



ANNA UNIVERSITY, CHENNAI
UNDERGRADUATE CURRICULUM (UNIVERSITY DEPARTMENTS)

Campus: Alagappa College of Technology (ACT)

Department: Leather Technology

Programme: B.Tech. Leather Technology

Regulations: 2023 (Revised 2024), with effect from the AY 2024 – 25 to all the students of UG Programme.

OVERVIEW OF CREDITS

Sem	PCC	PEC	ESC	HSMC	ETC	OEC	SDC	UC	SLC	Total
I	-	-	5	11	-	-	4	1	-	21
II	-	-	6	11	-	-	3	1	-	21
III	18	-	-	4	-	-	-	-	-	22
IV	18	-	-	-	-	-	3	3	-	24
V	15	3	-	-	-	-	4	-	-	22
VI	-	9	-	-	3	3	3	3	1	22
VII	3	6	-	3	3	3	3	-	-	21
VIII	-	-	-	-	-	-	8	-	-	8
Total	54	18	12	29	6	6	28	8	1	161
% of Category	33.33	11.11	7.40	17.90	3.70	3.70	17.28	4.93	0.6	

CATEGORY OF COURSES

PCC – Professional Core Course

PEC – Professional Elective Course

ETC – Emerging Technology Course

OEC – Open Elective Course

SLC – Self Learning Course

ESC – Engineering Science Course

HSMC – Humanities Science and Management Course

SDC – Skill Development Course

UC – University Course

****For Honours & Minor Degree, please refer the Regulations 2023 (Revised 2024).***

SEMESTER – I							
S. NO.	COURSE CODE	COURSE NAME	COURSE TYPE#	PERIODS / WEEK		CREDITS	CATEGORY
				L-T-P	TCP*		
1.	EN23C01	Foundation English	LIT	2-0-2	4	3	HSMC
2.	MA23C01	Matrices and Calculus	T	3-1-0	4	4	HSMC
3.	PH23C01	Engineering Physics	LIT	3-0-2	5	4	HSMC
4.	ME23C01	Engineering Drawing & 3DModelling	LIT	2-0-4	6	4	SDC
5.	EE23C03	Basics of Electrical and Electronics Engineering	LIT	2-0-2	4	3	ESC
6.	CE23C03	Basic Civil Engineering	T	2-0-0	2	2	ESC
7.	UC23H01	தமிழர்மரபு/ Heritage of Tamils	T	1-0-0	1	1	UC
8.	-	NCC/NSS/NSO/YRC	-	0-0-2	2	-	UC
9.	-	Audit Course – I	-	-	-	-	UC
TOTAL CREDITS						21	

* **TCP** – Total Contact Period(s)

#**TYPE OF COURSE**

LIT – Laboratory Integrated Theory

T – Theory

L – Laboratory Course

IPW – Internship cum Project Work

PW – Project Work

CDP – Capstone Design Project

SEMESTER – II							
S. NO.	COURSE CODE	COURSE NAME	COURSE TYPE#	PERIODS / WEEK		CREDITS	CATEGORY
				L-T-P	TCP*		
1.	EN23C02	Professional Communication	LIT	2-0-2	4	3	HSMC
2.	MA23C02	Ordinary Differential Equations and Transform Techniques	T	3-1-0	4	4	HSMC
3.	CY23C01	Engineering Chemistry	LIT	3-0-2	5	4	HSMC
4.	CS23C02	Computer Programming in Python	LIT	3-0-2	4	3	ESC
5.	ME23C04	Makerspace	LIT	1-0-4	5	3	SDC
6.	ME23C05	Basics of Mechanical Engineering	T	2-0-0	2	2	ESC
7.	UC23H02	தமிழ்நும்தொழில்நுட்பமும்த/Tamils and Technology	T	1-0-0	1	1	UC
TOTAL CREDITS						20	

SEMESTER – III							
S. NO.	COURSE CODE	COURSE NAME	COURSE TYPE#	PERIODS / WEEK		CREDITS	CATEGORY
				L-T-P	TCP*		
1.	MA23C05	Probability and Statistics	T	3-1-0	4	4	HSMC
2.	LT23301	Applied Chemistry	T	3-0-0	3	3	PCC
3.	LT23302	Principles of Leather Manufacture	LIT	3-0-2	5	4	PCC
4.	LT23303	Chemical Analysis	LIT	3-0-2	5	4	PCC
5.	LT23304	Skin Proteins and Pre- Tanning Process	LIT	3-0-0	3	3	PCC
6.	LT23305	Leather Testing	T	3-0-2	5	4	PCC
7.	-	Audit Course-II	-	-	-	-	UC
TOTAL CREDITS						22	

SEMESTER IV

S. NO.	COURSE CODE	COURSE NAME	COURSE TYPE#	PERIODS / WEEK		CREDITS	CATEGORY
				L-T-P	TCP*		
1.	LT23401	Leather from Hides	LIT	3-0-2	5	4	PCC
2.	LT23402	Organic Tannages	LIT	2-1-2	5	4	PCC
3.	LT23403	Inorganic Tannages	T	3-1-0	4	4	PCC
4.	LT23404	Industrial Engineering	T	3-0-0	3	3	PCC
5.	LT23405	Unit Processes and Operations	T	3-0-0	3	3	PCC
6.	LT23U01	Standards – Leather Technology	T	1-0-0	1	1	UC
7.	UC23U01	Universal Human Values	LIT	1-0-2	3	2	UC
8.	-	Industry Oriented Course I	-	-	-	1	SDC
9.	-	Skill Development Course I	-	-	-	2	SDC
TOTAL CREDITS						24	

SEMESTER – V (PREFERENCE FOR FOREIGN EXCHANGE)

S. NO.	COURSE CODE	COURSE NAME	COURSE TYPE#	PERIODS / WEEK		CREDITS	CATEGORY
				L-T-P	TCP*		
1.	LT23501	Leather from Skins	LIT	3-0-2	5	4	PCC
2.	LT23502	Introduction to Leather Products	T	4-0-0	4	4	PCC
3.	LT23503	Leather Finishing	LIT	3-0-2	5	4	PCC
4.	LT23U02	Environmental Science and Sustainability for Leather and Allied Industries	T	3-0-0	3	3	PCC
5.	-	Professional Elective I	T	3-0-0	3	3	PEC
6.	-	Skill Development Course II	-	-	-	2	SDC
7.	LT23504	Summer Internship I*	L	0-0-4	4	2	SDC
TOTAL CREDITS						22	

