Indian Leather Industry:

Procedures involved in imports and exports. India's export trade in leather and leather products – India's share at the global level – India's competitors and their strength – International prices – Indian Government policies in the export promotion – Role of Indian and Overseas promotional institutions for export growth – Strategies for export promotion – Market constraints (Quality, image, brand name & merchandising methods).

Project Identification and Preparation:

General considerations – Engineering aspects – Cost estimates and demand forecasting for leather and leather products – Different sources of finance – Budget preparation – Annual cost, variable cost and allocation of cost.

Suggested Books:

1. Indian Leather 2010 (A Technology, Industry and Trade Forecast) – Central Leather Research Institute, Madras.
2. The Indian Leather Industry – Secretariat for industrial assistance, Ministry of Industry, Govt. of India.
3. How To Export (Handbook on export business) – Small Industry Research Institute, Govt. of India.
4. Kothari's Desk Book Series - The Leather Industry.

Suggested Books :

01. Choice of technique in leather manufacture – M.M. Haq, H.Argaw – Scottish Academic Press. Edinburgh (1981)
02. Economics of Leather Industry- B.R.Rau, Calcutta University Press (1920).

LT 702

APPLIED STATISTICS & QUALITY CONTROL

3-0-0-3

a) Definitions of Probability & Related Basic Concepts:

Discrete and continuous probability distributions (Binomial, Poisson, Uniform, Normal, Gamma & exponential distributions), basic concepts of statistical population and random sampling, Mean Variance and covariance, Correlation coefficients, Moments. Basic concepts of Testing of Hypothesis. Analysis of variance and Co-variance.

b) Basic Concepts of Statistical quality Control (SQC):

Nature of Control limits, Purposes of control charts, Control charts for variables, Control charts for attributes, Cusum Control chart.

B.TECH. LEATHER TECHNOLOGY

Suggested Books :

LT 703 PHYSICAL TESTING OF LEATHER

0 - 0 - 3 - 2

STATISTICAL TESTING:

Basic statistical principles- Selection of sampling location for physical as well as chemical testing of leather.

Different methods and principles employed for physical testing of various leathers- measurement of tensile strength, stitch tearing strength, tongue tearing strength, modulus of elasticity at specified load and elongation at break.

MEASUREMENT OF PHYSICAL PROPERTIES OF LEATHER:

- ❖ Tear Strength.
- ❖ Ball Bursting Strength (Lastometer).
- ❖ Two Dimensional Extension.
- ❖ Shrinkage Temperature.
- ❖ Water vapour permeability.
- ❖ Resistance to abrasion of sole leather.
- ❖ Grain cracking (Conical Mandrel Test) in sole leather.
- ❖ Resistance to cracking of grain in other leathers.
- ❖ Resistance to repeated flexing.
- ❖ Water penetration (Kubelka Method).
- ❖ Dynamic waterproofness testing in both sole and upper leather.
- ❖ Non-destructive testing of leather.

Suggested Books :

1. An Introduction to the Principles of Physical Testing of Leather- Prof. S.S. Dutta, ILTA, Kolkata.
2. Technological Controls in Leather Manufacture – S.Bangaruswami, C.L.R.I.
3. The Chemistry and Technology of Leather – O' Flaherty, Roddy, Lollar, Robert E.Krieger Publishing Co. N.Y. (1977).

LT 704 MECHANICS OF LEATHER MACHINES-II

3 - 0 - 0 - 3

Leather Machinery:

Design and Construction of pits, drums and paddles, Hide processors; three compartment light speed drum, Mechanism, operation and control and adjustment of Fleshing, unhairing, shaving, sammying, staking, glazing, setting buffing, splitting and measuring machines and Ironing and embossing presses, Rotary Ironing machines, finiflex (Rotopress, Contilux) Foundation and erection of tannery machines.

Vacuum Drying and other drying equipment, roller coater, handling tools- Horse, pallets, fork lifters etc., conditioning machine.

Planning of Layouts:

Internal transport, safety, water and steam distribution, drainage and disposals in tannery, Layout of tannery pits, drums, paddles and machines, Maintenance in tannery, Automation in tannery.

