DEPARTMENT OF LEATHER TECHNOLOGY

ANNA UNIVERSITY, CHENNAI

Vision:

To become a premier centre of learning and research in Leather and Allied Technology.

Mission:

MD 1: To provide quality education in the area of Leather Technology with high professional values.

MD 2: To share and disseminate expertise to provide solutions for the problems faced by the Leather industry.

MD 3: To build an expertise based capsule of delivering technology to leather and allied sectors.

MD 4: To provide a learning ambience for innovators, researchers and technologists.

ANNA UNIVERSITY: :CHENNAI - 600 025
UNIVERSITY DEPARTMENTS
M.TECH. LEATHER TECHNOLOGY
REGULATIONS – 2019
CHOICE BASED CREDIT SYSTEM (CBCS)

1. PROGRAMME EDUCATIONAL OBJECTIVES (PEOs) :

1. To build an expertise base capsule of delivering technology based solution to leather and allied sectors.
2. To foster development of advanced human capacity for translational research for solution science.
3. To equip learners with relevant knowledge and expertise system for professional consultation.
4. To enable learners in the areas of pedagogy and advanced research.
5. To provide a learning ambience for innovators, researchers and professional technology authors.

2. PROGRAMME OUTCOMES (POs):

On successful completion of the programme,

PO	Graduate Attribute	Programme Outcome
1	Engineering knowledge	Apply knowledge of mathematics, basic science and engineering science.
2	Problem analysis	Identify, formulate and solve engineering problems.
3	Design/Development of solutions	Design a system or process to improve its performance, satisfying its constraints.
4	Conduct investigations of complex problems	Conduct experiments & collect, analyze and interpret the data.
5	Modern tool usage	Apply various tools and techniques to improve the efficiency of the system.
6	The Engineer and society	Conduct themselves to uphold the professional and social obligations.
7	Environment and sustainability	Design the system with environment consciousness and sustainable development.
8	Ethics	Interact in industry, business and society in a professional and ethical manner.
9	Individual and team work	Function in a multidisciplinary team.
10	Communication	Proficiency in oral and written Communication.
11	Project management and finance	Implement cost effective and improved system.
12	Life-long learning	Continue professional development and learning as a life-long activity.

Attested

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3. MAPPING OF PROGRAMME EDUCATIONAL OBJECTIVE WITH PROGRAMME OUTCOMES

PROGRAMME EDUCATIONAL OBJECTIVES	PROGRAMME OUTCOMES											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1.	✓	✓		✓	✓				✓			
2.	✓		✓		✓		✓				✓	
3.	✓	✓	✓	✓			✓					
4.								✓	✓	✓		✓
5.						✓		✓	✓			✓

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4. MAPPING OF COURSE OUTCOME AND PROGRAMME OUTCOME

		Course Name	PO 01	PO 02	PO 03	PO 04	PO 05	PO 06	PO 07	PO 08	PO 09	PO 10	PO 11	PO 12
YEAR 1	Semester1	Collagen Science and Technology	✓	✓	✓				✓					
		Quality Management and Assurance	✓	✓	✓							✓		
		Project Management Systems		✓								✓	✓	✓
		Orientation to Leather Manufacture (Bridge Course for UG students from non-leather)	✓	✓	✓				✓					
		Research Methodology and IPR												
		Audit Course I												
		Practice on Quality Management		✓		✓	✓	✓						
		Chemical and Physical Testing Laboratory	✓	✓	✓		✓							
	Semester2	Science of Leather Manufacturing	✓	✓	✓	✓			✓					
		Advanced Instrumental Methods	✓	✓	✓	✓								
		Leather Process Design Engineering	✓	✓	✓	✓					✓			
		Program Elective I												
		Program Elective II												
		Audit Course II												
		Leather Process Design Engineering Laboratory		✓		✓	✓	✓						
		Advanced Instrumental Methods Laboratory		✓		✓		✓						
YEAR 2	Semester3	Science and Technology of Leather Chemicals	✓	✓	✓				✓					
		Program Elective III												
		Program Elective IV												
		Open Elective												
		Internship/Training		✓					✓			✓		✓
		Project Phase I		✓		✓			✓			✓	✓	✓
	Semester4	Project Phase II		✓		✓			✓			✓	✓	✓

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ANNA UNIVERSITY: : CHENNAI
UNIVERSITY DEPARTMENTS
M.TECH. LEATHER TECHNOLOGY
REGULATIONS – 2019
CHOICE BASED CREDIT SYSTEM CURRICULA AND SYLLABI FOR I TO IV SEMESTERS

SEMESTER I

S. NO.	CODE NO	COURSE TITLE	CATE GORY	CONTACT PERIODS	L	T	P	C
1	LE5101	Collagen Science and Technology	PCC	3	3	0	0	3
2	LE5102	Quality Management and Assurance	PCC	3	3	0	0	3
3	LE5151	Project Management Systems	PCC	3	3	0	0	3
4	LE5152	Orientation to Leather Manufacture (Bridge Course)*	PCC	3	3	0	0	0
5	RM5151	Research Methodology and IPR	RMC	2	2	0	0	2
6		Audit Course I**	AC	2	2	0	0	0
PRACTICAL								
7	LE5111	Practice on Quality Management	PCC	6	0	0	6	3
8	LE5112	Chemical and Physical Testing Laboratory	PCC	6	0	0	6	3
			Total	**28**	**16**	**0**	**12**	**17**

* Compulsory for non-leather graduates
**Audit Course is Optional

SEMESTER – II

S. NO.	CODE NO	COURSE TITLE	CATE GORY	CONTACT PERIODS	L	T	P	C
1	LE5201	Science of Leather Manufacturing	PCC	3	3	0	0	3
2	LE5202	Leather Process Design Engineering	PCC	3	3	0	0	3
3	LE5203	Advanced Instrumental Methods	PCC	3	3	0	0	3
4		Program Elective I	PEC	3	3	0	0	3
5		Program Elective II	PEC	3	3	0	0	3
6		Audit Course II*	AC	2	2	0	0	0
PRACTICAL								
7	LE5211	Leather Process Design Engineering Laboratory	PCC	6	0	0	6	3
8	LE5212	Advanced Instrumental Methods Laboratory	PCC	6	0	0	6	3
			Total	**29**	**17**	**0**	**12**	**21**

*Audit Course is Optional

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SEMESTER – III

S. NO.	CODE NO	COURSE TITLE	CATE GORY	CONTACT PERIODS	L	T	P	C
1	LE5301	Science and Technology of Leather Chemicals	PCC	3	3	0	0	3
2		Program Elective III	PEC	3	3	0	0	3
3		Program Elective IV	PEC	3	3	0	0	3
4		Open Elective	OEC	3	3	0	0	3
	PRACTICAL							
7	LE5311	Internship/Training	EEC	2	2	0	0	2
8	LE5312	Project Phase I	EEC	12	0	0	12	6
			Total	**26**	**14**	**0**	**12**	**20**

SEMESTER – IV

S. NO.	CODE NO	COURSE TITLE	CATE GORY	CONTACT PERIODS	L	T	P	C
	PRACTICAL							
1	LE5411	Project Phase II	EEC	24	0	0	24	12
			Total	**24**	**0**	**0**	**24**	**12**

Total Credits: 70

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PROGRAM CORE COURSES (PCC)

S. No.	CODE NO.	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	LE5101	Collagen Science and Technology	PCC	3	3	0	0	3
2.	LE5102	Quality Management and Assurance	PCC	3	3	0	0	3
3.	LE5151	Project Management Systems	PCC	3	3	0	0	3
4.	LE5111	Practice on Quality Management **(LAB)**	PCC	6	0	0	6	3
5.	LE5112	Chemical and Physical Testing Laboratory **(LAB)**	PCC	6	0	0	6	3
6.	LE5201	Science of Leather Manufacturing	PCC	3	3	0	0	3
7.	LE5202	Leather Process Design Engineering	PCC	3	3	0	0	3
8.	LE5203	Advanced Instrumental Methods	PCC	3	3	0	0	3
9.	LE5211	Leather Process Design Engineering Laboratory **(LAB)**	PCC	6	0	0	6	3
10.	LE5212	Advanced Instrumental Methods Laboratory **(LAB)**	PCC	6	0	0	6	3
11.	LE5301	Science and Technology of Leather Chemicals	PCC	3	3	0	0	3

BRIDGE COURSES (PCC)

Sl. No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	LE5152	Orientation to Leather Manufacture (For B.E Mechanical, Production, Industrial Engg. Students)	PCC	3	3	0	0	0

PROFESSIONAL ELECTIVES COURSES (PEC)

S. No.	CODE NO	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	LE5001	Advanced Coordination Chemistry	PEC	3	3	0	0	3
2.	LE5002	Advanced Leather Biotechnology	PEC	3	3	0	0	3
3.	LE5003	Advanced Organic and Inorganic Chemistry	PEC	3	3	0	0	3
4.	LE5004	Colloids and Surface Chemistry	PEC	3	3	0	0	3
5.	LE5071	Corporate Social Responsibility	PEC	3	3	0	0	3
6.	LE5005	Energy Management in Industries	PEC	3	3	0	0	3
7.	LE5074	Engineering Economics in Production	PEC	3	3	0	0	3
8.	LE5006	Green Chemistry Approaches and Principles	PEC	3	3	0	0	3
9.	LE5072	Industrial Safety and Occupational Health	PEC	3	3	0	0	3
10.	LE5007	Marketing of Leather and Leather Chemicals	PEC	3	3	0	0	3
11.	LE5008	Nanotechnology and its Application in Leather	PEC	3	3	0	0	3
12.	LE5009	Science and Technology of Leather Supplements and Synthetics	PEC	3	3	0	0	3
13.	LE5073	Self-Management and Entrepreneurship	PEC	3	3	0	0	3

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14.	LE5010	Sustainability Engineering	PEC	3	3	0	0	3
15.	LE5011	Tannery Waste Management and Engineering	PEC	3	2	0	1	3

PROFESSIONAL ELECTIVE STREAMS

In order to develop professionals for academic research and development as well as for professional consultants/expert systems in area like Total Quality Management and project consultations, Environment and eco system services and Sustainability engineering and do ecology solutions, it is proposed to create four elective streams.

a) Professional Technology Services and Entrepreneurship,
b) Ecosystem services,
c) R&D and Pedagogy and
d) Do Ecology and sustainability engineering

Students are expected to choose any one the streams depending on their interest and capabilities. From the list of Professional Elective Courses, about 7 courses are proposed for each stream and students are expected to choose any 4 courses.

a) Professional Technology Services and Entrepreneurship stream

Sl. No.	COURSE CODE	COURSE TITLE	CATE GORY	CONTACT PERIODS	L	T	P	C
1.	LE5071	Corporate Social Responsibility	PEC	3	3	0	0	3
2.	LE5005	Energy Management in Industries	PEC	3	3	0	0	3
3.	LE5074	Engineering Economics in Production	PEC	3	3	0	0	3
4.	LE5072	Industrial safety and Occupational Health	PEC	3	3	0	0	3
5.	LE5007	Marketing of Leather and Leather Chemicals	PEC	3	3	0	0	3
6.	LE5009	Science and Technology of Leather Supplements and Synthetics	PEC	3	3	0	0	3
7.	LE5073	Self-Management and Entrepreneurship	PEC	3	3	0	0	3
8.	LE5011	Tannery Waste Management and Engineering	PEC	3	2	0	1	3

b) Ecosystem Services Stream

Sl. No.	COURSE CODE	COURSE TITLE	CATEG ORY	CONTACT PERIODS	L	T	P	C
1.	LE5002	Advanced Leather Biotechnology	PEC	3	3	0	0	3
2.	LE5071	Corporate Social Responsibility	PEC	3	3	0	0	3
3.	LE5005	Energy Management in Industries	PEC	3	3	0	0	3
4.	LE5074	Engineering Economics in Production	PEC	3	3	0	0	3
5.	LE5072	Industrial Safety and Occupational Health	PEC	3	3	0	0	3
6.	LE5073	Self-Management and Entrepreneurship	PEC	3	3	0	0	3
7.	LE5010	Sustainability Engineering	PEC	3	3	0	0	3
8.	LE5011	Tannery Waste Management and Engineering	PEC	3	2	0	1	3

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c) R&D and Pedagogy Stream

Sl. No.	COURSE CODE	COURSE TITLE	CATE GORY	CONTACT PERIODS	L	T	P	C
1.	LE5001	Advanced Coordination Chemistry	PEC	3	3	0	0	3
2.	LE5002	Advanced Leather Biotechnology	PEC	3	3	0	0	3
3.	LE5003	Advanced Organic and Inorganic Chemistry	PEC	3	3	0	0	3
4.	LE5004	Colloids and Surface Chemistry	PEC	3	3	0	0	3
5.	LE5006	Green Chemistry Approaches and Principles	PEC	3	3	0	0	3
6.	LE5008	Nanotechnology and its Application in Leather	PEC	3	3	0	0	3
7.	LE5009	Science and Technology of Leather Supplements and Synthetics	PEC	3	3	0	0	3
8.	LE5010	Sustainability Engineering	PEC	3	3	0	0	3

d) Do Ecology and Sustainability Engineering Stream

Sl. No.	COURSE CODE	COURSE TITLE	CATE GORY	CONTACT PERIODS	L	T	P	C
1.	LE5005	Energy Management in Industries	PEC	3	3	0	0	3
2.	LE5074	Engineering Economics in r Production	PEC	3	3	0	0	3
3.	LE5006	Green Chemistry Approaches and Principles	PEC	3	3	0	0	3
4.	LE5072	Industrial Safety and Occupational Health	PEC	3	3	0	0	3
5.	LE5008	Nanotechnology and its Application in Leather	PEC	3	3	0	0	3
6.	LE5073	Self-Management and Entrepreneurship	PEC	3	3	0	0	3
7.	LE5010	Sustainability Engineering	PEC	3	3	0	0	3
8.	LE5011	Tannery Waste Management and Engineering	PEC	3	2	0	1	3

RESEARCH METHODOLOGY AND IPR COURSES (RMC)

Sl. No.	Code No.	Course Title	Periods Per Week			Credits	Semester
			L	T	P		
1	RM5151	Research Methodology and IPR	2	0	0	2	1

