

Maulana Abul Kalam Azad University of Technology, West Bengal
(Formerly West Bengal University of Technology)
Syllabus for B. Tech in Leather Technology
 (Applicable from the academic session 2018-2019)
Curriculum Structure

Semester-III(2nd Year)						
3A. THEORETICAL PAPERS						
<i>COURSE NO.</i>	<i>COURSE TITLE</i>	<i>L</i>	<i>T</i>	<i>P</i>	<i>Total</i>	<i>Cr.</i>
HU 301	Values and Ethics in Profession	2	0	0	2	2
CH(LT) 301	Histology and Microbiology of Leather Manufacture - I	2	0	0	2	2
CH (LT)302	Biology for Engineers	3	0	0	3	3
LT 301	Fluid Mechanics	2	0	0	2	2
LT 302	Bio Chemistry of Protein & Fundamentals of Pre-tannage	3	0	0	3	3
LT 303	Fundamentals of Digital Computer	2	0	0	2	2
<i>Total Credits of Theoretical Papers</i>		14				
3B. PRACTICAL PAPERS						
CH(LT) 391	Histology and Microbiology of Leather Manufacture Lab - I	0	0	3	3	2
LT 391	Fluid Mechanics Lab	0	0	3	3	2
LT 392	Tannery Practice I	0	0	3	3	2
LT 393	Applied Information Technology Lab	0	0	3	3	2
<i>Total Credits of Practical Papers</i>		8				
<i>Total Credits of Semester</i>		22				

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Semester-IV(2nd Year)						
4A. THEORETICAL PAPERS						
<i>COURSE NO.</i>	<i>COURSE TITLE</i>	<i>L</i>	<i>T</i>	<i>P</i>	<i>Total</i>	<i>Cr.</i>
M(CS) 401	Numerical Methods	2	0	0	2	2
LT 401	Thermodynamics	2	0	0	2	2
LT 402	Chemistry & Technology of Inorganic Tannage	2	0	0	2	2
LT 403	Analytical Chemistry of Leather Auxiliaries –I	2	0	0	2	2
LT 404	Leather Footwear Design & Manufacture	2	0	0	2	2
LT 405	Histology and Microbiology of Leather Manufacture - II	2	0	0	2	2
<i>Total Credits of Theoretical Papers</i>		12				
4B. PRACTICAL PAPERS						
HU 481	Communication skill & Report Writing	0	0	3	3	2
M(CS)491	Numerical Methods with C Programming	0	0	2	2	2
LT 491	Tannery Practice II	0	0	3	3	2
LT 492	Analytical Chemistry of Leather Auxiliaries Lab-I	0	0	3	3	2
LT 493	Footwear Design Lab	0	0	3	3	2
LT 494	Histology and Microbiology of Leather Manufacture Lab - II	0	0	3	3	2
<i>Total Credits of Practical Papers</i>		12				
<i>Total Credits of Semester</i>		24				

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Semester-V(3rd Year)						
5A. THEORETICAL PAPERS						
<i>COURSE NO.</i>	<i>COURSE TITLE</i>	<i>L</i>	<i>T</i>	<i>P</i>	<i>Total</i>	<i>Cr.</i>
HU (LT) 501	Economics of Leather Industry	2	0	0	2	2
LT 501	Chemistry & Technology of Organic Tannage	2	0	0	2	2
LT 502	Applied Statistics and Quality Control	2	0	0	2	2
LT 503	Environmental Engg of Leather Processing	2	0	0	2	2
LT 504	Studies on JAVA	2	0	0	2	2
LT 505	Leather Goods Design & Manufacture	2	0	0	2	2
<i>Total Credits of Theoretical Papers</i>		12				
5B. PRACTICAL PAPERS						
LT 591	Tannery Practice III	0	0	3	3	2
LT 592	Leather Goods Design Lab	0	0	3	3	2
LT 593	Studies on JAVA Lab	0	0	3	3	2
LT 594	Analytical Chemistry of Wastewater related to Leather Processing	0	0	3	3	2
<i>Total Credits of Practical Papers</i>		8				
<i>Total Credits of Semester</i>		20				

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Semester-VI(3rd Year)						
6A. THEORETICAL PAPERS						
<i>COURSE NO.</i>	<i>COURSE TITLE</i>	<i>L</i>	<i>T</i>	<i>P</i>	<i>Total</i>	<i>Cr.</i>
HU 601	Principles of Management	2	0	0	2	2
LT 601	Chemistry & Technology of Post Tanning Operations	2	0	0	2	2
LT 602	Physical Testing of Leather	2	0	0	2	2
LT 603	Mechanics of Leather Machines and Design of Machine Parts	2	0	0	2	2
LT 604A	Material Science	2	0	0	2	2
LT 604B	Safety & Occupational Health of Leather industry					
LT 604 C	Industrial Sociology					
LT 605 A	DATA BASE Management System	2	0	0	2	2
LT605B	Industrial Psychology & Organisational Behaviour					
LT605C	Ecological Engineering and Eco- Audit					
<i>Total Credits of Theoretical Papers</i>		12				

6B. PRACTICAL PAPERS						
LT 691	Physical Testing Lab	0	0	3	3	2
LT 692	Mechanics of Leather Machines Lab	0	0	3	3	2
LT 693	Instrumental Analysis of Leather & Leather Chemicals	0	0	3	3	2
LT 694	DATABASE Management Lab	0	0	3	3	2
LT 695	Seminar			2	2	1
<i>Total Credits of Practical Papers</i>		09				
<i>Total Credits of Semester</i>		21				

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Semester-VII(4th Year)						
7A. THEORETICAL PAPERS						
<i>COURSE NO.</i>	<i>COURSE TITLE</i>	<i>L</i>	<i>T</i>	<i>P</i>	<i>Total</i>	<i>Cr.</i>
LT 701	Chemistry & Technology of Leather Finishing Operations	2	0	0	2	2
LT 702	Eco - Benign Options for Leather Processing	2	0	0	2	2
LT 703	Analytical Chemistry of Leather Auxiliaries –II	2	0	0	2	2
LT 704	Science & Technology of Polymer & Synthetics as Leather Substitute	2	0	0	2	2
LT 705	E-Commerce & Application	2	0	0	2	2
<i>Total Credits of Theoretical Papers</i>		10				
7B. PRACTICAL PAPERS						
HU 791	Group Discussion	0	0	3	3	2
LT 791	Tannery Practice IV	0	0	3	3	2
LT 792	Analytical Chemistry of Leather Auxiliaries Lab-II	0	0	3	3	2
LT 793	E-Commerce & Application Lab	0	0	3	3	2
LT 794	INDUSTRIAL TRAINING <u>4 weeks during 6th – 7th semester break</u>					2
<i>Total Credits of Practical Papers</i>		10				
<i>Total Credits of Semester</i>		20				

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Semester-VIII(4th Year)						
8A. THEORETICAL PAPERS						
<i>COURSE NO.</i>	<i>COURSE TITLE</i>	<i>L</i>	<i>T</i>	<i>P</i>	<i>Total</i>	<i>Cr.</i>
HU 801	Organisational Behaviour / Project Management	2	0	0	2	2
LT 801	Plant Layout and Entrepreneurship for Leather Sector	2	0	0	2	2
LT 802	Technology of Animal and Tannery Byproducts Utilization	2	0	0	2	2
Total Credits of Theoretical Papers		06				

8B. PRACTICAL PAPERS						
HU 891	Design Lab	0	0	4	4	2
LT 892	Project	0	0	12	12	5
LT 893	Grand Viva	0	0	2	2	2
Total Credits of Practical Papers		09				
Total Credits of Semester		15				

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Semester-III

DETAILED CONTENTS:

HU 301 Values and Ethics in Profession
Science, Technology and Engineering as knowledge and as Social and Professional Activities
Effects of Technological Growth:
Rapid Technological growth and depletion of resources, Reports of the Club of Rome. Limits of growth: sustainable development
Energy Crisis: Renewable Energy Resources
Environmental degradation and pollution, Eco-friendly Technologies. Environmental Regulations, Environmental Ethics
Appropriate Technology Movement of Schumacher; later developments
Technology and developing notions. Problems of Technology transfer, Technology assessment impact analysis.
Human Operator in Engineering projects and industries. Problems of man, machine, interaction, Impact of assembly line and automation. Human centered Technology.
Ethics of Profession:
Engineering profession: Ethical issues in Engineering practice, Conflicts between business demands and professional ideals. Social and ethical responsibilities of Technologists. Codes of professional ethics. Whistle blowing and beyond, Case studies.
Profession and Human Values:
Values Crisis in contemporary society
Nature of values: Value Spectrum of a good life
Psychological values: Integrated personality; mental health
Societal values: The modern search for a good society, justice, democracy, secularism, rule of law, values in Indian Constitution.
Aesthetic values: Perception and enjoyment of beauty, simplicity, clarity.
Moral and ethical values: Nature of moral judgments; canons of ethics; ethics of virtue; ethics of duty; ethics of responsibility.
Suggested Books:
1. Stephen H Unger, Controlling Technology: Ethics and the Responsible Engineers, John Wiley & Sons, New York 1994 (2nd Ed)
2. Deborah Johnson, Ethical Issues in Engineering, Prentice Hall, Englewood Cliffs, New Jersey 1991.
3. A N Tripathi, Human values in the Engineering Profession, Monograph published by IIM, Calcutta 1996.

