ANNA UNIVERSITY, CHENNAI

UNIVERSITY DEPARTMENTS

REGULATIONS – 2015

CHOICE BASED CREDIT SYSTEM

M. TECH. LEATHER TECHNOLOGY

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs) :

I. To prepare students to excel in research or to succeed in Leather Technology profession through globally renowned rigorous post graduate education.
II. To provide students with a solid foundation in Leather Science and Technology required to excel in their profession for an inclusive growth in leather manufacture
III. To train students with good scientific and engineering knowledge so as to comprehend, analyze, design, and create novel products and solutions for the real life problems.
IV. To inculcate students in professional and ethical attitude, effective communication skills, teamwork skills, multidisciplinary approach, and an ability to relate leather manufacture to broader social context.
V. To provide students with an academic environment aware of excellence, leadership, written ethical codes and guidelines, and the life-long learning needed for a successful professional career

PROGRAMME OUTCOMES (POs):

On successful completion of the programme,

1. Graduates will demonstrate knowledge of mathematics, science and engineering.
2. Graduates will demonstrate an ability to identify, formulate and solve technological problems.
3. Graduate will demonstrate an ability to design and conduct experiments, analyze and interpret data.
4. Graduates will demonstrate an ability to design a system, component or process as per needs and specifications.
5. Graduates will demonstrate an ability to visualize and work on laboratory and multidisciplinary tasks.
6. Graduate will demonstrate skills to use modern engineering tools, software and equipment to analyze problems.
7. Graduates will demonstrate knowledge of professional and ethical responsibilities.
8. Graduate will be able to communicate effectively in both verbal and written form.
9. Graduate will show the understanding of impact of engineering solutions on the society and also will be aware of contemporary issues.
10. Graduate will develop confidence for self education and ability for life-long learning.

Programme Educational Objectives	Programme Outcomes									
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
I	✓	✓		✓						
II	✓		✓		✓	✓	✓		✓	
III				✓	✓	✓	✓		✓	
IV							✓	✓	✓	✓
V		✓	✓						✓	✓

			PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
YEAR 1	SEM 1	Chemistry and Physics of Collagen	✓									
		Instrumental Methods in Leather Science	✓	✓	✓							
		Applied Mathematics	✓									
		Instrumental Methods Laboratory		✓		✓	✓	✓				
		Elective I										
		Elective II										
	SEM 2	Science of Leather Manufacturing	✓	✓								
		Leather Process Design Engineering	✓	✓	✓	✓					✓	
		Tannery Waste Management & Engineering	✓					✓				
		Leather Process Design Laboratory		✓		✓	✓	✓				
		Elective III										
		Elective IV										
YEAR 2	SEM 1	Science and Technology of Leather Auxiliaries	✓									
		Elective V Elective VI										
		Leather Chemicals Preparatory Lab				✓			✓	✓		✓
		Project Work Phase I		✓		✓			✓			✓
		Seminar				✓			✓	✓		✓
	SEM 2	Project Work Phase II		✓		✓			✓			✓

UNIVERSITY DEPARTMENTS

ANNA UNIVERSITY:CHENNAI – 600 025.

REGULATIONS – 2015

CHOICE BASED CREDIT SYSTEM

I – IV SEMESTER CURRICULUM AND SYLLABUS

M. TECH. LEATHER TECHNOLOGY

SEMESTER – I

S.N	Course Code	Course Title	Category	Contact Periods	L	T	P	C
Theory								
1.	LE7101	Chemistry and Physics of Collagen	FC	4	4	0	0	4
2.	LE7102	Instrumental Methods in Leather Science	PC	3	3	0	0	3
3.	MA7155	Advanced Numerical Methods	FC	4	4	0	0	4
4.		Elective I	PC	3	3	0	0	3
5.		Elective II	PE	3	3	0	0	3
Practicals								
6.	LE7111	Instrumental Methods Laboratory	PC	6	0	0	6	3
			TOTAL	**23**	**17**	**0**	**6**	**20**

SEMESTER – II

S.N	Course Code	Course Title	Category	Contact Periods	L	T	P	C
Theory								
1.	LE7201	Leather Process Design Engineering	PC	3	3	0	0	3
2.	LE7202	Science of Leather Manufacturing	PC	3	3	0	0	3
3.	LE7203	Tannery Waste Management and Engineering	PC	3	3	0	0	3
4.		Elective III	PE	3	3	0	0	3
5.		Elective IV	PE	3	3	0	0	3
Practicals								
6.	LE7211	Leather Process Design Laboratory	PC	6	0	0	6	3
			TOTAL	**21**	**15**	**0**	**6**	**18**

SEMESTER – III

S.n	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1.	LE7301	Science and Technology of Leather Chemicals	PC	3	3	0	0	3
2.		Elective V	PE	3	3	0	0	3
3.		Elective VI	PE	3	3	0	0	3
Practicals								
4.	LE7311	Leather Chemicals Preparatory Lab	PC	4	0	0	4	2
5.	LE7312	Industrial Training/Internship –I	EEC	2	0	0	2	1
6.	LE7313	Seminar	EEC	2	0	0	2	1
7.	LE7314	Project work Phase -I	EEC	12	0	0	12	6
			TOTAL	**29**	**9**	**0**	**20**	**19**

SEMESTER – IV

S.n	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1.	LE7411	Project work (Phase – II)	EEC	24	0	0	24	12
			TOTAL	**24**	**0**	**0**	**24**	**12**

TOTAL CREDITS : 69

Foundation Courses (FC)

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.		Advanced Numerical Methods	FC	4	4	0	0	4

Professional Core (PC)

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.		Chemistry and Physics of Collagen	PC	3	3	0	0	3
2.		Instrumental Methods in Leather Science	PC	3	3	0	0	3
3.		Instrumental Methods Laboratory**(Lab)**	PC	6	0	0	6	3
4.		Leather Process Design Laboratory **(Lab)**	PC	6	0	0	6	3
5.		Science of Leather Manufacturing	PC	3	3	0	0	3
6.		Leather Process Design Engineering	PC	3	3	0	0	3
7.		Tannery Waste Management & Engineering	PC	3	3	0	0	3
8.		Science and Technology of Leather Chemicals	PC	3	3	0	0	3

Professional Electives (PE)

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	LE7002	Advanced Leather Biotechnology [For M.Sc (Chemical Sciences, Environmental science), B.Tech(Leather)]	PE	3	3	0	0	3
2.	LE7003	Advanced Organic and Inorganic Chemistry(For B.Tech Leather Technology/ M.Sc(Biotechnology) / B.Tech(Biotechnology)students)	PE	3	3	0	0	3
3.	LE7010	Orientation to Leather Science and Technology [For M.Sc (Chemical Sciences, Environmental Science, Biotechnology), B. Tech(Biotech.)]	PE	3	3	0	0	3
4.	LE7004	Colloid and Surface Chemistry	PE	3	3	0	0	3
5.	LE7009	Nanotechnology and its Application in Leather	PE	3	3	0	0	3
6.	LE7011	Science and Technology of Leather Suppliments and Synthetics	PE	3	3	0	0	3
7.	LE7001	Advanced Coordination Chemistry	PE	3	3	0	0	3
8.	LE7005	Energy Management in Leather Industries	PE	3	3	0	0	3
9.	LE7006	Engineering Economics in Leather Production	PE	3	3	0	0	3
10.	LE7007	Industrial safety and Occupational Health	PE	3	3	0	0	3
11.	LE7008	Marketing of Leather and Leather Chemicals	PE	3	3	0	0	3

Employability Enhancement Courses (EEC)

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.		Project work Phase -I**(Lab)**	EEC	14	0	0	14	7
2.		Leather Chemicals Preparatory Lab **(Lab)**	EEC	2	0	0	2	1
3.		Industrial Training/Internship –I	EEC	4	0	0	4	2
4.		Project work Phase -II**(Lab)**	EEC	2	0	0	2	1

LE7101 CHEMISTRY AND PHYSICS OF COLLAGEN L T P C
3 0 0 3

OBJECTIVES
This subject is to impart advanced physical and chemical concepts associated with the structure of collagen

UNIT I - MOLECULAR STRUCTURE OF COLLAGEN 12
Collagen triple helix; helix stabilization–synthetic collagenlike polypeptides –denaturation renaturation.Native collagen fibrils- axial structure - 3 Dimensional structure – stabilization -assembly-fibril organisation.X-ray Diffraction studies of collagen.Electron microscopic appearance of collagen.Polymorphic ordered aggregates - Segment long spacing crystallites -Fibrous long spacing crystallites.