COURSES FOR HONOURS DEGREE

S. NO.	COURSE CODE	COURSE NAME	COURSE TYPE#	PERIODS / WEEK		CREDITS	CATEGORY
				L-T-P	TCP*		
1.	LT23D01	Capstone Design Project – Level I	CDP	0-0-12	12	6	SDC

(OR)

1.	-	Honours Elective – I				3	
2.	-	Honours Elective – II				3	

COURSES FOR MINOR DEGREE

S. NO.	COURSE CODE	COURSE NAME	COURSE TYPE#	PERIODS / WEEK		CREDITS	CATEGORY
				L-T-P	TCP*		
1.	-	Minor Elective – I				3	
2.	-	Minor Elective – II				3	

SEMESTER – VI (PREFERENCE FOR FOREIGN EXCHANGE)

S. NO.	COURSE CODE	COURSE NAME	COURSE TYPE#	PERIODS / WEEK		CREDITS	CATEGORY
				L-T-P	TCP*		
1.	-	Professional Elective II	T	3-0-0	3	3	PEC
2.	-	Professional Elective III	T	3-0-0	3	3	PEC
3.	-	Professional Elective IV	T	3-0-0	3	3	PEC
4.	-	Open Elective-I	T	3-0-0	3	3	OEC
5.	-	Emerging Technology Course-I	T	3-0-0	3	3	ETC
6.	LT23L01	Self-Learning Course	T	1-0-0	1	1	SLC
7.	-	Skill Development Course III	-	-	-	2	SDC
8.	-	Industry Oriented Course II	-	-	-	1	SDC
9.	UC23E01	Engineering Entrepreneurship Development	LIT	2-0-2	4	3	UC
TOTAL CREDITS						22	

COURSES FOR HONOURS DEGREE

S. NO.	COURSE CODE	COURSE NAME	COURSE TYPE#	PERIODS / WEEK		CREDITS	CATEGORY
				L-T-P	TCP*		
1.	LT23D02	Capstone Design Project – Level II	CDP	0-0-12	12	6	SDC

(OR)

1.	-	Honours Elective – III				3	
2.	-	Honours Elective – IV				3	

COURSES FOR MINOR DEGREE

S. NO.	COURSE CODE	COURSE NAME	COURSE TYPE#	PERIODS / WEEK		CREDITS	CATEGORY
				L-T-P	TCP*		
1.	-	Minor Elective – III				3	
2.	-	Minor Elective – IV				3	

SEMESTER – VII							
S. NO.	COURSE CODE	COURSE NAME	COURSE TYPE#	PERIODS / WEEK		CREDITS	CATEGORY
				L-T-P	TCP*		
1.	LT23701	Reduce, Reuse and Recycle	T	3-0-0	3	3	PCC
2.	LT23702	Total Quality Management	T	3-0-0	3	3	HSMC
3.	-	Professional Elective V	T	3-0-0	3	3	PEC
4.	-	Professional Elective VI	T	3-0-0	3	3	PEC
5.	-	Emerging Technology Course-II	T	3-0-0	3	3	ETC
6.	-	Open Elective II	T	3-0-0	3	3	OEC
7.	-	Industry Oriented Course III	-	-	-	1	SDC
8.	LT23702	Summer Internship II*	L	0-0-4	4	2	SDC
TOTAL CREDITS						21	
COURSES FOR HONOURS DEGREE							
S. NO.	COURSE CODE	COURSE NAME	COURSE TYPE#	PERIODS / WEEK		CREDITS	CATEGORY
				L-T-P	TCP*		
1.	LT23D03	Capstone Design Project – Level III	CDP	0-0-12	12	6	SDC
(OR)							
1.	-	Honours Elective – V				3	
2.	-	Honours Elective – VI				3	
COURSES FOR MINOR DEGREE							
S. NO.	COURSE CODE	COURSE NAME	COURSE TYPE#	PERIODS / WEEK		CREDITS	CATEGORY
				L-T-P	TCP*		
1.	-	Minor Elective – V				3	
2.	-	Minor Elective – VI				3	

SEMESTER – VIII							
S. NO.	COURSE CODE	COURSE NAME	COURSE TYPE#	PERIODS / WEEK		CREDITS	CATEGORY
				L-T-P	TCP*		
1.	LT23801	Project Work / Internship cum Project Work	PW/IPW	0-0-16	16	8	SDC
TOTAL CREDITS						8	

PROFESSIONAL ELECTIVE COURSES (PEC): VERTICALS

Professional Elective	Vertical I	Vertical II	Vertical III	Vertical IV	Vertical V
	Apparel and Goods	Footwear	Biotechnology	Sustainability	Management
1.	Computer Applications for Apparel and Goods	Computer Applications for Footwear	Collagen: Molecular Structure and Matrix	Principle and Design of ETP and CETP	Human Resource Management
2.	Automation in Garment and Goods Manufacture	Automation in Footwear Manufacture	Industrial Biotechnology	Value Addition to Waste	Organization and Management of Leather Manufacture
3.	Market Trends, Fashion Forecasting and Product Merchandising for Garments and Goods Industry	Footwear Market Forecasting and Merchandising	Protein Biophysics	Occupational Safety and Health in Leather Industries	Entrepreneurship Development
4.	Testing and Statistics for Goods and Garments	Principles of Testing for Footwear and Components	Bioprocess Technologies	Quality Assurance for Leather and Leather Products	Leather and Leather Products Costing
5.	Machineries for Apparels and Goods Manufacture	Machineries for Footwear Manufacture	Biomaterials and their Applications	Eco-labelling for Leather Sector	Marketing Management
6.	Design and Fabrication of Leather Goods and Garments	Design and Fabrication of Leather Footwear	Composite Materials	Leather Chemicals	Foreign Trade
7.					Supply Chain Management
8.					Enterprise Resource Planning
9.					Operational Research

VERTICAL I: APPAREL AND GOODS

S. NO.	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
			L	T	P		
1.	LT23001	Computer Applications for Apparel and Goods	3	0	0	3	3
2.	LT23002	Automation in Garment and Goods Manufacture	3	0	0	3	3
3.	LT23003	Market Trends, Fashion Forecasting and Product Merchandising for Garments and Goods Industry	3	0	0	3	3
4.	LT23004	Testing and Statistics for Good and Garments	3	0	0	3	3
5.	LT23005	Machineries for Apparels and Goods Manufacture	3	0	0	3	3
6.	LT23006	Design and Fabrication of Leather Goods and Garments	0	0	6	6	3

