

LT1301 Theory & Practices of preservation and pre-tanning operations

Preservation of Hides and Skins :

Principles and practice involved in long and short term preservation techniques for hides and skin, Preservation, defects.

5

PRETANNING PROCESSES :

Soaking :- Physico-chemical explanation of wetting, objectives materials, methods and different controls in soaking operation

4

Liming :- Chemistry of Unhairing, Unhairing by different methods, Objectives of liming, Effects of liming in collagen, controls in liming operation to achieve different physical properties of leather.

6

Deliming and Drenching :- Objectives, Principles and controls of deliming and drenching.

3

Bating :- Chemistry of proteolytic enzymes used for bating, Necessity of bating, its necessity and controls for desired properties of leather.

5

Pickling :- Acid binding capacity of collagen, use of organic acids or salts in pickling, its necessity and controls, concept of De-pickling.

4

Degreasing :- Objectives and necessity of Degreasing, different degreasing systems and methods.

3

CLEANER PROCESSING PRACTICES IN BEAM HOUSE

Salt free curing option, Sulfide free unhairing system, ammonia free deliming, salt free pickling system, eco friendly degreasing system, strategies to bring down BOD, COD and TDS of tannery effluents. **10**

Suggested Books :-

1. Introduction to the Principles of Leather Manufacture. By – S. S. Dutta, 4th Edition, ILTA, Kolkata.
2. Chemistry & Technology of Leather. By – Roddy, O' Flaherty & Lollar, Vol – 2 & 3, Robert E. Kreiger. Publishing Co., N.Y.
3. Theory & Practice of Leather Manufacture. By – K. T. Sarkar, Macmillan India Press, Chennai.
4. Fundamentals of Leather Manufacture. By- Eckent Hidem
5. Chemistry of Tanning Processes. By – K. H. Gustavson, Academic Press, N.Y.

LT 1402 Introduction to Leather Technology

Live stock population, animal mortality and availability of hides and skins in India.

05

Statistical analysis of leather Industries, Leather, Leather products (National & International Scenario).

12

Chemical constituents of hides and skins.

05

General principles involved in raw hide and skin preservation, assortment and their processing, pre tanning, tanning and post tanning operations.

15

Defects in leather, Microscopy & Bacteriology

05

LT 1403 Bio-Chemistry of Proteins

Fundamentals of Biochemistry :-

The molecular logic of life, strong and weak interactions, introductory concept of cell, bio-molecules and water.

5

Histology and fibre packing in commercially viable hides/skins.

3

Amino acids, peptides and proteins :-

Chemistry, Classification determination of amino acids, Qualitative and Quantitative determinations, Structure of Various amino acids, formation of peptides, polypeptides and separation of proteins, covalent structure of proteins, Reaction of Proteins with acid, bases and salts.

8

Polarity of amino acids and ionization of proteins, electro-phoresis, hydration, solubility of proteins, dielectric properties, intermolecular forces of proteins cross linking in collagen, Iso-electric point of collagen and its manipulation in various stages of leather manufacture. Acid and base binding capacity of collagen, reversible and irreversible acid and base binding capacity of collagen, Effects of anions, swelling (osmotic and lyotropic) and phase transition in collagen, helix-coil transition, Denaturation and melting of collagen. Glass transition of collagen, Shrinkage denaturation and optical birefringence of collagen.

12

Structure, function and chemical features of collagen reactive groups and Cross linking, Tropo collagen molecules, Sub-units of collagen, Types of collagen, Structure and function, Fibril formation, Precipitated forms of collagen, Electron microscopy of the collagen fibre, Bio-Synthesis.

9

Structure and functional role of other skin proteins like keratin, Reticulin and Elastic, albumin, globulin and mucine etc.

6

LT-1404 CHEMICAL ENGINEERING –I

- 1. Fluid Mechanics :-** Properties of fluids, Compressible, Incompressible fluid, Viscosity, Elasticity, Vapour pressure, Surface tension, Buoyancy and floatation. **10**
- 2. Flow Measurement :-** Pitot tube, Venturi meter, Orifice meter, Pumps, Manometers. **08**
- 3. Fluid Dynamics :-** Bernoulli's theorem, Continuity equation, Euler's equation, Energy and momentum equation, Basic concept of Newtonian and Non-Newtonian fluid. **08**
- 4. Heat transfer :-** Heat transfer by conduction, convection and radiation, Conduction through plain and cylindrical surfaces, Natural and forced convection, Heat transfer coefficient. Log mean temp. difference. **09**
- 5. Evaporation :-** Types of Evaporators, Operation of Evaporation unit, Different methods of feedings. **04**
- 6. Size Separation :-** Screening, Mixing and agitation, floatation, **04**

Practical :-

1. To verify Bernoulli's theorem.
2. Study and calibration of venturimeter.
3. Study of pilot tube and to measure discharge through it.
4. Study of orific meter and determination of C_v , C_d , C_c for free flow.
5. To study and draw various flow pattern of a fluid past body.
6. To find the metacentric height of a body.

LT-1505 CHEMICAL ENGINEERING –II

1. Nitration, Alkylation, Halogenation, Sulfonation. **10**
2. **Crystallization :-** Theory of crystallization, crystallization equipment for chemical processing. **08**
3. **Adsorption :-** Theory of adsorption, Industrial adsorbents adsorption equipments Decolourization of chemicals. **08**
4. **Diffusion :-** Binary diffusion Concept of mass transfer coefficients and interface mass transfer and stage wise contact. **09**
5. **Absorption :-** Theory of gas absorption, Design and operation of absorption towers, Humidity and its measurements. Adiabatic Saturation temp. Dry and wet bulb temp, Humidity chart. **08**

Practical :

1. To find out the Viscosity of a given fluid by Ostwald Viscometer and by capillary tube viscometer.
2. To study about bomb calorimeter.
3. To find the calorific value of a given solid fuel.
4. To separate the mixture of Benzene and Toluene by simple distillation method.
5. Screen analysis by Taylor's method.