UNIT II - CHEMISTRY OF COLLAGEN AND ITS DISTRIBUTION 5
Collagen chains - Amino acid composition and primary structure - molecules of nomenclature - common and distinctive chemical features – pro and α chains - carbohydrates - structure and functions of pro collagens.

UNIT III - COLLAGEN CROSSLINKS 5
Chemistry and properties of crosslinks - intramolecular and intermolecular crosslinks –difunctional and multifunctional crosslinks - lathyrism and (functional significance of) crosslinks - analysis of collagen crosslinks.

UNIT IV - ISOLATION AND CHARACTERISATION OF COLLAGEN 5
Extractability - selective precipitation behaviour - chromatographic properties – Electrophoretic properties.Circular Dichroism – FTIR.

UNIT V - BIOSYNTHESIS OF COLLAGEN 5
Transcription and translation - collagen genes and mRNA - synthesis of pro chains – intracellularprocessing of collagen - extracellular modifications. Steps in collagen biosynthesis and theirsignificance - specific enzymes and their reaction.

UNIT VI - COLLAGEN DEGRADATION 6
Mammalian collagenases - pathway of collagen degradation - sources of collagenases -methodology, assay and purification - biological properties - mechanism of action. Action ofcollagenases on collagen fibres - molecular weights of collagenases - latent collagenases.Inhibitors of collagenases.

UNIT VII - PHYSICO-CHEMICAL TECHNIQUES FOR COLLAGENOUS MATRICES 7
Microscopy and spectroscopy techniques for collagen morphology.Non-invasive methods ofliquid and solid imaging of biological specimen and their relevance to location of defects inhides/skins.

TOTAL : 45 PERIODS

Outcome
At the end of the course the students would have gained comprehensive knowledge on the chemistry and physics of molecular architecture, hydration, swelling, phase transitions, dimensional stability, relaxation, shrinkage and cross-linking phenomena of collagen.

REFERENCES:

1. G.N.Ramachandran (Ed) "Chemistry of Collagen, Treatise on collagen Vol.1, AcademicPress, 1967.
2. B.S.Gould (Ed) 'Biology of Collagen', Treatise on collagen, Vol.2, Academic Press,1968.
3. G.N.Ramachandran and A.H.Reddy (Eds) "Biochemistry of collagen", Plenum, New York,1976.
4. K.A.Pieze and A.H.Reddy, (Eds), "Extracellular Matrix Biochemistry", Elsevier,
5. New York, 1984.
6. N.Ramanathan (Ed), "Collagen:,Interscience Publishers, New York and London,
7. 1962.
8. Eyre D.R., Paz M.A., Gallop P.M., Annu. Rev. Biochem. 53, 717-748, 1984.
9. NimniM.E.(ed) Collagen: Vol.3, Boca Raton CRC, 1988.
10. Olsen B.R. and Nimni M.E.(ed) Collagen:Vol.4 Molecular Biology, Boca Raton CRC,1989.
11. Miller, EJ. Rhodes, R.K. Structural and Contractile Proteins Extracellular matrix : Methods Enzymol vol.82, 1982.
12. 10.Elizabeth D.Hay, `Cell Biology of Extracellular Matrix' Second Edition, Plenum Press, New York, 1991.
13. Kucharz, EJ; `The Collagens : Biochemistry and Pathophysiology', Berlin Springer, Verlag, (1992).
14. Fratzl, P; ‘Collagen: Structure and Mechanics’, Springer, 2008.

LE7102 INSTRUMENTAL METHODS IN LEATHER SCIENCE L T P C
3 0 0 3

OBJECTIVES

To have thorough understanding on the theory of instrumentation and applications of analytical equipment used for characterization of various products with special reference to leather technology.

UNIT I - SPECTROSCOPIC TECHNIQUES 10

Electromagnetic spectrum and spectroscopic techniques, principles of electronic vibrational and rotational spectroscopic techniques, principles of magnetic resonance, mass and microwave spectroscopic techniques, block diagram of the instruments involved, the fields of application of spectroscopic techniques including study of solid surfaces.

UNIT II - CHROMATOGRAPHIC TECHNIQUES 8

Theory and application of different chromatographic techniques such as paper, TLC, HPLC, ion-exchange, gel permeation, gel filtration, GLC and affinity chromotography.

UNIT III - APPLICATIONS OF SPECTROSCOPIC AND CHROMATOGRAPHIC METHODS IN LEATHER SCIENCE 12

Application of spectroscopy to the analysis of mineral tanning salts, formaldehyde, dyes, pigments and effluents, NMR techniques in the characterization of synthetic tanning agents, fatliquors, finishing agents - Application of chromotographic techniques in separation, analysis and characterization of mixtures containing compounds such as biocides, peptides, proteins, mineral tanning salts, vegetable tannins, dyes and finishing agents with special emphasis on the characterization of polymers.

UNIT IV - ELECTROANALYTICAL METHODS 5

Theory and applications of electroanalytical techniques like - Polarography, coulometry, cyclic voltammetry and chrono-potentiometry.

UNIT V - PRINCIPLES OF MICROSCOPIC AND OTHER TESTING METHODS IN LEATHER SCIENCE 10

Principles involved in the morphological investigation on leather and polymers (conventional, core shell morphologies), various microscopic techniques including electron microscopy, mechanical testing devices and criteria for the measurement of mechanical properties –Imaging techniques for surface applications. Differential Scanning Calorimetry(DSC) / Hyper DSC . Thermo Gravimetric Analysis (TGA).

TOTAL :45PERIODS

OUTCOME

At the end of the course the students can understand the principle and importance of various analytical instruments used for the characterization of various materials.

REFERENCES:

1. Hobart H. Willard, Lye L. Merritt, Jr. John A. Dean and Frank A. Settle, Jr., "InstrumentalMethods of Analysis", Sixth edition", CBS Publishers & Distributors, Delhi, 1986.
2. E.A.V. Ebsworth, David W.H. Rankin, Stephen Cradock, Structural Methods in InorganicChemistry, ELBS, 1988.
3. Vogel's Textbook of Quantitative Chemical Analysis, ELBS, V Edition, 1994.
4. H. Engelhardt, "Practice of High Performance liquid Chromatography", Springer - Verlag, Berlin, 1986.
5. Frank A. Bovey, "High Resolution NMR of macromolecules", Academic Press, New York, 1972.
6. P.O. Samuelson, "Ion Exchange Separation in Analytical Chemistry", John Wiley, NewYork, 1963.

MA7155 ADVANCED NUMERICAL METHODS L T P C
4 0 0 4

OBJECTIVE:

- The course objective is to impart knowledge on advanced numerical methods for solving differential equations in science and engineering.
- Analysis and application of advanced numerical methods for solving Partial Differential Equations (PDEs).