Suggested Books :

1. Leather Technician's HandBook – J. H. Sharphouse, Leather Producers' Association, Northampton, 1971.
2. Lecture Notes on Leather – P. S. Venkatchalam, CLRI, Chennai, 1964.

B.TECH. LEATHER TECHNOLOGY

3. Different Catalogues issued by different Leather Machinery producers.

LT 705

THERMODYNAMICS

3 - 0 - 0 - 3

Concept of thermodynamics, system, surrounding, closed system, open system, isolated system. Properties of system, isothermal process, adiabatic process, isochoric process, isobaric process, quasistatic process, internal energy, state of a system, 1st law of thermodynamics, reversible, irreversible process, work done in isothermal reversible process for ideal real gases, enthalpy and its physical significance, relation between internal energy and enthalpy, C_p and C_v and its relation, Kirchoff's equation, adiabatic changes.

Second law of thermodynamics, Carnot cycle, Carnot theorem, Joule- Thomson and throttling process and its application for vander Waals gases, Clausius inequality, entropy and its characteristic and expression, entropy change, in reversible and irreversible cyclic process, entropy relation with internal energy and enthalpy. Temperature dependence of entropy, entropy of an ideal gas and mixture of gases, Gibb's free energy and Helmholtz free energy, mathematical expression for ideal and real gases, standard and free energy, Gibbs-Helmholtz equation, Maxwell relations. Condition of spontaneity and equilibrium, Nernst heat theorem, the third law of thermodynamics, partial molal quantities, chemical potential, Gibbs-Duham relation, effect of pressure and temperature on chemical potential. Partial heat capacity, partial molal volume, activity and activity coefficient, fugacity, Nernst distribution law, Raoult's law.

Clapeyron equation, clausius-clapeyron equation, relation between the entropy and the chemical constant.

Suggested Books :

1. Thermodynamics for chemists- S. Glasstone.
2. Thermodynamics – P.C. Rakshit.
3. Thermodynamics- Zeemansky.

LP 791

PHYSICAL TESTING OF LEATHER

3 - 0 - 0 - 3

conditioning of Leathers for physical testing purpose. Determination of strength of tensile strength, stitch tear strength, tongue tear strength, buckle strength, tearing strength and percent elongation at break.

TESTING FOR UPPER LEATHER & OTHERS:

Bursting strength of upper leather, grain crackiness of upper leather, air and water vapour permeability, dry and wet rub fastness of dyed and finished leather. Measurement of shrinkage temperature, measurement of water penetration. Measurement of flexing endurance, Measurement of two- dimensional extension. Hand measurement of leather and sampling location both physical and chemical testing. Non- destructive testing of leather.

TESTING FOR SOLE LEATHER:

Measurement of apparent and real density and porosity of sole leather. Determination of abrasive resistance of sole leather. Dynamic waterproofness of sole leather. Hardness determination of sole leather. Determination of bond strength between the leather surface and the finish film of finished upper leather. Cold crack resistance of finished upper leather.

Suggested Books :

1. An Introduction to the Principles of Physical Testing of Leather- Prof. S.S. Dutta, ILTA, Kolkata.
2. Technological Controls in Leather Manufacture – S.Bangaruswami, C.L.R.I.
3. The Chemistry and Technology of Leather – O' Flaherty, Roddy, Lollar, Robert E.Krieger Publishing Co. N.Y. (1977).

B.TECH. LEATHER TECHNOLOGY

LP 792 MECHANICS OF LEATHER MACHINES-II

0 - 0 - 3 - 2

Study and adjustment of different parts of Fleshing, shaving, staking, buffing, glazing, setting and measuring machines.

Dismantling and assembling of mechanical type of shaving machine and staking machine.

Suggested Books :-

1. Leather Technician's HandBook – J. H. Sharpouse, Leather Producers' Association, Northampton, 1971.
2. Lecture Notes on Leather – P. S. Venkatchalam, CLRI, Chennai, 1964.
3. Different Catalogues issued by different Leather Machinery producers.