LT 1506 Principles of Inorganic Tannage

Tanning :- Theory, Chemistry, Factors and objectives of following inorganic tanning operations :- (a) Chrome Tannage (b) Aluminum Tannage (c) Iron Tannage (d) Zirconium Tannage (e) Titanium Tannage (f) Poly Phosphate Tannage and (g) Silica Tannage.

10

Introduction to Co-ordination Chemistry, metal ion in tanning :-

Historical introduction to mineral tanning, Introduction of factors controlling molecular stability of transition metal complexes, Werner's theory of Co-ordination, Role of d and f orbitals, Definition of ligands, Ligand Bond in Collage, Chelation, Masking agent :- Their requirement for use in chrome tanning, Effect of masking on chrome tanned leather & as chrome liquor.

10

Aqueous Chemistry of Chromium :-

Electric configuration, common oxidation states of chromium, stabilities of Chromium (IV) and Chromium (III) salt, Basicity, Olation, Oxolation and polymerization, complexity of chrome complexes.

07

Factor Controlling Chrome tanning :-

Single and double bath chrome tannage and their relative merits and demerits, preparation of Basic chromium sulphate salt, Effects of float Volume, PH, basicity, Masking temperature, drum speed, ageing chrome tanned substrate.

07

Mechanism of chrome tanning :-

Theories of chrome tanning, Absorption, Coating, Electrostatic and hydrogen bond interaction and co-ordinative forces involved in chrome tanning, hydro thermal stability of chrome-collagen compound.

07

Suggested Books :- Same as LT 1402

LT 1507 Principles of Organic Tannage

Vegetable Tannins –

Classification of Vegetable tannins – Structural aspects, Analysis of Chemistry of Hydrolysable & Condensed tannins, Manufacture of vegetable tannin extract use of additive for product notification, Reactions of vegetable tannins with collagen, Principle of vegetable tanning, Factors affecting tannin diffusion & factors affecting tannin fixation with collagen, Principle of Rapid tanning methods.

12

Synthetic tannins –

Chemistry & Multifunctional properties of syntans, Nontans in synthetic tannins, General Manufacturing methods of Phenol, Formaldehyde Naphthalene, Formaldehyde and Naphthol, Formaldehyde condensates, Supra Syntans, Use of Syntans for the Manufacture of various Leathers & for chemical modifications for specific objectives, use of Lignosulfonic acids in Leather processing.

12

Resin Syntans –

Urea, Formaldehyde & Melamine, Formaldehyde condensates as tanning agents for leather, their chemistry & structure, Property, Relationship, Polyacrylates & Polyurethanes as Resin tanning agent Principles of their use.

08

Aldehydes as tannins –

Formaldehyde and other mono, difunctional aldehydes their chemistry, Structure and general properties, Reaction of aldehydes with different functional groups of protein. Tanning faculty at different pH reactions, oil, sulphony/chloride quinone tannage.

08

Combination tannages –

Deficiencies of single tannage, Machanistic classification of tannages. All chrome based combination tannages, semi-chrome & semi – alum tannages.

LT 1508 Practices of Leather Manufacturing – I

General Practices in vegetable and chrome tanning with quality control in manufacture of the following Industrial and heavy leathers.

02

Traditional and Rapid methods of vegetable tannage of sole (Pit and Drum tanning). Chrome tanned sole and waxed chromed soles. Improvement of water resistance of vegetable tanned sole leathers.

06

Bag tanning of cattle and buffalo hides, different types of finished leather from bag tanned leathers, Belting harness, Saddlery and honing leathers.

05

Picking band leathers, Apron leathers, Hydraulic pneumatic leathers such as water and air pump leathers for turbines, Oil seals, Gas meters etc.

08

Sports goods leathers like Foot ball, Hokey ball, Volley ball, Cricket ball, Glove for wicket keepers and Boxing. Taxidermi.

03

Manufacture of Kattai, Banwar and case hides from Buff cattles.

06

LT 1509 Analytical Chemistry of Leather

1. Analysis of Lime

Principles underlying determination of following in lime

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

03

2. Analysis of Na₂S

Principles underlying analysis of Na₂S by official international method.

02

3. Analysis of lime liquors (Fresh & used)

Principles underlying determination of following in lime liquor :-

- (a) Total Alkalinity
- (b) Total lime
- (c) Total nitrogen
- (d) Hide substance
- (e) Amino acids

03

4. Analysis of limed pelt

Principles underlying determination of following in limed pelt

- (a) Total Alkalinity
- (b) Total Ammonia
- (c) Hide Substance

03

5. Analysis of Boric acid

01

6. Analysis of deliming agent (Ammonium chloride and Ammonium sulfate)

01

7. Analysis of enzyme bates

02

8. Analysis of used pickle liquors for following :-	
(a) Determination of acid	
(b) Determination of salt	
9. Analysis of Sodium formate	01
10. Analysis of Chrome liquor to determine	
(a) Basic chromium	
(b) Basicity of chrome liquor	
(c) Degree of Olation.	04
11. Analysis of basic chromium sulfate for following :-	
(Power of Crystal)	
(a) Moisture	
(b) Chromium	02
12. Analysis of acids & salts in vegetable tannin extracts by different methods.	02
13. Analysis of Zirconium and Alum. Tanning agents.	
14. Analysis of Formaldehyde.	02
15. Analysis of chrome tanned leather for following :-	
Moisture, ash, Chromic oxide content, Solvent extractable substances, Water soluble matter and difference figure.	03
16. Analysis of followings of Veg. tanned leather :-	
Moisture, ash, Water soluble matter, Solvent extractable substances and difference figure, Degree of tannage.	03
17. Analysis of followings of Alum. Tanned leather moisture, total ash, Solvent extractable substances, Aluminium as Alumina.	01
18. Analysis of followings of Zirconium tanned leather :-	
Moisture, Ash, Solvent extractable substances, Zirconium content.	01

19. Analysis of followings of combined tanned leather :-

Moisture, Ash, Solvent Extractable substances, Water soluble matter and difference figure, Chromic oxide content, Degree of tannage.