UNIT I ALGEBRAIC EQUATIONS 6

Systems of linear equations – Jacobi, Gauss Seidel, SOR methods, Thomas algorithm for tridiagonal systems; Systems of nonlinear equations - successive approximation method, methods for improved convergence, Newton Method and its variants, continuation methods for multiple solutions.

UNIT II ORDINARY DIFFERENTIAL EQUATIONS – IVPS 6

RungeKutta Methods, step size control and estimates of error, numerical stability, solution of stiff ODEs, ODE-IVPs coupled with algebraic equations;

UNIT III ORDINARY DIFFERENTIAL EQUATIONS – BVPS 12

Finite difference method, orthogonal collocation method, orthogonal collocation with finite element method, Galerkin finite element method, shooting technique.

UNIT IV PARTIAL DIFFERENTIAL EQUATIONS – FINITE DIFFERENCE METHOD 12

Parabolic equations – Different explicit and implicit methods, alternating direction explicit and implicit methods; Elliptic equations – Point iterative methods, line iterative methods, ADI methods; First order hyperbolic equations – method of characteristics, different explicit and implicit methods; numerical stability analysis, method of lines.

UNIT V PARTIAL DIFFERENTIAL EQUATIONS – FINITE ELEMENT METHOD 9

Partial differential equations – Finite element method - orthogonal collocation method, orthogonal collocation with finite element method, Galerkin finite element method.

L: 45, T: 15, TOTAL: 60 PERIODS

OUTCOME:

- Be familiar with numerical solution of ODEs.
  Setup and solve partial differential equations numerically

REFERENCES

1. Gupta, S.K., Numerical Methods for Engineers, New Age Publishers, 1995
2. Jain, M. K., S. R. Iyengar, M. B. Kanchi, R. K. Jain, Computational Methods for Partial Differential Equations, New Age Publishers, 1993.

LE7111 INSTRUMENTAL METHODS LABORATORY L T P C
0 0 6 3

OBJECTIVE
To provide practical knowledge in characterizing various leather chemicals and handle advanced instrumental techniques.

UNIT I - LEATHER CHEMICALS LABORATORY 35

Analysis and characterisation of natural and synthetic fatliquors in terms of charge, fat content,stability to acids and electrolytes - Evaluation of dyes and pigments in terms of hue, brilliance,particle size determination - Analysis of tannery effluents for their B.O.D., C.O.D., total solids,chrome, sulphide, and leathers for biocides & formaldehyde.

UNIT II - INSTRUMENTAL LABORATORY 55

UV and visible spectrophotometric techniques and their applications in the determination ofchromium, iron, formaldehyde, dyes, NMR methods for fatliquors - Functional group identification in polymers using IR and NMR techniques. 13 C spectra of polymeric syntans. GPC for molecular weight determination of polymeric syntans - Leather surface examination by electron microscope.Protein Purification techniques - Characterization of proteins viz., SDS-Page, Circular Dichroism, FTIR.

TOTAL : 90 PERIODS

OUTCOME
Students will have the practical skill to use advanced instruments associated science and technology

LE7202 SCIENCE OF LEATHER MANUFACTURING L T P C
3 0 0 3

OBJECTIVE
This subject is to impart advanced physical, chemical and biological concepts associated with the leather manufacture

UNIT I CHEMICAL PRINCIPLES INVOLVED IN PRETANNING OPERATIONS 14
Salt less/less salt curing methods - Swelling mechanisms; porosity of hides and skins.Diffusion of lime and sharpening agents into skin; Osmotic and lyotropic opening offibres.Nucleophillic displacement pathways in unhairing, mechanisms of unhairing based onchemical and enzymatic methods – concepts; changes in fibre structure during liming;mechanism of deliming, bating and degreasing - Role of mineral acids, neutral salts andnon-swelling acids, in pickling, the chemistry of pickling and the fibre structure and theimportance of pore size characteristics of pickled pelts.

UNIT II CHEMISTRY OF TANNING MATERIALS 10
Classification, isolation, characterization and structural elucidation of vegetable tannins;biogenesis and biosynthesis of hydrolysable and condensed tannins - Aqueous chemistry of Chromium (III), Aluminium (III), Iron (II) and (III), Titanium (IV), and Zirconium (IV) -coordinative interactions and hydrolytic behaviour of coordinated ligands, olation, oxolationandpolymerisation and their relevance to mineral tanning.

UNIT III MECHANISM OF TANNING 10
Transport of tanning materials into pelt, diffusion equilibria and mechanism of vegetable,mineral and combination tannages, role of crosslinking and fibre coating in matrix stability.

UNIT IV POST TANNING AND FINISHING 11
Physicochemical interactions of syntans, fatliquors and dyes with collagen and leather –Roleof surface charge and importance of electrostatic, H-bond, dipole-dipole and hydrophobicinteractions. Importance of Iso Electric Point (IEP) during tanning/post tanning ,Theoryoffinishing with special emphasis to optical properties of pigments /hollow spheres andbinders.Role of interfacial phenomena ,adhesion /cohesion and film formation mechanism inleather finishing.

TOTAL :45 PERIODS

OUTCOME
At the end of this course the students will be able understand the underpinning science in leather manufacture

REFERENCES:
1. O. Flaherty, William T. Roddy and Robert M. Lollar, "The Chemistry and Technology ofLeather, Vol. I, Preparation for tannages", E. Robert Krieger Publishing Company, New York,1978.
2. O. Flaherty, William T. Roddy and Robert M. Lollar, "The Chemistry and Technology ofLeather Vol. II, Type of tannages" E. Robert Krieger Publishing Corporation,New York, 1977.
3. Bienkiewicz, "Physical Chemistry of Leather Making", Krieger Publishing Co., Florida 1982.
4. D. Covington, Tanning Chemistry: The Science Of Leather, Royal Society of Chemistry, 2009.

LE7201 LEATHER PROCESS DESIGN ENGINEERING L T P C
3 0 0 3

OBJECTIVE
This course aims at imparting knowledge on the technology of making different types of leathers with cleaner and greener approach.

UNIT I - SPECIALITY LEATHERS 10
Different types of raw materials used, properties required, physical and chemical standards required and process details to achieve the specifications of different types of leathers such asupholstery, washable garment, water resistant leathers, chamois, glove and fashion leathers.Processing of exotic leathers such as reptiles, crocodiles, lizards, fish, ostrich etc.

UNIT II - CLEANER PROCESSING - BEAMHOUSE 8
Eco-friendly process technologies: Salt free curing options, sulphide free unhairingsystems,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.

UNIT III - CLEANER PROCESSING: TANNING, POST TANNING AND FINISHING 8
Less chorme and chrome-free tanning systems. Avoidance of eco sensitive substances viz.,Formaldehyde, APE, Cr(VI),; VOX, AOX free post tanning; solvent free finishing systems;Latest concepts and trends in leather processing. ECHA /REAChguidelines,Brand /Eco-labelling requirements and trend integrated strategies to achieve permissible BOD, CODand TDS standards of tannery effluents;

UNIT IV - ADVANCED FINISHING TECHNIQUES 13
Role of following finishing equipments;techniques for newer and novel finishing system viz.,aqueous based patent finishing, cationic finishing, foam finishing .
Shoe suede, garment suede, grain finished effect and speciality finishes at split leather -processing technologies and finishing techniques specially suited for the purpose. Upgradation of lower ends for better utilisation. New textures with enhanced properties; Transfer foil/coating,lamination techniques, etc in split finishing. Latest trends.