VERTICAL II: FOOTWEAR

S. NO.	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
			L	T	P		
1.	LT23007	Computer Applications for Footwear	3	0	0	3	3
2.	LT23008	Automation in Footwear Manufacture	3	0	0	3	3
3.	LT23009	Footwear Market Forecasting and Merchandising	3	0	0	3	3
4.	LT23010	Principles of Testing for Footwear and Components	3	0	0	3	3
5.	LT23011	Machineries for Footwear Manufacture	3	0	0	3	3
6.	LT23012	Design and Fabrication of Leather Footwear	0	0	6	6	3

VERTICAL III: BIOTECHNOLOGY

S. NO.	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
			L	T	P		
1.	LT23013	Collagen: Molecular Structure and Matrix	3	0	0	3	3
2.	LT23014	Industrial Biotechnology	3	0	0	3	3
3.	LT23015	Protein Biophysics	3	0	0	3	3
4.	LT23016	Bioprocess Technologies	3	0	0	3	3
5.	LT23017	Biomaterials and their Applications	3	0	0	3	3
6.	LT23018	Composite Materials	3	0	0	3	3

VERTICAL IV: SUSTAINABILITY

S. NO.	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
			L	T	P		
1.	LT23019	Principle and Design of ETP and CETP	3	0	0	3	3
2.	LT23020	Value Addition to Waste	3	0	0	3	3
3.	LT23021	Occupational Safety and Health in Leather Industries	3	0	0	3	3
4.	LT23022	Quality Assurance for Leather and Leather Products	3	0	0	3	3
5.	LT23023	Eco-labelling for Leather Sector	3	0	0	3	3
6.	LT23024	Leather Chemicals	3	0	0	3	3

VERTICAL V: MANAGEMENT

S. NO.	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
			L	T	P		
1.	LT23025	Human Resource Management	3	0	0	3	3
2.	LT23026	Organization and Management of Leather Manufacture	3	0	0	3	3
3.	LT23027	Entrepreneurship Development	3	0	0	3	3
4.	LT23028	Leather and Leather Products Costing	3	0	0	3	3
5.	LT23029	Marketing Management	3	0	0	3	3
6.	LT23030	Foreign Trade	3	0	0	3	3
7.	LT23031	Supply Chain Management	3	0	0	3	3
8.	LT23032	Enterprise Resource Planning	3	0	0	3	3
9.	LT23033	Operational Research	3	0	0	3	3

LIST OF SKILL BASED COURSE I, II AND III

S. NO.	COURSE CODE	COURSE TITLE	PERIOD PER WEEK			CREDITS
			L	T	P	
1.	LT23S01	Interpersonal Skills Development	0	0	4	2
2.	LT23S02	Parchment Leather and its Applications	0	0	4	2
3.	LT23S03	Leather in Musical Instruments	0	0	4	2
4.	LT23S04	Manufacture of Leather Toys	0	0	4	2
5.	LT23S05	Manufacture of Traditional Footwear	0	0	4	2
6.	LT23S06	Product Design and Development	0	0	4	2
7.	LT23S07	Exotic Leather	0	0	4	2
8.	LT23S08	Saddlery and Harness Leather Manufacture	0	0	4	2
9.	LT23S09	Leather Curative Technology	0	0	4	2
10.	LT23S10	Hair-On Leather	0	0	4	2
11.	LT23S11	Professional Development				2

LIST OF INDUSTRY ORIENTED COURSE I, II AND III

S. NO.	COURSE CODE	COURSE TITLE	PERIOD PER WEEK			CREDITS
			L	T	P	
1.	-	Leather Manufacturing – Beamhouse	1	0	0	1
2.	-	Leather Manufacturing – Post Tanning	1	0	0	1
3.	-	Leather Manufacturing – Finishing	1	0	0	1
4.	-	Effluent Treatment – ETP and CETP	1	0	0	1
5.	-	Leather Product Manufacturing	1	0	0	1

LIST OF UNIVERSITY COURSES (UC)

S. NO.	COURSE CODE	COURSE TITLE	PERIOD PER WEEK			CREDITS
			L	T	P	
1.	UC23H01	தமிழர்மரபு/ Heritage of Tamils	1	0	0	1
2.	-	NCC / NSS / NSO / YRC	0	0	2	0
3.	-	Audit Course – I*	2	0	0	0
4.	UC23H02	தமிழரும் தொழில்நுட்பமும்/ Tamils and Technology	1	0	0	1
5.	-	Audit Course – II*	2	0	0	0
6.	LT23U01	Standards – Leather Technology	1	0	0	1
7.	UC23U01	Universal Human Values	1	0	2	2
8.	UC23E01	Engineering Entrepreneurship Development	2	0	2	4
Total						9

LIST OF EMERGING TECHNOLOGY COURSES (ETC) (TWO COURSES)

S. NO.	COURSE CODE	COURSE TITLE	PERIOD PER WEEK			CREDITS
			L	T	P	
1.	LT23E01	Machine Learning for Intelligent Systems	3	0	0	3
2.	LT23E02	IoT Based Smart Systems	3	0	0	3
3.	LT23E03	Robotics and Automation	3	0	0	3
4.	LT23E04	Applied Image Processing	3	0	0	3
5.	LT23E05	Biomechanics	3	0	0	3
6.	LT23E06	3D Printing	3	0	0	3

LIST OF SELF LEARNING COURSES - NPTEL COURSES (ONE COURSE)

S. NO.	COURSE TITLE	CREDITS
4-week courses on CSE		
1.	Fundamental Algorithms: Design and Analysis	1
2.	Python for Data Science	1

3.	Demystifying Networking	1
4.	Software Testing	1
5.	Software Conceptual Design	1
6.	Introduction to Quantum Computing: Quantum Algorithms and Qiskit	1
8-week courses on CSE		
1.	Introduction to Programming In C	1
2.	Data Science for Engineers	1
3.	Cloud Computing and Distributed Systems	1
4.	Data Base Management System	1
5.	Programming, Data Structures and Algorithms Using Python	1
6.	Design and analysis of algorithms	1
7.	Machine Learning, ML	1
8.	Introduction to Machine Learning	1
12-week courses on CSE		
1.	Introduction to Internet of Things	1
2.	The Joy of Computing using Python	1
3.	Introduction to Database Systems	1
4.	Blockchain and its Applications	1
5.	Object Oriented System Development Using UML, Java and Patterns	1
6.	An Introduction to Artificial Intelligence	1
7.	Introduction to Machine Learning	1
8.	Programming in Java	1
9.	An Introduction to Programming Through C++	1
10.	Data Analytics with Python	1
11.	Programming in Modern C++	1
12.	Data Structure and Algorithms Using Java	1
4-week courses on Management		
1.	Design Thinking - A Primer	1
8-week courses on Management		
1.	Project Management	1

2.	Corporate Finance	1
3.	Investment Management	1
4.	Brand Management	1
5.	Supply Chain Analytics	1
6.	Foundation Course In Managerial Economics	1
12-week courses on Management		
1.	Marketing Analytics	1
2.	Principles of Management	1
3.	Production and Operation Management	1
4.	Introduction to Marketing Essentials	1
5.	Management Information System	1
6.	Six Sigma	1

COURSE OBJECTIVES:

- To develop students' foundational skills in reading, writing, grammar and vocabulary to enable them to understand and produce various forms of communication.
- To enhance students' proficiency in reading comprehension, narrative and comparative writing.
- To comprehend and analyse descriptive texts and visual images
- To articulate similarities and differences in oral and written forms.
- To improve students' proficiency in reading and writing formal letters and emails.