LP 793 EXOTIC LEATHER MANUFACTURING METHODS – I

0 - 0 - 3 - 2

Manufacture of different types of light / fancy categories crust from previously tanned different kind of metal tanned wet blues / wet whites Necessary finishing of the prepared crusts - Cost evaluation of the prepared finished leather - Relevant physical tests of those leathers - Market evaluation by industrial experts .

Suggested Books :-

1. Introduction to the Principles of Leather Manufacture - S . S . Dutta , 4th edition , ILTA , Calcutta .
2. Chemistry & Technology of Leather - Roddy , O' Flaharty & Lollar – Robert E . Krieger Publishing Co . N . Y .
3. Fundamentals Of Leather Manufacture - Eckhart Hidemann .
4. Theory & Practice Of Leather manufacture - K . T . Sarkar , Macmillan India Press , Madras .
5. Leather technician's Hand Book - J . H . Sharpouse , Vernon Lock Ltd . 125 , High Holborn , London Wcl .

LP 794 EXOTIC LEATHER MANUFACTURING METHODS -II

0 - 0 - 3 - 2

Manufacture of different types of light / fancy categories crust from previously tanned vegetable / synthetic tanned / aldehyde tanned / oil tanned crusts - Necessary finishing of the prepared crusts - Cost evaluation of the prepared finished leather - Relevant physical tests of those leathers - Market evaluation by industrial experts .

Suggested Books :-

6. Introduction to the Principles of Leather Manufacture - S . S . Dutta , 4th edition , ILTA , Calcutta .
7. Chemistry & Technology of Leather - Roddy , O' Flaharty & Lollar – Robert E . Krieger Publishing Co . N . Y .
8. Fundamentals Of Leather Manufacture - Eckhart Hidemann .
9. Theory & Practice Of Leather manufacture - K . T . Sarkar , Macmillan India Press , Madras .
10. Leather technician's Hand Book - J . H . Sharpouse , Vernon Lock Ltd . 125 , High Holborn , London Wcl .

B.TECH. LEATHER TECHNOLOGY

LT 801

POLYMER SCIENCE AND TECHNOLOGY

0 - 0 - 3 - 2

- 01. Science of Macromolecules:** Basic concepts, molecular forces and chemical bonding in polymers, molecular weight and its distribution.
- 02. Step Reaction Polymerisation:** Classification of polymers and polymerisation mechanisms, mechanisms of step growth polymerisation, kinetics, polyfunctional step growth polymerisation.
- 03. Radical Chain polymerisation:** Mechanism of vinyl polymerisation, kinetics of chain growth polymerisation, molecular weight and its distribution,
- 04. Ionic and Co-ordination Chain Polymerisation:** Similarity and contrasts in ionic polymerisation, mechanisms and kinetics of anionic, cationic and co-ordination polymerisations.
- 05. Copolymerisation:** Kinetics of copolymerisation, composition of copolymers, mechanism of copolymerisation, blocks and graft polymers.
- 06. Polymerisation Conditions and polymer Reactions:** Polymerisation in homogeneous and heterogeneous systems, polymerisation engineering, chemical reaction of polymers.
- 07. Polymer Solutions:** Criteria for polymer solution, conformation of dissolved polymer chains, thermodynamics of polymer solution.
- 08. Measurement of Molecular Weight and Size:** End group analysis, colligative properties measurement.
- 09. Structure–Property Relationship:** Polymer folding, thermodynamic and kinetic flexibility, Crystallisation and melting of polymers and the factors responsible, glass transition and phase transition of polymers.
- 10. Determination of Thermal Behaviour of Polymers:** Principles of DSC, DTA, TGA analyses.
- 11. Plasticization and Crosslinking of polymers:** Theory and mechanisms of plasticization, kinds of plasticizers, crosslinking of polymers and its effect in the physical property of polymer network.

Suggested Books: -

1. Textbook of Polymer Science-Billmeyer, F.W. Jr. (1994), 3rd Edn. Wiley Interscience Publication N.Y.
2. Polymer Science and Technology of Plastics and Rubbers -Ghosh, P.M. (1990), 2nd Edn.Tata McGraw-Hill Publishing Co. N.D.