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CH(LT) 301 Histology and Microbiology of Leather Manufacture – I
Histology of different hides and skins –
1.Histological structure
Buffalo, Cow, Goat and Sheep.
2. Histology and chemistry of epidermis
Epithelium-classification-Simple epithelia- simple squamous epithelium,simple columnar epithelium,simple cuboidal epithelium, Pseudo stratified epithelium, Stratified epithelia-stratified squamous epithelium,stratified columnar and stratified cuboidal epithelium,Transitional epithelium, Regeneration of epithelium.
3.Epidermis and process of keratinization
4.Histology and chemistry of dermis
Connective tissue fibres – white or collagen fibre, reticular fibres, elastic fibres, Ground substances, Glands, Origin of the connective tissue fibres
5.Histology of hair, hair follicle and wool
6.Histological Techniques
Fixing & hardening, dehydration, clearing, embedding, sectioning, staining, mounting for preparation of hides and Skins for observation under microscope.
7.Significance of histological characteristics on leather making properties
Hair and wool density, percentage of coarse hairs or wools,depth, diameter,angle of inclination of hair or wools, papillation of epidermis, thickness and compactness of grain and corium,tightness, and nature of merging of the grain into corium, uniformity of the fibre texture, angle of weave, fullness of collagen fibres, amount and distribution of natural fat, condition of sweat glands ,amount and condition of elastic and reticular tissues.
8.Assessment of leather
9.Photomicrography
Definition, utility of Photomicrography in leather science.
10.Study of diffects of hides/skin &leather
Suggested books:-
1.The chemistry and Technology of leather- volume-1- O’Flaherty,William T.Roddy and Robert M.Lollar-Kriege r publishing company, Malabar, Florida.
2.Theory & Practice of Leather manufacture- K.T.Sarkar-A.M.Sharif,555,Poonamallee High Road, Madras.
3.Indian hides & skins-Histological characteristics-(part-1)-Central Leather Research Institute, Madras, India.

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CH (LT) 302	Biology for Engineers
Introduction	
Purpose: To convey that Biology is as important a scientific discipline as Mathematics, Physics and Chemistry Bring out the fundamental differences between science and engineering by drawing a comparison between eye and camera, Bird flying and aircraft. Mention the most exciting aspect of biology as an independent scientific discipline. Why we need to study biology? Discuss how biological observations of 18th Century that lead to major discoveries. Examples from Brownian motion and the origin of thermodynamics by referring to the original observation of Robert Brown and Julius Mayor. These examples will highlight the fundamental importance of observations in any scientific inquiry.	
Classification	
Purpose: To convey that classification per se is not what biology is all about. The underlying criterion, such as morphological, biochemical or ecological be highlighted. Hierarchy of life forms at phenomenological level. A common thread weaves this hierarchy Classification. Discuss classification based on (a) cellularity- Unicellular or multicellular (b) ultrastructure- prokaryotes or eucaryotes. (c) energy and Carbon utilization -Autotrophs, heterotrophs, lithotropes (d) Ammonia excretion – aminotelic, uricotelic, ureotelic (e) Habitataacquatic or terrestrial (e) Molecular taxonomy- three major kingdoms of life. A given organism can come under different category based on classification. Model organisms for the study of biology come from different groups. E.coli, S.cerevisiae, D. Melanogaster, C. elegance, A. Thaliana, M. musculus	
Genetics	
Purpose: To convey that “Genetics is to biology what Newton’s laws are to Physical Sciences” Mendel’s laws, Concept of segregation and independent assortment. Concept of allele. Gene mapping, Gene interaction, Epistasis. Meiosis and Mitosis be taught as a part of genetics. Emphasis to be give not to the mechanics of cell division nor the phases but how genetic material passes from parent to offspring. Concepts of recessiveness and dominance. Concept of mapping of phenotype to genes. Discuss about the single gene disorders in humans. Discuss the concept of complementation using human genetics.	
Biomolecules	
Purpose: To convey that all forms of life has the same building blocks and yet the manifestations are as diverse as one can imagine Molecules of life. In this context discuss monomeric units and polymeric structures. Discuss about sugars, starch and cellulose. Amino acids and proteins. Nucleotides and DNA/RNA. Two carbon units and lipids.	
Enzymes	
Purpose: To convey that without catalysis life would not have existed on earth Enzymology: How to monitor enzyme catalyzed reactions. How does an enzyme catalyzereactions. Enzyme classification. Mechanism of enzyme action. Discuss at least two examples. Enzyme kinetics and kinetic parameters. Why should we know these parameters to understand biology? RNA catalysis.	
Information Transfer	
Purpose: The molecular basis of coding and decoding genetic information is universal Molecular basis of information transfer. DNA as a genetic material. Hierarchy of DNA structurefrom single stranded to double helix to nucleosomes. Concept of genetic code. Universality and degeneracy of genetic code. Define gene in terms of complementation and recombination.	
Macromolecular analysis	
Purpose: How to analyses biological processes at the reductionistic level Proteins- structure and function. Hierarch in protein structure. Primary secondary, tertiary and quaternary structure. Proteins as enzymes, transporters, receptors and structural elements.	
Metabolism	
Purpose: The fundamental principles of energy transactions are the same in physical and biological world. Thermodynamics as applied to biological systems. Exothermic and endothermic versus endergonic and exergoinc reactions. Concept of Keq and its relation to standard free energy. Spontaneity. ATP as an energy currency. This should include the breakdown of glucose to CO ₂ + H ₂ O (Glycolysis and Krebs cycle) and synthesis of glucose from CO ₂ and H ₂ O (Photosynthesis). Energy yielding and energy consuming reactions. Concept of Energy charge	
Microbiology Concept of single celled organisms. Concept of species and strains. Identification and classification of microorganisms. Microscopy. Ecological aspects of single celled organisms. Sterilization and media compositions. Growth kinetics.	
References:	
1) Biology: A global approach: Campbell, N. A.; Reece, J. B.; Urry, Lisa; Cain, M, L.; Wasserman, S. A.; Minorsky, P. V.; Jackson, R. B. Pearson Education Ltd 2) Outlines of Biochemistry, Conn. E.E; Stumpf, P.K; Bruening, G; Doi, R.H., John Wiley and Sons 3) Principles of Biochemistry (V Edition), By Nelson, D. L.; and Cox, M. M.W.H. Freeman	

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and Company 4) Molecular Genetics (Second edition), Stent, G. S.; and Calender, R.W.H. Freeman and company, Distributed by Satish Kumar Jain for CBS Publisher 5) Microbiology, Prescott, L.M J.P. Harley and C.A. Klein 1995. 2nd edition Wm, C. Brown Publishers

LT 301 Fluid Mechanics
Introduction:
The basics of Chemical Engineering Operations and Chemical Engineering Processes. Fundamentals of Momentum, Heat and Mass Transfer. The two basic approaches to the study of Momentum, Heat and Mass Transport - The Unit Operation Approach and the Transport Phenomena Approach. The physical and transport properties. Units and dimensions. Dimensional Analysis.
Section 1: Flow and Fluid Properties
Ideal & Real fluids, Viscosity, relationship between stress and strain-rate for Newtonian fluids, incompressible and compressible flows, differences between laminar and turbulent flows.
Section 2: Hydrostatics
Buoyancy, metacentre, manometry, forces on submerged bodies. Pressure at a point, gauge pressure, surface tension.
Section 3: Kinematics
Stream line, Eulerian and Lagrangian description of fluids motion, concept of local and convective accelerations, steady and unsteady flows.
Section 4: Integral analysis
Control volume analysis for mass, momentum and energy.
Section 5: Differential Analysis
Differential equations of mass and momentum for incompressible flows: inviscid - Euler equation and viscous flows - Navier-Stokes equations, concept of fluid rotation, vorticity, stream function, Exact solutions of Navier-Stokes equation for Couette Flow and Poiseuille flow, potential flow.
Section 6: Dynamics of ideal fluids
Inviscid flows, Bernoulli's equation - assumptions and applications, Total head; Velocity head; Pressure head, potential function, Elementary plane flows - uniform flow, source, sink and doublet and their superposition for potential flow past simple geometries.
Section 7: Dimensional analysis
Concept of geometric, kinematic and dynamic similarity, some common non-dimensional parameters and their physical significance: Reynolds number, Froude number and Mach number.
Section 8: Internal flows
Fully developed pipe flow, velocity profile, empirical relations for laminar and turbulent flows: friction factor and Darcy-Weisbach relation, pressure drop, friction loss, pipe fittings.
Section 9: Prandtl boundary layer equations
Concept and assumptions, qualitative idea of boundary layer and separation, streamlined and bluff bodies, drag and lift forces.
Section 10: Flow measurements
Basic ideas of flow measurement using venturimeter, pitot-static tube and orifice plate, etc.
REFERENCES
1. McCabe .W.L and Smith, J.C., Unit Operations in Chemical Engineering, McGraw Hill, Fourth Ed., 1993.
2. Treybal, R.E., Mass Transfer Operations, McGraw Hill Book Company, Third Ed. 1981.
3. Coulson, J.M., and Richardson, J.F., Chemical Engineering, Vol.I and II Third Ed. Pergamon press, 1978.
4. Welty, J.R., Wilson, R.E., and Wicks, C.E. Fundamentals of momentum, Heat and Mass Transfer, Third Ed., John Wiley, 1984.
5. Perry, J.H., Chemical Engineers Handbook, McGraw Hill, New York, Sixth Ed., 1984.
6. Geankoplis, C.J., Transport Processes and Separation Process Principles (Includes Unit Operations), 4th Edition.

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LT 302 Bio Chemistry of Protein & Fundamentals of Pre-tannage
Curing agents: Name of different Curing agents, their Manufacturing Methods and use in curing,
Curing:- Definition; necessity; principles and different state of cured hides and skins.
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 surface active Phenomenon - Method of preparation of different soaking agents and uses. Function and uses of preservatives in soaking.
Soaking:- Physico-Chemical explanation of wetting; objectives and different controls in soaking operation .
Lime:- Classification and manufacture of lime—Chemical composition of Indian limes and their suitability.
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.
Depilants:- Manufacture and properties of sodium sulphide, unhairing mechanism of sodium sulphide. Other unhairing agents—sodium sulfhydrate, Arsenic sulphides, Cyanides. etc.
Organic Depilating Agents:- Their unhairing chemistry. Enzyme depilants, Oxidative depilants.
Chemistry of Delimiting Agents:- Boric acid, Ammonium salts, Sodium bisulfite. Organic delimiting agents. Proprietary delimiting agents.Merits of proprietary delimiting agents over conventional delimiting chemicals.
Delimiting:- Objectives, principles and controls of delimiting.
Bating Agents:- Manufacture , properties and uses of Bating agents. Functions of different components in synthetic bates in bating operation. Acid bates vs alkaline bates.
Bating:- Chemistry of Proteolytic enzymes used for bating; necessity of bating ; its preparation and controls for desired properties of leather.
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.
Pickling:- Acid binding capacity of collagen; use of organic acids or salts in pickling; its necessity and controls; concept of Depickling.
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.