UNIT I BASICS OF COMMUNICATION 6

Reading - Telephone message, bio-note; Writing – Personal profile; Grammar – Simple present tense, Present continuous tense, wh-questions, indirect questions; Vocabulary – Word formation (Prefix and Suffix).

LAB ACTIVITY: 6

Listening – Telephone conversation; Speaking Self-introduction; Telephone conversation – Video conferencing etiquette

UNIT II NARRATION 6

Reading – Comprehension strategies - Newspaper Report, An excerpt from an autobiography; Writing – Narrative Paragraph writing (Event, personal experience etc.); Grammar – Subject-verb agreement, Simple past, Past continuous Tenses; Vocabulary – One-word substitution

LAB ACTIVITY: 6

Listening – Travel podcast; Speaking – Narrating and sharing personal experiences through a podcast

UNIT III DESCRIPTION 6

Reading – A tourist brochure, Travel blogs, descriptive article/excerpt from literature, visual images; Writing –Descriptive Paragraph writing, Grammar – Future tense, Perfect tenses, Preposition; Vocabulary – Descriptive vocabulary

LAB ACTIVITY: 6

Listening – Railway / Airport Announcements, Travel Vlogs; Speaking – Describing a place or picture description

UNIT IV COMPARE AND CONTRAST 6

Reading – Reading and comparing different product specifications - Writing – Compare and Contrast Essay, Coherence and cohesion; Grammar – Degrees of Comparison; Vocabulary – Transition words (relevant to compare and contrast)

LAB ACTIVITY: **6**

Listening – Product reviews, Speaking – Product comparison based on product reviews - similarities and differences

UNIT V EXPRESSION OF VIEWS **6**

Reading – Formal letters, Letters to Editor ; Writing – Letter writing/ Email writing (Enquiry / Permission, Letter to Editor); Grammar – Compound nouns, Vocabulary – Synonyms, Antonyms

LAB ACTIVITY: **6**

Listening – Short speeches; Speaking – Making short presentations (JAM)

TOTAL: 60 PERIODS

TEACHING METHODOLOGY

Interactive lectures, role plays, group discussions, listening and speaking labs, technology enabled language teaching, flipped classroom.

EVALUATION PATTERN

Internal Assessment

Written assessments

Assignment

Lab assessment

Listening

Speaking

External Assessment

End Semester Examination

LEARNING OUTCOMES

By the end of the courses, students will be able to

- Use appropriate grammar and vocabulary to read different types of text and converse appropriately.
- Write coherent and engaging descriptive and comparative essay writing.
- Comprehend and interpret different kinds of texts and audio visual materials
- Critically evaluate reviews and articulate similarities and differences
- Write formal letters and emails using appropriate language structure and format

TEXT BOOKS:

1. "English for Engineers and Technologists" Volume I by Orient Blackswan, 2022
2. "English for Science & Technology - I" by Cambridge University Press, 2023

REFERENCES

1. "Interchange" by Jack C.Richards, Fifth Edition, Cambridge University Press, 2017.
2. "English for Academic Correspondence and Socializing" by Adrian Wallwork, Springer, 2011.
3. "The Study Skills Handbook" by Stella Cortrell, Red Globe Press, 2019
4. www.uefap.com

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

OBJECTIVES:

- To develop the use of matrix algebra techniques in solving practical problems.
- To familiarize the student with functions of several variables.
- To solve integrals by using Beta and Gamma functions.
- To acquaint the student with mathematical tools needed in evaluating multiple integrals.
- To acquaint the students with the concepts of vector calculus which naturally arise in many engineering problems.

UNIT I MATRICES**9+3**

Eigenvalues and Eigenvectors of a real matrix – Properties of Eigenvalues and Eigenvectors- Cayley-Hamilton theorem (excluding proof) – Diagonalization of matrices - Reduction of Quadratic form to canonical form by using orthogonal transformation - Nature of a Quadratic form.

UNIT II FUNCTIONS OF SEVERAL VARIABLES**9+3**

Limit, continuity, partial derivatives – Homogeneous functions and Euler's theorem - Total derivative – Differentiation of implicit functions – Jacobians -Taylor's formula for two variables - Errors and approximations – Maxima and Minima of functions of two variables – Lagrange's method of undermined multipliers.

UNIT III INTEGRAL CALCULUS**9+3**

Improper integrals of the first and second kind and their convergence – Differentiation under integrals - Evaluation of integrals involving a parameter by Leibnitz rule – Beta and Gamma functions-Properties – Evaluation of single integrals by using Beta and Gamma functions..

UNIT IV MULTIPLE INTEGRALS**9+3**

Double integrals – Change of order of integration – Double integrals in polar coordinates – Area enclosed by plane curves – Triple integrals – Volume of Solids – Change of variables in double and triple integrals-

Evaluation of double and triple integrals by using Beta and Gamma functions.

UNIT V VECTOR CALCULUS**9+3**

Gradient of a scalar field, directional derivative – Divergence and Curl – Solenoidal and Irrotational vector fields - Line integrals over a plane curve - Surface integrals – Area of a curved surface – Volume Integral - Green's theorem, Stoke's and Gauss divergence theorems (without proofs)– Verification and applications in evaluating line, surface and volume integrals.

TOTAL: 60 PERIODS

Laboratory based exercises / assignments / assessments will be given to students wherever applicable from the content of the course.

General engineering applications / branch specific applications from the content of each units wherever possible will be introduced to students.