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OPEN ELECTIVE COURSES [OEC]*

*(Out of 6 Courses one Course must be selected)

S.NO	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			CREDITS	SEMESTER
			Lecture	Tutorial	Practical		
1.	OE5091	Business Data Analytics	3	0	0	3	3
2.	OE5092	Industrial Safety	3	0	0	3	3
3.	OE5093	Operations Research	3	0	0	3	3
4.	OE5094	Cost Management of Engineering Projects	3	0	0	3	3
5.	OE5095	Composite Materials	3	0	0	3	3
6.	OE5096	Waste to Energy	3	0	0	3	3

AUDIT COURSES (AC)

Registration for any of these courses is optional to students

S. NO.	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			CREDITS	SEMESTER
			Lectur	Tutorial	Practical		
1.	AX5091	English for Research Paper Writing	2	0	0	0	1/2
2.	AX5092	Disaster Management	2	0	0	0	
3.	AX5093	Sanskrit for Technical Knowledge	2	0	0	0	
4.	AX5094	Value Education	2	0	0	0	
5.	AX5095	Constitution of India	2	0	0	0	
6.	AX5096	Pedagogy Studies	2	0	0	0	
7.	AX5097	Stress Management by Yoga	2	0	0	0	
8.	AX5098	Personality Development Through Life Enlightenment Skills	2	0	0	0	
9.	AX5099	Unnat Bharat Abhiyan	2	0	0	0	

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EMPLOYABILITY ENHANCEMENT COURSES (EEC)

S. No.	COURSE CODE	COURSE TITLE	CATE GORY	CONTACT PERIODS	L	T	P	C
1.	LE5312	Project Phase I	EEC	12	0	0	12	6
2.	LE5411	Project Phase II	EEC	24	0	0	24	12
3.	LE5311	Internship/Training	EEC	2	2	0	0	2
			Total Credits:					**20**

SUMMARY

M.TECH – LEATHER TECHNOLOGY						
S. No.	**Subject Area**	**Credits per Semester**				**Credits Total**
		I	**II**	**III**	**IV**	
1.	PROGRAM CORE COURSES	15	15	3	0	33
2.	PROFESSIONAL ELECTIVES COURSES	0	6	6	0	12
3.	OPEN ELECTIVE COURSES	0	0	3	0	3
4.	EMPLOYABILITY ENHANCEMENT COURSES	0	0	8	12	20
5.	RESEARCH METHODOLOGY AND IPR COURSE	2	0	0	0	2
6.	AUDIT COURSE (Non Credit)	0	0	0	0	0
	Total Credit	**17**	**21**	**20**	**12**	**70**

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SYLLABI

SEMESTER I

LE5101	COLLAGEN SCIENCE AND TECHNOLOGY	L	T	P	C
		3	0	0	3

OBJECTIVE

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

UNIT I BIOSYNTHESIS AND MOLECULAR STRUCTURE OF COLLAGEN 10

Transcription and translation - collagen genes and mRNA - synthesis of pro chains – intracellular processing of collagen - extracellular modifications. Steps in collagen biosynthesis and their significance - specific enzymes and their reaction.

Collagen triple helix; Amino acid composition and primary structure; helix stabilization–synthetic collagen like polypeptides –denaturation, renaturation. Native collagen fibrils- axial structure - 3 Dimensional structure – stabilisation -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 – nomenclature- common and distinctive chemical features – pro and chains - carbohydrates - structure and functions of pro collagens.

UNIT III COLLAGEN CROSSLINKS 6

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 8

Extractability - selective precipitation behaviour - chromatographic properties – Electrophoretic properties. Microscopy and spectroscopy techniques for collagen morphology. Non-invasive methods of liquid and solid imaging of biological specimen and their relevance to location of defects in hides/skins.

UNIT V COLLAGEN DEGRADATION 8

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

UNIT VI BIOMATERIAL AND APPLICATION OF COLLAGEN 8

Biomaterials – Processing of collagen – preparation of different forms sponge/sheet/ gels – biomedical applications of collagen – wound Healing – Burns implants – Drug carrier – other bio-products from collagen.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, the students

CO1. Have comprehensive knowledge on the chemistry and physics of collagen.
CO2. Understand the structure and stability of collagen.
CO3. Have knowledge on applications of collagen.

REFERENCES:

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

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Course Articulation Matrix:

Course Outcomes	Statement	Program Outcome														
		PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO3	PSO 4
CO1	Have comprehensive knowledge on the chemistry and physics of collagen.	3	2	3	–	–	–	2	–	–	–	–	–	3	–	–	3
CO2	Understand the structure and stability of collagen	3	2	3	–	–	–	2	–	–	–	–	–	3	–	–	3
CO3	Have knowledge on applications of collagen	3	2	3	–	–	–	2	–	–	–	–	–	3	–	–	3
Collagen Science and Technology		3	2	3	–	–	–	2	–	–	–	–	–	3	–	–	3

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively

Attested

LE5102	QUALITY MANAGEMENT AND ASSURANCE	L	T	P	C
		3	0	0	3

OBJECTIVE

To provide comprehensive knowledge about the principles, practices, tools and techniques of Total quality management in leather and allied sector.

UNIT I QUALITY ASSURANCE SYSTEM FOR LEATHER INDUSTRY 9

Introduction to QAS: Designing and developing quality assurance system for leather industry – Structure of QAS, Understanding system requirements, Designing QAS for Leather industry, Implementing QAS, Verification of QAS.

UNIT II ISO 9001:2015 FOR LEATHER INDUSTRY 9

Guidelines and classes of ISO 9001:2015; Designing of Quality Management System in accordance to ISO 9001:2015 for leather industry – Setting the Quality policy and Objectives; Preparation of system procedures for leather industry; Implementing ISO 9001:2015 in leather industry - training and implementation of ISO 9001:2015 in leather industry; Continual improvement – audit, management review and continual improvement in leather industry.

UNIT III TOTAL QUALITY MANAGEMENT FOR LEATHER INDUSTRY 9

TQM Principles – Leadership, Supplier teaming, Customer focus, Employee empowerment, Continual improvement; Implementation of TQM principles in leather industry.

UNIT IV STATISTICAL TECHNIQUES FOR QUALITY MANAGEMENT IN LEATHER INDUSTRY 9

Statistical methods for quality management - Process quality – Describing variation, Discrete distribution, Continuous distribution, Probability Plots, Sampling distribution, Point estimation, Statistical inference; Application of process quality for leather.

Statistical Process Control – chance and assignable causes, statistical basis of control charts, Various control charts, Application of control charts in process control for leather manufacturing.

UNIT V STATISTICAL TECHNIQUES AND TOOLS 9

(a) Capability Analysis – Process capability, Process capability analysis using control charts, Process capability using designated experiments, Process capability with attribute data; application of process capability for leather.

(b) DMAIC - Basic concept and techniques of DMAIC – application of DMAIC for leather.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, students can

CO1. Describe key elements of effective quality control and improvement programs.

CO2. Apply structured problem-solving statistical techniques and tools to improve quality in the leather sector.

CO3. Identify current trends and benchmark organizations related to quality management.

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REFERENCES:

1. Poornima M. Charantimath, Total Quality Management, Pearson Education, 2011.
2. Dale H. Besterfield, Carol Besterfield-Michna, Glen Besterfield, Mary Besterfield-Sacre, Total quality management, Pearson publication, 3rd edition, 2011
3. James R. Evans, Six Sigma and Process Improvement, Cengage se Learning India private limited, 2009.
4. Foster T. S. Managing quality: An Integrative Approach. New Jersey: Prentice Hall, 2002. 476 pp.
5. Goetsch D. L., Davis S. B. Quality management. Introduction to TQM for production, processing and services. New Jersey: Prentice Hall, 2003.

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Course Articulation Matrix:

Course Outcomes	Statement	Program Outcome															
		PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO3	PSO 4
CO1	Describe key elements of effective quality control and improvement programs.	3	2	2	–	–	–	–	–	–	3	–	–	3	–	–	3
CO2	Apply structured problem-solving statistical techniques and tools to improve quality in the leather sector.	3	2	2	–	–	–	–	–	–	3	–	–	3	–	–	3
CO3	Identify current trends and benchmark organizations related to quality management.	3	2	2	–	–	–	–	–	–	3	–	–	3	–	–	3
Quality Management and Assurance		3	2	2	–	–	–	–	–	–	3	–	–	3	–	–	3

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively

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LE5151	PROJECT MANAGEMENT SYSTEMS	L	T	P	C
	"Syllabus is in Common with M.Tech (Footwear Engineering and Management) Programme"	**3**	**0**	**0**	**3**

OBJECTIVE

The purpose of this subject is to identify; formulate; foresee or predict problems as possible; and to plan, organize, control activities of the project to complete it successfully in spite of all risks.

UNIT I PROJECT IDENTIFICATION AND FORMULATION 10

Project Identification Analysis: Concept of Project, Search for Business Idea, Project Identification, Project Planning Formulation and Analysis, Project Screening and Presentation of Projects for Decision Making; Socio -economic Consideration in Project Formulation; Social Infrastructure Projects for Sustainable Development; Investment Opportunities. Project Life Cycle, Feasibilities of Projects-Different forms of Project Contracting.

UNIT II PROJECT BUDGETING AND FINANCING 9

Capital Investments and Difficulties, Types of Capital Investment, Phase of Capital Budgeting, Facets of Project Analysis, Financial Estimates and Deductions, Estimation of Project Cash Flows.

Social Cost Benefit Analysis – Rational for SCBA, UNIDO Approach, Multiple Project and Constraints – Linear Programming Model, Financing of Projects – Different Kind of Project Finance.

UNIT III PROJECT APPRAISAL AND RISK ANALYSIS 8

Project Appraisal: Time Value of Money; Project Appraisal Techniques –Payback Period, Accounting Rate of Return, Net Present Value, Internal Rate of Return, Benefit Cost Ratio; Social Cost Benefit Analysis; Effective Rate of Return.
Risk Analysis: Measures of Risk; Sensitivity Analysis; Stimulation Analysis; Decision Tree Analysis.

UNIT IV PROJECT DESIGN AND EVALUATION 7

Project Design – Logic Model – Creating Work Break Down Structure (WBS) – Project Roll– up, Process Break down Structure, Responsibility Matrix, Cost of Capital, Project Control Process, Performance Measurement, Evaluation, Planning Audit, Post Completion Audit.

UNIT V PROJECT SCHEDULING TOOLS AND TECHNIQUES 11

Critical Path Method (CPM); Critical Chain Method; Schedule Compression Techniques – Crashing – Fast Tracking; Resource Optimization Techniques – Leveling – Balancing; Modelling Techniques – What- if Analysis – Simulation; Leads and Lags; Scheduling tools; Schedule network Analysis.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, the student can

CO1. Successfully develop and implement all project's procedures.
CO2. Achieve project's main goal within the given constraints.
CO3. Develop techniques to manage and coordinate project managers, subcontractors, customers, team members and vendors.
CO4. Identify various implementation techniques.
CO5. Describe ways to manage scope in a rapidly changing business environment.

Attested

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REFERENCES:

1. Projects – Planning, Analysis Selection, Finance, Implementation and Review by Dr. Prasanna Chandra , Tata McGraw Hill Education (2009)7th Edition.
2. Project Management – Clifford F. Gray & Erik Larson, McGraw Hill Higher Education; 3rd Edition (2005)
3. Project Management: A Managerial Approach by Jack R. Meredith ,Samuel J. Mantel Jr , Wiley; 8th edition (2011)
4. The Practice and Theory of Project Management: Creating Value Through Change Richard Newton Basingstoke, Hampshire: Palgrave Macmillan, 2009.
5. Effective Project Management - James P. Clements, Jack Gido , South-Western Cengage Learning, 2012

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Course Articulation Matrix:

Course Outcomes	Statement	Program Outcome															
		PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO3	PSO 4
CO1	Successfully develop and implement all project's procedures.	–	3	–	–	–	–	–	–	–	3	3	2	3	–	–	3
CO2	Achieve project's main goal within the given constraints.	–	3	–	–	–	–	–	–	–	3	3	2	3	–	–	3
CO3	Develop techniques to manage and coordinate project managers, sub contractors, customers, team members and vendors.	–	3	–	–	–	–	–	–	–	3	3	2	3	–	–	3
CO4	Identify various implementation techniques.	–	3	–	–	–	–	–	–	–	3	3	2				
CO5	Describe ways to manage scope in a rapidly changing business environment.	–	3	–	–	–	–	–	–	–	3	3	2				
Project Management System		–	3	–	–	–	–	–	–	–	3	3	2	3	–	–	3

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively

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LE5152	ORIENTATION TO LEATHER MANUFACTURE	L	T	P	C
	[Bridge Elective Course for Non-Leather UG Graduates] **"Syllabus is Common with M.Tech (Footwear Engineering and Management) Programme"**	**3**	**0**	**0**	**0**

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 7

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 8

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

UNIT III TANNING 10

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

UNIT IV POST TANNING PROCESSES AND OPERATIONS 10

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

UNIT V FINISHING TECHNIQUES 10

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

TOTAL : 45 PERIODS

COURSE OUTCOME

Through this course the student

CO1. Understand the application and alternatives to leather in current global scenario
CO2. Have knowledge on pretanning, tanning and post tanning processes.
CO3. Comprehend the process rational for making specific leather.

REFERENCES:

1. Sarkar, K.T., "Introduction to the Principles of Leather Manufacture", Ajoy Sorcor, Madras,1981.
2. Dutta, S.S., "Introduction to the Principles of Leather Manufacture", Indian Leather Technologists Association, Calcutta, 1980.
3. Thorstenson, T.C., "Practical Leather Technology", Robert E. Krieger Publishing Co., Malabar, Florida, 1985.
4. Fred O Flaherty, Roddy, T.W. and Lollar, R.M., "The Chemistry and Technology of Leather", Vol.I& II, Type of tannages, Rober E. Krieger Publishing Co., New York, 1977.
5. 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.