03

20. Analytical Chemistry of Post tanning and Finishing agent

Analysis of lipids for following :

- (a) Acid value
- (b) Saponification value by reflux method.
- (c) Iodine value by Hanus method.
- (d) Unsaponifiables by extraction method.
- (e) Analysis of sulfated oils and ready made fat liquors.

05

21. Principles underlying examination and analysis of dyes used in leather manufacture

01

22. Principles underlying examination and analysis of readymade finishes and finishing materials used in leather manufacture.

02

Suggested Books :-

1. Analytical Chemistry of leather manufacture - P. K. Sarkar, ILTA, Kolkata.
2. The Chemistry and Technology of leather – F – O Flaharty, Roddy, Lollar. Krieger Publishing Co. Florida USA.
3. Official methods of Analysis SLTC, U.K.
4. Different standards issued by BIS from time to time.

LT 1610 Principles of Post-Tanning Operation

NEUTRALISATION :- Its objectives, necessities and control to achieve desired uptake of dyes and fat liquors.

03

BLEACHING :- Definition, Theory, Mechanism of chemical bleaching, classification and application of different methods of bleaching to leathers.

03

DYEING :- Classification of dyes based on their chemical nature and also according to their application, Theory of colour, Manual colour matching, Theory and mechanism of dyeing, Chemistry and application of dyeing auxiliaries such as levelling agents, wetting agents, dispersing agents and dye fixative, Metal complex dye.

10

FAT LIQUORING :- Theory of stability of Emulsion (Surface tension theories and Electrical theories), Fatliquor based on natural oils, their chemistry and preparation, Oxidation, Sulphation, Sulphonation, Bisulphitation and their properties, Synthetic Fat liquor :- Preparation and Properties, Principles and objectives of fatliquoring, Differences between synthetic and natural fat & oils concept of curring.

10

RETANNING SYNTANS AND RETANNING :- Classification of retanning syntans, Tanning power of retanning syntan, Dipole theory of syntan tanning, General method of manufacture of aromatic syntans their general properties, Objective of retanage, Effect of different retanning agents on properties of leather principle of bondage of retanning material.

07

THEORY OF LEATHER DRYING :- principles of energy and mass transfer, Physio-Chemical aspect of leather drying, Different methods of drying followed in leather Industry

07

Suggested Books :- Same as LT 1402

LT 1611 Leather Bio-Technology

Microbiology (Bacteria) :-

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

The Cultivation reproduction & Growth :- Nutritional requirement, nutritional types of bacteria, Prototroph Chemotrophs autotrophs & heterotrophs, obligate parasites.

10

Bacteriological media :- Types of media, preparation of media, Physical conditions required for growth.

02

Reproduction :- Modes of cell division, new cell formation .

02

Methods of isolating pure culture :- The streak plate technique, the pour plate and spread techniques, micro manipulator techniques, the maintenance and preservation of pure culture, culture collection cultural characteristics colony characteristics, Characteristics of broth culture.

Characteristics, Classification of mold, Role of bacteria and mold in leather, uses of Bactericides and Fungicides in leather.

05

Enzyme, their Physico-chemical concept regulation of enzyme synthesis in microbes, classification, function methodology, Enzyme reaction mechanism :- Enzyme kinetics isolation and purification of enzymes. Immobilization of enzymes in whole cell and enzyme reactors.

02

Cleaner Leather processing :- use of enzyme option in beam house operations – Soaking, Unhairing, Bating Degreasing, offal treatment, Types of enzymes – Proteases, Lipases, Properties and Production.

05

Fermentation :- Mechanism of alcoholic fermentation of carbohydrate, bacterial fermentation, fermentation by coliform organisms, fermentation of nitrogenous compound, vinegar.

04

Bacterial Genetics :- Biosynthesis of deoxyribonucleic acid (DNA)- Structure of DNA, Biosynthesis of nucleotides in DNA strands, Replication of the DNA molecule, Transcription & translation of genetic information in protein synthesis.

Bacterial mutation :- Types of mutation, How mutation occur, How mutation are repaired, Bacterial recombination, Bacterial conjugation, Bacterial transduction, Bacterial transformation, Recombinant DNA Technology, DNA Cloning.

04

Lisation of collagenous tissues for Biomedical and other application :-

Collagen and its application in food, cosmetic and medical fields.

05

Suggested Books :-

1. Microbiology – Michel J. Pelczar, JR, E.C.S Chan R, Krieg (Fifth edition).
2. Molecular Biology of gene-walson, Hopkins, Roberts Steitz Weiner (Fourth Edition)
3. Biological waste water treatment – Theory and application – C.P. Lertem Grady, Jr. Henry C. Um.
4. Stryer, L. Biochemistry 3/e W.H. Freeman and Co. 1989.
5. Lehninger A.L. Principles of Biochemistry Buttercoorth, 1982.

LT 1612 Leather Product Technology – I

1. Introduction

History of Footwear industry, Functions of footwear, Different parts of Footwear (Upper, Bottom and hidden components)

03

2. Anatomy of Human foot

Bones, Joints, Muscles, Ligaments, arches of skin of human foot, Internal and external changes of human foot from infant to adult stage, Analysis of human locomotion, Common foot abnormalities and their remedies. Foot comfort and foot care.