Suggested Laboratory based exercises / assignments / assessments :

Matrices

1. Finding eigenvalues and eigenvectors
2. Verification of Cayley-Hamilton theorem
3. Eigenvalues and Eigenvectors of similar matrices
4. Eigenvalues and Eigenvectors of a symmetric matrix
5. Finding the powers of a matrix
6. Quadratic forms

Functions of Several Variables

1. Plotting of curves and surfaces
2. Symbolic computation of partial and total derivatives of functions

Integral Calculus

1. Evaluation of beta and gamma functions
2. Computation of error function and its complement

Multiple Integrals

1. Plotting of 3D surfaces in Cartesian and Polar forms

Vector Calculus

1. Computation of Directional derivatives
2. Computation of normal and tangent to the given surface

OUTCOMES:

CO 1 :Use the matrix algebra methods for solving practical problems.

CO 2 :Use differential calculus ideas on several variable functions.

CO 3 :Apply different methods of integration in solving practical problems by using Beta and Gamma functions.

CO 4 :Apply multiple integral ideas in solving areas and volumes problems.

CO 5 :Apply the concept of vectors in solving practical problems.

TEXT BOOKS:

1. Joel Hass, Christopher Heil, Maurice D.Weir "'Thomas' Calculus", Pearson Education., New Delhi, 2018.
2. Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, 45th Edition, New Delhi, 2020.
3. James Stewart, Daniel K Clegg & Saleem Watson "Calculus with Early Transcendental Functions", Cengage Learning, 6th Edition, New Delhi,2023.

REFERENCES:

1. Erwin Kreyszig, "Advanced Engineering Mathematics", 10th Edition, Wiley India Pvt Ltd., New Delhi, 2018.
2. Greenberg M.D., "Advanced Engineering Mathematics", Pearson Education 2nd Edition, 5th Reprint, Delhi, 2009.

3. Jain R.K. and Iyengar S.R.K., "Advanced Engineering Mathematics", Narosa Publications, 5th Edition, New Delhi, 2017.
4. Narayanan S. and Manicavachagom Pillai T. K., "Calculus" Volume I and II, S. Viswanathan Publishers Pvt. Ltd., Chennai, 2009.
5. Peter V.O'Neil, "Advanced Engineering Mathematics", Cengage Learning India Pvt., Ltd, 7th Edition, New Delhi, 2012.
6. Ramana B.V., "Higher Engineering Mathematics", Tata McGraw Hill Co. Ltd., 11th Reprint, New Delhi, 2010.

CO – PO Mapping:

Course Outcomes	PROGRAMME OUTCOMES											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	P11	P12
CO1 :	3	3	2	3	1	2	1	1	1	1	1	3
CO2 :	3	3	2	3	1	2	1	1	1	1	1	3
CO3 :	3	3	2	3	1	2	1	1	1	1	1	3
CO4 :	3	3	2	3	1	2	1	1	1	1	1	3
CO5 :	3	3	2	3	1	2	1	1	1	1	1	3

COURSE OBJECTIVES

- To familiarize with crystal structure, bonding and crystal growth.
- To impart knowledge on Mechanics of Materials.
- To impart knowledge of oscillations, sound and Thermal Physics
- To facilitate understanding of optics and its applications, different types of Lasers and fiber optics.
- To introduce the basics of Quantum Mechanics and its importance.

UNIT I CRYSTAL PHYSICS**9+6**

Crystal Bonding – Ionic – covalent – metallic and van der Waals's/ molecular bonding. Crystal systems - unit cell, Bravais lattices, Miller indices - Crystal structures - atomic packing density of BCC, FCC and HCP structures. NaCl, Diamond, Graphite, Graphene, Zincblende and Wurtzite structures - crystal imperfections- point defects - edge and screw dislocations – grain boundaries. Crystal Growth – Czochralski method – vapor phase epitaxy – Molecular beam epitaxy- Introduction to X-Ray Diffractometer.

1. Determination of Lattice parameters for crystal systems.
2. Crystal Growth – Slow Evaporation method
3. Crystal Growth Sol – Gel Method

UNIT II MECHANICS OF MATERIALS**9+6**

Rigid Body – Centre of mass – Rotational Energy - Moment of inertia (M.I)- Moment of Inertia for uniform objects with various geometrical shapes. Elasticity –Hooke's law - Poisson's ratio - stress-strain diagram for ductile and brittle materials – uses- Bending of beams – Cantilever - Simply supported beams - uniform and non-uniform bending - Young's modulus determination - I shaped girders –Twisting couple – Shafts. Viscosity – Viscous drag – Surface Tension.

4. Non-uniform bending -Determination of Young's modulus of the material of the beam.
5. Uniform bending -Determination of Young's modulus of the material of the beam
6. Viscosity – Determination of Viscosity of liquids.

UNIT III OSCILLATIONS, SOUND AND THERMAL PHYSICS**9+6**

Simple harmonic motion - Torsional pendulum -- Damped oscillations –Shock Absorber -Forced oscillations and Resonance –Applications of resonance.- Waves and Energy Transport –Sound waves – Intensity level – Standing Waves - Doppler effect and its applications - Speed of blood flow. Ultrasound – applications - Echolocation and Medical Imaging. Thermal Expansion – Expansion joints – Bimetallic strip – Seebeck effect – thermocouple -Heat Transfer Rate – Conduction – Convection and Radiation.

7. Torsional pendulum-Determination of rigidity modulus of wire and moment of inertia of the disc
8. Melde's string experiment - Standing waves.
9. Ultrasonic interferometer – determination of sound velocity and liquids compressibility

UNIT IV OPTICS AND LASERS**9+6**

Interference - Thin film interference - Air wedge- Applications -Interferometers–Michelson Interferometer -- Diffraction - CD as diffraction grating – Diffraction by crystals -Polarization - polarizers -- Laser – characteristics – Spontaneous and Stimulated emission- population – inversion - Metastable states - optical feedback - Nd-YAG laser, CO₂ laser, Semiconductor laser - Industrial and medical applications - Optical Fibers – Total internal reflection – Numerical aperture and acceptance angle – Fiber optic communication – Fiber sensors – Fiber lasers.

10. Laser - Determination of the width of the groove of the compact disc using laser.
Laser Parameters
Determination of the wavelength of the laser using grating
11. Air wedge -Determination of the thickness of a thin sheet/wire
12. Optical fibre - Determination of Numerical Aperture and acceptance angle
-Determination of bending loss of fibre.
13. Michelson Interferometer (Demonstration)

UNIT V QUANTUM MECHANICS**9+6**

Black body radiation (Qualitative) – Planck's hypothesis – Einstein's theory of Radiation - Matter waves–de Broglie hypothesis - Electron microscope – Uncertainty Principle – The Schrodinger Wave equation (time-independent and time-dependent) – Meaning and Physical significance of wave function - Normalization - Particle in an infinite potential well-particle in a three-dimensional box - Degenerate energy states - Barrier penetration and quantum tunneling - Tunneling microscope.