UNIT V - NEWER CONCEPTS IN LEATHER MANUFACTURE 6
Process controls and automation – productivity – quality consistency – Water management and Zero Discharge approaches - energy audit - Environmental footprints

TOTAL : 45 PERIODS

OUTCOME
At the end of the course, the students will be in a position to make conceptual design to make cleaner leather

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.

LE7203 TANNERY WASTE MANAGEMENT AND ENGINEERING L T P C
3 0 0 3

OBJECTIVE

This subject is to impart knowledge on primary, secondary and tertiary treatment associated with the management of waste water and safe disposal of solid wastes.

UNIT I - PHYSICO-CHEMICAL TREATMENT OF WASTEWATER 8

Screening – Flow Equilisation – Theory on Coagulation & Flocculation – Sedimentation – Filtration – Detail study and design aspects with reference to tannery wastewater.

UNIT II - INTRODUCTION TO BIOLOGICAL TREATMENT OF WASTEWATER 7

Introduction to microbial metabolism – Bacterial growth – Kinetics of Biological Growth

UNIT III - BIOLOGICAL TREATMENT OF WASTEWATER 8

Aerobic suspended growth system - Aerobic attached growth system - Anaerobic suspended growth system - Anaerobic attached growth system – Advanced Biological System – UASB – EGSB

UNIT IV - ADVANCED WASTEWATER TREATMENT FOR THE REMOVAL OF REFRACTORY ORGANIC COMPOUNDS 12

Theories on Advanced Oxidation Process viz., Photocatalytic treatment, Membrane Separation, Homogenous catalysis system using hydrogen peroxide, ozone etc - Heterocatalytic systems using metal oxides, activated carbon – Removal of Inorganic Componds through electro dialysis, reverse osmosis, multiple effect evaporator, ion-exchange.

UNIT V - SOLID WASTE DISPOSAL 10

Secured land fill: leachability studies and management of leachates – Biomethanisation of Solid waste: with reference to energy recovery – Thermal incineration – Bacterical compositing – Vermi composting – Bioremidiation-RO reject management.

TOTAL : 45 PERIODS

OUTCOME

At the end of the course, the students will be in a position to understand the methods and means to manage tannery wastes

REFERENCES:

1. Arceivala S.J. "Waste water treatment and disposal" Marcel Dekkar Inc., New York, 1981.
2. Metcalf and Eddy,H `Tchobanoglous, G. and Burton, F.L. (Ed), Waste water Engineering,treatment, disposal and reuse, 3rd edn. Tata-McGraw Hill Publishing, New Delhi 1991.
3. Besselievie, B.E. and Schwartz, M. "The Treatment of Industrial wastes", 2nd edn., McGraw Hill.
4. McCarty, P., Parkin, G.F. and Sawyer, C.N., "Chemistry for Environmental Engineering4th Edition", McGraw Hill, 1994.
5. Hans-Joachim Jordening and Josef Winter, "Environmental Biotechnology", Wiley-VCHVerlag GmbH & Co. KGaA, Weinheim, 2004.

6. M.C.Carre, A Vulliermet and B.Vulliermet, "Environment and Tannery", Centre TechniqueduCuir, Lyon, France, 1983.
7. UNEP/IEO & UNIDO - Tanneries and the Environment - A Technical guide, UNEP/IEO,Paris, 1991.
8. R.E. Hester and R.M. Harrison, Waste treatment and disposal, The Royal Society ofChemistry Cambridge CB4 4WF, 1995.

LE7211 LEATHER PROCESS DESIGN LAB L T P C
0 0 6 3

OBJECTIVE
To impart practical exposure in making different types of leathers using cleaner approaches

Advanced processing techniques with emphasis on eco friendly leather manufacture. Case studies for specific product mix (upper, garment, upholstery, glove) with details of chemical audit, energy audit, water consumption during processing.

OUTCOME
At the end of the course, the students will be in a position to make different types of leather using cleaner methods

TOTAL: 90 PERIODS

LE7301 SCIENCE AND TECHNOLOGY OF LEATHER CHEMICALS L T PC
3 0 0 3

OBJECTIVE
The course provides advanced concepts on the technology of making different auxiliaries viz., fatliquors, syntans, dyes and finishing chemicals used for leather manufacture.

UNIT I 9
Definition and function of leather auxiliaries, role of wetting agents, syntans, fatliquors, dyes, pigments, binder, top coats, feel modifiers and matting agents in leather processing. Surface tension and principles of wetting, importance of HLB, Chemical classification of wetting agents.

UNIT II 9
Chemical classification of syntans, sulphonation of naphthalene, phenols, Napthols, Phenol formaldehyde condensation reactions, chemistry of light fast syntans, chemistry of amino resins and PU, Unit operations in syntan manufacture.

UNIT III 13
Composition of fatliquors; Functionalisation of oils for surface active function, chemical classification natural and synthetic oils, sulphation, sulphonation, sulphitation reactions of oils, role of double bonds and iodine value in functionalisation of oils, sulphochlorination, sulphoamidation, transesterification, phosphorylation reactions for fatliquor preparation. Stability of emulsions, grain and particle sizes of emulsions, factors controlling grain sizes of emulsions. Fatliquor manufacturing technology.
Theory of colors, chromphoric groups, structural features of dyes; acid, basic and reactive dye classification. Chemistry and technology of dye manufacture.

UNIT IV **9**

Definition of pigments, groups of polymer bases for colour. Classification, formulations of pigments, particle size, refractive index, density, opacity criteria for the choice of pigment bases, Different techniques in particle size reduction and importance of particle size on functional properties of pigment formulation.

Functional definition of binders, chemical classification of binders, acrylic, protein, polyurethane, introduction to manufacturing of binder formulations.

UNIT V **5**

Different types of top coat formulations, choice of polymers for surface protection, role of plasticizers, internal and external plasticizers.

Principles of feel modification of polymer surfaces, types of feel modifiers and matting agents.

TOTAL : 45 PERIODS

OUTCOME

At the end of the course students would know the science of making different types of leather auxiliaries

TEXT BOOKS AND REFERENCES

1. Fred O Flaherty, Roddy, T.W. andLollar, R.M. `The Chemistry and Technology of Leather', Vol.II, Type of tannages, Rober E. Krieger Publishing Co., New York, 1977.
2. Gustavson, K.H. `Chemistry of Tanning Processes' Academic Press, New York, 1956.
3. Venkataraman , K. `Chemistry of Synthetic Dyes', Academic Press, New York and Lond, 1971.
4. Myers, R.R., and Lond, J.S. `Treatise on Coatings', Marcel Dekker, New York, 1975.

LE7311 LEATHER CHEMICALS PREPARATORY LAB L T P C
0 0 4 2

OBJECTIVE

To impart practical exposure on the synthetic approaches for leather chemicals manufacture

Preparation and characterization of Phenol, Naphthalene condensation products; Mineral syntans; Vegetable tannin extracts; Various types of Fatliquors; Pigment formulations.

TOTAL : 60 PERIODS

OUTCOME

At the end of the course, the students will be in a position to synthesize different leather chemicals

LE7313 SEMINAR L T P C
0 0 2 1

OBJECTIVE

The industrial internship is expected to enhance the technical employability skills of the students.

Students are expected to pursue one month industrial/laboratory training during the summer vacation. Seminar presentations need to be made based on their comprehension of theirexposure.

OUTCOME

At the end of this course the students will have confidence in handling practical aspects in a tannery or leather chemicals manufacture and also to improve the presentation skills of the students

LE7314 **PROJECT WORK PHASE I** **L T P C**
0 0 12 6

OBJECTIVE
The objective of this course is to facilitate the students to identify innovative projects that promotes creativity.