07

3. Last

Definition, Classification of last, Different parts of last, Seasoning of wood for wooden last, Last measurement, Comparison of last with human foot.

04

4. Shoe Sizes and Fittings

Relation between foot sizes and fittings and shoe, sizes and fittings, English, American, French, Continental and mondopoint shoe sizes and fittings system.

03

5. Designing

Introduction, Classification of Basic design, Elements of Design, Elements of Fashion design procedure, Concept of inside form, outside form and mean form, Making a basic shoe standard, pattern making allowances, Grading (Grading m/c)

10

6. Footwear materials

(a) Upper and Lining materials – Different natural and synthetic materials.

(b) Adhesive – Definition, Different types of adhesives use in footwear industry and their relative advantages and disadvantages.

(c) Sole, Insole, Toe, PUA, Shonic, Stiffner, Itec, Thread, Required properties of these materials, Different types of these materials.

09

7. Footwear Costing

Material, Labour and Overhead cost, Determining the material consumption, Leather consumption – One pair tracing insole consumption, Adhesive and thread consumption etc.

04

Suggested Books :-

1. Manual of Shoe making –Clark
2. The text book of Footwear menu – J. H. Throntin.
3. Principle of Footwear Manufacture – Somnath ganguly.

LT 1613 Principles of Material Testing

1. Introduction

Thumb tests, Necessity of Physical Testing, Classification, Sampling positions, Conditioning of test samples

05

2. Different Strengths of Leather

Determination of Tensile strength and percent elongation of break, Stitch tear strength, Tearing strength, Tongue tearing strength, Buckle tear strength, Split tear strength, Distension and strength of grain by Boll Burst test – (i) The Lastometer (ii) The Tensometer.

09

3. Few more tests for upper and light leather

Flexing endurance test, air and water vapour permeability, Dynamic water proofness test, Dry and wet rub fastness test, Measurement of shrinkage temperature.

09

4. Tests for Sole leather

Measurement of apparent and real density, Determination of Abrasive resistance of sole leather, Dynamic water proofness of sole leather (Kubelka method), Grain cracking in sole leather (Mandrel test)

09

5. Tests for Finish -film

Determination of bond strength between the leather surface and finish film, cold, crack resistance, Light fasters test.

05

6. Specification

Shoe upper, Sole, Lining Leather, Clothing, Glove, Technical leathers, Upholestry and fancy leather.

03

Suggested Books :-

1. An Introduction to the principles of physical testing of leather – Prof. S. S. Dutta, ILTA, Kolkata.
2. Technical Controls in Leather Manufacture – By Bangau Swami, CLRI.
3. The Chemistry and Technology of Leather – O' Flaherty, Roddy, Lollar, Robert E, Kvieger Publishin Co. N.Y.

LT-1614 CHEMICAL ENGINEERING - III

1. **Distillation :-** Vapour-liquid, Equilibria, Theory of distillation of Binary liquid mixture, Fraction, Design and operation of distillation column for separation of binary mixture by Mc. Cabe thiel method. **12**
2. **Filtration :-** Theory and Mechanism of filtration, continuous and batch type filtration equipment. **10**
3. **Drying :-** Drying characteristics of material, Theory and Mechanism of drying, estimation of drying rate. Type of dryers. **08**
4. **Extraction:-** Extraction, Types of extraction, liquid-liquid extraction liquid-solid extraction, operation of stagewise and differential contact extractors. **07**
5. **Chemical Process :-** Manufacture of Bleaching powder, Alkali Industries Sodium sulfide, Sodium dichromate Basic Chromium sulphate. **07**

LT 1715 Leather Finishing Materials and Auxiliaries

1. Pigments :-

Inorganic and Organic Pigments, Preparation of Pigments, Methods of Preparation of Pigments, Aqueous Pigment Paste, Properties required in Pigments. **08**

2. Principles of Finishing, Finish Formulation and their Application:-

Definition, Aim, Film- Formulation mechanism, Properties of films such as transparency, Gloss and resistance to heat, light and solvent, Role is dispersion and stability – Requirement in multiple coat technique- Single coat, Composition and methods of application like spraying, Curtain coating, Roller coating etc, Cationic finishes and their relative merits. **06**

3. Chemistry and Preparation of Nitrocellulose, lacquers, lacquer emulsion, Coloured lacquers, Wax emulsions, Silicone emulsion. **06**

4. Chemistry and Properties required of Synthetic Polymers, Impregnating agents, Binders, Chemistry of Polyurethane lacquers. **06**

5. Chemistry and Mechanism of Plasticization, Internal and External Plasticizers. **06**

6. Definition of Water proofing, Theory of water Proofing, Chemistry & Mechanism involved in water proofing. **06**

7. Upgradation technologies in finishing.
General introduction to addition, condensation, Natural polymer, Casein, Cellulose **06**

Suggested Books :-

1. Acrylics and their uses in leather manufacture. By Rajadesa, S. and Kula Sekhran, S. CLRI 3 Chennai –1956.

2. Chemistry of Tanning Process. By Gustavson, K.H. Academic Press, New York-1956.
3. The Chemistry and Technology of Leather. By Fred O, Flaherty, Toddy T.W. and Hollar, R. M. Vol – II, Types of tannages, Rober E. Krieger, Publishing Co. New York – 1977.