14. Photoelectric effect – Determination of Planck's constant.
15. Black Body Radiation (Demonstration)
16. Electron Microscope (Demonstration)

TOTAL: 75 PERIODS**COURSE OUTCOMES:**

After completion of the course, the students will be able to

- CO1:** Understand the significance of crystal structure and bonding. Learn to grow crystals.
- CO2:** Obtain knowledge on important mechanical and thermal properties of materials and determine them through experiments.
- CO3:** Conceptualize and visualize the oscillations and sound.
- CO4:** Grasp optical phenomenon and their applications in real life.
- CO5:** Appreciate and evaluate the quantum phenomenon.
- CO6** Develop skill set to solve engineering problems and design experiments.

TEXT BOOKS:

1. Raymond A. Serway, John W. Jewett, Physics for Scientists and Engineers, Thomson Brooks/Cole, 2013.
2. D. Halliday, R. Resnick and J. Walker, Principles of Physics. John Wiley & Sons, 10th Edition, 2015.
3. N. Garcia, A. Damask and S. Schwarz, Physics for Computer Science Students, Springer-Verlag, 2012.

4. Alan Giambattista, Betty McCarthy Richardson and Robert C. Richardson, College Physics, McGraw-Hill Higher Education, 2012.

REFERENCES:

1. R. Wolfson, Essential University Physics. Volume 1 & 2. Pearson, 2016.
2. D. Kleppner and R. Kolenkow. An Introduction to Mechanics, McGraw Hill Education, 2017.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1		1							
CO2	3	2	1	1								
CO3	3	2	1	1								
CO4	3	2	1	1	1							
CO5	3	2	1	1	1							
CO6	3	2	1	2								

COURSE OBJECTIVES

After successful completion of this course, the students will be able to:

1. Understand and use the engineering curves in engineering applications and projection techniques to construct conic curves, points and lines.
2. Develop skills in projecting surfaces and solids and create 2D models using CAD software.
3. Develop skills in 3D projection and 3D modeling of simple parts manually as well as using CAD software.
4. Understand and apply sectioning techniques to solids and assemble components.
5. Develop skills in lateral surface development and sheet metal design.

INTRODUCTION

Manual drawing tools (Mini Drafter, Set Squares, Protractor, Compass, and different grades of pencil). 'BIS' specifications and rules of Engineering Drawing – Arrows (2H thin line body, HB Filled head and L:W = 3:1 ratio), lettering (Digital fonts, font sizes pertaining to usage and representation), types of line and their syntax (Drawing based – Continuous thin & thick, dashed, dashed dotted and Application based – extension, dimensioning, construction, projection, reference, axis, section, hatching, and break lines), scaling (up, down and equal), and dimensioning. Placing and positioning the 'A3' size drawing sheet over the drawing table. Principal planes and projection, Division of line and circle in to equal parts, and construction of polygons

UNIT i: ENGINEERING CURVES, PROJECTION OF POINTS AND LINES 6+12

Construction of conic curves with their tangent and normal – ellipse, parabola, and hyperbola by eccentricity method

Construction of special curves with their tangent and normal – cycloid, epicycloid, and involute

Projection of points and I angle projection of lines inclined to both principal planes by rotating line method and trapezoidal rule – marking their traces.

Lab exercises: Study exercise – Introduction to Sketching (or) Drawing, and modification tools in CAD software (AutoCAD, CREO, CATIA, Solid Works, Inventor, Fusion 360)

Activities based learning: Identification of the curves used in the application given in the flash card, demonstration of the instantaneous centre of rotation of governors with respect to angle of inclination of the arms of the governors

UNIT II PROJECTION OF SURFACES & SOLIDS, AND 2D MODELING 6+12

Projection of surfaces inclined to both the principal planes – polygonal, trapezoidal, rhomboidal and circular

Projection of solids – prisms, pyramids, and axisymmetric solids when the axis inclined to both the principal planes – freely hanging – contour resting condition on either of the planes by rotating object method

Lab exercises: Construction of basic sketches – lines, circle, polygon, spline curves, coils, along with dimensioning. Familiarizing with geometric constraints and their types

Activities based learning: Making the solids using cardboards, shadow mapping and contour drawing at different orientation of the solids using torches,

UNIT III 3D PROJECTION OF SOLIDS AND 3D MODELING OF SIMPLE PARTS 6+12

Free hand sketching – I & III angle projections of engineering parts and components

Isometric projection of combination of solids – prisms, pyramids, axisymmetric solids, frustum

Perspective projection of prisms, pyramids and axisymmetric solids by visual ray method

Lab exercises: 3D Modeling and 2D drafting of machine parts

Activities based learning: Flipped classroom for Free hand sketching, Jig saw activity for Isometric projection, arts and crafts for perspective view

UNIT IV SECTION OF SOLIDS AND SECTIONED DRAFTING OF ASSEMBLED COMPONENTS 6+12

Section of simple and hollow solids – prisms, pyramids and axisymmetric solids, solids with holes/slots when the section plane perpendicular to one principal plane and inclined to other principal plane ('On the axis' and 'from the axis' conditions)

Application based – section of beams (I, T, L, and C), section of pipe bracket, wood joints, composite walls, shells, flange of a coupling and other similar applications

Lab exercises: Assembly of parts with respect to engineering constraints, and sectioned drafting of assembled components

Activities based learning: Making of mitered joint in wood, sectioning the beams in different angles of orientation and identifying the true shape

UNIT V LATERAL SURFACE DEVELOPMENT AND SHEET METAL DESIGN 6+12

Lateral surface development of sectioned solids when the section plane perpendicular to VP and inclined to HP.

Application based – construction of funnel, chimney, dish antenna, door latch, trays, AC vents, lamp shade, commercial packaging boxes with respect to sectioning conditions and other similar applications

Lab exercises: Sheet metal design and drafting, drafting of coils, springs and screw threads

Activities based learning: Fabrication of funnels, chimney, lamp shade, boxes using card boards, ply woods, acrylics

Total: 90 Hours

Note: Activities based learning should not be covered in the regular class hours. It should be given as assignments to the group of maximum 3 members

Question pattern suggestion: Part – A (Either or type) (5 × 16 = 80) & Part – B (Compulsory) (1 × 20 = 20)

COURSE OUTCOME:-

After successful completion of the course, the students will be able to:

CO1: Construct and identify different types of conic curves and special curves, and project the points and lines pertaining to engineering applications

CO2: Project and visualize surfaces and solids in different orientations and utilize the CAD tools for designing.