Under Project Work Phase I the students are expected to pursue preliminary work on a project undertaken by and assigned to him/her by the Department. A report should be submitted based on the information available in the literature or data determined in the laboratory/industry. The objective of the project work is to make use of the knowledge gained by the student at various stages of the degree programme. Project Work Phase I is intended to facilitate the better completion of project extended through Project Work Phase II in Semester IV.

VIVA VOCE
The object of the viva-voce examination is to determine whether the objectives of the Project work have been met by the student as well as to assess the originality and initiative of the student as demonstrated in the Project Work.

OUTCOME
At the end of the project phase I period, students should be familiar with current thinking in their field, and able to apply the concepts to relevant research problems or practical applications.

LE7411 **PROJECT WORK PHASE II** **L T P C**
0 0 24 12

OBJECTIVE
The objective of the project is to make use of the knowledge gained by the student at various stages of the degree programme. This helps to judge the level of proficiency, originality and capacity for application of the knowledge attained by the student at the end of the programme.

The students should continue their work proposed in Project Work Phase I and are expected to complete the proposed work. A report should be submitted based on the data determined in the laboratory/industry. The objective of the project work is to make use of the knowledge gained by the student at various stages of the degree programme. This helps to judge the level of proficiency, originality and capacity for application of the knowledge attained by the studentat the end of the programme.

VIVA VOCE
The object of the viva-voce examination is to determine whether the objectives of the Project work have been met by the student as well as to assess the originality and initiative of the student as demonstrated in the Project Work.

OUTCOME
The project work is expected to shape the student to think originally, plan/execute work properly, analytical abilities and reporting/communication skills

LE7002	ADVANCED LEATHER BIOTECHNOLOGY	L T P C
	[Bridge Elective Course for M.Sc (Chemical Sciences, Environmental Science), B.Tech (Leather)]	3 0 0 3

OBJECTIVE

Objective of this course is to understand the advanced biotechnology concepts in various unit processes and operations in leather manufacture

UNIT I - MICROBIAL BIOTECHNOLOGY **8**

Microbial fermentation methods.Types of fermentations.Fermentation equipments, preparation of media, preparation of inoculum, sterilization, separation and purification of products.Examples of microbial biotechnology in industry.

UNIT II - PROTEIN AND ENZYME CHEMISTRY **10**

Protein classification, separation, chromatographic and electrophoretic techniques, criteria ofhomogeneity.Enzyme classification, methods of estimation, sources of enzymes, purificationand properties, specificity, activation, inhibition.Immobilization of enzymes and microbial cells for industrial applications.

UNIT III - MOLECULAR BIOLOGY **8**

DNA; genetic role, structure and replication - Structure of RNA and transcription - gentic Code -protein synthesis - control of gene expression – strain improvement by mutation/genetic engineering - principles and methods -recombinant DNA technology and its potentials.

UNIT IV - BIOCHEMICAL ENGINEERING **12**

Basic principles, kinetics of growth. , batch, fed-batch, continuous, well-mixed, plug flowtubular, mass and enthalpy balances, choice of reactor - Transport phenomena in biosystems-mass transfer in gas-liquid systems, Design of fermentor and other fermentation vessels - instrumentation andcontrol - downstream processes - application of various systems.

UNIT V - BY-PRODUCT UTILISATION **7**

Animal based raw materials for Industries with particular reference to India; Role of enzymes and micro organisms in animal wastes utilization. Biological treatment of waste water.

TOTAL : 45 PERIODS

OUTCOME

At the end of the course the students would have gained knowledge on the role of biotechnological approaches in leather manufacture.

REFERENCES:

1. P.F.Stanbury and A.Whitaker, "Principles of Fermentation Technology", Pergamon Press,1984.
2. Lehninger "Biochemistry : the molecular basis of cell structure and function, 2nd Edition,"Kalyani Publishers, Ludhiana, 1978.
3. G.S.Stent and C.Calendar, "Molecular Genetics : an introductory narrative, 2nd Edition," Freeman, San Francisco, 1978.
4. A.Wiseman, "Topics in Enzyme and Fermentation Biotechnology" (Several volumes). Vol.2.

5. T. A. Brown, “Gene Cloning and DNA Analysis: An Introduction”, Blackwell Publishing, Fifth edition, 2005,
6. “Microbes and Enzymes - -Basics and Applied”, R. Puvanakrishnan, Former Sc.G. and Head, Dept. of Boitechnolohy, CLRI

LE7003 ADVANCED ORGANIC AND INORGANIC CHEMISTRY L T P C
3 0 0 3

[Bridge Elective Course for B.Tech Leather Technology / M.Sc (Biotechnology) / B.Tech(Biotechnology) Students]

OBJECTIVE

To impart advanced knowledge on inorganic and organic chemistry that is essential for leather technologists

UNIT I - BONDING MODELS 9

Ionic compounds

Crystal systems, Structures of crystal lattices, Lattice energy and the Born-Haber Cycle, Atomic size revisited - ionic radii

Covalent compounds

Valence bond theory
Lewis structures: (1) resonance, (2) formal charges
Hybridization
VSEPR theory
Molecular orbital theory
Linear combination of atomic orbitals: (1) delocalization, (2) antibonding orbitals
Symmetry and overlap
Homonuclear diatomic molecules
Heteronuclear diatomic molecules
Bond order and bond strength
Polyatomic molecules

UNIT II - MECHANISM OF ORGANIC REACTIONS USED IN THE MANUFACTURE OF LEATHER CHEMICALS 11

Methods of determining reaction mechanism, factors influencing SN1 and SN2, E1, E2reactions. Electron displacements, inductive effect, inductometric effect, mesomericeffect,electrometric effect, hyperconjugation, steric inhibition of resonance.Aromatic electrophilic and nucleophilic substitution reactions.

UNIT III - ORGANIC REACTION TYPES ENCOUNTERED IN LEATHER SCIENCE 10

Free radical reactions, addition to carbon- carbon, carbon – oxygen multiple bonds, elimination reactions, molecular rearrangements, oxidation and reduction reactions.

UNIT IV - CHEMISTRY OF TRANSITION METALS 9

D-block element with special emphasis on Chromium, Titanium, Iron, Aluminium and Zirconium including their redox behaviour.Variable oxidation statics, stabilization of oxidation statics.

UNIT V - REACTION MECHANISMS OF METAL COMPLEXES 6

Ligands in a metal ion complex; ligand substitution mechanisms; oxidative addition" or"reductive elimination" of ligands, election transfer reactions, redox reaction.

TOTAL :45 PERIODS

OUTCOME

Students would gain knowledge on some of the advanced aspects of inorganic and organic chemistry

REFERENCES:

1. Jerry March, "Advanced organic chemistry, Reactions, mechanisms and structure, 3rd Ed.Reprinted" Wiley Eastern, New Delhi, 1991.
2. I.L.Finar, "Organic Chemistry", Vol.I and II, Fifth Edition, Reprinted ELBS Ed., New Delhi, 1991.
3. T.W.G.Solomons, "Organic Chemistry", 3rd Ed., Wiley, New York, 1984.
4. R.O.C.Norman, "Principles of Organic Synthesis", 2nd Ed., Chapman and Hall, London, 1978.
5. D.G.Torgeson, "Fungicides - An advanced treatise, agricultural and industrial applications, environmental interactions", Vol I and II, Academic Press, New York, 1967.
6. "Reagent for Organic Synthesis" L.F. Fieser& Mary Fieser, 1968.
7. "The Flavonoids" J.B. Harborne T.J. Mabry and Helga Mabry, 1975.
8. F.Cotton and G.Wilkinson, "Advanced inorganic chemistry", John Wiley, New York, VEdition, 1988.
9. James Huheey, Inorganic Cemistry IV Edition, 1993.
10. Kettle, "Co-ordination compounds", ELBS, 1975.