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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.lollar. Published by Robert E.Krieger Publishing Company Huntington, New York(1978)
4) Fundamentals of Leather Manufacture – Eckhart Hidemann.
5) Theory and Practice of Leather Manufacture –K. T. Sarkar, Macmillan India Press, Madras.
6) Leather Technician's Handbook –J. H. Sharphouse, Vernon Lock Ltd., 125 High Holborn, London W-C1.
7) Nelson, D.L. and Cox, M.M. (2000), <i>Lehninger principles of biochemistry</i> , 3rd Edn. Worth Publishers, N.Y.
8) Gilbert, F.G. (1997) <i>Development Biology</i> , 5th Edn. Sinauer Associates, Massachusetts.
9) Kleinsmith, L.J. and Kish, V.M. (1998), <i>Principles of cell biology</i> , Harpar & Row publishers, N.Y.
10) Gustavson, K.H. (1956), <i>The chemistry and reactivity of collagen</i> , Academic press, N.Y.
11) Hames, B.D., Hooper, N.M. and Houghton, J.D. (1999), <i>Instant notes on Biochemistry</i> , Viva Books Pvt. Ltd. N.D.
12) Turner, P.C., McLennan, A.G., Bates, A.D. and White, M.R.H. (1999), <i>Instant notes on Molecular Biology</i> , Viva Books Pvt. Ltd. N.D.
13) Elden, H.R. <i>Biophysical properties of skins</i> , vol.1 of treatise of skin, Wiley Interscience a divn. of John Wiley & sons. N.Y.
14) Dutta, S.S. (2000), <i>An introduction to the principles of leather manufacture</i> , 4th Edn. Indian Leather Technologists Association, Calcutta

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LT 303 Fundamentals of Digital Computer
1.Introduction:
Historical background- Computer generations, idea of operating systems their developments, concept of machine, assembly and high level languages and assemblers and compilers – the basic functions and objectives
2. Number systems: Idea of positional number systems, decimal, binary, octal and hexadecimal numbers and inter conversion amongst them. Arithmetic with binary numbers. Representation of numbers in digital computers – concept of radix mantissa form.
3. Digital logic:
AND, OR, NOT and EXOR gates with truth tables. Universal gates. Introductory idea of Boolean algebra, De Morgan’s Theorem without proof. Simplification of Boolean functions with up to four variables using K-maps. Half and full adders. Introduction to Latches and flip-flops, concept of clock – S-R, J-K, D, T truth tables only. Use of F-F for construction of various registers memories circuits and simple explanations only; no analysis and timing diagrams needed.
4. Introduction to Digital computers:
CPU – ALU and Control units and their functions, Memory unit – brief description and use of magnetic memories, RAM, ROM and Cache, idea of virtual memory. Input and output units – description of Display and keyboard, mouse, printers- interfacing concept of serial and parallel ports taking printer port, RS232 and USB port.
5. Introduction to Operating systems:
Idea of hardware and software as scarce resources. Functions of OS, Processor management – processes creation and termination, processor environment, idea of threads; memory management – paging and segmentation basic concepts use of page and segment tables, scheduling methods- FIFO, LIFI, LRU algorithms. Deadlocks - conditions for deadlocks, Concurrency control - idea of critical section semaphores and locks.
6. Problem Solving Techniques:
Concept of program as data structure plus algorithm. Data types and data structures – arrays, trees, linked list, stacks and queues. Inorder, preorder and postorder traversal of trees with examples. Concept of algorithms., termination condition. Concepts of iteration and recursion with simple examples; sorting and searching techniques without proof and analysis – bubble sort, insertion sort and binary sort, linear search. Idea of complexity of computation – Big Oh notation with simple examples.
Suggested Books:
1. Hayes-- Computer Architecture & Organization,3/e ,MH
2. Carter—Computer Architecture (Schaum Series), TMH
3. Chaudhury P. Pal—“ Computer Organization & Design” , PHI
4. Tanenbaum A.S., “Operating System Design & Implementation”, Practice Hall NJ.
5. Silbersehatz A. and Peterson J. L., “Operating System Concepts”, Wiley.
6. Dhamdhare: Operating System TMH
7. Horowitz Ellis & Sartaj Sahni, “Fundamentals of Data Structures”, Galgotria Pub.

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CH(LT) 391 Histology and Microbiology of Leather Manufacture Lab – I
Histology of hides/ skins
Setting up of a compound microscope
Preparation of microscopic slides by paraffin embedding method and By freezing method
Identification of hides and skins from their histological structures and from their grain pattern- Buffalo, Cow, Sheep and Goat
Microscopic assessment of fibre structure during the process - Soaking, liming, pickling and tanning of finished leather - sole leather.
Suggested books:-
1.The chemistry and Technology of leather- volume-1- O’Flaherty,William T.Roddy and Robert M.Lollar-Kriege r publishing company, Malabar, Florida.
2.Theory & Practice of Leather manufacture- K.T.Sarkar-A.M.Sharif,555,Poonamallee High Road, Madras.
3.Indian hides & skins-Histological characteristics-(part-1)-Central Leather Research Institute,Madras,India.

LT 391 Fluid Mechanics Lab
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 – Application of Bernoulli’s equation.
REFERENCES
1. Unit Operations – McCabe & Smith – McGraw Hill in Chemical Engineering.
2. Chemical Engineering – Coulson & Richardson – Pergamon Press.
3. Transport Processes and Separation Process Principles - Geankoplis, C.J.

LT 392 Tannery Practice I
Brief functions of various machineries used in leather manufacture
1. Assortment of hides and skins
2. Processing of wet-blue from hides and skins
3. Introduction to various post tanning and finishing processes for the manufacture of upper and garment leathers
4. Introduction to various mechanical operations.

LT 393 Applied Information Technology Lab
1) Overview of Computer Parts and its Application.
Introduction to JAVA as OOPS
An overview of Java
Data Types – variables and arrays
Operators, Control statements
Classes and objects, Inheritance, String and string buffer, Packages, Interfaces, Exception handling, Multithreaded Programming, Applets,
Event handling
Abstract Window Toolkit
2) 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 :
Operating systems – William Stallings (TMH)
DOS guide – Peter Norton (PHI)
Windows Operating System – Teach yourself Windows 98 (Techmedia)
UNIX concepts & applications – S.DAS (TMH)

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Semester-IV

M(CS) 401 Numerical Methods
Approximation in numerical computation: Truncation and rounding errors, Fixed and floating-point arithmetic, Propagation of errors. (4)
Interpolation: Newton forward/backward interpolation, Lagrange's and Newton's divided difference Interpolation. (5)
Numerical integration: Trapezoidal rule, Simpson's 1/3 rule, Expression for corresponding error terms. (3)
Numerical solution of a system of linear equations: Gauss elimination method, Matrix inversion, LU Factorization method, Gauss-Seidel iterative method. (6)
Numerical solution of Algebraic equation: Bisection method, Regula-Falsi method, Newton-Raphson method. (4)
Numerical solution of ordinary differential equation: Euler's method, Runge-Kutta methods, Predictor-Corrector methods and Finite Difference method. (6)
Text Books:
1. C.Xavier: C Language and Numerical Methods.
2. Dutta & Jana: Introductory Numerical Analysis.
3. J.B.Scarborough: Numerical Mathematical Analysis.
4. Jain, Iyengar , & Jain: Numerical Methods (Problems and Solution).
References:
1. Balagurusamy: Numerical Methods, Scitech.
2. Baburam: Numerical Methods, Pearson Education.
3. N. Dutta: Computer Programming & Numerical Analysis, Universities Press.
4. Soumen Guha & Rajesh Srivastava: Numerical Methods, OUP. Srimanta Pal: Numerical Methods, OUP

LT 401 Thermodynamics
1. Concept of thermodynamics:
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, Cp and Cv and its relation, Kirchoff's equation, adiabatic changes.
2. Second law of thermodynamics:
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.
3. Gibb's free energy:
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.
4. Clapeyron equation:
Clapeyron equation, clausius-clapeyron equation, relation between the entropy and the chemical constant.
Suggested Books:
1. Engineering Thermodynamics – P.K. Nag
2. Thermodynamics for chemists- S. Glasstone.
3. Thermodynamics – P.C. Rakshit.
4. Thermodynamics- Zeemansky.

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LT 402 Chemistry & Technology of Inorganic Tanning
1. Tanning:
Theory, chemistry, factors and objectives of following Inorganic Tanning operations:
(A) Chrome Tanning,
(B) Aluminium Tanning,
(C) Iron Tanning,
(D) Zirconium Tanning,
(E) Titanium Tanning,
2. 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 Tanning, 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.
3. Masking agents:
Masking agents and 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.
4. 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. 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, 4 th. Edn. I. L. T. A., Calcutta.
2. Chemistry & Technology of Leather-Roddy, O' Flaherty & Lollar, Vol. 3. Robert E. Krieger 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.
8. Advanced Inorganic chemistry -- F A Cotton & G Wilkinson Wiley – Interscience
Fundamental principles of inorganic chemistry -- D. Banerjee. Sultan Chand & Co., New Publication.

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LT 403 Analytical Chemistry of Leather Auxiliaries – I
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
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
08. Analysis of Metal Tanning Agents:
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:
09. Analysis of Vegetable Tannin:
Principles underlying estimation of tannin in vegetable tanstuffs, extracts, liquors etc. by ----
a) lead acetate method
b) Hide powder method
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.