B.TECH. LEATHER TECHNOLOGY

3. The Chemistry and Physics of Polymers -Kuleznev, V.N. and Shershnev, V.A. (1990) Mir Publishers, Moscow.

LT 802 INDUSTRIAL MANAGEMENT AND ACCRERDITATION PLANNING

0 - 0 - 3 - 2

Nature and scope of Business Administration - Definition - Nature - Management is science & art or both. The common aim of all management - Management ethics - Social responsibility of management .

Planning - Nature of Planning - characteristics - Advantage and limitations of Planning

Organisation - Nature and purpose - Principles of Organisation - Types of Organisation .

The line and staff relationship - concepts - Responsibilities - Line and staff authority relationship **Motivation and Direction** - Human relation & industrial psychology - Process of motivation - the average man , some theories and concepts of man and his nature . Motivation analysis - theories models - Money as a motivator .

Control - meaning - Steps in control - The human element in control and the control steps .

Cost control - Costing - Classification of costs - Advantages of costing - break even chart .

Budgetary control - Areas of budgeting - Certain innovations of budgetary control - Program budgeting - Performance budgeting - Milestone budgeting .

Industrial administration - Nature manufacturing - Principal functions - Research and product development - Building Plants and Equipments - Methods of Analysis and control - Material control - Inventory control Quality control - Production control .

Total Quality Management - Historical background - Importance of Quality - TQC and TQM - The Kaizen philosophy - Components of TQM -The PDCA cycle - Tools Techniques required for TQM implementation - Rating factory profits through waste elimination .The 5S campaign - The 4M check list - House keeping - Work sheets .

Planning for continuous improvement - Team concept - Organisational structure for continuous improvement .

Quality and Costs system concept - Quality cost definition - Quality cost matrix - Zero defect level **Process management** - Requirements necessary for process stability - Guidelines and forms for performing process analysis - Project management - Project planning system Developing the team - Problem identification - Prioritization and solution - Material flow analysis Flow process chart - Computer application to Quality system - Benchmarking - Software development - Quality standard in developing countries - Western Europe - United States - Japan - Peoples Republic Of China - Latin America .

Pareto analysis - Steps for performing Pareto analysis - CE Diagram & force Field Diagram .

Brainstorming - Random brainstorming - Structured Brainstorming - Recommended rules and techniques for a brainstorming session .

Quality Circles - History of QC - Structuring and operating a Quality Circle - Several new QC tools - Quality function Deployment .

Just – In – Time Philosophy or JIT Philosophy - JIT implementation - Kanban inventory system .

ISO 9000 - TheOrigin and Development of standards - Terminologies used in context of ISO 9001 - ISO 9000 certification procedure - Proposed modifications .

Suggested Books :-

1. Ghosh , S.K. , A Guide to ISO 9000 Implementation - Oxford Publishing House .
2. Juran , J .M and Gryna , F .M (Jr) . Tata Mcgraw - Hill Publication .
3. A Guide To Total Quality Management - K . Maitra & S . K . Ghosh .

B.TECH. LEATHER TECHNOLOGY

4. Management - Koontz , O" Donnel , Wehrich .
5. Juran's Quality Hand book - Juran & Godfrey .
6. Management Challenges For 21st Century . - Peter . F . Drucker .

LT 803 PLANT LAYOUT AND PROJECT FORMULATION OF TANNERY

0 - 0 - 3 - 2

Introduction to Plant Layout; Scope and Importance; Factors affecting Plant Layout; Approach to Designing, Organisation for layout; Data Acquisition and Analysis for basic layout; Planning for Layout, Developing and Installation of the Layout, Case Studies of plant layout.