LT 1716 ELECTIVE – I

(One Elective paper will be taken up out of the following four options with the consultation of H.O.D)

LT 1716 Animals & Tannery Byproducts Utilization (LTE 1.1)

1. An Overview :- Types of tannery available in India. Their nature and composition. Present methods of collection and utilization. Recovery of salt from the same. Its treatment and re-use. Theoretical and practical aspects of recovery of chrome, Protein and biogas from the tannery waste.
2. Beam-house Products :- Recovery of fat, proteins, chemicals and glue and their use. Pet Treats, finished split, gloves, washers etc.
3. Leather shavings and Trimmings :- Chemistry and Processing into hydrolysates, glue gelatin, syntans, fertilizers, processing into leather and acoustic boards.
4. Nature of Tannery Hair :- Chemistry and processing into protein meal hydrolysates and their uses – Conversion into felts and other utility products.
5. Process Studies :- Glue and protein meal from tannery fleshing, Quality evaluation of glue and protein meal, pet treats limited stock recovery of salt from used salt – Analytical procedures of protein meals.

LT 1716 Polymer Science and Technology(LTE 1.2)

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

Suggested Books: -

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

LT 1716 Co-ordination Chemistry. (LTE 1.3)

General characteristics of d block elements, Metallic character, Colour, Magnetic properties, Double salts, Tendency to form complexes, Coordination compounds, Coordination complexes and complex ions, Isomerism coordination number, important ligands, chelating ligands and chelates,

12

Postulates of werner's co-ordination theory, to explain the different oxidation states of Cr, Al, Zr, Pt, Ti, P As, Sb, Bi, Co etc. Explain the structure of Cr, Al, and Zr Ammines on the basis of Werner's Coordination theory, Experimental evidence in favour of Werner's theory, complex co-ordination, Molecular orbital and ligand field theories, Sidgwick's electronic concept of Co-ordination bond, limitations of sidgwick's electronic concept of Co-ordination bond, sidgwick's effective atomic number (EAN) Rule, Calculation of EAN of the central Metal atom in complex ions, Application of EAN Rule, Some typical Problems with Solutions, Metallurgy of Cr, Ti, Al, V, Co, Mn, Mo and Zr.

24

Chemistry of chromium salts and chrome tanning, factors affecting the formation and stability of different complexes like Al, Cr, Zr etc.

4

LT 1716 Organic Chemistry (LTE 1.4)

1. Carbohydrates :-

Introduction – Mono and Diaccharides, Trisacchrides , Polysacchrides, Strach and Cellulose, Derivatives of cellulose, Carboxy Methyl cellulose, Structural aspects of cellulose and starch.

2. Amino acids and Proteins :-

Classification of Proteins, Test of Proteins, Denaturation, Structural aspects of wool.

3. Oils, Fats and Waxes :-

Analysis of Oils, Fats and Waxes, Natural sources, General properties and reactions.

4. Dyes and Dyeing :-

Chemical classification of dyes, Synthesis of some important dyes, Synthesis of triphenyl methane dyes, Anthraquinone dyes, Phthalein dyes, Introduction to Natural and reactive dyes, Metal complex dyes.

5. Reaction of mechanism :-

Homolytic bond fission, free radicals, heterolytic bond fission, electrophiles, Carbonium ion, Nucleophiles, Acids and bases, Bronsted lowry concept lewis concept, Strength of acids and bases, substitutions reactions – S_{N1} , S_{N2} , S_{Ni} , Addition reactions, Elimination reactions, condensation, redox reactions.

LT 1717 Practices of Leather Manufacturing – II

Manufacture of different types of wet blue/wet white from raw Cow/Goat/Sheep/Buffalo hides/skins.

05

Modern practices in E.I. tanning, E.I. Kips and their dressing into upper, lining and leather for goods.

06

Semi chrome/Full chrome/Chrome retain hunting suede, Safety uppers burnishable upper leathers from cattle hides. Printed and shrunken grain leathers, Chrome tanned Buff uppers, Upholdstry and printed leathers. Vegetable and chrome tanned lining leathers.

20

Morocco leathers, Chamois leathers, book binding leathers and pleated leathers.

10

LT 1718 Theory of Leather supplements & Synthetics

1. Chemistry of the most common Polymeric materials used in leather industry as supplements.
04
2. Concept of a macromolecule, natural & synthetics polymer, modes of polymerization, radical, condensation, stereo regular polymerization, polymerization kinetics, mechanism, anionic and cationic polymerization.
10
3. Manufacture of industrially important polymer for plastics, fibres and elastomer, polyethylene, polypropylene, polyvinyl, chloride, polyvinyl, alcohol, polyacrylonitrile, polyurethane, fluoro – carbon polymer, epoxy resins, polyamides, polyesters, alkyd resin, silicon polymers, cellulose, polyacrylates, polyurethanes and their common applications.
12
4. Testing of Polymers, Mechanical and thermal testing.
04
5. Polymer and Rubber industries in India.
04
6. Manufacture of Rubber and Synthetic rubber, Natural rubber processing and vulcanizing synthetic elastomers, butadiene copolymer, Polyisoprene, Polybutadiene, Thermosetting, Thermoplastic.
10

LT 1719 Instrumentation & Process control

AIM

To know the principle and importance of various analytical instruments used for the characterization of various materials.

2

OBJECTIVES

To have thorough understanding of theory, instrumentation and applications of analytical equipments used in Industries for testing quality of raw materials, intermediates and finished products.

Introduction to spectroscopical methods of Analysis

Electromagnetic Radiation :- Various ranges, Dual properties, Various energy levels, Interaction of photons with matter, absorbance & transmittance and their relationship, Permitted energy levels for the electrons of an atom and simple molecules, Classification of instrumental methods based on physical properties.

10

Quantitative Spectroscopy :- Beer-Lambert's law, Limitations, Deviations (Real, Chemical, Instrumental), Estimation of inorganic ions such as Fe, Ni and estimation of Nitrate using Beer-Lambert's Law.