LE7010 ORIENTATION TO LEATHER SCIENCE AND TECHNOLOGY L T P C

[Bridge Elective Course for M.Sc (Chemical Sciences, Environmental Science, Biotechnology), B.Tech (Biotech)] **3 0 0 3**

OBJECTIVE

This course objective is to orient the non-leather students on the fundamental science and technology of leather manufacture.

UNIT I - HIDES, SKINS and PRESERVATION 9

Origin and characteristics of hides and skins; Categories of livestock; Grading systems;Defects in hides and skins; Various preservation techniques and their principles.

UNIT II - PRETANNING PROCESSES AND OPERATIONS 10

Principles and objectives of beamhouse processes viz., soaking, liming, reliming, deliming,bating, pickling, depickling and degreasing; Various unit opeartions in pretanning.

UNIT III - TANNING 10

Definition and objectives of tanning; Types and basic chemistry of vegetable tannins; Basicchemistry of basic chromium sulfate; Principles involved in vegetable and chrome tanning andtheir mechanism in brief; Combination tannages.

UNIT IV - POST TANNING PROCESSES AND OPERATIONS 10

Principles and objectives of post tanning processes viz., neutralisation, retanning, dyeing andfatliquoring; Various unit operations involved.

UNIT V - FINISHING TECHNIQUES 10

Types of binders; Basic chemistry of protein, resin and PU binders; Types of pigments; Basiccharacteristics of pigments; Basic theory of coating; Principles and objectives of finishing;Classification of finishing; Types of auxiliaries and finishes.

TOTAL:45 PERIODS

OUTCOME

Through this course the student gains an appreciation of the underpinning science and technology involved in manufacturing of leathers.

REFERENCES:

1. Sarkar, K.T., “Introduction to the Principles of Leather Manufacture”, AjoySorcor, Madras,1981.
2. Dutta, S.S.,” Introduction to the Principles of Leather Manufacture”, Indian Leather
3. Technologists Association, Calcutta, 1980.
4. Thorstenson, T.C.,” Practical Leather Technology”, Robert E. Krieger Publishing Co.,Malabar, Florida, 1985.
5. Fred O Flaherty, Roddy, T.W. and Lollar, R.M., “The Chemistry and Technology of
6. Leather”, Vol.I& II, Type of tannages, Rober E. Krieger Publishing Co., New York,
7. 1977.
8. Tchobanoglous, G., Burton, F.L. and Stensel, H.D. (Eds), “Waste water Engineering,treatment, disposal and reuse: Metcalf and Eddy”, 3rd edn. Tata-McGraw Hill Publishing, NewDelhi, 1991.

LE7001 ADVANCED COORDINATION CHEMISTRY L T P C
3 0 0 3

OBJECTIVE

This objective of the course is to present the students on the advanced concepts associated with coordinate covalent complexes.

UNIT I - CONCEPTS IN CHEMICAL BONDING 5

Concepts and types of chemical bonding, group theoretical approach to structure and reactivity.

UNIT II - THEORIES OF CO-ORDINATION 10

Valance bond theory, ligand field theory, molecular orbital theory, importance of ligand field stabilization energy, coordination geometrics and various oxidation states of metal ions.

UNIT III - SYNTHESIS, STRUCTURE AND SPECTROCOPY OF TRANSITION METALCOMPLEXES 15

Synthetic strategies to transition metal complexes, spectroscopy of co-ordination compounds, structure and property relations in 'd' block elements. Aqueous chemistry of chromium, titanium, iron, aluminium and zirconium including their redox behaviour.

UNIT IV - REACTIVITIES OF TRANSITION METAL COMPLEXES 10

Ligand substitution process and their kinetics and mechanisms.Electron transfer reactions of metal complexes.Stability constant and equilibrium constants.

UNIT V - METAL PROTEIN INTERACTIONS 5

Metal - protein interactions and their role in structural stability of protein.

TOTAL : 45 PERIODS

OUTCOME

At the end of this course the students would be in a position to understand the coordination chemistry of transitions metals

REFERENCES:

1. F.Cotton and G.Wilkinson, "Advanced inorganic chemistry", John Wiley, New York, V Edition, 1988.
2. James Huheey, Inorganic Cemistry IV Edition, 1993.
3. Kettle, "Co-ordination compounds", ELBS, 1975.
4. M.L.Tobe,"Inorganic reaction mechanism",Nelkson, London, 1972.
5. C.K.Jorgenson,"Modern ligand field theory",North Holland, London, 1971.
6. A.B.P.Leaver, "Inorganic electronic spectroscopy", Elsevier, Amsterdam, 1968.
7. R.S.Drago, "Physical methods in inorganic chemistry", East West, New Delhi, 1975.

LE7004 COLLOID AND SURFACE CHEMISTRY L T P C
3 0 0 3

OBJECTIVE

This objective of the course is to present the students on the advanced concepts associated with coordinate covalent complexes.

UNIT I - SURFACE TENSION, INTERFACIAL TENSION AND SURFACE ACTIVITY 9

Definition, effect of temperature, spreading, wetting etc. - Young Laplace and Kelvin equations -Gibbs Law and its application - Critical evaluation of methods of surface tension determination.

UNIT II - BULK PROPERTIES OF SURFACTANT SOLUTIONS AND MONOLAYERS 9

Critical micelle concentration (CMC) - Shape, Size, Aggregation, Hydration, Correlation times,Weight of micelles, etc. Different models and thermodynamics of micelle formation.Factors affecting CMC, Monolayers, types, their behaviour and industrial application. Lyophobic sols,Lyophilic systems and stability.

UNIT III - ADSORPTION BY SOLIDS 9

Solid-liquid interfaces (changing of surfaces, Electrical Double Layer, adsorption)

P[article-particle interactions : Elctrostatic forces; Analysis of surface change and surface chemistry (electrokinetics electrophoresis, streaming potential, electro-osmosis, sedimentation potential, electroacoustics, surface spectroscopy, ESR)

Particle-particle Interactions: steric forces & polymer-mediated forces; Particle-particle interactions: hydrophobic forces; Analysis of particle interactions (rheometry, AFM, CFM, MASSIF, SFA)Flocculation& coagulation – Schulze-Hardy rule, inorganic coagulants, polymeric flocculants, wastewater treatment**;** Surface Active Agents & Association Structures of Amphiphillic Molecules

UNIT IV - SURFACTANTS 9

Surface activity – adsorption at interfaces, Gibbs, Traube's rule, Rose-Nishioka rule structure of a surfactantMeasuring surfactant adsorption – by difference, SPR, TIRF, FTIR, ellipsometryassociation structures – micelles, vesicles, surface mecelles, giant worm-like micelles Structure of adsorbed films, SAMS, L-B films, surface micelles

An extra unit on Bubbles and Foams (gases dispersed in liquids) may be introduces
Foam stability
Film Drainage
Film rupture
Film rheology
Emulsion and pseudo-emulsion films
Phase diagrams
Measuring thin film properties – disjoining pressure, thin film balance
Frothing agents
Foam breaking
Antifoaming agents & mechanisms
Measuring foam properties
Flotation
Purification of surface active agents using foams

UNIT V - APPLICATION TO LEATHER TECHNOLOGY 9

Wetting, cohesion & adhesion, contact angle, foams, detergency, emulsions, stability, surfaceproperties and membrane technology.