Terms of reference, background of the project, background of the organisation and status now and foreseen, location and suitability- capacity and target decision, building and shed etc., study of water, electricity, storage facilities and other environmental conditions,

Study of pollution control systems, study of availability of raw materials and proposed arrangement, determination of product mix, analytical study of raw material/ chemical/ product mix/ capacity, study of technical capabilities and input, types of machines required- both indigenous and imported, analysis of quality of machines making end products and keeping provision for flexibility, study of established machine manufacturer, appropriate charges of various operations per piece and output, study of organisational structure and manpower, marketing and market survey, total capital requirement, means of financing, cost estimation of buildings, scheme wise estimate of building, manpower requirement, wages calculation (direct wages) , management/staff requirement (including fringe benefits), indirect salary and wages, calculation of total estimated overheads, estimation of Break-Even points, assumption of projected profitability, list of plant and equipment and prices thereof, energy requirements and capacity of plant & equipment, boilers, estimated electrical installation, statement of projected profitability, details of taxation, projected cash flow statement, details of depreciation (preparation of cost of running individual machines),

Set up of industrial characteristics: production parameters, structural parameters, input parameters etc.

Key Co-efficient: Productivity/man, yield in terms of flow space, yield per hide, power factor, consumption of chemicals, consumption of fuel, consumption of electricity, unit consumption of chemicals, hides/skins per worker, output per worker in terms of weight, availability of electricity from plant generators, water consumption, water consumption per kg. of input, transformation, weight of individual machines, output of machines, boiler output in respect to hides/ kg., relationship to flow space to heating area of boilers, output in terms of flow space, relationship of flow space to horsepower, processing capacity of the horsepower installation, output of the compressors, relationship of water consumption to flow space, relationship of drum capacity to flow space.

B.TECH. LEATHER TECHNOLOGY

Suggested Books :-

LTO 607

QUANTUM MECHANICS

3 – 0 – 0 – 3

Postulates Of Quantum Mechanics, Observable, Operators, Schrodinger Equation, Eigen Values, Eigen Functions, Commuting Operators, Uncertainty Principle, Schwartz Inequality, How to write Hamiltonian?

Free particle, quasi-free particle, particle in a one-dimensional potential box, simple hermonic oscillator, vibrational spectra, a selection rule orbital, angular momentum, angular wave function, schrodinger equation for H₂ atom, atomic orbital.

Variational principle, many-electron wave function, slater determinant, hatree-fock model, electron spin, total angular momentum, rotational spectra, selection rule, molecular orbitals, hybrid orbitals, koopman's theorem, virtual orbitals, building up of elements, slater rule, aufbau principle

Born-ohrenheimer approximate, hückel molecular orbital treatment, resonance energy of some organic components, ethylene, allyl system, cyclopropenyl system etc.

Raleigh-schrodinger perturbation theory, zeeman and stark effects, lande g-factor, spin orbit interaction, crystal field splitting, ligand field theory, anharmonic oscillator.

Time-dependent perturbation theory, transition probability, fermi golden rule, auger effect, electron and proton transfer, hermonic perturbation, einstein coefficients of induced emission and absorption, black-body radiations, absorption spectroscopy, selection rules.

Suggested Books: -

1. "Quantum Mechanics -----An Introduction"----L.I. Schiff.
2. "Quantum Mechanics ----- An Introduction" ---H.L. Strass.
3. Quantum Theory -----D.Bohm.

B.TECH. LEATHER TECHNOLOGY

4. Lecture on Quantum Mechanics --- G. Baym.
5. Quantum Chemistry --- H.Eyig, f. Watter, and G.E.Kimbal.
6. Introduction to Quantum Mechanics ---- L.Pauling and E.B. Wilson.
7. 'Variation method in Quantum Chemistry' -----S.T. Epstein.
8. Quantum Chemistry ---I. Levine.
9. The molecular Orbital Theory of Conjugal Systems -----L.Salem.
10. Quantum Theory of atomic structure -----J.C. Slater.
11. The Hatree-Fock Theory of Atoms ----C.Froese-Fiseher.
12. Molecular Structure and Bonding ----B.M. Grievance.
13. Group Theory and its Atomic Spectra ----E.P.Wigher.