UV – Vis Spectrophotometry :- Determination of spectra of some known organic compounds and identification of molecular transitions and functional groups in single beam spectrophotometer, quantitative estimation of various compounds in single beam spectrophotometers, estimation of Cr^{6+} , Fe^{3+} , NO_3 , PO_4^{3-} , COD in spectrophotometer.

07

Atomic Absorption Spectrophotometry :- Determination of some heavy metal concentrations (like total Cr, Fe, Zn, Pb, Zr etc.) from solution, leather, effluent, soil/sludge, plant and fish tissues.

IR, RAMAN AND ATOMIC SPECTROSCOPY :-

Theory of IR spectroscopy, Various stretching and vibration modes for diatomic and triatomic molecules both linear and nonlinear), various ranges of Ir (Near, Mid, Finger print and Far) and their usefulness, Instrumentation (Only the sources and detectors used in different regions), sample preparation techniques, Applications.

Raman spectroscopy : Theory, Differences Between IR and Raman.

Atomic Absorption spectrophotometry :- Principle, Instrumentation (Types of burners, Types of fuels, Hollow cathode lamp, Chopper only) and Applications, various interferences observed in AAS (Chemical, radiation and excitation).

Flame photometry :- Principle, Instrumentation, quantitative analysis (Standard addition method and internal standard method) and applications.

CHROMATOGRAPHIC METHODS :-

Classification of chromatographic methods, Column, Thin layer, Paper, Gas, High Performance Liquid Chromatographical methods (Principle, mode of separation and Technique). Separation of organic compounds by column and Thin layer, mixture of Cu, Co and Ni by Paper, separation of amino acids by paper, estimation of organic compounds by GC and HPLC.

Controls in leather processing :-

Concept continuous processes, material and energy optimization, conventional and computer assisted control strategies, case studies.

LT 1720 Leather Product Technology – II

1. Clicking

Characteristics and variations in leather, Material selection, Clicking of upper linings, Socks and fabrics.

2. Preparation (Pre – Closing)

- (a) Identification making, stitch making, Punching, Perforating and embossing.
- (b) Skiving – Objectives, different types skiving.
- (c) Reinforcements.
- (d) Topline and edge treatments.

06

3. Closing operations

- (a) Stitching – Types of stitching m/c, Types of stitch, Different types of seam.
- (b) Eyeleting , lasting, etc

05

4. Construction

Assembly, Definition of construction, Types of Construction, Flowchart of different construction., Details of cemented construction – Methods, Details of moulded construction – DVP construction, Direct PVC moulded construction, Direct PU moulded construction, Veldtschoen construction, Machine welted construction. Slip – lasted construction, string lasted shoes.

16

5. Treeing Department (Shoe-room operations)

Shoe-room operations for grain, leather and suede leather uppers.

03

6. Quality control in footwear industry, Marketing of footwear, Hand tools and fittings for footwear industry.

05

Suggested Books :-

1. Manual of Shoe – making – Clark.
2. Text book of Footwear Manufacture – J. H. Thronton.
3. Principle of Footwear Manufacture – Dr. Somnath Ganguly.

LT 1821 ELECTIVE – II

(One Elective paper will be taken up out of the following four options with the consultation of H.O.D)

LT 1821 Fashion styling and Computer added design of leather product (LTE 2.5)

International Fashion Trends :

Historical evolution of footwear and garment styling, seasonal, cultural and geographical influences on foot wear and leather garments fashion, trends in fashion, concepts, colour and human psychology.

Colour characteristics :

Primary colours and colour scheming for aesthetics, colour blending and techniques for colour matching.

Decorative styling Techniques :

Decorative components, decorative techniques like batik, stitching, punching, printing, embossing, knitting etc.

CAD of Leather Product :

Introduction to general CAD, Input and output devices required for CAD and their working principles. Capabilities of CAD for styling purpose- colour, basic primitives etc. Design methods using CAD for leather products, Pattern assessment methods for inter locking and economic cutting.

Introduction to CAM :

Tools required in CAM, Possible application of CAM in leather products, Introduction of the commercial CAM systems for leather products.

LT 1821 Advance Leather Process Technology (LTE 2.6)

Anatomical structures of hides and skins, Retanning, dyeing and fat liquoring in light and heavy leathers composition of finishes, formulation and application of Leather auxiliaries like protein and resin binders, pigments, wax emulsions, lacquer and lacquer emulsions coloured lacquers, silicones and slip agents, pretanning and neutralizing syntans etc. in manufacture of above leathers.

Function of different finishing ingredients – Newer approaches in finishing, problems encountered in finishing and their solutions.

Novel finishing techniques :

Role of newer equipments like auto spray, roller coats, continuous embossing machines, finiflex etc., Methods such as oil-pull-up, Waxy burnishable, antique, grain sueded, screen printing, roller coating, pearl finishing easy care and petent finishing.

Light leathers from heavy hides and skins :

Resin upper, glazed uppers, lining leathers shoe-suedes, garment suedes- sheep nappa, glove leathers, E.I.- Wet-blue, wet – white, etc – details of processing techniques split processing for shoe suede, garment sued, grain finished and specialty finishes.

Upgradation through processing technologies and finishing techniques specially suited for the purpose like selection and use of retannage systems, Embossing-special effects by screen and block printing, roller coating, gravure printing, Tie and Dye leather.

LT 1821 Applied Statistics and Quality Control (LTE 2.7)

Definition of Probability and Related basic concept :

Discrete and continuous probability distributions (Binomial, Poisson, uniform, normal, Gamma and exponential), Basic concept of statistical population and sampling, Sampling design, random sampling, Mean variance and co-variance, correlation coefficient, Moments. Basic concepts of testing of hypothesis, Analysis of variance and Co-variance.