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LT 404 Leather Footwear Design & Manufacture
1. Introduction: (4 hours)
History of footwear evolution . Nomenclature of different types of footwear. Different parts of footwear.
2. 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.
3. 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.
4. 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.
5. 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;
6. 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.
7. 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, Stiffener, Heel, Thread and Needle: Required properties of these materials, different types of these material and their relatives advantages & disadvantages.
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.

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LT 405 Histology and Microbiology of Leather Manufacture – II
1. Mould and Bacterial aspect on leather:
Different types of moulds associated with leather manufacture., Effect of mould/bacterial growth during processing of skins/hides, finished leathers, leather goods and during transportation. Prevention of mould/bacterial growth during processing, storage of finished goods and transportation..Testing of efficacy of fungicide on finished leather.
2. Enzymes:
Definition of enzymes; active site, substrate, coenzyme, cofactor and external factors affecting enzyme performances.Role of enzymes in different stages of leather processing (with a regular provision of upgradation.)
3. Morphology & fine structure of bacteria:
The size, shape & arrangement of bacterial cells, Bacterial structures-structres external to the cell wall- flagella & motility, pili, capsules, sheaths, prosthecae & stalks.
4. 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.
5. The cultivatioin, reproduction & growth:
Nutritional requirments, nutritional types of bacteria – Phototrophs, chemotrophs autotrophs & hetrotrophs, obligate parasites.
6. Bacteriological media:
Types of media , preparation of media. Physical conditions required for growth.
7.Reproduction:
Modes of cell division, new cell formation.
8.Growth:
Normal growth cycle (growth curve) , tansitionsal periods between growth phases, synchronous growth, continuous culture.
9.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.
10.Methods of isolating pure cultures:
The streak plate technique, the pour plate and spread techniques, micro manipulator techniques, the maintence & preservation of pure cultures. Culture collections, cultural characteristics, colony characateristics, characteristics of broth culture.
11. Bacterial Genetics:
Bacterial mutation, bacterial recombination- bacterial conjugation,transduction, transformation
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) The Science of Ecologys- Second Edition-Richard Brewe
5) Textbook of microbiology-C.P. Baveja.
6) Microbiology-Prescott,Harley, Klein-McGrawHill
7) Microbiology Principles and Explorations-J.G.Black
8) Textbook of Microbiology- Paniker

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HU 481 Communication skill & Report Writing
Objectives of this Course: This course has been designed: 1. To inculcate a sense of confidence in the students. 2. To help them become good communicators both socially and professionally. 3. To assist them to enhance their power of Technical Communication.
Detailed Course Outlines:
A. Technical Report Writing : 2L+6P
1. Report Types (Organizational / Commercial / Business / Project)
2. Report Format & Organization of Writing Materials
3. Report Writing (Practice Sessions & Workshops)
B. Language Laboratory Practice
I. Introductory Lecture to help the students get a clear idea of Technical Communication & the need of Language Laboratory Practice Sessions 2L
2. Conversation Practice Sessions: (To be done as real life interactions) 2L+4P a) Training the students by using Language Lab Device/Recommended Texts/cassettes /cd's to get their Listening Skill & Speaking Skill honed b) Introducing Role Play & honing over all Communicative Competence
3. Group Discussion Sessions: 2L+6P a) Teaching Strategies of Group Discussion b) Introducing Different Models & Topics of Group Discussion c) Exploring Live /Recorded GD Sessions for mending students' attitude/approach & for taking remedial measure
Interview Sessions: 2L+6P a) Training students to face Job Interviews confidently and successfully b) Arranging Mock Interviews and Practice Sessions for integrating Listening Skill with Speaking Skill in a formal situation for effective communication
4. Presentation: 2L+6P a) Teaching Presentation as a skill b) Strategies and Standard Practices of Individual /Group Presentation c) Media & Means of Presentation: OHP/POWER POINT/ Other Audio-Visual Aids
5. Competitive Examination: 2L+2P a) Making the students aware of Provincial /National/International Competitive Examinations b) Strategies/Tactics for success in Competitive Examinations c) SWOT Analysis and its Application in fixing Target
Books – Recommended:
Nira Konar: English Language Laboratory: A Comprehensive Manual PHI Learning, 2011 D.
Sudharani: Advanced Manual for Communication Laboratories & Technical Report Writing Pearson Education (W.B. edition), 2011
References:
Adrian Duff et. al. (ed.): Cambridge Skills for Fluency A) Speaking (Levels 1-4 Audio Cassettes/Handbooks) B) Listening (Levels 1-4 Audio Cassettes/Handbooks) Cambridge University Press 1998 Mark Hancock: English Pronunciation in Use 4 Audio Cassettes/CD'S OUP 2004

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M(CS)491 Numerical Methods with C Programming
1. Assignments on Newton forward /backward, Lagrange's interpolation.
2. Assignments on numerical integration using Trapezoidal rule, Simpson's 1/3 rule, Weddle's rule.
3. Assignments on numerical solution of a system of linear equations using Gauss elimination and Gauss-Seidel iterations.
4. Assignments on numerical solution of Algebraic Equation by Regular-falsi and Newton Raphson methods.
5. Assignments on ordinary differential equation: Euler's and Runge-Kutta methods.
6. Introduction to Software Packages: Matlab / Scilab / Labview / Mathematica.

LT 491 Tannery Practice II
At the end of the course students will gain confidence in processing of chrome tanning for various types of leathers
Manufacture of chrome tanned leather by normal tannage
Manufacture of leathers by masked chrome tannage

LT 492 Analytical Chemistry of Leather Auxiliaries Lab-I
01. Analysis of Water:
a) Determination of hardness
i) Conventional method
ii) E.D.T.A. method
b) Determination of Iron content
c) Determination of Chloride content
02. Analysis of lime:
i) Determination of Available lime
ii) Determination of Total base
iii) Determination of 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
05. Analysis Chrome tanning agents and liquors:
i) Determination of Moisture
ii) Determination of Chromic oxide content
iii) Determination of Acid combined with chromium
iv) Determination of Percentage basicity
v) Determination of Change of basicity
vi) Determination of Degree of olation
06. 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
07. Analysis of Synthetic Tanning agents: Determination of
i) Moisture
ii) Total soluble & solids

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iii) Non-tannins
iv) Tannins
v) Colour by Lovibond Tintometer &
vi) pH of extract
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 493 Footwear Design Lab
Different techniques of clicking. Tools and machinery for clicking. Nesting of diferent 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.
8. Leather Work - I.P.Roseman ; The Manual Arts Press.

LT 494 Histology and Microbiology of Leather Manufacture Lab – II
1. Preparation of various culture media
2. Staining of bacteria
3. Enumeration of bacteria in hides and skins and in tan liquors
4. Isolation of bacteria from tan liquors
5. Biochemical test of isolated pure bacterial culture
6. Isolation and identification of fungi in leathers
7. Mildew resistance test for leathers
8. Identification of insect and parasitic damages
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) The Science of Ecologys- Second Edition-Richard Brewe
5) Textbook of microbiology-C.P. Baveja.
6) Microbiology-Prescott,Harley, Klein-McGrawHill
7) Microbiology Principles and Explorations-J.G.Black
8) Textbook of Microbiology- Paniker

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Semester-V

HU (LT) 501	Economics of Leather Industry
Group A	
1. Business firms and the market place: Concept of organized firm and industry-managerial issues in the context of an open market set up. Impact of competition, technological change and public policy.	
2. Theory of demand: Law of demand- impacts of price and income changes. Parametric vs non-parametric shifts in the demand curve. The axiomatic approach to the theory of demand-price and income effects. Distinction between normal, inferior and Giffen goods. Demand forecasting.	
3. Theory of Firm: Technology and productivity. Law of variable proportions and returns to scale. Optimal production decision using isoquant and budget line. Mathematical derivation of optimality conditions. Cost concepts-short run and long run analysis of cost. Revenue and profit-conditions for profit maximization.	
4. Market Structure: Analysis of important market forms-competition, monopoly, monopolistic competition and oligopoly.	
Group B	
1. Introduction:	
Economic importance of leather. Antiquity of leather industry. Uses of leather in different sorts of life.	
2. Hides and Skins:	
Indian livestock population over two decades – Hides and skins availability, their sizes, marketing centres, channels and prices over two decades.	
3. 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.	
4. 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.	
5. 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).	
6. 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:	
Suggested books:	
1. H R. Varian. Intermediate Microeconomics: a Modern Approach. Affiliated East-West Press.	
2. R S. Pindyck, D.L. Rubinfeld and Mehta (2007). Microeconomics, 7th edition, Prentice Hall India.	
3. Indian Leather 2010 (A Technology, Industry and Trade Forecast) – Central Leather Research Institute, Madras.	
4. The Indian Leather Industry – Secretariat for industrial assistance, Ministry of Industry, Govt. of India.	
5. How To Export (Handbook on export business) – Small Industry Research Institute, Govt. of India.	
6. Kothari's Desk Book Series - The Leather Industry.	
7. Choice of technique in leather manufacture – M.M. Haq, H. Argaw – Scottish Academic Press. Edinburgh (1981)	
8. Economics of Leather Industry- B.R.Rau, Calcutta University Press (1920).	