LTO 608

PHOTOCHEMISTRY OF LEATHER AUXILIARY

3 - 0 - 0 -3

1. **Fundamentals of Photochemistry:** Characteristics of light, Maxwell's equation, Wave-particle duality. Light as source of energy, Blackbody radiation, Planck' radiation law, laws of photoelectricity, Compton's scattering, De Broglie's hypothesis, Heisenberg's uncertainty principle, simple application, Schrodinger's equation, simple solution, zero-order perturbation theory, Pauli's exclusion principle, Hund's rule of multiplicity, fundamentals of molecules- VB treatment, MO theory, FEMO theory (particle-in-box), quantum mechanical model of molecule, concept of electronic, vibrational, rotational and transitional energies. First law of photochemistry, second law of photochemistry.
2. **Chemistry of the Excited States:** L-S coupling, selection rule for electronic transitions, chemistry of antibonding orbitals, electronic transitions, singlet state, triplet state, intersystem crossing, fluorescence, factors affecting fluorescence phosphorescence, sensitization, photofragmentation, photochemical free radical substitution (halogenation and sulfochlorination), radiation stabilisers and their reaction mechanism, optical bleaching, optical darkening, light fastness of dye molecules and tan stuffs.
3. **Photochemical Primary Processes:** Classification of photochemical processes, rate constants and lifetime of reactive energy states, effect of light energy on the photochemical reactions.
4. **Inorganic and Organic Photochemistry:** Photooxidation, photooxygenation and photoreduction, cycloaddition, Woodward-Hoffman rule of electrocyclic reaction, Chemiluminescence, transitional metal complexes.
5. **Current Topics of Photochemistry:** Origin of life, mutagenic effect of radiation, photosynthesis, photoelectrochemistry of excited state redox reaction, solar energy conversion and storage.

Suggested Books: -

1. Fundamentals of Photochemistry- Rahotgi-Mukherjee, K.K., (1978) Wiley Eastern Ltd. N.D.
2. Molecular Reactions and Photochemistry -DePuy, C.H. and Chapman, O.S. (1988) Prantice-Hall of India, N.D.
3. The Importance of Antibonding Orbitals -Orchin, M. and Jaffe, H.H. (1967) Oxford & IBH Publishing Co., N.D.

LTO 609

SAFETY & OCCUPATIONAL HEALTH OF LEATHER INDUSTRY

3 - 0 - 0 -3

Introduction to Occupational Health & Safety.

Basic principals in Epidemiological Practice:

How to perform an investigation, Basic measures & terms, Epidemiological researchs, retrospective cohort studies, concept of 'relative risk', preventive role of epidemiology.

Ergonomics & Occupational Injuries:

B.TECH. LEATHER TECHNOLOGY

Approach to prevention of occupation. Injuries, improvement of work & work place design, Use of anthropometric data. Biomechanics of lifting, pushing, pulling. role of environmental factors in occupational injuries. Setting up an 'ideal' computer work station.

Musculoskeletal injuries (mention only with causes), cumulative trauma disorders-occupations associated with.

Noise & Occupational hearing loss-prevention of hearing loss.

(1) Noise & its measurements, Impact & impulse noise, sound level meters, noise exposure evaluation, machines of hearing – brief overview, hearing tests, TTS, Assessment of hearing loss- brief overview, hearing conservation – reduction of noise exposure.

Working in heat – effects on human system.

thermal environment, heat exchange man-environment, response and adaptation to work in heat, occupations with 'heat' risk, Heat cramps, heat exhaustion, Heat stroke stress criteria-WBGT index, Effective temperature, effect of heat on productivity, control of heat stress.

Working with non-ionising radiation.

solar radiation, Infrared, visible radiation, ultraviolet, extreme low frequency radiations, lasers, electric fields, magnetic fields, -known effects, unconfirmed effects.

Ionizing Radiation

radiation physics-basics, radiation measurements, biological effects of radiation in man. Sources of radiation in the workplace. External radiation exposure prevention, shielding, radiation exposure guidelines for works.

Occupational Toxicology

basic principles, toxicokinetics, inhalation toxicology, toxicity testing, carcinogenesis, application of toxicology.

Biological monitoring

Environmental & biological monitoring, exposure monitoring, effect monitoring sources of error & quality assurance, monitoring exposure to carcinogens, In vivo measurement of body burden of chemicals, interpretation of chemicals, Interpretation of result, Analysis of specific chemicals-Al, As, Cd, Cr, Pd, Mn, Hg, CS₂, CO & Benzene, Toluene, Xylene, Dichloro methane, etc.