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Course Articulation Matrix:

Course Outcomes	Statement	Program Outcome														
		PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO3	PSO 4
CO1	Understand the application and alternatives to leather in current global scenario	3	3	2	–	–	–	3	–	–	–	–	–	3	–	–	3
CO2	Have knowledge on pretanning, tanning and post tanning processes.	3	3	2	–	–	–	3	–	–	–	–	–	3	–	–	3
CO3	Comprehend the process rational for making specific leather.	3	3	2	–	–	–	3	–	–	–	–	–	3	–	–	3
Orientation to Leather Manufacture		3	3	2	–	–	–	3	–	–	–	–	–	3	–	–	3

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively

Attested

RM5151 RESEARCH METHODOLOGY AND IPR

LT P C
2 0 0 2

COURSE OBJECTIVES:

To impart knowledge and skills required for research and IPR:

- Problem formulation, analysis and solutions.
- Technical paper writing / presentation without violating professional ethics
- Patent drafting and filing patents.

UNIT I RESEARCH PROBLEM FORMULATION 6

Meaning of research problem- Sources of research problem, criteria characteristics of a good research problem, errors in selecting a research problem, scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, necessary instrumentations

UNIT II LITERATURE REVIEW 6

Effective literature studies approaches, analysis, plagiarism, and research ethics.

UNIT III TECHNICALWRITING /PRESENTATION 6

Effective technical writing, how to write report, paper, developing a research proposal, format of research proposal, a presentation and assessment by a review committee.

UNIT IV INTRODUCTION TO INTELLECTUAL PROPERTY RIGHTS (IPR) 6

Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

UNIT V INTELLECTUAL PROPERTY RIGHTS (IPR) 6

Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications. New Developments in IPR: Administration of Patent System, IPR of Biological Systems, Computer Software etc.
Traditional knowledge Case Studies, IPR and IITs.

TOTAL: 30 PERIODS

COURCE OUTCOMES:

1. Ability to formulate research problem
2. Ability to carry out research analysis
3. Ability to follow research ethics
4. Ability to understand that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity
5. Ability to understand about IPR and filing patents in R & D.

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	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓										
CO2	✓											
CO3	✓							✓				
CO4	✓				✓							
CO5	✓					✓						✓

REFERENCES:

1. Asimov, “Introduction to Design”, Prentice Hall, 1962.
2. Halbert, “Resisting Intellectual Property”, Taylor & Francis Ltd ,2007.
3. Mayall, “Industrial Design”, McGraw Hill, 1992.
4. Niebel, “Product Design”, McGraw Hill, 1974.
5. Ranjit Kumar, 2nd Edition, “Research Methodology: A Step by Step Guide for beginners” 2010

LE5111	PRACTICE ON QUALITY MANAGEMENT	L	T	P	C
		0	0	6	3

OBJECTIVE

To provide practice on the principles, practices, tools and techniques of Total quality management in leather and allied sector.

Students will be oriented on Quality control and Management practice requirements in leather manufacture for converting raw hides/skins into finished leather. To provide this practical orientation, any two types of leather (upper, garment etc.) will be used. The practice would involve preparation of charts used in tannery.

TOTAL: 90 PERIODS

COURSE OUTCOMES:

At the end of the course students will be:
CO1. Able to apply quality management practice in leather manufacture
CO2. Able to analyses quality feature associated with leather manufacture
CO3. Able to understand quality check and quality assurance involved during leather manufacture

Course Articulation Matrix:

Course Outcomes	Statement	Program Outcome															
		PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO3	PSO 4
CO1	Able to apply quality management practice in leather manufacture	–	3	–	2	3	3	–	–	–	–	–	–	3	–	–	3
CO2	Able to analyses quality feature associated with leather manufacture	–	3	–	2	3	3	–	–	–	–	–	–	3	–	–	3
CO3	Able to understand quality check and quality assurance involving during leather manufacture	–	3	–	2	3	3	–	–	–	–	–	–	3	–	–	3
Practice on Quality Management		–	3	–	2	3	3	–	–	–	–	–	–	3	–	–	3

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively

Attested

LE5112	CHEMICAL AND PHYSICAL TESTING 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 45

Analysis and characterization 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 chrome and formaldehyde in syntan and leather.

UNIT II PHYSICAL TESTING LABORATORY 45

Analysis of Strength Properties **(**Tensile Strength and Elongation at break, Tongue tear strength, Stitch tear and slit tear strengths) of leather - Water vapour permeability – perspiration resistance – Abrasion resistance – Grain crack resistance - Evaluation of fastness properties (Rub fastness, Light fatness, Colour fastness) on wet and dry condition.

TOTAL: 90 PERIODS

OUTCOMES:

Students will

CO1. Have the practical skill to use advanced instruments associated with leather science and technology

CO2. Have analytical skill to characterize the leather chemicals

CO3. Have practical knowledge in physical testing of leather

Course Articulation Matrix:

Course Outcomes	Statement	Program Outcome															
		PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO3	PSO 4
CO1	Have the practical skill to use advanced instruments associated with leather science and technology	3	3	2	–	3	–	–	–	–	–	–	–	3	–	–	3
CO2	Have analytical skill to characterize the leather chemicals	3	3	2	–	3	–	–	–	–	–	–	–	3	–	–	3
CO3	Have practical knowledge in physical testing of leather	3	3	2	–	3	–	–	–	–	–	–	–	3	–	–	3
Chemical and Physical Testing Laboratory		3	3	2	–	3	–	–	–	–	–	–	–	3	–	–	3

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively

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SEMESTER II

LE5201	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 MATERIALS SCIENCE ASPECTS OF SKIN AND LEATHER 10

Pore size distribution, hydration and swelling phenomenon; Various transport processes into multiphasic systems; Steady and non-steady state diffusion; Leather as a composite material – bulk and surface properties, stiffness and damping/energy; Viscoelastic and dynamic mechanical properties; Ordering and long range order – concepts.

UNIT II PRINCIPLES INVOLVED IN PRETANNING AND TANNING OPERATIONS 15

Preservation towards salt less/less salt methods - Swelling mechanisms; Diffusion of lime and sharpening agents into skin; Osmotic and lyotropic opening of fibres. Mechanisms of unhairing based on chemical and enzymatic methods – concepts; Principles of deliming, bating and degreasing in designing eco-benign processes; Role of mineral acids, neutral salts and non-swelling acids in pickling; Changes in porosity of hides and skins during processing; Aqueous chemistry of Chromium (III), Aluminium (III), Iron (II) and (III), Titanium (IV), and Zirconium (IV) - coordinative interactions and hydrolytic behavior of coordinated ligands, and their relevance to mineral tanning. 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 III PRINCIPLES INVOLVED IN POST TANNING AND FINISHING 10

Physicochemical interactions of syntans, fatliquors and dyes with collagen and leather – Role of surface charge and importance of electrostatic, H-bond, dipole-dipole and hydrophobic interactions. Theory of finishing with special emphasis to optical properties of pigments and binders. Role of interfacial phenomena, adhesion /cohesion and film formation mechanism in leather finishing.

UNIT IV SUSTAINABILITY OF LEATHER MAKING 10

Sustainability concepts; Triple bottom line approach; Do-Undo concepts in leather processing; Effect of pH alternations; Do-ecology concepts; Narrow pH and reverse leather processing concepts; Bio-catalytic concepts to replace chemicals; Process integration; Waterless and low-water leather processing; Input-output process audit for atom economy.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of this course, the students will be able to

CO1. Understand the underpinning science in leather manufacture
CO2. Understand the advanced concepts and principle involved in the leather manufacture.
CO3. Have knowledge on sustainable leather making.

REFERENCES:

1. O. Flaherty, William T. Roddy and Robert M. Lollar, "The Chemistry and Technology of Leather, 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 of Leather 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, 2011.

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Course Articulation Matrix:

Course Outcomes	Statement	Program Outcome															
		PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO3	PSO 4
CO1	Understand the underpinning science in leather manufacture	3	3	2	3	–	–	3	–	–	–	–	–	3	–	–	3
CO2	Understand the advanced concepts and principle involved in the leather manufacture	3	3	2	–	3	–	–	–	–	–	–	–	3	–	–	3
CO3	Have knowledge on sustainable leather making.	3	3	2	–	3	–	–	–	–	–	–	–	3	–	–	3
Science of Leather Manufacturing		3	3	2	–	3	–	–	–	–	–	–	–	3	–	–	3

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively

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LE5202	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 as upholstery, 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 unhairing systems, ammonia - free deliming, salt free pickling systems, solvent free degreasing systems. Paradigm shift from chemical processing of hides and skins to bio beam house processing.

UNIT III CLEANER PROCESSING: TANNING, POST TANNING AND FINISHING 8

Less chrome 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 /REACH guidelines, Brand /Eco-labelling requirements and trend integrated strategies to achieve permissible BOD, COD and 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 specialty 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

COURSE OUTCOMES

At the end of the course, the students will be in a position to

CO1. Understand the conceptual design to make leather.
CO2. Have knowledge in cleaner leather processing.
CO3. Have knowledge in newer concepts in leather manufacture.

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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.
3. Exploration of GSK'S solvent selection guide in leather industry: A CSIR-CLRI tool for sustainable leather manufacturing. (2016) Green Chemistry.
4. Alternative carrier medium for sustainable leather manufacturing–A review and perspective. (2016) Journal of Cleaner Production, 112(1), *49-58*

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Course Articulation Matrix:

Course Outcomes	Statement	Program Outcome															
		PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO3	PSO 4
CO1	Understand the conceptual design to make leather.	3	3	2	3	–	–	–	–	3	2	3	3	3	–	–	3
CO2	Have knowledge in cleaner leather processing.	3	3	2	3	–	–	–	–	3	2	3	3	3	–	–	3
CO3	Have knowledge in newer concepts in leather manufacture.	3	3	2	3	–	–	–	–	3	2	3	3	3	–	–	3
Leather Process Design Engineering		3	3	2	3	–	–	–	–	3	2	3	3	3	–	–	3

1, 2 and 3 are correlation levels with weightingsas Slight (Low), Moderate (Medium) and Substantial (High) respectively

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LE5203	ADVANCED INSTRUMENTAL METHODS	L	T	P	C
		3	0	0	3

OBJECTIVE

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, ionexchange, gel permeation, gel filtration, GLC and affinity chromatography.

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 chromatographi.c 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: 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students can

CO1. Gain fundamental knowledge on various instrumental methods.
CO2. Understand the underpinning science behind various instrumental techniques.
CO3. Aware of advanced analytical techniques.

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REFERENCES:

1. Hobart H. Willard, Lye L. Merritt, Jr. John A. Dean and Frank A. Settle, Jr., "Instrumental Methods 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.

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Course Articulation Matrix:

Course Outcomes	Statement	Program Outcome															
		PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO3	PSO 4
CO1	Gain fundamental knowledge on various instrumental methods.	3	3	2	3	–	–	–	–	–	–	–	–	3	–	–	3
CO2	Understand the underpinning science behind various instrumental techniques.	3	3	2	3	–	–	–	–	–	–	–	–	3	–	–	3
CO3	Aware of advanced analytical techniques.	3	3	2	3	–	–	–	–	–	–	–	–	3	–	–	3
Advanced Instrumental Methods		3	3	2	3	–	–	–	–	–	–	–	–	3	–	–	3

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively

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LE5211	LEATHER PROCESS DESIGN ENGINEERING LAB	L	T	P	C
		0	0	6	3

OBJECTIVE

To impart practical exposure in

- Designing and applying processes for 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.

TOTAL: 90 PERIODS

COURSE OUTCOMES:

At the end of the course, the students will be in a position.

CO1. Make different types of leather using cleaner methods.
CO2. Analyze process efficiencies.
CO3. Construct process strategy for speciality leathers.

Course Articulation Matrix:

Course Outcomes	Statement	Program Outcome															
		PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO3	PSO 4
CO1	Make different types of leather using cleaner methods.	–	3		3	3	2	–	–	–	–	–	–	3	–	–	3
CO2	Analyze process efficiencies.	–	3		3	3	2	–	–	–	–	–	–	3	–	–	3
CO3	Construct process strategy for speciality leathers.	–	3		3	3	2	–	–	–	–	–	–	3	–	–	3
Leather Process Design Engineering Laboratory		–	3		3	3	2	–	–	–	–	–	–	3	–	–	3

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively

Attested

LE5212	ADVANCED 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.

INSTRUMENTAL LABORATORY

UV and visible spectrophotometric techniques and their applications in the determination of chromium, 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

COURSE OUTCOMES:

At the end of the course, the students would

CO1. Have practical knowledge on various instrumental methods.
CO2. Understand the underpinning science behind various instrumental techniques.
CO3. Have knowledge on advanced analytical techniques.

Course Articulation Matrix:

Course Outcomes	Statement	Program Outcome															
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	Have practical knowledge on various instrumental methods.	–	3	–	2	–	3	–	–	–	–	–	–	3	–	–	3
CO2	Understand the underpinning science behind various instrumental techniques.	–	3	–	2	–	3	–	–	–	–	–	–	3	–	–	3
CO3	Have knowledge on advanced analytical techniques.	–	3	–	2	–	3	–	–	–	–	–	–	3	–	–	3
Advanced Instrumental Methods Laboratory		–	3	–	2	–	3	–	–	–	–	–	–	3	–	–	3

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively

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SEMESTER III

LE5301	SCIENCE AND TECHNOLOGY OF LEATHER CHEMICALS	L	T	P	C
		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 INTRODUCTION **8**

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 SYNTANS **7**

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 FATLIQUOR AND DYEING **8**

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 PIGMENTS AND BINDERS **12**

Definition of pigments, groups of polymer bases for color. 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 FINISHING **10**

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

COURSE OUTCOMES

At the end of the course, students would

CO1. Understand the structure and properties of various leather auxiliaries
CO2. Have knowledge on the chemistry of finishing chemicals
CO3. Aware of various application in leather processing.