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LT 501 Chemistry & Technology of Organic Tannage
1. Vegetable tannins and tanning
Chemistry, classification (gallotannins, ellagitannins, condensed and complex tannins) and properties of tannins; Characteristics of some important vegetable tannins (Tara, Wattle, Quebracho, Chestnut, Gambier, Myrobalan); Modified vegetable tannins (modification of mimosa); Constitution, properties and application of tan-liquor – role of tan/non-tan ratio, pH, astringency, acid and salt content, specific gravity, concentration; Chemistry of vegetable tanning, Properties of vegetable tanned leather.
2. Synthetic tannins
Chemistry and multifunctional properties of syntans; General Manufacturing Methods of Phenol–Formaldehyde, Naphthalene–Formaldehyde and Naphthol–Formaldehyde Condensates, Urea–formaldehyde and Melamine–Formaldehyde condensates – Supra Syntans –Diversified application of syntans for manufacturing different leathers to achieve various objectives. Use of lignosulfonic acids in leather processing.
3. Resin syntans
Acrylic syntans- Pre-tanning agent (acrylic acid ester co-polymer derivatives), Retanning and lubricating agents methyl methacrylate/butyl acrylate copolymer; Polyurethanes as Resin Tanning Agent – chemistry and applications.
4. Aldehyde tanning agents
Formaldehyde, glyoxal and glutaraldehyde tanning agents– 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.
5. Oil Tanning, Sulfonyl Chloride Tanning
Suggested Readings:
1. Vegetable Tannage -- Tanning Extract Producers Federation Limited, England.
2. An Introduction to the Principles of Leather Manufacture – S. S. Dutta, Indian Leather Technologists Association, Calcutta, India
3. Karamali Khanbabaee and Teunis van Ree, Tannins: Classification and Definition, Nat. Prod. Rep., 2001, 18, 641–649.
4. Lorenzo Tambi, Piero Frediani, Marco Frediani, Luca Rosi and Mara Camaiti, Hide Tanning with Modified Natural Tannins, Journal of Applied Polymer Science, Vol. 108, 1797–1809 (2008).
5. Quideau S. et al., Plant Polyphenols: Chemical Properties, Biological Activities, and Synthesis, Angew. Chem. Int. Ed. 2011, 50, 586 – 621.

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LT 502 Applied Statistics and Quality Control
Definitions of Probability & Related Basic Concepts
a) Discrete and continuous probability distributions (Binomial, Poisson, Uniform, Normal, Gamma & exponential distributions), (8 hours)
b) Basic concepts of statistical population and random sampling, Mean Variance and covariance, Correlation coefficients, Moments. (6 hours)
c) Basic concepts of Testing of Hypothesis. Analysis of variance; one factor classification & two factors classification. (6 hours)
d) Design of Experiments; some basic designs of experiments; comparison of Randomised Block design (RBD) and Latin square Design (LSD). (8 hours)
2. Basic Concepts of Statistical quality Control (SQC)
a) Nature of Control limits; Type I and Type II errors; Chance variation and assignable variation (6 hours).
b) Purposes of control charts, Control charts for variables, Control charts for attributes, Cusum Control chart. (8 hours)
Suggested Books
1) Introduction to Statistical Quality Control: By D.C. Montgomery, John Wiley (student edition), 4th edition (2004)
2) Design and Analysis of Experiments: By D.C. Montgomery; John Wiley & sons (2nd edition), 1984
3) Introduction to Quality Engineering: By G. Taguchi, UNIPUB, White-Plain, N.Y.
4) Probability & Statistics for Engineering & Scientists (seventh edition), Walpole, Myers, Myers. YE., Pearson Education (Asia), 2002
5) Probability, Statistics and Random Process: By T. Veerarajan (2nd edition), Tata Mc. Graw Hill (2003)

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LT 503 Environmental Engg of Leather Processing
Wastewater characteristics
Waste water characteristics – physical, chemical & biological. Waste water characterization studies – sampling -- location & interval of sampling – sampling equipment – preservation of sample.
2. Composition & Analysis
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.
3. Unit operations
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.
4. Solid waste management
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.
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.

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LT 504 Studies on JAVA
INTRODUCTION TO JAVA
1.Introduction to Java programming concepts:
Programming language Types and Paradigms, Computer Programming Hierarchy, How Computer Architecture Affects a Language? , Why Java?, Flavors of Java, Features of Java Language, JVM –The heart of Java , Java’s Magic Byte code
2.The Java Environment
Installing Java, Java Program Development, Java Source File Structure, Compilation, Executions. Lexical Tokens, Identifiers, Keywords, Literals, Comments, Primitive Datatypes, Operators Assignments
3 Object Oriented Programming
Class Fundamentals , Object & Object reference, Object Life time & Garbage Collection, Creating and Operating Objects , Constructor & initialization code block, Access Control, Modifiers, methods, Abstract Class & Interfaces Defining Methods, Argument Passing Mechanism, Method Overloading, Recursion, Dealing with Static Members, Finalize() Method, Native Method.
4. Extending Classes and Inheritance
Use and Benefits of Inheritance in OOP, Types of Inheritance in Java, Inheriting Data members and Methods, Role of Constructors in inheritance, Overriding Super Class Methods, Use of “super”, Polymorphism in inheritance, Implementing interfaces
5. Package
Organizing Classes and Interfaces in Packages, Packages Access Protection, Defining Package, CLASSPATH Setting for Packages, Naming Convention For Packages.
6. Multithreading
Definition and introduction
7. GUI programming
Designing basic Graphical User Interfaces in Java, Components and Containers, Basics of Components, Using Containers,
Suggested Books:
1. Patrick Naughton, Herbert Schildt – "The complete reference-Java2" – TMH
2. E. Balagurusamy – " Programming With Java: A Primer" – 3rd Ed. – TMH
3. Rambaugh, James Michael, Blaha – "Object Oriented Modelling and Design" – Prentice Hall, India
4. R.K Das – "Core Java For Beginners" – VIKAS PUBLISHING

LT 505 Leather Goods Design & Manufacture
1. Brief outline about different types of Leathers used for making of Leather Goods.
2. Brief outline about various materials used for Leather Goods Fabrication.
3. A glimpse of Machineries and Tools used in leather goods making.
4. The classification of leather goods.
5. Different types of constructions in leather goods manufacturing.
6. A complete understanding of the Product Making process for Leather Goods including Cutting, splitting and skiving as well as Assembly and stitching with finishing of the product.
Suggested Books:
1. Making Leather Handbags: Inspirational Designs by Ellen Goldstein-Lynch , Sarah Mullins and Nicole Malone.
2. Handbag Workshop: Design and Sew the Perfect Bag by Anna M. Mazur.
3. 46 Leatherwork Projects Anyone Can Do by Geert Schelling.

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LT 591 Tannery Practice III
Manufacture of synthetic tanned leather
Manufacture of resin tanned leather
Manufacture of Aldehyde tanned leather
Manufacture of Oil tanned leather

LT 592 Leather Goods Design Lab
Leather Assortment
Layout preparation
Preparation and cutting
Assembling and stitching operation
Process scheduling and line balancing
Bottom Stock Preparation
Practice in CAD/CAM and pattern grading using machine
Practice in classic leather goods making

LT 593 Studies on JAVA Lab
1. Assignments on class, constructor, overloading, inheritance, overriding
2. Assignments on developing interfaces- inheritance, extending interfaces
3. Assignments on creating and accessing packages
4. Assignments on multithreaded programming
5. Assignments on GUI programming
Note: Use Java for programming
Preferably download "java_ee_sdk-6u4-jdk7-windows.exe" from
http://www.oracle.com/technetwork/java/javase/downloads/java-ee-sdk-6u3-jdk-7u1-downloads-523391.html

LT 594 Analytical Chemistry of Wastewater related to Leather Processing
Determination of:
1) Total solids
2) Total dissolved solids
3) Total suspended solids
4) Total volatile solids
5) Total non -volatile solids content in wastewater.
2) Determination of the Acidity / Alkalinity of the given sample of wastewater
3) Determination of the Salinity of wastewater
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
9) Determination of the Ammoniacal Nitrogen present (NH ₃ —N) in tannery effluent
10) Determination of the Biochemical Oxygen Demand (BOD ₅) of a given waste water
11) Determination of the Chemical Oxygen Demand of given waste water
12) Determination of the Total Iron Content in given waste water
13) Determination of the Ferrous Iron content in given waste water
14) Determination of the Proteinous substance in given waste water

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Semester-VI

HU 601 Principles of Management
1. Basic concepts of management: Definition – Essence, Functions, Roles, Level.
2. Functions of Management : Planning – Concept, Nature, Types, Analysis, Management by objectives; Organisation Structure – Concept, Structure, Principles, Centralization, Decentralization, Span of Management; Organisational Effectiveness.
3. Management and Society – Concept, External Environment, CSR, Corporate Governance, Ethical Standards.
4. People Management – Overview, Job design, Recruitment & Selection, Training & Development, Stress Management.
5. Managerial Competencies – Communication, Motivation, Team Effectiveness, Conflict Management, Creativity, Entrepreneurship
6. Leadership: Concept, Nature, Styles.
7. Decision making: Concept, Nature, Process, Tools & techniques.
8. Economic, Financial & Quantitative Analysis – Production, Markets, National Income Accounting, Financial Function & Goals, Financial Statement & Ratio Analysis, Quantitative Methods – Statistical Interference, Forecasting, Regression Analysis, Statistical Quality Control.
9. Customer Management – Market Planning & Research, Marketing Mix, Advertising & Brand Management.
10. Operations & Technology Management – Production & Operations Management, Logistics & Supply Chain Management, TQM, Kaizen & Six Sigma, MIS.
Readings:
1. Management : Principles, Processes & Practices – Bhat, A & Kumar, A (OUP).

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LT 601 Chemistry & Technology of Post Tanning Operations
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 & De-emulsification – 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, 4 th 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.L 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.

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LT 602 Physical Testing of Leather
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

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LT 603 Mechanics of Leather Machines and Design of Parts
Group A
Mechanics of Leather Machinery:
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.
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.
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, Different heating systems and economic usage depending upon the final results; thermostatic controls. Varieties of pumps used in tannery, effluent treatment system.
Group B:
Design of parts:
Analysis of Biaxial Stresses-Mohr's circle for biaxial stress principle Stress and Pure shear & Strain energy. Stresses in beams; shear force (SF), axial force and bending moment (BM); differential Relations for BM,SF and load; bending stresses in straight beams, Torsion of a circular shaft. Modes of failure; Design/allowable stress; Factor of safety(FoS);
Theories of failure-maximum normal Stress theory, maximum shear stress theory, Distortion energy theory. Design for stability: buckling analysis-Johnson and Euler columns, Design of Shafts & Axels, Design of Cotter joint , Knuckle joint and Fillet Welded joint of bracket. Bolted joints: Metric thread, standardsizes, use of locknuts and washers; Applications in structures including brackets, turn buckle; Pre-stressed bolts; Riveted joints: Unwin's formula; Brief discussion on single, double and triple row lap joints, butt joints with single or double strap /cover plate; simple strength design; joint efficiencies
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.
Suggested Books :
01. Leather Technician's HandBook – J. H. Sharphouse, 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.