15

Basic concept of statistical Quality control (S & C) :

Development of various quality control and quality assurance concepts, Concept of product quality, Concept of quality control system, Nature of control limits, purposes of control charts, control charts for variables, control charts for attributes, cusum control chart.

15

Application of computers to quality systems.

4

Introduction to ISO 9000 and TQM :

ISO 9000 genesis, advantages, documentation, procedures. ISO 9000 VS classical quality control concepts.

System evaluation, system development, system implementation, and maintenance, ISO 9000 and ISO 14000 standards

8

LT 1821 Surface and colloid chemistry (LTE 2.8)

Colloidal State :

Introduction to colloidal state, Distinction among true solutions, colloids, Suspensions
classification of colloids based on (physical state, Nature of interaction, Type of particles)
Study of different phases (micellar, liquid crystalline and microemulsions) as well as
aggregates such as vesicles, Purification of colloidal solutions, General physical properties
of Colloidal solutions (colligative, Mechanical and electrical properties of colloidal
solutions), Protective colloids and Gold number.

24

Application of colloids, stability of emulsions, electrophoresis, dialysis, coagulation and
flocculation and their characteristics summary of surface chemistry.

8

Adsorption Physisorption and chemisorption and their characteristics, factors affecting
adsorption of gases on solids – Freundlich and Langmuir adsorption, Isotherms, Adsorption
from solutions.

8

LT 1822 ELECTIVE – III

(One Elective paper will be taken up out of the following four options with the consultation of H.O.D)

LT 1822 Computer application for Leather Technology(LTE 3.9)

1. Computer Programming Languages Operating System :- An overview of operating systems – DOS, UNIX, OS/2, MS-WINDOWS Review of Programming Languages – Basic, C & Fortran.
2. Data Processing :- Introduction to spread sheets, Analysis of data, Graphical representation.
3. Office Automation & Presentation Softwares :- Word Processing, Presentation Softwares, Professional Report generation using the above., Audio visual presentations using Multimedia.
4. Database and its Application :- Basic structures Retrieval of data for Reports, query and other formats and their export to other applications.
5. Cad Systems for Leather & Leather Products :-
Pattern Grading & Cutting for Footwear and Garments.
Design & Development of Leather Products.
Computerised colour matching system –its Principle & application.

LT 1822 Profession Ethics (LTE 3.10)

1. **Engineering Ethics :-** Senses of Engineering Ethics Variety of moral issue- types of inquiry – moral dilemmas- moral autonomy kolberg's theory – consensus and controversy professions and professionalism – professional ideals and virtues – theories about right action – self – interest – customs and religion – uses of ethical theories.
2. **Engineering as social experimentation :-** Engineering as experimentation – engineers as responsible experimenters-codes of ethics-a balanced outlook on law-the challenger case study.
3. **Engineer's responsibility for safety :-** Safety and risk – assessment of stability and risk benefit analysis-reducing risk-the three mile island and chernobyl case studies.
4. **Responsibilities and rights :-** Collegiality and loyalty – respect for authority – collective bargaining- confidentiality – conflicts of interest – occupational crime-professional right – employee rights – intellectual property rights (ipr) – discrimination.
5. **Global issues :-** Multination corporations –environmental ethics-computer ethics-weapons development-engineers as managers-consulting engineers as expert witnesses and advisors-moral leadership-sample code of conduct.

LT 1822 Entrepreneurship(LTE 3.11)

1. Introduction :

Productivity in India, Resources, Availability and mobilization, Land Labour and capital, Industrial Growth in five year plan period, Human resources development.

2. Technology and Investment :

Industrial climate in India, Technological investment, Transfer of Technology, Factors influencing technical investment, NRI, Capital market in India.

06

3. Technocrats :

Development of Technocrats, Role of educational institutions, Psychology of India technocrats, Technocrats as entrepreneur, Characteristics of an entrepreneur.

06

4. Leadership :

Attitudes and aptitudes, Qualities and development, Risk taking and decision making, Personal involvement.

04

5. Value Engineering Techniques :

Value added products, Value adding techniques, cost reduction techniques, Waste control, Alternate product application, Functional value of the product, Improvement and expansion.

06

6. Marketing :

Indian and International markets, Market surveys, Strategies and development of market, Need based marketing techniques.

06

7. Business Laws and Regulations :

Company law of India, Taxation Laws, Labour Laws, Factories Act., ESI Act., Workmen Compensation act., Licencing procedures of State and the Central Governments, Industrial subsidies.

08

8. Entrepreneurship Development and Government: Role of Central Government and State Government in promoting Entrepreneurship - Introduction to various incentives, subsidies and grants - Export Oriented Units - Fiscal and Tax concessions available. Women Entrepreneurs Reasons for low / no women Entrepreneurs their Role, Problems and Prospects.

05

References :

1. G. Meredith, R.E. Nelson, and P.A. Nech, The Practice of Entrepreneurship, I.L.O. Publishers, Geneva, 1982.
2. R. Dirk Larkran, Profit Improvement Technology, College Book publishing Company, Canada, 1981.
3. Sukumar Bhattacharya, Indian Direct Taxes, Wadhva and Co. 1983.
4. K.D. Shrivasthava, Commentaries on workmen compensation Act and ESI Act.
5. K.D. Shrivasthava, Factories Act. 1948.
6. How to start your own Industry-Circular by ITCOT and SIDCO Greams Road, Madras – 600006.

LT 1822 Total Quality Management(LTE 3.12)

1. Introduction

Definition of Quality, Dimensions of Quality, Quality Planning, Quality costs – Analysis Techniques for Quality Costs, Basic Concepts of Total Quality Management, Historical Review, Principles of TQM, Leadership – Concepts, Role of Senior Management, Quality Council, Quality Statements, Strategic Planning, Demin Philosophy, Barriers to TQM Implementation.