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REFERENCES:

1. Fred O Flaherty, Roddy, T.W. and Lollar, 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.
5. Samir Dasgupta, Treatise on Fatliquors and Fatliquoring of Leather, Indian Leather Technologists Association Publications, Kolkatta

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Course Articulation Matrix:

Course Outcomes	Statement	Program Outcome															
		PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO3	PSO 4
CO1	Understand the structure and properties of various leather auxiliaries	3	3	3	–	–	–	2	–	–	–	–	–	3	–	–	3
CO2	Have knowledge on the chemistry of finishing chemicals	3	3	3	–	–	–	2	–	–	–	–	–	3	–	–	3
CO3	Aware of various application in leather processing.	3	3	3	–	–	–	2	–	–	–	–	–	3	–	–	3
Science and Technology of Leather Chemicals		3	3	3	–	–	–	2	–	–	–	–	–	3	–	–	3

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively

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LE5311	INTERNSHIP / TRAINING	L	T	P	C
		0	0	4	2

OBJECTIVE

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

Students are expected to undertake industrial internship programme during the summer vacation. Minimum duration of this should be 1 month. During their internship programme, the students are expected to resolve atleast one of the problems faced by the industry. Students pursuing R&D elective stream will be allowed to take up their internship at a research lab. As a part of this course students are expected to make presentations and report on the work they have carried out during their internship.

COURSE OUTCOMES:

At the end of this course, the students will have confidence in handling practical aspects in Leather and allied sector and also to improve the presentation skills of the students.

Course Articulation Matrix:

Course Outcomes	Statement	Program Outcome															
		PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO3	PSO 4
CO1	Have confidence in handling practical aspects in Leather and allied sector and also to improve the presentation skills of the students	–	3	–	–	–	–	2	–	–	3	–	3	3	–	–	3

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively

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LE5312	PROJECT 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 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 Phase I is intended to facilitate the better completion of project extended through Project 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.

TOTALS:: 180 PERIODS

COURSE OUTCOMES:

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 by taking up a suitable research/industry problem.

Course Articulation Matrix:

Course Outcomes	Statement	Program Outcome															
		PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO3	PSO 4
CO1	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 by taking up a suitable research / industry problem.	–	3		3	–	–	2	–	–	3	2	3	3	–	–	3

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively

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SEMESTER IV

LE5411	**PROJECT 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 Phase I and are expected to complete the proposed work. A report should be submitted based on the data determined in the laboratory/industry. 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.

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.

TOTAL: 360 PERIODS

COURSE OUTCOMES:

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

Course Articulation Matrix:

Course Outcomes	Statement	Program Outcome															
		PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO3	PSO 4
CO1	The project work is expected to shape the student to think originally, plan/execute work properly, analytical abilities and reporting/ communication skills.	–	3		3	–	–	2	–	–	3	3	3	3	–	–	3

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively

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ELECTIVES

LE5001	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 8

Concepts and types of chemical bonding, group theoretical approach molecular symmetry elements, symmetry operation, point groups, application. Pi back bonding, organic metallic compounds, synthesis bonding and structure.

UNIT II THEORIES OF CO-ORDINATION 8

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 10

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 9

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

UNIT V METAL PROTEIN INTERACTIONS 10

Metal - protein interactions and their role in structural stability of protein. Bio inorganic chemistry, characterization of inorganic compounds by IR, NMR, UV-Vis and Mass spectroscopy

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of this course, the students would be in a position to

CO1. Understand chemical bonding and coordination chemistry of transitions metals
CO2. Understand the synthesis, structure and reactivity of transition metal complexes
CO3. Understand metal-protein interactions

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.

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Course Articulation Matrix:

Course Outcomes	Statement	Program Outcome															
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	Understand chemical bonding and coordination chemistry of transitions metals	3	3	2	-	-	-	-	-	-	-	-	-	3	-	-	3
CO2	Understand the synthesis, structure and reactivity of transition metal complexes	3	3	2	-	-	-	-	-	-	-	-	-	3	-	-	3
CO3	Understand metal-protein interactions	3	3	2	-	-	-	-	-	-	-	-	-	3	-	-	3
Advanced Coordination Chemistry		3	3	2	-	-	-	-	-	-	-	-	-	3	-	-	3

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively

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LE5002	ADVANCED LEATHER BIOTECHNOLOGY	L	T	P	C
		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 equipment, 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 of homogeneity. Enzyme classification, methods of estimation, sources of enzymes, purification and 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 and control - 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

COURSE OUTCOMES:

At the end of the course, the students are expected to
CO1. Gain knowledge on the role of biotechnological approaches in leather manufacture.
CO2. Understand the concepts of molecular biology
CO3. Aware of by product utilization technology

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REFERENCES:

1. P.F.Stanbury and A.Whitaker, "Principles of Fermentation Technology", Pergamon Press, 3rd edition, 2016.
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.5, 1982
5. T. A. Brown, “Gene Cloning and DNA Analysis: An Introduction”, Blackwell Publishing, Sixth edition, 2010.
6. “Microbes and Enzymes - -Basics and Applied”, R. Puvanakrishnan, Former Sc.G. and Head, Dept. of Biotechnology, CLRI.

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Course Articulation Matrix:

Course Outcomes	Statement	Program Outcome															
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	Gain knowledge on the role of biotechnological approaches in leather manufacture.	3	3	2	-	3	-	-	-	-	-	-	-	3	-	-	3
CO2	Understand the significance molecular biology	3	3	2	-	3	-	-	-	-	-	-	-	3	-	-	3
CO3	Aware of by product utilization technology	3	3	2	-	3	-	-	-	-	-	-	-	3	-	-	3
Advanced Leather Biotechnology		3	3	2	-	3	-	-	-	-	-	-	-	3	-	-	3

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively

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LE5003	ADVANCED ORGANIC AND INORGANIC CHEMISTRY	L	T	P	C
		3	0	0	3

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

Lewis structures: (1) resonance, (2) formal charges
VSEPR theory ; Valence Bond Theory, hybridization
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 ORGANIC REACTION TYPES ENCOUNTERED IN LEATHER SCIENCE **9**

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

UNIT III MECHANISM OF ORGANIC REACTIONS USED IN THE MANUFACTURE OF LEATHER CHEMICALS **10**

Methods of determining reaction mechanism, factors influencing SN1 and SN2, E1, E2reactions. Electron displacements, inductive effect, induct metric effect, mesomeric effect, electrometric effect, hyper conjugation, steric inhibition of resonance. Aromatic electrophilic and nucleophilic substitution reactions.

UNIT IV CHEMISTRY OF TRANSITION METALS **9**

General properties, electronic configuration, Oxidization states, Ionization energy of D-block element. Chemistry of Chromium, Titanium, Iron, Aluminum and Zirconium including their redox behaviour. Variable oxidation statics, stabilization of oxidation states.

UNIT V REACTION MECHANISMS OF METAL COMPLEXES **8**

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

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On the completion of the course students are expected to
CO1. Gain knowledge on some of the advanced aspects of organic and inorganic chemistry.
CO2. Understand the mechanism of organic reaction
CO3. Understand the chemistry of transition metals

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REFERENCES:

1. Jerry March, "Advanced organic chemistry, Reactions, mechanisms and structure, 7th Ed. Wiley Eastern, New Delhi, 2015.
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", 12th Ed., Wiley, New York, 2016.
4. R.O.C.Norman, "Principles of Organic Synthesis", 3rd Ed., Chapman and Hall, London, 2017.
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, VI Edition, 1999.
9. James Huheey, Inorganic Chemistry IV Edition, 1993.
10. Kettle, "Co-ordination compounds", ELBS, 1975.

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Course Articulation Matrix:

Course Outcomes	Statement	Program Outcome															
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	Gain knowledge on some of the advanced aspects of inorganic and organic chemistry.	3	3	2	-	3	-	-	-	-	-	-	-	3	-	-	3
CO2	Understand the mechanism of organic reaction	3	3	2	-	3	-	-	-	-	-	-	-	3	-	-	3
CO3	Understand the chemistry of transition metals	3	3	2	-	3	-	-	-	-	-	-	-	3	-	-	3
Advanced Organic and Inorganic Chemistry		3	3	2	-	3	-	-	-	-	-	-	-	3	-	-	3

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively

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LE5004	COLLOIDS 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 colloids and surface chemistry.

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) Particle-particle interactions : Electrostatic forces; Analysis of surface change and surface chemistry (electro kinetics electrophoresis, streaming potential, electro-osmosis, sedimentation potential, electroacoustic, 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 Amphiphilic Molecules

UNIT IV SURFACTANTS **9**

Surface activity – adsorption at interfaces, Gibbs, Traube's rule, Rose-Nishioka rule structure of a surfactant Measuring surfactant adsorption – by difference, SPR, TIRF, FTIR, ellipsometry association structures – micelles, vesicles, surface micelles, 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

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UNIT V APPLICATION TO LEATHER TECHNOLOGY 9

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

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of this course, the students are expected to
CO1. Understand the role of colloid and surface chemistry in leather applications.
CO2. Gain knowledge on bulk properties of surfactant solutions and monolayers.
CO3. Understand the adsorption phenomena of solids.

REFERENCES:

1. T.H.E.Garret, "Surface Active Chemicals", Pergamon Press, London, 1972.
2. A.W.Adamson, "Physical Chemistry of Surfaces, 5th Edn.", Wiley Inter-Science, NewYork, 1990.
3. Bienkienwicz, "Physical chemistry of leather making", Krieger Publishing Co., Florida, 1983.
4. Aya Kitahara and Akira Watanabe, Electrical Phenomena at interfaces, Pub:- MarcelDekker Inc., New York, 1984.
5. D. J. Shaw, B. Heinemann, Introduction to Colloid and Surface Chemistry, 4th Edition, 1992.
6. Surfactant Science Series, John-Wiley Interscience Publications, New York.
7. Colloidal Dispersions : Suspensions, Emulsions, and Foams by I.D. Morrison and S. Ross (2002, Wiley Interscience, NY; ISBN : 0-471-17625-7)

Course Articulation Matrix:

Course Outcomes	Statement	Program Outcome															
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	Understand the role of colloid and surface chemistry in leather applications	3	3	2	-	-	-	-	-	-	-	-	-	3	-	-	3
CO2	Gain knowledge on bulk properties of surfactant solutions and monolayers	3	3	2	-	-	-	-	-	-	-	-	-	3	-	-	3
CO3	Understand the adsorption phenomena of solids	3	3	2	-	-	-	-	-	-	-	-	-	3	-	-	3
Colloid and Surface Chemistry		3	3	2	-	-	-	-	-	-	-	-	-	3	-	-	3

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively

LE5071	CORPORATE SOCIAL RESPONSIBILITY	L	T	P	C
		3	0	0	3

OBJECTIVES

- To equip individuals with knowledge and skills undertaking Corporate Social Responsibility.
- To develop competencies for effective field interventions, research and management of CSR interventions.
- To develop an insight into present CSR strategies of model business organization.
- To enable students with conceptual clarity on need, purpose and relevance of research applicability in CSR practice.

UNIT I INTRODUCTION **9**

Introduction to CSR - Meaning & Definition of CSR, History & evolution of CSR. Concept of Charity, Corporate philanthropy, Corporate Citizenship, CSR-an overlapping concept. Concept of sustainability & Stakeholder Management.
CSR through triple bottom line and Sustainable Business; relation between CSR and Corporate governance; environmental aspect of CSR; Chronological evolution of CSR in India; models of CSR in India, Carroll's model; drivers of CSR; major codes on CSR; Initiatives in India.

UNIT II PRINCIPLES OF CSR **9**

International framework for Corporate Social Responsibility, Millennium Development goals, Sustainable development goals, Relationship between CSR and MDGs. United Nations (UN) Global Compact 2011. UN guiding principles on business and human rights. OECD CSR policy tool, ILO tri-partite declaration of principles on multinational enterprises and social policy.

UNIT III LEGISLATION AND ACTS **6**

CSR-Legislation In India & the world. Section 135 of Companies Act 2013.Scope for CSR Activities under Schedule VII, Appointment of Independent Directors on the Board, and Computation of Net Profit's Implementing Process in India.

UNIT IV REGULATORY REFORMS **7**

The Drivers of CSR in India, Market based pressure and incentives civil society pressure, the regulatory environment in India Counter trends. Performance in major business and programs. Voluntarism Judicial activism.

UNIT V GUIDELINES OF CSR **8**

Identifying key stakeholders of CSR & their roles. Role of Public Sector in Corporate, government programs that encourage voluntary responsible action of corporations. Role of Nonprofit & Local Self-Governance in implementing CSR; Contemporary issues in CSR & MDGs. Global Compact Self-Assessment Tool, National Voluntary Guidelines by Govt. of India. Understanding roles and responsibilities of corporate foundations.

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UNIT VI CSR REVIEW AND INITIATIVES 6

Review current trends and opportunities in CSR.CSR as a Strategic Business tool for Sustainable development. Review of successful corporate initiatives & challenges of CSR. Case Studies of Major CSR Initiatives.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, the students are expected to

CO1. Gain comprehensive knowledge on the relate and describe the multidisciplinary, strategic, and evolving nature of corporate social responsibility.

CO2. Able to apply ethical decision making principles in a professional or business context.

CO3. Aware of guidelines of CSR.

REFERENCES:

1. Corporate Social Responsibility: An Ethical Approach - Mark S. Schwartz, Peterborough, Ont : Broadview, 2011.
2. The World Guide to CSR : a Country-by-Country Analysis of Corporate Sustainability and Responsibility, Routledge, 2017
3. Innovative CSR by Lelouche, Idowu and Filho
4. Corporate Social Responsibility in India -Sanjay K Agarwal, London Responce Books 2008
5. Handbook on Corporate Social Responsibility in India, CII.
6. Handbook of Corporate Sustainability: Frameworks, Strategies and Tools -M. A.Quaddus, Muhammed Abu B. Siddique, Cheltenham : Edward Elgar Publishing, ©2011
7. Growth, Sustainability, and India's Economic Reforms – T.N Srinivasan, Oxford : Oxford University Press, 2011
8. Corporate social responsibility : concepts and cases : the Indian experience, C V Baxi; Ajit Prasad, New Delhi : Excel Books, 2006
9. Mallin, Christine A., Corporate Governance (Indian Edition), Oxford University Press, New Delhi.
10. Blowfield, Michael, and Alan Murray, Corporate Responsibility, Oxford University Press, 2014

Course Articulation Matrix:

Course Outcomes	Statement	Program Outcome															
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	Gain comprehensive knowledge on the relate and describe the multidisciplinary, strategic, and evolving nature of corporate social responsibility.	-	3	3	3	3	3	3	-	2	-	2	3	-	-	3	3
CO2	Able to apply ethical decision making principles in a professional or business context.	-	3	3	3	3	3	3	-	2	-	2	3	-	-	3	3
CO3	Aware of guidelines of CSR	-	3	3	3	3	3	3	-	2	-	2	3	-	-	3	3
Corporate Social Responsibility		-	3	3	3	3	3	3	-	2	-	2	3	-	-	3	3

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively

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LE5005	ENERGY MANAGEMENT IN INDUSTRIES	L	T	P	C
		3	0	0	3

OBJECTIVE

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

UNIT I ENERGY SCENARIO 7

Energy Scenario, Energy Analysis of Fuels, Energy Needs of Growing Economy, Long Term Energy Scenario, Energy Pricing, Energy Sector Reforms, Energy and Environment: Air Pollution, Climate Change, Energy Security, Energy Conservation and its Importance, Energy Strategy for the Future, Energy Conservation.