TOTAL :45 PERIODS

OUTCOME

At the end of this course the students would be in a position to understand the coordination chemistry of transitions metals

REFERENCES:

1. H.E.Garret, "Surface Active Chemicals", Pergamon Press, London, 1972.
2. A.W.Adamson, "Physical Chemistry of Surfaces, 3rd Edn.", Wiley Inter-Science, NewYork, 199O.
3. Bienkienwicz, "Physical chemistry of leather making", Krieger Publishing Co., Florida,1983.
4. AyaoKitahara and Akira Watanabe, Electrical Phenomena at interfaces, Pub:-MarcelDekker Inc., New York, 1984.
5. ArvedDatyner, Surfactants in Textile Processing, Pub:- Marcel Dekker Inc., New York,1983.
6. D. J. Shaw, B. Hewemann, Introduction to Colloid and Surface Chemistry, 1992.
7. Surfactant Science Series, John-Wiley Interscience Publications, New York.
8. Colloidal Dispersions : Suspensions, Emulsions, and Foams by I.D. Morrison and S. Ross (2002, Wiley Interscience, NY; ISBN : 0-471-17625-7)

LE7005 ENERGY MANAGEMENT IN LEATHER INDUSTRIES L T P C
3 0 0 3

OBJECTIVE
This objective of the course is to orient the students to asses the energy requirement and management in leather manufacture.

UNIT I - ENERGY SCENARIO 9

Energy Scenario, Energy Analysis of Fuels, Energy Needs of Growing Economy, Long TermEnergy Scenario, Energy Pricing, Energy Sector Reforms, Energy and Environment: AirPollution, Climate Change, Energy Security, Energy Conservation and its Importance, EnergyStrategy for the Future, Energy Conservation.

UNIT II - ENERGY FORMS 9

Energy forms: (a) thermal (b) Electricity (c) Non-Conventional Sources Thermal: DifferentFuels& its Energy Contents, Temperature & Pressure, Heat Capacity. Steam and MoistAir. Electricity: AC & DC, Load Management, Maximum Demand Control, AggregatedTechnical& Commercial Losses (ATC); Non-Conventional: Various Forms; Some Applications related to Non- Conventional Energy Sources.

UNIT III - ENERGY MANAGEMENT 9

Need for Energy Management, Various Approaches, Cost Effectiveness, Bench Marking,Optimization of Energy Requirements and Maximization of System Efficiencies. Fuel andEnergySubstitution..A Few Case Studies of Real Systems.

UNIT I V - ENERGY AUDIT 9

Requirements for Energy Audit, Different Approaches viz, Preliminary and Detailed EnergyAudit, Case Studies for Real Systems.

UNIT V - ENERGY MANAGEMENT AND AUDITING IN LEATHER IDUSTRY 9
Energy requirement – management – auditing in Leather and Leather Products ManufacturingIndustry.

TOTAL : 45 PERIODS

OUTCOME
At the end of this course the students would be in a position to understand the energy requirement and controls in leather manufacture

REFERENCES:
1. Jernold H. Krentz, “Energy conservation and Utilisation”, Allyu and BacunInc, 1976.
2 Gemand M. Gramlay, “Energy” Macmillan Publishing Co., New York, 1975.
3. Rused, C.K. “Elements of Energy Conservation”, McGraw Hill Book Co., 1985.

LE7006 ENGINEERING ECONOMICS IN LEATHER PRODUCTION L T P C
3 0 0 3

OBJECTIVE
The objective of this course is to present students on project feasibility analysis, management, organization and budgeting that will enable the students to perform as efficient managers.

UNIT I - PROJECT IDENTIFICATION AND PREPARATION 10
General considerations - choice of project between alternative propositions - engineering aspects- cost estimates and demand forecasting for leather tanning industry.

UNIT II - PRINCIPLES OF PROJECT APPRAISAL 10
Investment appraisal and financial analysis through the measurement of project return –bydiscounted cash flow method - net present value of a project - internal rate of return - project payback period - cash flows accounting profit - intangible returns - Inflation and project appraisal.

UNIT III - IMPLEMENTATION AND MANAGEMENT 9
Methodological and organisational aspects of implementation - pert and other methods - risk anduncertainty - probability theory.

UNIT IV - SOURCES OF FINANCE AND BUDGETING 9
Different sources of finance - ownership finance - ordinary share, short, medium and long termloan - budget preparation - annual cost, variable costs - allocation of costs.

UNIT V - METHODS OF BUDGETING 7
Marketability method - benefit method - use of facilities method - special cost method, alternativesingle purpose expenditure method.

TOTAL :45 PERIODS

OUTCOME
Engineering economics concepts will facilitate the students in better management of the leather industry

REFERENCES:
1. An Introduction to Engineering Economics", The institutions of civil engineer,1972.
2. DasGupta A.K. and Pearle D.W. Cost - Benefit analysis Theory and Practice, MacMillan, 1972.
3. Little M.D. and MirrleesJ.A.,Project Appraisal and Planning for Developing countries, H.E.B, London.
4. Economic Analysis of agricultural projects. Price Githinger 1.B.R.D.

LE7007 INDUSTRIAL SAFETY AND OCCUPATIONAL HEALTH L T P C
3 0 0 3

OBJECTIVE
This course will make the students to understand the regulations and practices associated with safety and occupational health.

UNIT I - SAFETY PHILOSOPHY 9
Place of industry in society Industrial management role - supervisors role - role of workers – role of trade unions - role of govt. and various other agencies - Factory Act 1948 and the rules. Hazardous Industry - need for safety, legal humanitarian, economic safety and productivity. Factors impeding safety.

UNIT II - ACCIDENT PREVENTION & SAFETY TRAINING 9

Definition of accident, injury, dangerous occurrence, unsafe act, unsafe condition. Theories of accident occurrence - principles of accident - prevention - accident inventive methods – industrial accident inventive methods - industrial accidents - frequencies of industrial accidents in India and foreign countries - classification of accidents - industry wise and causation wise.

PREVENTION - ACCIDENT INVESTIGATION

Methods - developing safety training programme - training of supervisors - training of workers-Inplant& External courses - training of new workers - role of supervision - need for re-training.

UNIT III - SAFE GUARDING OF MACHINERY AND MATERIAL HANDLING 9

Principle of machine guarding.Ergonomics of machine guarding.Type of guards - guarding of different types of machinery.Material & construction of guards. Maintenance & repair of guards, lifts & lifting tables, chairs, rope slings, rings, hooks, shackle, eyebolts power tracks and tractors, safety features.

UNIT IV - FIRE HAZARDS AND CONTROL 9

Chemistry of fire, classification of fire, portable fire extinguishers and their operation – Industrial fire.Types of all fire protection equipment. Hazard Identification : Fire, explosions, indices consequence analysis, HAZOP, likelihood analysis, risk concepts and criteria, risk management Toxicity.

UNIT V - OCCUPATIONAL HEALTH 9

Physical hazard, noise vibration, x-rays - ultra violet radiation - permissible exposure limits -effects of exposure - preventive & control measures. Chemical Hazards : toxic chemicals, dirt gases, furies, mists, vapours. Noise pollution, exposures evaluation, common occupational diseases, etc.

TOTAL : 45 PERIODS

OUTCOME

The importance of safety in tanneries will be known and implementation of safety procedures will be gained at the end of the course

REFERENCES:

1. William Handley, Industrial Safety - Hand Book, 2nd Edition, McGraw Hill Book Company, 1969.
2. H.W.Heinrich, P.E. Dan Peterson and Nester, Road Industrial Accident Prevention, McGraw Hill Book Co., 1980.
3. R.P.Blake, Industrial Safety, II Edn., Prentice Hall Inc., New Jersy, 1963.
4. Frank P. Lees, Loss Prevention in the process industries, Butterworth Heinemann, 1996, Vol. 1 to 3.
5. V.C. Marshall, Major Chemical hazards, John Wiley & Sons, New York, 1987.
6. Guidelines for Chemical Process Quantitative Risk Analysis prepared for centre for Chemical Process Safety of the American Institute of Chemical Engineering, 1989.