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LT 604A Material Science
1. Processing of Materials:
Powder synthesis, sintering, chemical methods, crystal growth techniques, zone refining, preparation of nano particles and thin films
2. Characterisation Techniques:
X-ray diffraction, spectroscopic techniques like UV-vis, IR, Raman. Optical and Electron microscopy
3. Structure and Imperfections:
Crystal symmetry, point groups, space groups, indices of planes, close packing in solids, bonding in materials, coordination and radius ratio concepts, point defects, dislocations, grain boundaries, surface energy and equilibrium shapes of crystals
4. Thermodynamics and Kinetics:
Phase rule, phase diagrams, solid solutions, invariant reactions, lever rule, basic heat treatment of metals, solidification and phase transformations, Fick's laws of diffusion, mechanisms of diffusion, and temperature dependence of diffusivity
5. Properties of Materials:
Mechanical Properties: Stress-strain response of metallic, ceramic and polymer materials, yield strength, tensile strength and modulus of elasticity, toughness, plastic deformation, fatigue, creep and fracture
6. Electronic Properties: Free electron theory, Fermi energy, density of states, elements of band theory, semiconductors, Hall effect, dielectric behaviour, piezo, ferro, pyroelectric materials
7. Magnetic Properties: Origin of magnetism in metallic and ceramic materials, paramagnetism, diamagnetism, ferro and ferrimagnetism
8. Thermal Properties: Specific heat, thermal conductivity and thermal expansion, thermoelectricity
9. Optical Properties: Refractive index, absorption and transmission of electromagnetic radiation in solids, electrooptic and magneto optic materials, spontaneous and stimulated emission, gas and solid state lasers
10. Material types
Concept of amorphous, single crystals and polycrystalline materials, crystallinity and its effect on physical properties, metal, ceramic, polymers, classification of polymers, polymerization, structure and properties, additives for polymer products, processing and applications, effect of environment on materials, composites
11. Environmental Degradation
Corrosion, oxidation and prevention
12. Elements of Quantum Mechanics and Mathematics
Basics of quantum mechanics, quantum mechanical treatment of electrical, optical and thermal properties of materials, analytical solid geometry, differentiation and integration, differential equations, vectors and tensors, matrices, Fourier series, complex analysis, probability and statistics

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LT 604B Safety & Occupational Health of Leather industry
Introduction to Occupational Health & Safety.
Basic principals in Epidemiological Practice:
How to perform an investigation, Basic measures & terms, Epidemiological researches, retrospective cohort studies , concept of 'relative risk', preventive role of epidemiology.
Ergonomics & Occupational Injuries:
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 in 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, CS ₂ , CO& Benzene, Toluene, Xylene, Dychloro 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.

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LT 604 C Industrial Sociology
1. Nature 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.
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.

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LT 605 A DATABASE Management System
1. Database System Architecture - Data Abstraction, Data Independence, Data Definitions and Data Manipulation Languages.
Data models - Entity Relationship(ER), Mapping ER Model to Relational Model, Network .Relational and Object Oriented Data Models, Integrity Constraints and Data Manipulation Operations.
2. Relation Query Languages, Relational Algebra, Tuple and Domain Relational Calculus, SQL and QBE.
Relational Database Design: Domain and Data dependency, Armstrong's Axioms, Normal Forms, Dependency Preservation, Lossless design, Comparison of Oracle & DB2
3. Query Processing and Optimization: Evaluation of Relational Algebra Expressions, Query Equivalence, Join strategies, Query Optimization Algorithms.
4. Storage Strategies: Indices, B-Trees, Hashing, Transaction processing: Recovery and Concurrency Control, Locking and Timestamp based Schedulers, Multiversion and Optimistic Concurrency Control Schemes.
Advanced topics: Object-Oriented and Object Relational databases. Logical Databases, Web Databases, Distributed Databases, Data Warehouse and Data Mining.
5. Overview of Data Communications and Networking.
Physical Layer : Analog and Digital, Analog Signals, Digital Signals, Analog versus Digital, Data Rate Limits, Transmission Impairment, More about signals.
Digital Transmission: Line coding, Block coding, Sampling, Transmission mode.
Analog Transmission: Modulation of Digital Data; Telephone modems, modulation of Analog signals.
Multiplexing: FDM 150, WDM 155, TDM 157,
Transmission Media: Guided Media, Unguided media (wireless)
Circuit switching and Telephone Network: Circuit switching, Telephone network.
6. Data Link Layer: Error Detection and correction : Types of Errors, Detection, Error Correction,
Data Link Control and Protocols: Flow and error Control, Stop-and-wait ARQ. Go-Back-N ARQ, Selective Repeat ARQ, HDLC.
Point-to -Point Access : PPP
Point -to- Point Protocol, PPP Stack,
Multiple Access, Random Access, Controlled Access, Channelization, Local area Network: Ethernet, Traditional Ethernet, Fast Ethernet, Gigabit Ethernet, Wireless LANs: IEEE 802.11, Bluetooth virtual circuits: Frame Relay and ATM.
7. Network Layer: Host to Host Delivery: Internetworking, addressing and Routing Network Layer Protocols: ARP, IPV4, ICMP, IPV6 ad ICMPV6 Transport Layer : Process to Process Delivery : UDP; TCP congestion control and Quality of service.
8. Application Layer: Client Server Model, Socket Interface, Domain Name System (DNS):
Electronic Mail (SMTP) and file transfer (FTP) HTTP and WWW.
Security Cryptography, Message security, User Authentication.
Text Books:-
1. Elmasri & Navathe -Fundamentals of Database Systems, 4th Edition, Pearson Education
2. C.J.Date - An introduction to Database Systems, Pearson Education
3. Bipin Desai -An introduction to Database System, Galgotia Publication
4.Data Communications and Networking : Third Edition. Behrouz A. Forouzan Tata McGraw-Hill Publishing company Limited.
5 Henry F. Korth and Silberschatz Abraham, "Database System Concepts", Mc.Graw Hill.
6. Elmasri Ramez and Novathe Shamkant, "Fundamentals of Database Systems", Benjamin Cummings Publishing. Company.
7. Ramakrishnan: Database Management System , McGraw-Hill
References:
1. James Martin, "Principles of Database Management Systems", 1985, Prentice Hall of India, New Delhi
2. "Fundamentals of Database Systems", Ramez Elmasri, Shamkant B.Navathe, Addison Wesley Publishing Edition

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3. "Database Management Systems", Arun K.Majumdar, Pritimay Bhattacharya, Tata McGraw Hill
4. Gray Jim and Reuter Address, "Transaction Processing : Concepts and Techniques", MoraganKauffman Publishers.

LT 605 B Industrial Psychology & Organisational Behaviour
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 environmentnoise, 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.

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LT 605 C Ecological Engineering & Eco-Audit
1. Ecosystem Concept:
Definition and Types, Biogeochemistry, Eco-cycling and Eco-energetics
2. Ecology and Individual Organisms:
Tolerance Range, Limiting Factors and Environmental Complex, Ecological Indicators
3. Population Ecology:
Population Growth, Population Density and Regulation
4. Community Ecology:
Organisation of Communities and Types of Interactions, Ecological Diversity, Natural Landscape and Community Change
5. Resources and Pollution:
Renewable and non-renewable resources, Bio-degradable and non-biodegradable pollutants, Treatment and Disposal Techniques, Eco-sphere and Pollution
6. Ecotoxicology:
Disciplines and Relevance of Toxicological Studies, Toxic response in Organisms, Exposure, Accumulation and Biotransformation of Toxins, Excretion of Toxic Agents, Toxic Action and Detection of Exposure, Toxicity Reduction and Antidotal Procedures
7. Ecotechnology:
Biomanipulation of eutrophication, Biofilters for hazardous wastes, Construction of Reed-beds land treatment of wastewater, Vermi-composting – system, design, benefits and limitations, Biogas technology – requirements, operation, benefits and limitations, Aquatic weeds and their utilisation in phytoremediation, Wastewater fed aquaculture – energy from effluent, Garbage farming – energy from solid wastes.
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.

LT 691 Physical Testing Lab
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).

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LT 692 Mechanics of Leather Machines Lab
Free hand sketch and drawing of tannery drums and paddle. 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. 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. Sharphouse, 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.

LT 693 Instrumental Analysis of Leather & Leather Chemicals
1. Application of UV-VIS spectroscopy in evaluating the characteristics of organic dyes and phenolic substances in leather processing.
2. Application of atomic absorption spectrometry in determining the heavy metal components in leather and leather chemicals.
3. Application of Fourier Transform Infrared Spectroscopy for determining various chemical species such as amides, aromatic components, aldehydes, sulfonates/ sulfonic acids in processed leather and leather chemicals.
4. ¹ H-/ ¹³ C-NMR analysis of collagenic materials
5. Application of thermal analyses (TGA, DSC), XRD, SEM, chromatography, pH _{zpc} measurement, for analysis and determination of quality of raw materials, processing chemicals and finished products as required in the leather and allied industries.
References:
1. H.H. Willard, L.L. Merritt, Jr, J.A. Dean and F.A. Selte. 'Instrumental Methods of Analysis' - 6 th Edition CBS Publishers & Distributors, Delhi.
2. Snell F.D. and Snell F.D. - 'Calorimetric methods of Analysis' D. Van Nostrand, New York.