UNIT II ENERGY FORMS 8

Energy forms: (a) thermal (b) Electricity (c) Non-Conventional Sources Thermal: Different Fuels& its Energy Contents, Temperature & Pressure, Heat Capacity. Steam and Moist Air. Electricity: AC & DC, Load Management, Maximum Demand Control, Aggregated Technical& Commercial Losses (ATC); Non-Conventional: Various Forms; Some Applications related to Non- Conventional Energy Sources.
Different types of energy forms – SI units, Basics of heat, Power and Pressure, AC & DC motors, Basic of Pump and its types, Refrigeration and Air conditioning, Compressor and Boiler used in leather units and treatment system.

UNIT III ENERGY MANAGEMENT 10

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

UNIT IV ENERGY AUDIT 10

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

UNIT V ENERGY MANAGEMENT AND AUDITING IN LEATHER IDUSTRY 10

Energy requirement – management – auditing in Leather and Leather Products Manufacturing Industry.
Performance evaluation of Motor, Pump and Air compressor used in leather production and treatment units

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On the completion of the course students are expected to
CO1. Understand the energy requirements in leather manufacture.
CO2. Gain knowledge in energy controls in leather manufacture.
CO3. Make case studies for real systems.

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.

Course Articulation Matrix:

Course Outcomes	Statement	Program Outcome															
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	Understand the energy requirements in leather manufacture	-	3	3	3	3	3	3	-	2	-	3	3	-	-	3	3
CO2	Gain knowledge in energy controls in leather manufacture	-	3	3	3	3	3	3	-	2	-	3	3	-	-	3	3
CO3	Make case studies for real systems	-	3	3	3	3	3	3	-	2	-	3	3	-	-	3	3
Energy Management in Industries		-	3	3	3	3	3	3	-	2	-	3	3	-	-	3	3

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively

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LE5074	ENGINEERING ECONOMICS IN PRODUCTION	L	T	P	C
	"Syllabus is in Common with M.Tech (Footwear Engineering and Management) Programme"	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 –by discounted 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 and uncertainty - probability theory.

UNIT IV SOURCES OF FINANCE AND BUDGETING 9

Different sources of finance - ownership finance - ordinary share, short, medium and long term loan - 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, alternative single purpose expenditure method.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of this course, the students are expected to
CO1. Understand the financial management and economics in the leather industry
CO2. Understand the profit value analysis
CO3. Have knowledge in organizational aspects of implementation

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 Gittinger 1.B.R.D.

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Course Articulation Matrix:

Course Outcomes	Statement	Program Outcome															
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	Understand the financial management and economics in the leather industry	-	3	3	3	3	3	3	-	2	-	2	3	-	-	3	3
CO2	Understand the profit value analysis	-	3	3	3	3	3	3	-	2	-	2	3	-	-	3	3
CO3	Have knowledge in organizational aspects of implementation	-	3	3	3	3	3	3	-	2	-	2	3	-	-	3	3
Engineering Economics in Leather Production		-	3	3	3	3	3	3	-	2	-	2	3	-	-	3	3

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively

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LE5007	GREEN CHEMISTRY APPROACHES AND PRINCIPLES	L	T	P	C
		3	0	0	3

OBJECTIVE

To impart knowledge on green chemistry options for cleaner leather processing.

UNIT I INTRODUCTION TO GREEN CHEMISTRY 8

Principles and Concepts of Green Chemistry-Atom Economy-Life Cycle Assessment-Use of Renewable Resources

UNIT II PRINCIPLES OF GREEN CHEMISTRY IN LEATHER PROCESSING 12

Prevent waste-Maximize atom economy-Design less hazardous chemical syntheses-Design safer chemicals and products-Use safer solvents and reaction conditions-Increase energy efficiency-Use renewable feedstocks-Avoid chemical derivatives-Use catalysts, not stoichiometric reagents- Design chemicals and products to degrade after use- Analyze in real time to prevent pollution-Minimize the potential for accidents

UNIT III GREENER APPROACHES IN PRETANNING PROCESSES 8

Saltless curing technology - Enzymes in leather processing - Role of ionic liquids in unhairing and fibre opening – Supercritical Carbon dioxide based deliming

UNIT IV CLEANER OPTIONS IN TANNING 10

Role of water in tanning - Alternative solvent system for cleaner leather processing - Waterless chrome tanning - Metal free tanning system - Strategy for high exhaustion Chrome Tanning - Mass balance, diffusion and reactivity of Tanning agent – Pickle free chrome tanning - Zero liquid discharge tanning system

UNIT V GREENER TECHNOLOGY FOR POST TANNING AND FINISHING 7

Formaldehyde, Phenol, AOX free post tanning systems – Biopolymers based retanning agent - Role of finishing equipments such as HVLP spray, foam finishing, etc in cleaner perspective. Aqueous finishing concepts and formulation; Other novel finishing techniques to reduce VOC emission - Nano technology in post tanning and finishing

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, the students are expected to
CO1. Gain knowledge on the various concepts of greener chemistry involving in the leather process (*viz*., pre-tanning, tanning, post-tanning and finishing systems).
CO2. Understand the various cleaner options for leather manufacturing.
CO3. Aware of recent greener technological options.

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REFERENCES:

Books

1. Clark, J. H., & Macquarrie, D. J. (Eds.). (2008). Handbook of green chemistry and technology. John Wiley & Sons.
2. DeSimone, J. M., & Tumas, W. (Eds.). (2003). Green chemistry using liquid and supercritical carbon dioxide. Oxford University Press.

Journals

1. Thanikaivelan, P., Silambarasan, S., Aravindhan, R., & Rao, J. R. (2017). Non-polar Medium Enables Efficient Chrome Tanning. JOURNAL OF THE AMERICAN LEATHER CHEMISTS ASSOCIATION, 112(10), 338-346.
2. Madhan, B., V. Subramanian, J. Raghava Rao, Balachandran Unni Nair, and T. Ramasami. "Stabilization of collagen using plant polyphenol: role of catechin." International journal of biological macromolecules 37, no. 1-2 (2005): 47-53.
3. Sathish, M., Silambarasan, S., Madhan, B., & Rao, J. R. (2016). Exploration of GSK'S solvent selection guide in leather industry: a CSIR-CLRI tool for sustainable leather manufacturing. Green Chemistry, 18(21), 5806-5813.
4. Clifford, A. A., & Williams, J. R. (2000). Introduction to supercritical fluids and their applications. In Supercritical fluid methods and Protocols (pp. 1-16). Humana Press.
5. Anastas, P., & Eghbali, N. (2010). Green chemistry: principles and practice. Chemical Society Reviews, 39(1), 301-312.
6. Kerton, F. M., & Marriott, R. (2013). Alternative solvents for green chemistry (No. 20). Royal Society of chemistry.
7. Leitner, W. (2000). Green chemistry: designed to dissolve. Nature, 405(6783), 129.

Course Articulation Matrix:

Course Outcomes	Statement	Program Outcome															
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	Gain knowledge on the various concepts of greener chemistry involving in the leather process (*viz.*, pre-tanning, tanning, post-tanning and finishing systems)	3	3	2	-	3	-	3	-	-	-	-	-	3	-	-	3
CO2	Understand the various cleaner options for leather manufacturing	3	3	2	-	3	-	3	-	-	-	-	-	3	-	-	3
CO3	Aware of recent greener technological options	3	3	2	-	3	-	3	-	-	-	-	-	3	-	-	3
Green Chemistry Approaches and Principles		3	3	2	-	3	-	3	-	-	-	-	-	3	-	-	3

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively

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LE5072	INDUSTRIAL SAFETY AND OCCUPATIONAL HEALTH	L	T	P	C
	"Syllabus is in Common with M.Tech (Footwear Engineering and Management) Programme"	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

COURSE OUTCOMES:

At the end of the course, the students will be in the position to understand the
CO1. Legal framework of safety and health in India and international conventions.
CO2. Hazard identification and assessment.
CO3. Productive machine safety in the leather industry.
CO4. Emergency prevention and preparedness safety and health management.

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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.

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Course Articulation Matrix:

Course Outcomes	Statement	Program Outcome															
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	Legal framework of safety and health in India and international conventions	-	-	-	3	3	3	3	-	-	-	-	3	-	-	3	2
CO2	Hazard identification and assessment	-	-	-	3	3	3	3	-	-	-	-	3	-	-	3	2
CO3	Productive machine safety in the leather industry	-	-	-	3	3	3	3	-	-	-	-	3	-	-	3	2
CO4	Emergency prevention and preparedness safety and health management	-	-	-	3	3	3	3	-	-	-	-	3	-	-	3	2
Industrial Safety and Occupational Health		-	-	-	3	3	3	3	-	-	-	-	3	-	-	3	2

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively

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LE5008	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

COURSE OUTCOMES:

On the completion of the course students are expected to
CO1. Understand the international trade, government policies in export aspects of world trade related to leather sector, custom tariff and international marketing.
CO2. Gain knowledge on concepts of international marketing.
CO3. Aware of India’s share in the global level.

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REFERENCES:

1. Philip Kolter, "Marketing Management", Fifth Edition, Prentice Hall, New Delhi, 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

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Course Articulation Matrix:

Course Outcomes	Statement	Program Outcome															
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	Understand the international trade, government policies in export aspects of world trade related to leather sector, custom tariff and international marketing	-	-	3	3	3	3	-	-	-	-	-	-	-	-	3	3
CO2	Gain knowledge on concepts of international marketing	-	-	3	3	3	3	-	-	-	-	-	-	-	-	3	3
CO3	Aware of India's share in the global level	-	-	3	3	3	3	-	-	-	-	-	-	-	-	3	3
Marketing of Leather and Leather Chemicals		-	-	3	3	3	3	-	-	-	-	-	-	-	-	3	3

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively

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LE5009	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 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 9

- Scanning and Transmission Electron Microscopy
- Scanning Probe Microscopies: Atomic Force, Scanning tunneling microscopy
- Diffraction and scattering techniques
- Vibrational Spectroscopy
- Surface techniques

UNIT IV APPLICATION OF NANO TECHNOLOGY IN TANNING, POST TANNING ANDFINISHING 9

Collagen – Skin Matrix – Association of nano materials with collagen matrix at various stages of 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 6

Synthesis, Water purification, Beneficial and adverse effect of nanomaterials.

TOTAL: 45 PERIODS

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COURSE OUTCOMES:

On the completion of the course students are expected to
CO1. Understand the advancements in nano technology and their impact in leather manufacture.
CO2. Gain knowledge on nanomaterial and its characterization.
CO3. Aware of environmental aspects of nanotechnology.

REFERENCES:

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

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Course Articulation Matrix:

Course Outcomes	Statement	Program Outcome															
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	Understand the advancements in nano technology and their impact in leather manufacture	3	3	2	-	-	-	-	-	-	-	-	-	3	-	-	3
CO2	Gain knowledge on nanomaterial and its characterization	3	3	2	-	-	-	-	-	-	-	-	-	3	-	-	3
CO3	Aware of environmental aspects of nanotechnology	3	3	2	-	-	-	-	-	-	-	-	-	3	-	-	3
Nanotechnology and its Applications in Leather		3	3	2	-	-	-	-	-	-	-	-	-	3	-	-	3

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively

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LE5010	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 ANALYSIS 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 POLYMERS FOR INDUSTRIAL APPLICATIONS **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.

UNIT V 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: 45 PERIODS

COURSE OUTCOMES:

On the completion of the course students are expected to

CO1. Have knowledge on the chemistry of most common polymeric materials used in leather industry as supplements.

CO2. Understand the importance of polymers for industrial application.

CO3. Understand the fabrication process of polymer.

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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.

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Course Articulation Matrix:

Course Outcomes	Statement	Program Outcome															
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	Have knowledge on the chemistry of most common polymeric materials used in leather industry as supplements	3	3	2	-	-	-	-	-	-	-	-	-	3	-	-	3
CO2	Understand the importance of polymers for industrial application	3	3	2	-	-	-	-	-	-	-	-	-	3	-	-	3
CO3	Understand the fabrication process of polymer	3	3	2	-	-	-	-	-	-	-	-	-	3	-	-	3
Science and Technology of Leather Supplements and Synthetics		3	3	2	-	-	-	-	-	-	-	-	-	3	-	-	3

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively

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LE5073	SELF MANAGEMENT AND ENTREPREUNERSHIP	L	T	P	C
	"Syllabus is in Common with M.Tech (Footwear Engineering and Management) Programme"	3	0	0	3

OBJECTIVE

To provide understanding on the need to self-manage and other management competency for a successful entrepreneurship.

UNIT I SELF-MANAGEMENT 12

Defining self-management - Writing a mission statement - Self-discipline - Self-evaluation - Self-analysis by personal SWOT; Planning & Goal setting; Developing a career plan.

UNIT II BUSINESS DEVELOPMENT 9

Intellectual property and copyright; Trademarks and patents; Types of businesses – Pvt, Public, Partner; Business development report - Institutions & organization for business development.

UNIT III FINANCE MANAGEMENT 9

Pricing your work & budgeting; Building an online portfolio; Branding; Networking and Partnership building; The elevator pitch Fundraising; Establishing a value network.

UNIT IV TIME MANAGEMENT 6

Time management; Project management; Time map and project management plan; Reflection on perfectionism.