Occupational exposure and effects of some specific agents--

(incidence, industrial occurrence, jobs involved and at high risk, systemic effects, acute effects, chronic effects, preventive measure, bio-monitoring, symptoms & signs of ailments, treatments as available)

Occupational health laws in India-

Factories act, workmen's compensation act, ESI act-schedule of compensable occupational diseases, legal requirements as per factories act-physical amenities to be provided by employer, obligation of employer, obligation of practitioner in the field.

Suggested Books:

1. Occupational Medicine, 3rd Ed, Mosby, ---Carl Zenz, Ed: O. Bruce Dickerson, Edward P. Horvath Jr.
2. Occupational & Environmental Medicine, 2nd Ed, Prentice-Hall Int. Inc. Ed Joseph Ladon.

LTO 706

INDUSTRIAL SOCIOLOGY

3 - 0 - 0 - 3

1. Nature's definition and scope of industrial sociology.
2. Industrialisation process: early industrialisation, and its impact on temporary society.
3. Characteristics of industrial organisation.
4. Scientific management.
5. Hawthorne experiments and their impact on organisational structure.
6. Role of formal and informal groups.
7. Industrial management: Concept and techniques of management, top, middle and first levels of management.
8. Industrial relations and work; concept of work in traditional (Hindu) and modern societies.

B.TECH. LEATHER TECHNOLOGY

9. Workers and management relations: Consensus versus conflict process; arbitration, adjudication and conciliation.
10. Social structure and trade unionism: trade unionism as an instrument of power, collective bargaining, trade unions, strikes and lockouts.
11. Industry and society: Industry and community; industry and family; industry and government; industrialism and social change; automation
12. and its effect on society.

LTO 707 INDUSTRIAL PSYCHOLOGY & ORGANISATIONAL BEHAVIOUR

3 - 0 - 0 - 3

1. **Introduction:** Meaning; objectives; scope; definition; methods of psychology applied to industry; history of industrial psychology.
2. **Occupational information:** Definition; occupational information and psychology; job description; job analysis; job evaluation; methods of evaluation.
3. **Individual differences and their evaluation:** introduction; personality, traits; motives; scheme; individual differences in various traits; expressive traits; physical traits; movement traits; perceptual traits; style traits; age and sex; physical performance Traits; intellectual abilities; interest.
4. **Personnel selection:** The selection problem; the problem on criteria; some available criteria; company records; rating critical; incident technique; forced-choice technique; selection by interview and application blank.
5. **Personnel test:** Value, use; status of intelligence test; steps in a test program; purposes of personnel tests in industry; selection; placement; promotion; kinds of personnel test, clerical ability; mechanical ability; personality; trade.
6. **Training in industry:** Introduction; steps in training needs; human relations; production waste; upgrading; satisfaction; safety; versatility; free enterprise; culture; training methods; systematic versus unsystematic training; individual training; conference versus lecture; case discussion; role playing.
7. **Accident and safety:** Concept of accident; cause of accident; personal factors, intelligence, vision, co-ordination; personality characteristics; fatigue experience: basic acceptance; environmental conditions related to accidents; lighting and temperature; severity of work; industrial theories of safety psychology; accident proneness theory ; goals; freedom_ alertness theory; adjustment-stress theory; industrial safety programme; overall accident prevention strategy.
8. **Work and Conditions of Work:** Common characteristics of work; rest, pauses and worker efficiency; repetitive work; eliminate boredom ;time and motion study; working environment noise, music atmospheric effects; financial incentives as applied to people at work.
9. **Motivation:** motivation and work; fundamentals of motivation; important incentives; Pay, wage-incentive systems; competition, praise and punishment; knowledge of result ; participation ; arousing enthusiasm.
10. **Attitudes, Job-Satisfaction and Morale:** methods of finding employee attitudes; factors related to jobsatisfaction; personnel factors; inherent in the job; increasing job satisfaction ; meaning of morale; measurement and factors of morale; improving morale.