LE7008 MARKETING OF LEATHER AND LEATHER CHEMICALS L T P C

3 0 0 3

OBJECTIVE

The knowledge on marketing of leather and leather chemicals in international market and foreign trade policies will be gained from this course.

UNIT I - MARKETING CONCEPTS 8

Definition of basic management and marketing concepts - role of marketing in the production function - marketing concepts relevant to consumer durable like leather and leather chemicals.

UNIT II - HIDES AND SKINS - LEATHERS **8**

Indian livestock population over two decades - hides and skins availability, their sizes, marketing centres, channels, prices over two decades - leather production centres - channels, prices -leather products - centres and marketing channels.

UNIT III - MARKETING FUNCTION **9**

Market classification and segmentation - consumer market and buying behaviour – market management and forecasting - market planning and control - competition marketing strategy -product life cycle strategy - product and price strategy - sales promotion, publicity, advertising, packaging- marketing organisations- techniques of marketing research for consumer products.

UNIT IV - INTERNATIONAL TRADE **10**

General concepts of international marketing, principles relevant to leather and leather chemicals -global market for leather and leather chemicals - important production and consumption centres,product wise in the world - major world suppliers of leather chemicals.

UNIT V - EXPORT TRADE INDIA **10**

India's export trade in leather. India's share in 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.

TOTAL : 45 PERIODS

OUTCOME

At the end of the course the students would understand the international trade, government policies in export aspects of world trade related to leather sector, custom tariff and international marketing

REFERENCES:

1. Philip Kolter, "Marketing Mangement", Fifth Edition, Prentice Hall, New Delhi,
1. 1984.
2. CLRI, Report of All India Survey on Raw Hides and Skins, CLRI, Madras 1987.
3. CLRI, Report on Capacity Utilisation and Scope for Modernisation in Indian Tannery Industry, CLRI, Chennai 1990.
4. World Statistical compendium for Raw Hides and Skins, Leathers and Leather
5. Footwear (FAO of UN).
6. Employment and working conditions and competitiveness in Leather and Footwear
7. Industry (ILO of UN).
8. Thyagarajan, G., Srinivasan, A.V. and Amudeswari, A, "Indian Leather 2O1O, A technology, Industry and Trade Forecast", CLRI, Madras, 1994.
9. Sadulla, S.,The Leather Industry Kothari's Deskbook Series, H.C. Kothari Group (Publications Division), Madras 1995.
10. ILO Tanning of hides and skins, Third Impression 1989, Geneva.
11. CLRI, Report of nationwide survey on leather product units in India, CLRI, Chennai, 1997

LE7009 NANOTECHNOLOGY AND ITS APPLICATIONS IN LEATHER L T P C
3 0 0 3

OBJECTIVE
This objective of the course is to present the students on nano technology concepts and their applications in leather manufacture.

UNIT I - INTRODUCTION TO NANOTECHNOLOGY 3
The nanoscale. What is nanotechnology? Consequences of the nanoscale for technology and society.Beyond Moore's Law.

UNIT II - NANOMATERIALS: FABRICATION 9
- Structure and bonding
- Electronic band structure
- Electron statistics
- Bottom-up vs. top-down
- Epitaxial growth
- Self-assembly
- Chemical Synthesis
- Green Synthesis

UNIT III - NANOMATERIALS: CHARACTERIZATION 10

Structural
XRD, TEM, SEM, STM, AFM, TGA, DSC, N2 adsorption, FTIR spectroscopy, Raman spectroscopy

Chemical

Optical

UNIT IV - APPLICATION OF NANO TECHNOLOGY IN TANNING, POST TANNING ANDFINISHING 9
Collagen – Skin Matrix – Association of nano materials with collagen matrix at various stagesof processing – Pre tanning. Tanning. Post Tanning and Finishing.

UNIT V - NANO LEATHER CHEMICALS 9
Manufacture of Nano based materials for leather manufacture: syntans, fatliquor, coloring and finishing chemicals

UNIT VI - ENVIRONMENTAL ASPECTS OF NANOTECHNOLOGY 5
Synthesis, Water purification, Beneficial and adverse affect of nanomaterials

TOTAL : 45 PERIODS

OUTCOME
At the end of this course the students would be in a position to understand the advancements in nano technology and their impact in leather manufacture

REFERENCE:

1. C. P. Poole, F. J. Owens, "Introduction to Nanotechnology", Wiley-Interscience, 2003.
2. B. Bhushan, "Sringer Handbook of Nano-Technology", Springer, 2004.

LE7011 SCIENCE AND TECHNOLOGY OF LEATHER SUPPLEMENTS AND SYNTHETICS **L T P C 3 0 0 3**

OBJECTIVE

The objective of this course is to present concepts of polymerization of various polymers used. Analytical skills on testing of polymers will be emphasized that will enable them to understand various polymer properties and manufacturing methods.

UNIT I - POLYMERS **5**

Polymer and rubber industries in India. Chemistry and Technology of the most common polymeric materials used in leather industry as supplements.

UNIT II - POLYMERIZATION TECHNIQUES **15**

Concept of a macromolecule, natural and synthetic polymers, modes of polymerization, radical, condensation, stereo-regular polymerization, polymerization kinetics, mechanism, anionic and cationic polymerization. Polymers with linear, branched and cross linked structure, thermoplastic and thermosetting polymers, bulk, solution, suspension and emulsion polymerization.

UNIT III - ANALYSES AND TESTING OF POLYMERS **10**

Molecular weight and distributions of polymers, different methods of molecular weight determinations, colligative properties, viscometry, light scattering techniques, thermal analysis of polymers, crystallinity, glass transitions and other mechanical properties, spectral analysis such as IR, UV and NMR of polymers.

UNIT IV - INDUSTRIAL POLYMERS **10**

Manufacture of industrially important polymers for plastics, fibres and elastomer - Polyethylene, polypropylene, polyvinyl chloride, polyvinyl acetate, copolymers, formaldehyde resins, polyvinyl alcohol, polyacrylonitrile, polystyrene, polyurethane, fluoro-carbon polymers, epoxy resins, polyamides, polyesters, alkyd resins, silicone polymers, cellulosics.

UNITV-FABRICATION **5**

Fabrication of polymeric materials, compounding and mixing, casting, extrusion, fibre spinning, moulding, coating foam fabrication.Manufacture of rubber and elastomers, Natural rubber, processing, vulcanizing synthetic elastomers, butadiene copolymer, nitrile rubber, polyisoprene, polybutadiene.

TOTAL : 45PERIODS

OUTCOME

At the end of this course, the students would have gained knowledge on the chemistry of most common polymeric materials used in leather industry as supplements.

REFERENCES:

1. Williams, D.J., `Polymer Science and Engineering', Prentice Hall, New York, 1971.
2. Austin, G.T., Shrere's `Chemical Process Industries',5th ed., McGraw Hill InternationalBook Co., Singapore, 1984.
3. Elrich, F.R., `Science and Technology of Rubber', Academic Press, New York, 1978.
4. G.Lubin, S.T.Peters, `Handbook of composites', Van Nostrand Reinhold Co., New York, 1997.

5. F. Rodriguez, `Principles of Polymer System', Temple Press, London, 1965.
6. D.C. Miles & J.H. Briston, `Polymer Technology',Temple Press, London, 1965.
7. R.W. Moncrieff, `Man-made Fibres', 5th Edn., Heywood Books, London, 1970.
8. F. W. Billmeyer, Jr., Textbook of Polymer Science, 2nd Ed., Wiley. - Interscience, New York, 1971.