CO3: Create and draft accurate 3D models and 2D drawings of machine parts manually as well as using CAD softwares

CO4: Determine the true shape of a sectioned solid and draft the assemble parts accordingly

CO5: Develop lateral surfaces of sectioned solids and design sheet metal components

TEXTBOOKS:

1. Engineering Drawing” by N S Parthasarathy and Vela Murali
2. Engineering Drawing and Graphics with Auto CAD” by Venugopal K

REFERENCE BOOKS:

1. “Basic Engineering Drawing: Mechanical Semester Pattern” by Mehta and Gupta
2. "Engineering Drawing” by Basant Agrawal and C M Agrawal
3. “Engineering Drawing With Auto CAD” by B V R Gupta
4. "Engineering Drawing” by P S Gill
5. “Engineering Drawing with an Introduction to AutoCAD” by Dhananjay Jolhe
6. “Engineering Drawing” by M B Shah
7. "Fundamentals of Engineering Drawing” by Imtiaz Hashmi
8. “Computer Aided Engineering Drawing” by S Trymbaka Murthy
9. “CAED : Computer Aided Engineering Drawing for I/II Semester BE/Btech Courses” by Reddy K B
10. “Computer-Aided Engineering Drawing” by Subrata Pal

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	3	2		1				3	1		3	3	3	2
2	3	3	2		2				3	2		3	3	3	2
3	3	3	3	1	2				3	3		3	3	3	2
4	3	3	3	1	3				3	3		3	3	3	2
5	3	3	3	1	3				3	3		3	3	3	2

UNIT-I BASIC ELECTRICAL CIRCUITS**6**

Basic Elements: R,L,C- DC Circuits: Ohm's Law - Kirchhoff's Laws –Mesh and Nodal Analysis(Only Independent Sources). AC Circuits: Average Value, RMS Value, Impedance Instantaneous Power, Real Power, Reactive Power and Apparent Power, Power Factor-Steady state Analysis of RL,RC and RLC circuits.

UNIT II AC AND DC MACHINES**6**

Magnetic Circuit Fundamentals -DC Machines - Construction and Working Principle, Types and Application of DC generator and Motor, EMF and Torque Equation. AC Machines: Principle, Construction, Working and Applications of Transformer -Three phase Alternator - Three Phase Induction Motor.

UNIT III ANALOG AND DIGITAL ELECTRONICS**6**

Operation and Characteristics of electronic devices: PN Junction Diodes, Zener Diode and BJT Applications: Diode Bridge Rectifier and Shunt Regulator. Introduction to Digital Electronics: Basics Logic Gates-Flip Flops.

UNIT IV SENSORS AND TRANSDUCERS**6**

Solenoids, electro-pneumatic systems, proximity sensors, limit switches, Strain gauge, LVDT, Piezo electric transducer, optical and digital transducers, Smart sensors, Thermal Imagers.

UNIT V MEASUREMENTS AND INSTRUMENTATION**6**

Functional Elements of an Instrument, Operating Principle of Moving Coil and Moving Iron Instruments,Power Measurement, Energy Meter, Instrument Transformers - CT and PT, Multimeter- DSO - Block Diagram Approach.

TOTAL 30**LAB COMPONENT:**

1. Verification of ohms and Kirchhoff's Laws.
2. Load test on DC Shunt Motor.
3. Load test on Single Phase Transformer.
4. Load test on 3 Phase Induction Motor.
5. Uncontrolled diode bridge Rectifiers.
6. Application of Zener diode as shunt regulator.
7. Verification of truth table of logic gates and flip flops.
- 8.Characteristics of LVDT.
- 9.Three phase power measurement using two wattmeter method.
- 10.Study of DSO.

COURSE OUTCOMES:

Students will be able to

- CO1** Compute the electric circuit parameters for simple circuits.
- CO2** Understand the working principles and characteristics of electrical machines.
- CO3** Understand the basic electronic devices.
- CO4** Understand the basic operating principles of sensors and transducer.
- CO5** Understand the operating principles measuring devices

TEXT BOOKS:

1. Kotharai DP and Nagarath IJ, "Basic Electrical and Electronics Enigneering", McGraw Hill Education, Second Edition, 2020.
2. Bhattacharya SK, "Basic Electrical and Electronics Engineering", Pearson Education, Second Edition, 2017.

REFERENCES:

1. Mehta V.K. & Mehta Rohit, "Principles of Electrical Engineering and Electronics", McGraw Hill Education, Second Edition, 2020.
2. Mehta V.K. & Mehta Rohit, "Principles of Electrical Machines", S. Chand Publishing, second edition 2006.
3. Albert Malvino & David Bates, "Electronic principles", McGraw Hill Education, Seventh Edition, 2017.

Mapping COs and POs:																
COs	Pos									PSOs						
	P O 1	P O 2	P O 3	P O 4	P O 5	P O 6	P O 7	P O 8	P O 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3	PS O4
CO1	2	1														
CO2	2	1														
CO3	2	1														
CO4	2	1														
CO5	2	1														
Avg	2	1														

UNIT I CIVIL ENGINEERING MATERIALS**6**

Traditional materials - Stone, timber, brick, lime, cement - Mortars - Concrete - Metals - Bitumen - Paints - Tiles.

UNIT II BUILDING CONSTRUCTION**6**

Building elements - Planning - Types of buildings - Super structure - Substructure - Damp proofing.

UNIT III SURVEYING**6**

Principles of surveying - Classification of surveying - Chain surveying - Compass surveying - Levelling - Theodolite - Total station - GIS - Remote sensing.

UNIT IV WATER SUPPLY AND SANITATION**6**

Water supply engineering: Sources of water - Quality of water - Treatment.
Sanitary Engineering: Sewage - Sewage disposal - Septic tank - Treatment - Solid waste management.

UNIT V DISASTER MANAGEMENT**6**

Types of disaster - Earthquake - Wind - Cyclone - Flood - Fire - Precautions to be taken - Disaster management and planning.

TOTAL: 30 PERIODS**COURSE OUTCOMES:**

On completion of this course, the student is expected to be able to:

CO1	Identify the civil engineering materials for construction
CO2	Gain knowledge on construction of buildings
CO3	Acquire basic knowledge on various types of surveying
CO4	Get familiarized with the importance of water supply and sanitary engineering
CO5	Gain awareness on various natural disasters and their mitigation

TEXTBOOKS:

1. Bhavikatti S. S., "Basic Civil Engineering", New Age International Publishers, New Delhi, 2010.
2. Punmia B. C., Ashok K. Jain, Arun K. Jain, "Basic Civil Engineering", Laxmi Publications (P) Ltd., New Delhi, 2004.