LTO 708 ECOLOGICAL ENGINEERING & ECOAUDIT

3 - 0 - 0 - 3

1. **Ecosystem Concept:**
 - 1.1. Definition and Types

B.TECH. LEATHER TECHNOLOGY

- 1.2. Biogeochemistry
- 1.3. Eco-cycling and Eco-energetics

2. Ecology and Individual Organisms:

- 2.1 Tolerance Range
- 2.2 Limiting Factors and Environmental Complex
- 2.3 Ecological Indicators

3. Population Ecology:

- 3.1 Population Growth
- 3.2 Population Density and Regulation

4. Community Ecology:

- 4.1 Organisation of Communities and Types of Interactions
- 4.2 Ecological Diversity
- 4.3 Natural Landscape and Community Change

5. Resources and Pollution:

- 5.1 Renewable and non-renewable resources
- 5.2 Bio-degradable and non-biodegradable pollutants
- 5.3 Treatment and Disposal Techniques
- 5.4 Eco-sphere and Pollution

6. Ecotoxicology:

- 6.1 Disciplines and Relevance of Toxicological Studies
- 6.2 Toxic response in Organisms
- 6.3 Exposure, Accumulation and Biotransformation of Toxins
- 6.4 Excretion of Toxic Agents
- 6.5 Toxic Action and Detection of Exposure
- 6.6 Toxicity Reduction and Antidotal Procedures

7. Ecotechnology:

- 7.1 Biomaniipulation of eutrophication.
- 7.2 Biofilters for hazardous wastes.
- 7.3 Construction of Reed-beds land treatment of wastewater
- 7.4 Vermi-composting – system, design, benefits and limitations.
- 7.5 Biogas technology – requirements, operation, benefits and limitations.
- 7.6 Aquatic weeds and their utilisation in phytoremediation.
- 7.7 Wastewater fed aquaculture – energy from effluent.
- 7.8 Garbage farming – energy from solidwastes.

Suggested Books: -

- 1. Fundamentals of Ecology -Odum, E.P.
- 2. Basic Ecology-Odum, E.P.
- 3. Ecology-Chapman,
- 4. Instant notes on Ecology -Mackenzie, A., Ball, A.S. and Virdee, S.R. (1999) Viva Books pvt. Ltd. N.D.

LT0 709

ADVANCED BIOTECHNOLOGY OF LEATHER

4 – 0 – 0 – 4

Histology of Leather:

Connective tissue proper –

B.TECH. LEATHER TECHNOLOGY

Introduction ,origin of connective tissue fibres , Loose connective tissue, Extracellular components, collagenous fibers, Elastic fibres, Reticular fiber, Ground substance, , Fibroblasts, Mesenchymal cells, adipose cells,

Histological characteristics of different hides and skins –

Buffalo, Cow, Goat and Sheep.Histological characteristics of Hair

Histological characteristics of different processed & finished leather.

Histological processes for preparation of hides and Skins for observation under microscope.

Photomicrography and its utility in leather science.

Fermentation-

Mechanism of alcoholic fermentation of carbohydrate, bacterial fermentation, fermentation by coliform organisms, fermentation of nitrogenous compounds, vinegar.

Bacterial Genetics—

Biosynthesis of deoxyribonucleic acid (DNA)- structure of DNA, the biosynthesis of nucleotides in DNA strands,, replication of the DNA molecule, transcription & translation of genetic information, the process of protein synthesis.

bacterial mutation- types of mutation, how mutations occur, how mutations are repaired, bacterial recombination, bacterial conjugation,bacterial transduction, bacterial transformation., recombinant DNA technology, DNA cloning .

Suggested Books :-

- 1)Microbiology- Michel J . Pelczar, JR, E.C.S. Chan,
Noel R. Krieg (Fifth Edition)
- 2)Molecular Biology of the gene-watson, Hopkins, Roberts, Steitz
Weiner (Fourth Edition)
- 3)Standard Methods –Examination of water and wastewater-20th Edition
Lenove S. Clesceri, Arnold E. Greenberg,Andrew D. Eaton
- 4)Biological wastewater treatment-Theory and applications-C.P. Lesline,
Grady,Jr. Henry C. Lim.
- 5)The Science of Ecology- Second Edition-Richard Brewer.