UNIT V MARKETING MANAGEMENT 9

Publicity and advertising; Press releases; Digital and social media marketing.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, one can

CO1. Differentiate between multiple leadership styles and ways of managing individuals
CO2. Recognize the various roles of managers and types of business management
CO3. Identify the fundamentals of managing the time and finance
CO4. Recall methods of communication, working in groups and stages of leadership

REFERENCES:

1. Brigham, Ehrhardt, Financial Management Theory & Practice, 14th edition, Cengage Learning.
2. Samuel J. Mantel, Jr, Jack R. Meredith, Scott M. Shafer, Margaret M. Sutton, M.R. Gopalan, "Project Management – Core Textbook" First Indian Edition (2006), Wiley India publication, 2011.
3. Philip Kotler, Kevin Lane Keller, Abraham Koshy, and MitheleswarJha, "Marketing Management", 13th Edition, Pearson Publications Limited.2012.

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Course Articulation Matrix:

Course Outcomes	Statement	Program Outcome															
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3	PSO 4
CO1	Differentiate between multiple leadership styles and ways of managing individuals	-	-	3	3	3	3	-	-	-	-	-	3	-	-	3	3
CO2	Recognize the various roles of managers and types of business management	-	-	3	3	3	3	-	-	-	-	-	3	-	-	3	3
CO3	Identify the fundamentals of managing the time and finance	-	-	3	3	3	3	-	-	-	-	-	3	-	-	3	3
CO4	Recall methods of communication, working in groups and stages of leadership	-	-	3	3	3	3	-	-	-	-	-	3	-	-	3	3
Self Management and Entrepreunership		-	-	3	3	3	3	-	-	-	-	-	3	-	-	3	3

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively

LE5011	SUSTAINABILITY ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVE

This subject is to learn about holistic overview of the environmental, social and economic aspects of sustainability management and how to address them strategically to achieve the sustainable industry.

UNIT I INTRODUCTION TO SUSTAINABILITY 12

Definition, Concept and challenges of Sustainability, Pillars of sustainability – Environment, Economic and Social, Values and principles of sustainability, Integrated sustainability into business – System Thinking, value chain perspective and sustainability strategy & planning and stakeholder engagement, Integrated sustainability management - Sustainable performance management, Continuous improvement and integrated sustainability management systems, Sustainability measurement and tools – ISO standards and Life cycle Assessment.

UNIT II ENVIRONMENTAL SUSTAINABILITY 9

Introduction to Sustainability and the Environment, Environmental life cycle assessment, Environmental Protection- Role of Government, Legal aspects, initiatives by Non-governmental organizations (NGO), Environmental Education, Specific Environmental Concerns – Climate Change, Air & Water pollution, Waste, Human Health and Diversity of life, Strategies for Environmental Sustainability – Hazardous waste management, Solid waste management and Reduce-Reuse-Recycle concept.

UNIT III ECONOMIC SUSTAINABILITY 8

Economic sustainability – Strategy, Technology Innovation, current and future economic prospects and market position; Types of economic contribution impact to the industry (Direct, Indirect and Induced impact.

UNIT IV SOCIAL SUSTAINABILTY 8

Social sustainability – Safety, health, community involvement, tax issues and corruption; Social sustainable management; Organizational behavior and sustainable Human Resources (HR); Measuring social impacts and benefits.

UNIT V SUSTAINABLE INDUSTRIAL DEVELOPMENT 8

Securing a sustainable future, Relationship between environmental, economic and social on industry development, Strategies for sustainability in Industries, Sustainable Industrial Manufacture, Energy consumption and reducing emissions, Manufacturing Waste reduction – recycle & Reuse, Water Usage – Reducing water consumption, Wastewater Systems – Water treatment & Management, Case Study: Study of core technologies in leather industry relating to sustainability.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Upon successful completion of this course, students are expected to

CO1. Gain a fundamental knowledge of issues, principles, concepts, processes related to sustainability, describe how core technologies in the industry relate to sustainability.

CO2. Understand the sustainability in environment, economic and social.

CO3. Aware of strategy for sustainable leather industry development

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REFERENCES:

1. Bendell , J & Kearins, K. (2005). The political bottom line: the emerging dimension to corporate responsibility for sustainable development. Business Strategy and the Environment 14(6), 372–383
2. Bennet, N & Van der Lugt, C (2004). Tracking global governance and sustainability: is the system working? In Henriques & Richardson (2004)
3. Daly, HE (1990). Toward some operational principles of sustainable development. Ecological Economics 2, 1–6
4. Hopwood, B, Mellor, M & O'Brien, G (2005). Sustainable development: mapping different approaches. Sustainable Development 13, 38–52

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Course Articulation Matrix:

Course Outcomes	Statement	Program Outcome															
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	Gain a fundamental knowledge of issues, principles, concepts, processes related to sustainability, describe how core technologies in the industry relate to sustainability	-	3	3	3	3	3	3	-	2	-	2	3	-	-	3	3
CO2	Understand the sustainability in environment, economic and social	-	3	3	3	3	3	3	-	2	-	2	3	-	-	3	3
CO3	Aware of strategy for sustainable leather industry development	-	3	3	3	3	3	3	-	2	-	2	3	-	-	3	3
Sustainability Engineering		-	3	3	3	3	3	3	-	2	-	2	3	-	-	3	3

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively

LE5012	TANNERY WASTE MANAGEMENT AND ENGINEERING	L	T	P	C
		2	0	1	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 WASTE GENERATION AND ENVIRONMENTAL LEGISLATION 5

Sources of waste water generation, Characteristics of effluent and pollution load from tanneries, significant pollutants in tanneries, Environmental discharge norms.

UNIT II INTRODUCTION TO BIOLOGICAL TREATMENT OF WASTEWATER 6

Screening – Flow Equalization – Theory on Coagulation & Flocculation – Sedimentation – Filtration – Detail study and design of these primary treatment unit.

UNIT III BIOLOGICAL TREATMENT OF WASTEWATER 12

Introduction to microbial metabolism – Bacterial growth – Kinetics of Biological Growth.
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 AND WASTE MINIMIZATION 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 Compounds through electro dialysis, reverse osmosis, multiple effect evaporator, ion-exchange. Various in plant control measures for waste minimization at source.

UNIT V SOLID WASTE DISPOSAL 10

Source of solid waste generation and its Characteristics, Various treatment options for tannery solid wastes, Design of Secured land fill: Biomethanisation system with energy recovery option – Thermal incineration – Bacterical compositing – Vermi composting – RO reject management.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, the students will be in a position to
CO1. Understand the methods and means to manage tannery wastes.
CO2. Gain knowledge on advanced wastewater treatment.
CO3. Aware of various treatment option for solid water management.

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.

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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 of Chemistry Cambridge CB4 4WF, 1995.

Course Articulation Matrix:

Course Outcomes	Statement	Program Outcome															
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	Understand the methods and means to manage tannery wastes	-	3	3	3	3	3	3	-	2	-	2	3	-	-	3	3
CO2	Gain knowledge on advanced wastewater treatment	-	3	3	3	3	3	3	-	2	-	2	3	-	-	3	3
CO3	Aware of various treatment option for solid water management	-	3	3	3	3	3	3	-	2	-	2	3	-	-	3	3
Tannery Waste Management and Engineering		-	3	3	3	3	3	3	-	2	-	2	3	-	-	3	3

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively

OPEN ELECTIVE COURSES (OEC)

OE5091 BUSINESS DATA ANALYTICS L T P C
3 0 0 3

OBJECTIVES:

- To understand the basics of business analytics and its life cycle.
- To gain knowledge about fundamental business analytics.
- To learn modeling for uncertainty and statistical inference.
- To understand analytics using Hadoop and Map Reduce frameworks.
- To acquire insight on other analytical frameworks.

UNIT I OVERVIEW OF BUSINESS ANALYTICS 9

Introduction – Drivers for Business Analytics – Applications of Business Analytics: Marketing and Sales, Human Resource, Healthcare, Product Design, Service Design, Customer Service and Support – Skills Required for a Business Analyst – Framework for Business Analytics Life Cycle for Business Analytics Process.

Suggested Activities:

- Case studies on applications involving business analytics.
- Converting real time decision making problems into hypothesis.
- Group discussion on entrepreneurial opportunities in Business Analytics.

Suggested Evaluation Methods:

- Assignment on business scenario and business analytical life cycle process.
- Group presentation on big data applications with societal need.
- Quiz on case studies.

UNIT II ESSENTIALS OF BUSINESS ANALYTICS 9

Descriptive Statistics – Using Data – Types of Data – Data Distribution Metrics: Frequency, Mean, Median, Mode, Range, Variance, Standard Deviation, Percentile, Quartile, z-Score, Covariance, Correlation – Data Visualization: Tables, Charts, Line Charts, Bar and Column Chart, Bubble Chart, Heat Map – Data Dashboards.

Suggested Activities:

- Solve numerical problems on basic statistics.
- Explore chart wizard in MS Excel Case using sample real time data for data visualization.
- Use R tool for data visualization.

Suggested Evaluation Methods:

- Assignment on descriptive analytics using benchmark data.
- Quiz on data visualization for univariate, bivariate data.

UNIT III MODELING UNCERTAINTY AND STATISTICAL INFERENCE 9

Modeling Uncertainty: Events and Probabilities – Conditional Probability – Random Variables – Discrete Probability Distributions – Continuous Probability Distribution – Statistical Inference: Data Sampling – Selecting a Sample – Point Estimation – Sampling Distributions – Interval Estimation – Hypothesis Testing.

Suggested Activities:

- Solving numerical problems in sampling, probability, probability distributions and hypothesis testing.
- Converting real time decision making problems into hypothesis.

Suggested Evaluation Methods:

- Assignments on hypothesis testing.
- Group presentation on real time applications involving data sampling and hypothesis testing.
- Quizzes on topics like sampling and probability.

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UNIT IV ANALYTICS USING HADOOP AND MAPREDUCE FRAMEWORK 9

Introducing Hadoop– RDBMS versus Hadoop–Hadoop Overview – HDFS (Hadoop Distributed File System) – Processing Data with Hadoop– Introduction to MapReduce – Features of MapReduce – Algorithms Using Map-Reduce: Matrix-Vector Multiplication, Relational Algebra Operations, Grouping and Aggregation – Extensions to MapReduce.

Suggested Activities:

- Practical – Install and configure Hadoop.
- Practical – Use web based tools to monitor Hadoop setup.
- Practical – Design and develop MapReduce tasks for word count, searching involving text corpus etc.

Suggested Evaluation Methods:

- Evaluation of the practical implementations.
- Quizzes on topics like HDFS and extensions to MapReduce.

UNIT V OTHER DATA ANALYTICAL FRAMEWORKS 9

Overview of Application development Languages for Hadoop – PigLatin – Hive – Hive Query Language (HQL) – Introduction to Pentaho, JAQL – Introduction to Apache: Sqoop, Drill and Spark, Cloudera Impala – Introduction to NoSQL Databases – Hbase and MongoDB.

Suggested Activities:

- Practical – Installation of NoSQL database like MongoDB.
- Practical – Demonstration on Sharding in MongoDB.
- Practical – Install and run Pig
- Practical – Write PigLatin scripts to sort, group, join, project, and filter data.
- Design and develop algorithms to be executed in MapReduce involving numerical methods for analytics.

Suggested Evaluation Methods:

- Mini Project (Group) – Real time data collection, saving in NoSQL, implement analytical techniques using Map-Reduce Tasks and Result Projection.

TOTAL: 45 PERIODS

OUTCOMES:

On completion of the course, the student will be able to:

- Identify the real world business problems and model with analytical solutions.
- Solve analytical problem with relevant mathematics background knowledge.
- Convert any real world decision making problem to hypothesis and apply suitable statistical testing.
- Write and Demonstrate simple applications involving analytics using Hadoop and MapReduce
- Use open source frameworks for modeling and storing data.
- Apply suitable visualization technique using R for visualizing voluminous data.

REFERENCES:

1. VigneshPrajapati, “Big Data Analytics with R and Hadoop”, Packt Publishing, 2013.
2. Umesh R Hodeghatta, UmeshaNayak, “Business Analytics Using R – A Practical Approach”, Apress, 2017.
3. AnandRajaraman, Jeffrey David Ullman, “Mining of Massive Datasets”, Cambridge University Press, 2012.
4. Jeffrey D. Camm, James J. Cochran, Michael J. Fry, Jeffrey W. Ohlmann, David R. Anderson, “Essentials of Business Analytics”, Cengage Learning, second Edition, 2016.
5. U. Dinesh Kumar, “Business Analytics: The Science of Data-Driven Decision Making”, Wiley, 2017.
6. A. Ohri, “R for Business Analytics”, Springer, 2012
7. Rui Miguel Forte, “Mastering Predictive Analytics with R”, Packt Publication, 2015.

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	PO1	PO2	PO3	PO4	PO5	PO6
CO1	1	1	1	2	3	1
CO2	2	1	1	2	1	1
CO3	1	1	2	3	3	1
CO4	2	2	1	2	1	1
CO5	1	1	2	2	1	1
CO6	1	1	1	3	2	1

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OE5092 **INDUSTRIAL SAFETY** **LT P C**
3 0 0 3

OBJECTIVES:

- Summarize basics of industrial safety
- Describe fundamentals of maintenance engineering
- Explain wear and corrosion
- Illustrate fault tracing
- Identify preventive and periodic maintenance

UNIT I INTRODUCTION 9

Accident, causes, types, results and control, mechanical and electrical hazards, types, causes and preventive steps/procedure, describe salient points of factories act 1948 for health and safety, wash rooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc, Safety color codes. Fire prevention and firefighting, equipment and methods.

UNIT II FUNDAMENTALS OF MAINTENANCE ENGINEERING 9

Definition and aim of maintenance engineering, Primary and secondary functions and responsibility of maintenance department, Types of maintenance, Types and applications of tools used for maintenance, Maintenance cost & its relation with replacement economy, Service life of equipment.