LT 694 DATABASE Management Lab
<u>Structured Query Language</u>
1. Creating Database
<u>Creating a Database</u>
<u>_ Creating a Table</u>
<u>_ Specifying Relational Data Types</u>
<u>_ Specifying Constraints</u>
<u>_ Creating Indexes</u>
2. Table and Record Handling
<u>_ INSERT statement</u>
<u>_ Using SELECT and INSERT together</u>
<u>_ DELETE, UPDATE, TRUNCATE statements</u>
<u>_ DROP, ALTER statements</u>
3. Retrieving Data from a Database
<u>_ The SELECT statement</u>
<u>_ Using the WHERE clause</u>
<u>_ Using Logical Operators in the WHERE clause</u>
<u>_ Using IN, BETWEEN, LIKE, ORDER BY, GROUP BY and HAVING Clause.</u>

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_ Using Aggregate Functions
_ Combining Tables Using JOINS
_ Subqueries
4 Database Management
_ Creating Views
_ Creating Column Aliases
_ Creating Database Users
_ Using GRANT and REVOKE
COMPUTER NETWORKS
__ NIC Installation & Configuration (Windows/Linux) __ Familiarization with
Networking cables (CAT5, UTP)
Connectors (RJ45, T-connector)
Hubs, Switches
__ TCP/UDP Socket Programming
__ Multicast & Broadcast Sockets
__ Implementation of a Prototype Multithreaded Server
__ Implementation of
Data Link Layer Flow Control Mechanism (Stop & Wait, Sliding Window)
Data Link Layer Error Detection Mechanism (Cyclic Redundancy Check)
Data Link Layer Error Control Mechanism (Selective Repeat, Go Back N)

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Semester-VII

LT 701 Chemistry & Technology of Leather Finishing Operations
OBJECTIVES: To impart knowledge on materials and processes/operations involved in leather finishing.
OUTCOMES: At the end of this course, the students would be in a position to •Appreciate the role of various finishing agents and auxiliaries used in leather finishing •Formulate strategies for finishing different types of leathers •Study various upgradation techniques •Methods of drying –Toggle drying, paste drying, vacuum drying etc. and preparing the crust
1. 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.
2. 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.
3. 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, Phthalocyanine pigments, Azo pigments, Carbon black. Extender pigments- their functions in surface coatings. Chemistry and properties of Luminescent pigments.
4. 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.
5. 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.
6. Nitrocellulose lacquer:
Chemistry and properties of N.C. lacquer, 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.
7. 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.
8. 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.
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 Dekker, 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.

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LT 702 Eco - Benign Options for Leather Processing
CLEANER PROCESSING -BEAMHOUSE
Eco-friendly process technologies: Salt free curing options, sulphide free unhairing systems, ammonia -free deliming, salt free pickling systems, solvent free degreasing systems.
Paradigm shift from chemical processing of hides and skins to bio beam house processing.
CLEANER PROCESSING: TANNING
Less chrome and chrome-free tanning systems. Latest concepts and trends in leather processing. Eco-labelling. Integrated strategies to achieve permissible BOD, COD and TDS standards of tannery effluents.
CLEANER PROCESSING: POST TANNING
Formaldehyde, Phenol, AOX free post tanning systems; Latest concepts and trends in leather processing. Eco-labelling. Integrated strategies to achieve permissible BOD, COD and TDS standards of tannery effluents.
CLEANER PROCESSING: FINISHING
Cleaner processing and solvent free finishing systems; Eco-labelling. integrated strategies to achieve permissible BOD, COD and TDS standards of tannery effluents
REFERENCES
1.P.S.Briggs, “Gloving, Clothing and special leathers” products Institute, London, 1981.
2.J.H.Sharphouse, “Leather Technicians Hand Book”, Leather Producers Association, Northampton NN3 1JD, Reprinted 1995.

LT 703 Analytical Chemistry of Leather Auxiliaries –II
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 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
05. Principles underlying analysis of the followings of Chrome tanned leather:
i) moisture
ii) Volatile matter
iii) Total ash
iv) Solvent extractable substances
v) Nitrogen and Hide substance
vi) Water soluble matter
vii) Chromic oxide content
viii) Difference figure of water-soluble matter.
06. 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

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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
07. 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
08. 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
09. 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
10. Principles underlying analysis of Formaldehyde tanned leather
11. Principles underlying analysis of oil tanned leather
12. 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 & 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.

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LT 704 Science & Technology of Polymer & Synthetics as Leather Substitute
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 polymerization.
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 average molecular weight and size:
End group analysis, measurement of colligative properties.
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. 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.
TECHNOLOGY OF AUXILIARIES / SYNTHETICS
11. Preparation and applications of some industrially important polymers for leather manufacturing: polyamides, phenol-formaldehyde resin/condensate, urea-formaldehyde resin/condensate, melamine-formaldehyde resin/condensate, polyacrylic acid, polyacrylates, polymethacrylates, polystyrene, polyurethane, silicones, polybutadiene, cellulose nitrate/nitrocellulose, cellulose acetate butyrate, styrene-maleic anhydride copolymer, styrene-butyl acrylate copolymer, butyl acrylate-acrylic acid copolymer
12. Testing of polymers: mechanical (tensile, tearing, compression), diffractometric (XRD), morphological (SEM and TEM) and thermal (DSC, DTA, TGA) properties.
13. Fabrication of polymeric material, compounding and mixing, casting, extrusion, fibre spinning, molding, coating, foam fabrication.\
14. Synthesis, characterization and application of homo-/co-/ter polymer based hydrogels and membranes.
15. Manufacture of rubber and elastomers. Natural rubber processing & vulcanizing synthetic elastomers; butadiene copolymer, polyisoprene polybutadiene - processing and vulcanizing.
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.
3. The Chemistry and Physics of Polymers -Kuleznev, V.N. and Shershnev, V.A. (1990) Mir Publishers, Moscow.
4. Williams, D.J., " Polymer Science & Engineering ", Prentice Hall, New York, 1971.
5. Austin, G.T., Shrer's " Chemical Process Industries ", 5th Edition, McGraw-Hill International Book Co., Singapore, 1984.
6. Elrich F.R. " Science & Technology of Rubber ", Academic Press, New York, 1978.
7. Lubin, " Handbook of compsites ", Van Nostand Reinhold Co., New York.

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LT 705 E-Commerce & Application
Introduction to E-commerce: Introduction, E-commerce or Electronic Commerce- An Overview, Electronic Commerce – Cutting edge, Electronic Commerce Framework
Evolution of E-commerce: Introduction, History of Electronic Commerce, Advantages and Disadvantage of E-commerce, Roadmap of e-commerce in India (only short description)
Network Infrastructure: Introduction, Network Infrastructure- An Overview, The Internet Hierarchy, Basic Blocks of e-commerce, Networks layers & TCP/IP protocols, The Advantages of Internet, World Wide Web
E-commerce Infrastructure: Introduction, E-commerce Infrastructure-An Overview, Hardware, Server Operating System, Software, Network Website
e-Commerce Process Models: Introduction, Business Models, E-business Models Based on the Relationship of Transaction Parties, e-commerce Sales Life Cycle (ESLC) Model
Risks of Insecure Systems: Introduction, An Overview of Risks Associated with Internet Transactions, Intranet Associated Risks, risks associated with Business Transaction Data Transferred between Trading Partners
Management of Risk: Introduction, Introduction to Risk Management, Disaster Recovery Plans, Risk Management Paradigm
Electronic Payment Systems: Electronic Payment Systems, Electronic Cash, Smart Cards and Electronic Payment Systems, Credit Card Based Electronic Payment Systems, Risks and Electronic Payment Systems
Electronic Data Interchange(EDI): The Meaning of EDI, History of EDI, EDI Working Concept, Financial EDI, EDI and Internet (Describe only with the diagram of EDI)
E-Marketing: The scope of E-Marketing, Internet Marketing Techniques
Website Design Issues: Factors that Make People Return to Your Site, Strategies for Website Development
Consumer Oriented Business: Consumer Market, One-to-One Marketing, Consumer Demographics, Maintaining Loyalty, Gaining Acceptance, Online Catalogue, the Pilot Catalogue, A Unique Search Engine
Future Directions: Software Agents, Technology Behind Software Agents, Types of Software Agents, Characteristics and Properties of Software Agents, Frame-work for Software Agent-based e-commerce, m-commerce, m-commerce Architecture, Areas of Potential Growth and Future for m-commerce
Books:
3. E-Commerce-Strategy, Technologies & Applications by David Whitley, TMH
4. E-Commerce- The cutting edge of business by Kamlesh K. Bajaj, TMH
5. E-Commerce through ASP by W Clarke- BPB
6. Beginning E-Commerce with VB, ASP, SQL Server 7.0 & MTS by Mathew Reynolds, Wrox Publishers
7. Global Electronic Commerce- Theory and Case Studies by J. Christopher Westland and Theodore H. K Clark, University Press

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LT 791 Tannery Practice IV
Processing of Chrome tanned and vegetable tanned leather.
Finishing of chrome tanned and vegetable tanned crust.
Manufacture of Finished Leather from chrome tanned crust
Manufacture of Finished leathers from vegetable tanned crust

LT 792 Analytical Chemistry of Leather Auxiliaries Lab-II
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
05. 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
06. 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) Epson salt
x) Invert sugar
07. Analysis of the followings of Alum tanned leather:
i) Moisture
ii) Total ash
iii) Solvent extractable substances
iv) Aluminium as Alumina
08. 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

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vi) Chromic oxide content
vii) Degree of tannage
09. Analysis of Zirconium tanned leather for the followings:
i) Moisture
ii) Ash
iii) Solvent extractable substances
iv) Zirconium Content
10. Analysis of formaldehyde tanned leather
11. Analysis of oil tanned leather
12. 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 & 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.