2. TQM Principles

customer satisfaction – Customer Perception of Quality, Customer Complaints, Service Quality, Customer Retention, Employee Involvement – Motivation, Empowerment, Teams, Recognition and Reward, Performance Appraisal, Benefits, Continuous Process Improvement – Juran Trilogy, PDSA Cycle, 5S, Kaizen, Supplier Partnership – Partnering, Sourcing, Supplier Selection, Supplier Rating, Relationship Development, Performance Measures – Basic Concepts, Strategy, Performance Measure.

3. Statistical Process Control (SPC)

the seven tools of quality, Statistical Fundamentals – Measures of central Tendency and Dispersion, Population and Sample, Normal Curve, Control Charts for variables and attributes, Process capability, Concept of six sigma, New seven Management tools.

4. Total Quality Management Tools

Benchmarking – Reasons to Benchmark, Benchmarking Process, Quality Function Deployment (QFD) – House of Quality, QFD Process, Benefits, Taguchi Quality Loss Function, Total Productive Maintenance (TPM) – Concept, Improvement Needs, FMEA – Stages of FMEA.

5. Quality System

Need for ISO 9000 and other Quality Systems, ISO 9000:2000 Quality System – Elements, Implementation of Quality System, Documentation, Quality Auditing, QS 9000, ISO 14000 – Concept, Requirements and Benefits.

Suggested Books :-

2. Dale H. Besterfo;ed. et at., Total Quality Management, Person Education Asia, 1999. (Indian reprint 2002)

References :-

2. James R. Evans & William M. Lidsay, The Management and Control of Quality, (5th Edition), South-Western (Thomson Learning), 2002 (ISBN O –324-06680-5)
3. Feigenbaum. A.V. “Total Quality Management” M.cGraw-Hill, 1991.
4. Oakland.J.S. “Total Quality Management Butterworth” – Hcinemann Ltd., Oxford 1989.
5. Narayana V. and Sreenivasan, N.S. Quality Management –Concepts and Tasks, New Age International 1996.
6. Zeiri. “ Total Quality Management for Engineers, Wood Head Publishers, 1991.

LT 1823 Tannery Waste Management

Water Pollution in General Perspectives: -

Leather industry attributed for water pollution. Types of water pollution – Physical, Chemical and Biological pollution. Hazardous effects of water pollution on land, Ground water, Surface water, Aquatic life and sea. Ecological system and water pollution.

10

Tannery Effluent :-

Types of tannery effluent, Characteristics of effluent from beam house processes, Tan yard processes and finishing processes their nature and pretreatment before disposal, Most toxic ingredients- Hazards of tannery effluent, Principles involved in removing their toxic effect from tannery effluent, Principles for estimation of TDS, SS, DO, COD, BOD, Sulphides, Chromium and non bio-degradable aromatic substances in waste water.

10

Primary Treatment :-

Main object of primary treatment – Primary treatment units, Collection system of discharged waste water in tanneries, Screening, Equalisation of waste water.

05

Secondary Treatment :-

Principles of secondary treatment – Different processes involved in secondary treatment system, Lagoon treatment, Aeration Treatment, Trickling filter, Systematic design of these systems. Lecture-05

Tertiary Treatment :-

Unit operation in controlling pollutant at tertiary stage.

03

Standards and Specifications :-

Indian standards, International standards specifications for Industrial effluent discharge, Types of effluent disposal.

04

Recovery of Waste Water and Materials :-

Different processes in recovery and reuse of waste water & material in tanning industry,
Economic feasibility of different processes.

04**Suggested Book :-**

Environmental & Tannery – M.C.C. Carre et. Al. center technique du cuir, Lyon, France.

LT 1824 Practices of Leather Manufacturing – III

General practices and techniques involved in manufacture of different types of light leathers.

02

Glove kin, Resin upper, Glazed uppers, Lining leathers, Shoe suedes, Garment Swedes, Grain garment leathers, Gloving leathers.

10

Sheep nappa, Suede garments, Uppers and safety uppers, Lining and diaphragm leathers.

10

Nubuck, Oil pull up leathers, Dressing of for skins and processing of reptiles.

10

Combination tanning, Embossing, Grain correction, Special effects by spray, Screen printing, Roller coating, Gravure printing, tie and dye leathers, imitation leathers.

10

LT 1825 Leather Product Technology – III

Historical evolution of Garment and Goods styling, Seasonal cultural and geographical influences on fashion, Friends in fashion concept, Colour and human psychology.

05

Classification of Leather Goods and Garments, Selection of materials, Grading and assortment of Leathers for leather goods and garments. Property requirement for leather and lining materials. Accessories for leather goods and garments comparison between manual and machine cutting, Maintenance of knives and tools, clicking machines mechanical, Hydraulic/Pneumatic pattern interlocking/nesting for material optimization Assembly and sticking (Closing).

09

Different types of sewing machines (Flat bed, inclined bed, special type machines), Feed mechanisms, Various types of assembly techniques for leather goods and garments.

09

Pattern Designing

Basic design development, Measurements/Sizing chart for Man, Women and Children, Adaptation of stages to basic blocks. Pattern development, grading. Application of CAD for leather goods and garments design and production. Feasibility reports for leather goods and garments production. Machinery requirement/plant layout, process scheduling and line balancing, Quality control measures. Packaging methods and practices. Costing, pricing and marketing procedures for domestic and international markets.

09

LT 1826 Project Work

A Comprehensive innovative project work will be taken up by individual student or a group of students related to Leather and allied subjects with consultation with H.O.D. or the Teacher concerned. At the end of the semester every students will submit project report for evaluation. There will be two pre-reviews before the final submission of the project report for internal assestment. These reviews will be conducted by A Board of two or three internal examiners (including guide/s)