UNIT III WEAR AND CORROSION AND THEIR PREVENTION 9

Wear- types, causes, effects, wear reduction methods, lubricants-types and applications, Lubrication methods, general sketch, working and applications, i. Screw down grease cup, ii. Pressure grease gun, iii. Splash lubrication, iv. Gravity lubrication, v. Wick feed lubrication vi. Side feed lubrication, vii. Ring lubrication, Definition, principle and factors affecting the corrosion. Types of corrosion, corrosion prevention methods.

UNIT IV FAULT TRACING 9

Fault tracing-concept and importance, decision tree concept, need and applications, sequence of fault finding activities, show as decision tree, draw decision tree for problems in machine tools, hydraulic, pneumatic, automotive, thermal and electrical equipment's like, I. Any one machine tool, ii. Pump iii. Air compressor, iv. Internal combustion engine, v. Boiler, vi. Electrical motors, Types of faults in machine tools and their general causes.

UNIT V PERIODIC AND PREVENTIVE MAINTENANCE 9

Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, overhauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance. Steps/procedure for periodic and preventive maintenance of: I. Machine tools, ii. Pumps, iii. Air compressors, iv. Diesel generating (DG) sets, Program and schedule of preventive maintenance of mechanical and electrical equipment, advantages of preventive maintenance. Repair cycle concept and importance

TOTAL: 45 PERIODS

OUTCOMES:

CO1: Ability to summarize basics of industrial safety
CO2: Ability to describe fundamentals of maintenance engineering
CO3: Ability to explain wear and corrosion
CO4: Ability to illustrate fault tracing
CO5: Ability to identify preventive and periodic maintenance

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	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓											
CO2	✓											
CO3	✓	✓	✓									
CO4	✓	✓	✓									
CO5	✓	✓	✓									

REFERENCES:

1. Audels, Pump-hydraulic Compressors, Mcgrew Hill Publication, 1978.
2. Garg H P,Maintenance Engineering, S. Chand and Company,1987.
3. Hans F. Winterkorn ,Foundation Engineering Handbook, Chapman & Hall London,2013.
4. Higgins & Morrow , Maintenance Engineering Handbook,Eighth Edition,2008

OE5093 OPERATIONS RESEARCH LT P C
3 0 0 3

OBJECTIVES:

- Solve linear programming problem and solve using graphical method.
- Solve LPP using simplex method
- Solve transportation , assignment problems
- Solve project management problems
- Solve scheduling problems

UNIT I LINEAR PROGRAMMING 9

Introduction to Operations Research – assumptions of linear programming problems - Formulations of linear programming problem – Graphical method

UNIT II ADVANCES IN LINEAR PROGRAMMING 9

Solutions to LPP using simplex algorithm- Revised simplex method - primal dual relationships – Dual simplex algorithm - Sensitivity analysis

UNIT III NETWORK ANALYSIS – I 9

Transportation problems -Northwest corner rule, least cost method,Voges's approximation method - Assignment problem -Hungarian algorithm

UNIT IV NETWORK ANALYSIS – II 9

Shortest path problem: Dijkstra' s algorithms, Floyds algorithm, systematic method -CPM/PERT

UNIT V NETWORK ANALYSIS – III 9

Scheduling and sequencing - single server and multiple server models - deterministic inventory models - Probabilistic inventory control models

TOTAL: 45 PERIODS

OUTCOMES:

CO1: To formulate linear programming problem and solve using graphical method.
CO2: To solve LPP using simplex method
CO3: To formulate and solve transportation, assignment problems
CO4: To solve project management problems
CO5: To solve scheduling problems

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	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓											
CO2	✓											
CO3	✓	✓	✓									
CO4	✓	✓	✓									
CO5	✓	✓	✓									

REFERENCES:

1. Harvey M Wagner, Principles of Operations Research: Prentice Hall of India 2010
2. Hitler Libermann, Operations Research: McGraw Hill Pub. 2009
3. Pant J C, Introduction to Optimisation: Operations Research, Jain Brothers, Delhi, 2008
4. Pannerselvam, Operations Research: Prentice Hall of India 2010
5. Taha H A, Operations Research, An Introduction, PHI, 2008

OE5094 COST MANAGEMENTOF ENGINEERING PROJECTS L T P C
3 0 0 3

OBJECTIVES:

- Summarize the costing concepts and their role in decision making
- Infer the project management concepts and their various aspects in selection
- Interpret costing concepts with project execution
- Develop knowledge of costing techniques in service sector and various budgetary control techniques
- Illustrate with quantitative techniques in cost management

UNIT I INTRODUCTION TO COSTING CONCEPTS 9

Objectives of a Costing System; Cost concepts in decision-making; Relevant cost, Differential cost, Incremental cost and Opportunity cost; Creation of a Database for operational control.

UNIT II INTRODUCTION TO PROJECT MANAGEMENT 9

Project: meaning, Different types, why to manage, cost overruns centres, various stages of project execution: conception to commissioning. Project execution as conglomeration of technical and nontechnical activities, Detailed Engineering activities, Pre project execution main clearances and documents, Project team: Role of each member,Importance Project site: Data required with significance, Project contracts.

UNIT III PROJECT EXECUTION AND COSTING CONCEPTS 9

Project execution Project cost control, Bar charts and Network diagram, Project commissioning: mechanical and process, Cost Behavior and Profit Planning Marginal Costing; Distinction between Marginal Costing and Absorption Costing; Break-even Analysis, Cost-Volume-Profit Analysis, Various decision-making problems, Pricing strategies: Pareto Analysis, Target costing, Life Cycle Costing.

UNIT IV COSTING OF SERVICE SECTOR AND BUDGETERY CONTROL 9

Just-in-time approach, Material Requirement Planning, Enterprise Resource Planning, Activity-Based Cost Management, Bench Marking; Balanced Score Card and Value-Chain Analysis, Budgetary Control: Flexible Budgets; Performance budgets; Zero-based budgets.

UNIT V QUANTITATIVE TECHNIQUES FOR COST MANAGEMENT 9

Linear Programming, PERT/CPM, Transportation problems, Assignment problems, Learning Curve Theory.

TOTAL: 45 PERIODS

OUTCOMES

CO1 – Understand the costing concepts and their role in decision making CO2– Understand the project management concepts and their various aspects in selection
CO3–Interpret costing concepts with project execution
CO4–Gain knowledge of costing techniques in service sector and various budgetary control techniques
CO5 - Become familiar with quantitative techniques in cost management

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓		✓			✓	✓		✓	✓
CO2	✓	✓	✓		✓				✓		✓	✓
CO3	✓	✓	✓		✓	✓					✓	✓
CO4	✓	✓	✓		✓		✓				✓	✓
CO5	✓	✓	✓		✓	✓	✓				✓	✓

REFERENCES:

1. Ashish K. Bhattacharya, Principles & Practices of Cost Accounting A. H. Wheeler publisher, 1991
2. Charles T. Horngren and George Foster, Advanced Management Accounting, 1988
3. Charles T. Horngren et al Cost Accounting A Managerial Emphasis, Prentice Hall of India, New Delhi, 2011
4. Robert S Kaplan Anthony A. Alkinson, Management & Cost Accounting, 2003
5. Vohra N.D., Quantitative Techniques in Management, Tata McGraw Hill Book Co. Ltd, 2007

OE5095 COMPOSITE MATERIALS L T P C
3 0 0 3

OBJECTIVES:

- Summarize the characteristics of composite materials and effect of reinforcement in composite materials.
- Identifythe various reinforcements used in composite materials.
- Compare the manufacturing process of metal matrix composites.
- Understand the manufacturing processes of polymer matrix composites.
- Analyze the strength of composite materials.

UNIT I INTRODUCTION 9

Definition – Classification and characteristics of Composite materials - Advantages and application of composites - Functional requirements of reinforcement and matrix - Effect of reinforcement (size, shape, distribution, volume fraction) on overall composite performance.

UNIT II REINFORCEMENTS 9

Preparation-layup, curing, properties and applications of glass fibers, carbon fibers, Kevlar fibers and Boron fibers - Properties and applications of whiskers, particle reinforcements - Mechanical Behavior of composites: Rule of mixtures, Inverse rule of mixtures - Isostrain and Isostress conditions.

UNIT III MANUFACTURING OF METAL MATRIX COMPOSITES 9

Casting – Solid State diffusion technique - Cladding – Hot isostatic pressing - Properties and applications. Manufacturing of Ceramic Matrix Composites: Liquid Metal Infiltration – Liquid phase sintering. Manufacturing of Carbon – Carbon composites: Knitting, Braiding, Weaving - Properties and applications.

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UNIT IV MANUFACTURING OF POLYMER MATRIX COMPOSITES 9

Preparation of Moulding compounds and prepregs – hand layup method – Autoclave method –Filament winding method – Compression moulding – Reaction injection moulding - Properties and applications.

UNIT V STRENGTH 9

Laminar Failure Criteria-strength ratio, maximum stress criteria, maximum strain criteria, interacting failure criteria, hygrothermal failure. Laminate first play failure-insight strength; Laminate strength-ply discount truncated maximum strain criterion; strength design using caplet plots; stress concentrations.

TOTAL: 45 PERIODS

OUTCOMES:

- CO1 - Know the characteristics of composite materials and effect of reinforcement in composite materials.
- CO2 – Know the various reinforcements used in composite materials.
- CO3 – Understand the manufacturing processes of metal matrix composites.
- CO4 – Understand the manufacturing processes of polymer matrix composites.
- CO5 – Analyze the strength of composite materials.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1		✓	✓	✓								
CO2		✓✓	✓	✓	✓						✓	
CO3			✓	✓	✓		✓				✓	
CO4			✓	✓	✓		✓				✓	
CO5				✓	✓		✓					

REFERENCES:

1. Cahn R.W. - Material Science and Technology – Vol 13 – Composites, VCH, WestGermany.
2. Callister, W.D Jr., Adapted by Balasubramaniam R, Materials Science and Engineering, An introduction, John Wiley & Sons, NY, Indian edition, 2007.
3. Chawla K.K., Composite Materials, 2013.
4. Lubin.G, Hand Book of Composite Materials, 2013.

OE5096 **WASTE TO ENERGY** **L T P C**
3 0 0 3

OBJECTIVES:

- Interpret the various types of wastes from which energy can be generated
- Develop knowledge on biomass pyrolysis process and its applications
- Develop knowledge on various types of biomass gasifiers and their operations
- Invent knowledge on biomass combustors and its applications on generating energy
- Summarize the principles of bio-energy systems and their features

UNITI INTRODUCTION TO EXTRACTION OF ENERGY FROM WASTE 9

Classification of waste as fuel – Agro based, Forest residue, Industrial waste - MSW – Conversion devices – Incinerators, gasifiers, digestors

UNITIIBIOMASS PYROLYSIS 9

Pyrolysis – Types, slow fast – Manufacture of charcoal – Methods - Yields and application – Manufacture of pyrolytic oils and gases, yields and applications.

UNITIII BIOMASS GASIFICATION 9

Gasifiers – Fixed bed system – Downdraft and updraft gasifiers – Fluidized bed gasifiers – Design, construction and operation – Gasifier burner arrangement for thermal heating – Gasifier engine arrangement and electrical power – Equilibrium and kinetic consideration in gasifier operation.

UNITIV BIOMASS COMBUSTION 9

Biomass stoves – Improved chullahs, types, some exotic designs, Fixed bed combustors, Types, inclined grate combustors, Fluidized bed combustors, Design, construction and operation - Operation of all the above biomass combustors.

UNITV BIO ENERGY 9

Properties of biogas (Calorific value and composition), Biogas plant technology and status - Bio energy system - Design and constructional features - Biomass resources and their classification - Biomass conversion processes - Thermo chemical conversion - Direct combustion - biomass gasification - pyrolysis and liquefaction - biochemical conversion - anaerobic digestion - Types of biogas Plants – Applications - Alcohol production from biomass - Bio diesel production -Urban waste to energy conversion - Biomass energy programme in India.

TOTAL: 45 PERIODS

OUTCOMES:

CO1 – Understand the various types of wastes from which energy can be generated
CO2 – Gain knowledge on biomass pyrolysis process and its applications
CO3 – Develop knowledge on various types of biomass gasifiers and their operations
CO4 – Gain knowledge on biomass combustors and its applications on generating energy
CO5 – Understand the principles of bio-energy systems and their features

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓		✓									✓
CO2	✓		✓									✓
CO3	✓	✓	✓		✓							✓
CO4	✓	✓	✓		✓		✓					✓
CO5	✓	✓	✓		✓							✓

REFERENCES:

1. Biogas Technology - A Practical Hand Book - Khandelwal, K. C. and Mahdi, S. S., Vol. I & II, Tata McGraw Hill Publishing Co. Ltd., 1983.
2. Biomass Conversion and Technology, C. Y. WereKo-Brobby and E. B. Hagan, John Wiley & Sons, 1996.
3. Food, Feed and Fuel from Biomass, Challal, D. S., IBH Publishing Co. Pvt. Ltd., 1991.
4. Non Conventional Energy, Desai, Ashok V., Wiley Eastern Ltd., 1990.

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AUDIT COURSES (AC)

AX5091 ENGLISHFOR RESEARCHPAPERWRITING L T P C
2 0 0 0

OBJECTIVES

- Teach how to improve writing skills and level of readability
- Tell about what to write in each section
- Summarize the skills needed when writing a Title
- Infer the skills needed when writing the Conclusion
- Ensure the quality of paper at very first-time submission

UNITI INTRODUCTION TO RESEARCH PAPER WRITING 6

Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness

UNIT II PRESENTATION SKILLS 6

Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticizing, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts, Introduction

UNIT III TITLE WRITING SKILLS 6

Key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check

UNIT IV RESULT WRITING SKILLS 6

Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions

UNIT V VERIFICATION SKILLS 6

Useful phrases, checking Plagiarism, how to ensure paper is as good as it could possibly be the first-time submission

TOTAL: 30 PERIODS

OUTCOMES

CO1 –Understand that how to improve your writing skills and level of readability
CO2 –Learn about what to write in each section
CO3 –Understand the skills needed when writing a Title
CO4 – Understand the skills needed when writing the Conclusion
CO5 – Ensure the good quality of paper at very first-time submission

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1										✓		✓
CO2										✓		✓
CO3										✓		✓
CO4										✓		✓
CO5										✓		✓

REFERENCES

1. Adrian Wallwork , English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011
2. Day R How to Write and Publish a Scientific Paper, Cambridge University Press 2006
3. Goldbort R Writing for Science, Yale University Press (available on Google Books) 2006
4. Highman N, Handbook of Writing for the Mathematical Sciences, SIAM. Highman's book 1998.