LT 793 E-Commerce & Application Lab
E-Commerce experiments (to be given by faculty) are to be implemented using either VB, ASP, SQL or JAVA, JSP, SQL.
Creation and presentation of a business and project plan.
Selection of implementation environment and tools.
Orientation of concepts and techniques in e-commerce and web-based systems, e.g., through student presentations.
Practical use of databases, web servers, scripting languages, electronic signatures and encryption.
Development of an e-commerce application.
Continuous monitoring and reporting of project work.
Books:
E-Commerce through ASP by W Clarke- BPB
Beginning E-Commerce with VB, ASP, SQL Server 7.0 & MTS by Mathew Reynolds, Wrox Publishers
Professional Java Server Programming J2EE 1.3 Edition By Allamaraju et al, SPD.

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Semester-VIII

HU 801A Organisational Behaviour / Project Management
Organisational Behaviour:
1. Organizational Behaviour: Definition, Importance, Historical Background, Fundamental Concepts of OB, Challenges and Opportunities for OB.
2. Personality and Attitudes: Meaning of personality, Personality Determinants and Traits, Development of Personality, Types of Attitudes, Job Satisfaction.
3. Perception: Definition, Nature and Importance, Factors influencing Perception, Perceptual Selectivity, Link between Perception and Decision Making.
4. Motivation: Definition, Theories of Motivation - Maslow's Hierarchy of Needs Theory, McGregor's Theory X & Y, Herzberg's Motivation-Hygiene Theory, Alderfer's ERG Theory, McClelland's Theory of Needs, Vroom's Expectancy Theory.
5. Group Behaviour: Characteristics of Group, Types of Groups, Stages of Group Development, Group Decision Making.
6. Communication: Communication Process, Direction of Communication, Barriers to Effective Communication. [2]
7. Leadership: Definition, Importance, Theories of Leadership Styles.
8. Organizational Politics: Definition, Factors contributing to Political Behaviour.
9. Conflict Management: Traditional vis-a-vis Modern View of Conflict, Functional and Dysfunctional Conflict, Conflict, Process, Negotiation – Bargaining Strategies, Negotiation Process.
10. Organizational Design: Various Organizational Structures and their Effects on Human Behaviour, Concepts of Organizational Climate and Organizational Culture.
References:
1. Robbins, S. P. & Judge, T.A.: Organizational Behavior, Pearson Education, 15th Edn.
2. Luthans, Fred: Organizational Behavior, McGraw Hill, 12th Edn.
3. Shukla, Madhukar: Understanding Organizations – Organizational Theory & Practice in India, PHI
4. Fincham, R. & Rhodes, P.: Principles of Organizational Behaviour, OUP, 4th Edn.
5. Hersey, P., Blanchard, K.H., Johnson, D.E.- Management of Organizational Behavior Leading Human Resources, PHI, 10th Edn.

Or

HU801B Project Management
1. Project Management Concepts: Concept and Characteristics of a Project, Importance of Project Management.
2. Project Planning: Project Evaluation, Financial Sources, Feasibility Studies.
3. Project Scheduling: Importance of Project Scheduling, Work Breakdown Structure and Organization Breakdown Structure, Scheduling Techniques – Gantt Chart and LOB, Network Analysis – CPM/PERT.
4. Time Cost Trade-off Analysis – Optimum Project Duration.
5. Resource Allocation and Leveling.
6. Project Life Cycle.
7. Project Cost – Capital & Operating Costs, Project Life Cycle Costing, Project Cost Reduction Methods.
8. Project Quality Management: Concept of Project Quality, TQM in Projects, Project Audit.
9. Software Project Characteristics and Management
10. IT in Projects: Overview of types of Softwares for Projects, Major Features of Project Management Softwares like MS Project, Criterion for Software Selection.
References:
1. Gopalkrishnan P. and Rama Mmoorthy: Text Book of Project Management, Macmillan
2. Nicholas John M.: Project Management for Business and Technology – Principles and Practice, Prentice Hall India, 2nd Edn.
3. Levy Ferdinand K., Wiest Jerome D.: A Management Guide to PERT/CPM with GERT/PDM/DCPM and other

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networks, Prentice Hall India, 2nd Edn.
4. Mantel Jr., Meredith J. R., Shafer S. M., Sutton M. M., Gopalan M. R.: Project Management: Core Text Book, Wiley India, 1st Indian Edn.
5. Maylor H.: Project Management, Pearson, 3rd Edn.
6. Nagarajan K.: Project Management, New Age International Publishers, 5th Edn.
7. Kelkar. S.A, Software Project Management: A concise Study, 2nd Ed., PHI

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LT 801 Plant Layout and Entrepreneurship for Leather Sector
Group A
Plant Layout:
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.
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. Hydraulic & pneumatic steering mechanism for leather machinery. Air compressors, blowers and dust control equipment used in tannery, Drying mechanism and dryers used in tannery.
Part B
Entrepreneurship for Leather Sector:
Global Leather and Allied Industries:
Concepts and Fundamental Principles in global leather -Factors influencing business environment, Opportunity assessment, Business forecasting and prospective in leather sector -Leather as an economic and export opportunity sector -Influence of national and international environment on the sustainability of the leather sector
Venture Planning and Development as Applied to Leather and Allied Sector
Resource planning, Product and process selection criteria - Market segmentation and selection -Investment strategies, Business financing systems, Financial analysis for investment decision - Policy issues and legal clearances -Venture planning in tanneries, shoe units, chemical units and leather garments and goods units - Return on investments in leather sector - Financial sensitivity analysis for investments in the leather sector as applied in industrial leather sector.
Techno –Economic Feasibility Reports (TEFR) for Leather and Allied Sector
Components of TEFR -size of projects,Project costing -Selection and means of finance -cash-flow projections -Costing and pricing -Implementation schedules -PERT and related project scheduling charts -TEFR for tannery, shoe plants, leather chemical, leather garments and leather goods units
Resource Management and Production Planning for Leather and Allied Sector
Material and money flow -Labour management -Principles of production management -TQM concepts -ISO and related certification methods -Purchase management in leather sector -Credit financing and labour issues in leather sector - Productivity bottlenecks in tanneries and shoe plants and debottlenecking strategies -Inventory control measures for leather sector.
Operations research -time-motion studies -Principles of time management -Management information system -Intranet and Internet communication and its relevance in managing enterprises -Factors concerning system productivity in leather sector

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Global Leather Markets, Market demand assessment techniques -Taxation and internal revenue issues -Market forecasting tools and techniques -Brand building -Export -import guidelines and trade issues - Market sensitivity analysis -Global trade in leather inter-country comparison of strengths and weaknesses at market place -WTO and related issues influencing leather -Eco-criteria and its influence in leather market -Forecasting domestic market for leather products and market driven planning of an enterprise in leather sector.
Reference books:
1.Brandt, Steven C., The 10 Commandments for Building a Growth Company, Third Edition, Macmillan Business Books, Delhi, 1977
2. Bhide, Amar V., The Origin and Evolution of New Businesses, Oxford University Press, New York, 2000.
3. Desai, Vasant, Small Scale Enterprises Vols. 1-12, Mumbai, Himalaya Publishing House. (Latest edition).
4.Dollinger, Mare J., Entrepreneurship: Strategies and Resources, Illinois, Irwin, 1955.
5.Holt, David H., Entrepreneurship: New Venture Creation, Prentice-Hall of India, New Delhi, latest Edition.
6.Panda, Shiba Charan, Entrepreneurship Development, New Delhi, Anmol Publications. (Latest Editions)
7.Patel, V. G., The Seven Business Crises and How to Beat Them, Tata-McGraw, New Delhi, 1995.
8.SIDBI Report on Small Scale Industries Sector (Latest Editions)

LT 802 Technology of Animal and Tannery Byproducts Utilization
Animal & Tannery Byproducts Utilization
Types of animal byproducts - from abattoirs, meat processing plants, poultry, fishing and other sources including fallen animals. Present methods of collection, processing and utilisation in developing countries vis - a - vis developed countries: conservation techniques and concept of two tier technology. Protein meals from animal by-products including fallen animals and their significance in livestock feeds. Bone products and their utilisation. Keratinous proteins - various sources keratinous based products and their uses.
ANIMAL BLOOD, ITS PRODUCTS AND THEIR UTILISATION
Alimentary tract and its processing into various products. Present status of the industry in the country. Pet foods methods of preparation in brief.
COLLECTION AND CONSERVATION OF ORGANS AND GLANDS FROM SLAUGHTERED ANIMALS : POSSIBLE SCOPE OF THEIR UTILISATION
Anaerobic digestion, its significance for the preparation of animal feed, fuel gas, fertilizer, etc. Quality control including microbiological aspects of products processed from animal by products.
PRESENT INDUSTRIAL STATUS OF VARIOUS BY-PRODUCTS IN THE COUNTRY
Process studies on
a. Glue making from tannery wastes
b. Bone glue and deproteinisation of bone
c. Horn and hoof meal
d. Protein meals by different methods
References:
1. Burnham, F. " Rendering - the invisible industry ", Aero Publishers, Inc., Fallbrook, CA 92028, 1978.
2. Mann, I. " Processing and Utilisation of animal by-products ", Food and Agriculture organisation, Rome, 1962.
3. Scaria, K.J., Mahendrakumar and Divakaran, S. " Animal by-Products - processing and utilisation ", Central Leather Research Institute, Madras, 1981.
4. Taiganides, E.P. " Animal Wastes Applied Science ", Publishers Ltd., Essex, 1977.
5. Mahendrakumar, " Hand Book of rural technology for the processing of animal by-products ", FAO Agricultural Services Bulletin 79, Food and Agriculture Organisation.
6. Divakaran, S. " Animal Blood - Processing and utilisation Food and Agriculture Organisation ", Rome, 1978.

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HU 891 Design Lab
A. 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 .
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.
B. Design of pilot effluent treatment Plant
C. Model solar powered leather and leather goods unit
D. Design of innovative eco - friendly bio leather and leather products

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LT 892 Project
Various projects based on industrial requirement (Done in industry itself or in-house)

LT 893 Grand Viva