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AX5092 DISASTER MANAGEMENT L T P C

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OBJECTIVES

- Summarize basics of disaster
- Explain a critical understanding of key concepts in disaster risk reduction and humanitarian response.
- Illustrate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
- Describe an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
- Develop the strengths and weaknesses of disaster management approaches

UNIT I INTRODUCTION 6

Disaster: Definition, Factors and Significance; Difference between Hazard And Disaster; Natural and Manmade Disasters: Difference, Nature, Types and Magnitude.

UNIT II REPERCUSSIONS OF DISASTERS AND HAZARDS 6

Economic Damage, Loss of Human and Animal Life, Destruction Of Ecosystem. Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts And Famines, Landslides And Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks And Spills, Outbreaks Of Disease And Epidemics, War And Conflicts.

UNIT III DISASTER PRONE AREAS IN INDIA 6

Study of Seismic Zones; Areas Prone To Floods and Droughts, Landslides And Avalanches; Areas Prone To Cyclonic and Coastal Hazards with Special Reference To Tsunami; Post-Disaster Diseases and Epidemics

UNIT IV DISASTER PREPAREDNESS AND MANAGEMENT 6

Preparedness: Monitoring Of Phenomena Triggering a Disaster or Hazard; Evaluation of Risk: Application of Remote Sensing, Data from Meteorological And Other Agencies, Media Reports: Governmental and Community Preparedness.

UNIT V RISK ASSESSMENT 6

Disaster Risk: Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. Techniques of Risk Assessment, Global Co-Operation in Risk Assessment and Warning, People's Participation in Risk Assessment. Strategies for Survival

TOTAL : 30 PERIODS

OUTCOMES

CO1: Ability to summarize basics of disaster
CO2: Ability to explain critical understanding of key concepts in disaster risk reduction and humanitarian response.
CO3: Ability to illustrate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
CO4: Ability to describe an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
CO5: Ability to develop the strengths and weaknesses of disaster management approaches

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓											
CO2	✓											
CO3	✓	✓	✓									
CO4	✓	✓	✓									
CO5	✓	✓	✓									

Attested

REFERENCES

1. Goel S. L., Disaster Administration And Management Text And Case Studies", Deep & Deep Publication Pvt. Ltd., New Delhi,2009.
2. Nishitha Rai, Singh AK, "Disaster Management in India: Perspectives, issues and strategies "'New Royal book Company,2007.
3. Sahni, Pardeep Et.Al. ," Disaster Mitigation Experiences And Reflections", Prentice Hall Of India, New Delhi,2001.

AX5093 SANSKRIT FOR TECHNICAL KNOWLEDGE L T P C
2 0 0 0

OBJECTIVES

- Illustrate the basic sanskrit language.
- Recognize sanskrit, the scientific language in the world.
- Appraise learning of sanskrit to improve brain functioning.
- Relate sanskrit to develop the logic in mathematics, science & other subjects enhancing the memory power.
- Extract huge knowledge from ancient literature.

UNIT I ALPHABETS 6

Alphabets in Sanskrit

UNIT II TENSES AND SENTENCES 6

Past/Present/Future Tense - Simple Sentences

UNIT III ORDER AND ROOTS 6

Order - Introduction of roots

UNIT IV SANSKRIT LITERATURE 6

Technical information about Sanskrit Literature

UNIT V TECHNICAL CONCEPTS OF ENGINEERING 6

Technical concepts of Engineering-Electrical, Mechanical, Architecture, Mathematics

TOTAL: 30 PERIODS

OUTCOMES

- CO1 - Understanding basic Sanskrit language.
- CO2 - Write sentences.
- CO3 - Know the order and roots of Sanskrit.
- CO4 - Know about technical information about Sanskrit literature.
- CO5 - Understand the technical concepts of Engineering.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1										✓		✓
CO2										✓		✓
CO3												✓
CO4												✓
CO5												✓

REFERENCES

1. "Abhyaspustakam" – Dr.Vishwas, Samskrita-Bharti Publication, New Delhi
2. "Teach Yourself Sanskrit" Prathama Deeksha-Vempati Kutumbshastri, Rashtriya Sanskrit Sansthanam, New Delhi Publication
3. "India's Glorious Scientific Tradition" Suresh Soni, Ocean books (P) Ltd., New Delhi, 2017.

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AX5094	VALUE EDUCATION	L T P C 2 0 0 0

OBJECTIVES

Students will be able to

- Understand value of education and self-development
- Imbibe good values in students
- Let the should know about the importance of character

UNIT I

Values and self-development–Social values and individual attitudes. Workethics,Indianvisionofhumanism.Moralandnon-moralvaluation.Standards and principles. Value judgements

UNIT II

Importance of cultivation of values. Sense of duty. Devotion, Self-reliance. Confidence, Concentration. Truthfulness, Cleanliness. Honesty, Humanity. Power of faith, National Unity. Patriotism. Love fornature, Discipline

UNIT III

Personality and Behavior Development-Soul and Scientific attitude. Positive Thinking. Integrity and discipline. Punctuality, Love and Kindness. Avoid fault Thinking. Free from anger, Dignity of labour. Universal brother hood and religious tolerance. True friendship. Happiness Vs suffering, love for truth. Aware of self-destructive habits. Association and Cooperation. Doing best for saving nature

UNIT IV

Character and Competence–Holy books vs Blind faith. Self-management and Good health. Science of reincarnation. Equality, Nonviolence, Humility, Role of Women. All religions and same message. Mind your Mind, Self-control. Honesty, Studying effectively.

TOTAL: 30 PERIODS

OUTCOMES

Students will be able to

- Knowledge of self-development.
- Learn the importance of Human values.
- Developing the over all personality.

Suggested reading

1. Chakroborty, S.K.“Values and Ethics for organizations Theory and practice”, Oxford University Press, New Delhi

AX5095 **CONSTITUTION OF INDIA** **L T P C**
2 0 0 0

OBJECTIVES

Students will be able to:

- Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
- To address the growth of Indian opinion regarding modern Indian intellectuals' constitutional
- Role and entitlement to civil and economic rights as well as the emergence nation hood in the early years of Indian nationalism.
- To address the role of socialism in India after the commencement of the Bolshevik Revolutionin1917and its impact on the initial drafting of the Indian Constitution.

UNIT I HISTORY OF MAKING OF THE INDIAN CONSTITUTION:

History, Drafting Committee, (Composition &Working)

UNIT II PHILOSOPHYOFTHE INDIANCONSTITUTION:

Preamble, Salient Features

UNIT III CONTOURS OF CONSTITUTIONAL RIGHTS AND DUTIES:

Fundamental Rights, Right to Equality, Right to Freedom, Right against Exploitation, Right to Freedom of Religion, Cultural and Educational Rights, Right to Constitutional Remedies, Directive Principles of State Policy, Fundamental Duties.

UNIT IV ORGANS OF GOVERNANCE:

Parliament, Composition, Qualifications and Disqualifications, Powers and Functions, Executive, President, Governor, Council of Ministers, Judiciary, Appointment and Transfer of Judges, Qualifications, Powers and Functions.

UNIT V LOCAL ADMINISTRATION:

District's Administration head: Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative, CEO, Municipal Corporation. Pachayati raj: Introduction, PRI: Zila Pachayat. Elected officials and their roles, CEO Zila Pachayat: Position and role. Block level: Organizational Hierarchy(Different departments), Village level:Role of Elected and Appointed officials, Importance of grass root democracy.

UNIT VI ELECTION COMMISSION:

Election Commission: Role and Functioning. Chief Election Commissioner and Election Commissioners - Institute and Bodies for the welfare of SC/ST/OBC and women.

TOTAL: 30 PERIODS

OUTCOMES

Students will be able to:

- DiscussthegrowthofthedemandforcivilrightsinIndiaforthebulkofIndiansbeforethe arrival of Gandhi in Indian politics.
- Discusstheintellectualoriginsoftheframeworkofargumentthatinformedtheconceptualization
- of social reform sliding to revolution in India.
- DiscussthecircumstancessurroundingthefoundationoftheCongressSocialistParty[CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.
- DiscussthepassageoftheHinduCodeBillof1956.

Suggested reading

1. TheConstitutionofIndia,1950(BareAct), Government Publication.
2. Dr. S. N. Busi, Dr. B. R.AmbedkarframingofIndianConstitution,1st Edition,2015.
3. M.P. Jain,IndianConstitutionLaw,7th Edn.,Lexis Nexis,2014.
4. D.D. Basu, Introduction to the Constitution of India, Lexis Nexis,2015.

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AX5096 **PEDAGOGY STUDIES** **L T P C**
2 0 0 0

OBJECTIVES

Students will be able to:

- Review existing evidence on there view topic to inform programme design and policy
- Making under taken by the DfID, other agencies and researchers.
- Identify critical evidence gaps to guide the development.

UNIT I INTRODUCTION AND METHODOLOGY:

Aims and rationale, Policy background, Conceptual framework and terminology - Theories of learning, Curriculum, Teacher education - Conceptual framework, Research questions **-** Overview of methodology and Searching.

UNIT II THEMATIC OVERVIEW

Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries - Curriculum, Teacher education.

UNIT III EVIDENCE ON THE EFFECTIVENESS OFPEDAGOGICALPRACTICES

Methodology for the in depth stage: quality assessment of included studies - How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy? - Theory of change - Strength and nature of the body of evidence for effective pedagogical practices - Pedagogic theory and pedagogical approaches - Teachers' attitudes and beliefs and Pedagogic strategies.

UNIT IV PROFESSIONAL DEVELOPMENT

Professional development: alignment with classroom practices and follow up support - Peer support - Support from the head teacher and the community - Curriculum and assessment - Barriers to learning: limited resources and large class sizes

UNIT V RESEARCH GAPS AND FUTURE DIRECTIONS

Research design – Contexts – Pedagogy - Teacher education - Curriculum and assessment - Dissemination and research impact.

TOTAL: 30 PERIODS

OUTCOMES

Students will be able to understand:

- Whatpedagogicalpracticesarebeingusedbyteachersinformalandinformalclassrooms in developing countries?
- What is the evidence on the effectiveness soft he sepedagogical practices, in what conditions, and with what population of learners?
- How can teacher education(curriculum and practicum)and the school curriculum and guidance materials best support effective pedagogy?

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Suggested reading

1. Ackers, HardmanF(2001)ClassroominteractioninKenyanprimaryschools,Compare,31(2): 245-261.
2. AgrawalM (2004)Curricular reform in schools: The importance of evaluation, JournalofCurriculumStudies,36(3):361-379.
3. AkyeampongK(2003)TeachertraininginGhana-doesitcount?Multi-siteteachereducationresearchproject(MUSTER) country report 1.London:DFID.
4. Akyeampong K,LussierK, PryorJ, WestbrookJ (2013) Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count? International Journal Educational Development, 33(3): 272–282.
5. Alexander RJ(2001) Culture and pedagogy: International comparisons in primary education. Oxford and Boston: Blackwell.
6. ChavanM (2003) Read India: Amass scale, rapid, 'learningtoread 'campaign.
7. www.pratham.org/images/resource%20working%20paper%202.pdf

AX5097 **STRESS MANAGEMENT BY YOGA** **L T P C**
2 0 0 0

OBJECTIVES

- To achieve overall health of body and mind
- To overcome stress

UNIT I

Definitions of Eight parts of yoga.(Ashtanga)

UNIT II

Yam and Niyam - Do`s and Don't'sin life - i) Ahinsa, satya, astheya, bramhacharya and aparigraha, ii) Ahinsa, satya, astheya, bramhacharya and aparigraha.

UNIT III

Asan and Pranayam - Various yog poses and their benefits for mind & body - Regularization of breathing techniques and its effects-Types of pranayam

TOTAL: 30 PERIODS

OUTCOMES

Students will be able to:

- Develop healthy mind in a healthy body thus improving social health also
- Improve efficiency

SUGGESTEDREADING

1. 'YogicAsanasforGroupTarining-Part-I":JanardanSwamiYogabhyasiMandal, Nagpur
2. "Rajayogaorconquering the Internal Nature" by Swami Vivekananda, Advaita Ashrama (Publication Department),Kolkata

AX5098	PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS	L T P C 2 0 0 0

OBJECTIVES

- To learn to achieve the highest goal happily
- To become a person with stable mind, pleasing personality and determination
- To a waken wisdom in students

UNIT I

Neetishatakam-holistic development of personality - Verses- 19,20,21,22 (wisdom) - Verses- 29,31,32 (pride & heroism) – Verses- 26,28,63,65 (virtue) - Verses- 52,53,59 (dont's) - Verses- 71,73,75,78 (do's)

UNIT II

Approach to day to day work and duties - Shrimad BhagwadGeeta: Chapter 2-Verses 41, 47,48 - Chapter 3-Verses 13, 21, 27, 35 Chapter 6-Verses 5,13,17,23, 35 - Chapter 18-Verses 45, 46, 48.

UNIT III

Statements of basic knowledge - Shrimad BhagwadGeeta: Chapter2-Verses 56, 62, 68 Chapter 12 - Verses 13, 14, 15, 16,17, 18 -Personality of role model - shrimadbhagwadgeeta - Chapter2-Verses 17, Chapter 3-Verses 36,37,42 - Chapter 4-Verses 18, 38,39 Chapter18 – Verses 37,38,63

TOTAL: 30 PERIODS

OUTCOMES

Students will be able to

- Study of Shrimad- Bhagwad- Geeta will help the student in developing his personality and achieve the highest goal in life
- The person who has studied Geeta will lead the nation and man kind to peace and prosperity
- Study of Neetishatakam will help in developing versatile personality of students.

Suggested reading

1. Gopinath, Rashtriya Sanskrit Sansthanam P, Bhartrihari's Three Satakam, Niti-sringar-vairagya, New Delhi,2010
2. Swami Swarupananda , Srimad Bhagavad Gita, Advaita Ashram, Publication Department, Kolkata, 2016.