REFERENCES:

1. Varghese P. C., "Building Materials", Prentice Hall of India Learning Pvt. Ltd., New Delhi, 2015.
2. Arora S. P. and Bindra S. P., "The Textbook of Building Construction", Dhanpat Rai Publishing Co. Pvt. Ltd., 2019.
3. Kanetkar T. P. and Kulkarni S. V., "Surveying and Levelling", Pune Vidyarthi Griha Prakashan Publications, Pune, 2015.
4. Santosh Kumar Garg, "Environmental Engineering Volumes I and II", Khanna Publishers, New Delhi, 2010.
5. Subramanian R., "Disaster Management", Vikas Publishing House, New Delhi, 2018.

CO-PO-PSO MAPPING: BASIC CIVIL ENGINEERING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2	3	2	3	3	3	3	2	2	3	3	3	3	3
2	3	2	3	2	3	3	3	3	3	3	2	3	3	3	3
3	3	3	3	3	3	2	2	3	2	2	3	3	3	3	3
4	2	2	2	2	3	2	1	1	1	1	1	1	3	3	3
5	2	2	3	2	2	3	3	2	3	2	2	3	3	3	3
Avg.	3	2	3	2	3	3	2	2	2	2	2	3	3	3	3

அலகு I மொழி மற்றும் இலக்கியம்: 3
இந்திய மொழிக் குடும்பங்கள் – திராவிட மொழிகள் – தமிழ் ஒரு செம்மொழி – தமிழ் செவ்விலக்கியங்கள் - சங்க இலக்கியத்தின் சமயச் சார்பற்ற தன்மை – சங்க இலக்கியத்தில் பகிர்தல் அறம் – திருக்குறளில் மேலாண்மைக் கருத்துக்கள் – தமிழ்க் காப்பியங்கள், தமிழகத்தில் சமண பௌத்த சமயங்களின் தாக்கம் - பக்தி இலக்கியம், ஆழ்வார்கள் மற்றும் நாயன்மார்கள் – சிற்றிலக்கியங்கள் – தமிழில் நவீன இலக்கியத்தின் வளர்ச்சி – தமிழ் இலக்கிய வளர்ச்சியில் பாரதியார் மற்றும் பாரதிதாசன் ஆகியோரின் பங்களிப்பு.

அலகு II மரபு – பாறை ஓவியங்கள் முதல் நவீன ஓவியங்கள் வரை – சிற்பக் கலை: 3
நடுகல் முதல் நவீன சிற்பங்கள் வரை – ஐம்பொன் சிலைகள் – பழங்குடியினர் மற்றும் அவர்கள் தயாரிக்கும் கைவினைப் பொருட்கள், பொம்மைகள் – தேர் செய்யும் கலை – சுடுமண் சிற்பங்கள் – நாட்டுப்புறத் தெய்வங்கள் – குமரிமுனையில் திருவள்ளூர் சிலை – இசைக் கருவிகள் – மிருதங்கம், பறை, வீணை, யாழ், நாதஸ்வரம் – தமிழர்களின் சமூக பொருளாதார வாழ்வில் கோவில்களின் பங்கு.

அலகு III நாட்டுப்புறக் கலைகள் மற்றும் வீர விளையாட்டுகள்: 3
தெருக்கூத்து, கரகாட்டம், வில்லுப்பாட்டு, கணியான் கூத்து, ஓயிலாட்டம், தோல்பாவைக் கூத்து, சிலம்பாட்டம், வளரி, புலியாட்டம், தமிழர்களின் விளையாட்டுகள்.

அலகு IV தமிழர்களின் திணைக் கோட்பாடுகள்: 3
தமிழகத்தின் தாவரங்களும், விலங்குகளும் – தொல்காப்பியம் மற்றும் சங்க இலக்கியத்தில் அகம் மற்றும் புறக் கோட்பாடுகள் – தமிழர்கள் போற்றிய அறக்கோட்பாடு – சங்ககாலத்தில் தமிழகத்தில் எழுத்தறிவும், கல்வியும் – சங்ககால நகரங்களும் துறை முகங்களும் – சங்ககாலத்தில் ஏற்றுமதி மற்றும் இறக்குமதி – கடல்கடந்த நாடுகளில் சோழர்களின் வெற்றி.

அலகு V இந்திய தேசிய இயக்கம் மற்றும் இந்திய பண்பாட்டிற்குத் தமிழர்களின் பங்களிப்பு: 3
இந்திய விடுதலைப்போரில் தமிழர்களின் பங்கு – இந்தியாவின் பிறப்பகுதிகளில் தமிழ்ப் பண்பாட்டின் தாக்கம் – சுயமரியாதை இயக்கம் – இந்திய மருத்துவத்தில், சித்த மருத்துவத்தின் பங்கு – கல்வெட்டுகள், கையெழுத்துப்படிக்கள் - தமிழ்ப் புத்தகங்களின் அச்ச வரலாறு.

TOTAL : 15 PERIODS

TEXT-CUM-REFERENCE BOOKS

1. தமிழக வரலாறு – மக்களும் பண்பாடும் – கே.கே. பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்).

2. கணினித் தமிழ் – முனைவர் இல. சுந்தரம். (விகடன் பிரசுரம்).
3. கீழடி – வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)
4. பொருறை – ஆற்றங்கரை நாகரிகம். (தொல்லியல் துறை வெளியீடு)
5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
6. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies.
7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
9. Keeladi - 'Sangam City Civilization on the banks of river Vaigai' (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
10. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Publishedby: The Author)
11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
12. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

UNIT I LANGUAGE AND LITERATURE 3

Language Families in India - Dravidian Languages – Tamil as a Classical Language - Classical Literature in Tamil – Secular Nature of Sangam Literature – Distributive Justice in Sangam Literature - Management Principles in Thirukural - Tamil Epics and Impact of Buddhism & Jainism in Tamil Land - Bakthi Literature Azhwars and Nayanmars - Forms of minor Poetry - Development of Modern literature in Tamil - Contribution of Bharathiyar and Bharathidhasan.

UNIT II HERITAGE - ROCK ART PAINTINGS TO MODERN ART – SCULPTURE 3

Hero stone to modern sculpture - Bronze icons - Tribes and their handicrafts - Art of temple car making - - Massive Terracotta sculptures, Village deities, Thiruvalluvar Statue at Kanyakumari, Making of musical instruments - Mridhangam, Parai, Veenai, Yazh and Nadhaswaram - Role of Temples in Social and Economic Life of Tamils.

UNIT III FOLK AND MARTIAL ARTS 3

Therukoothu, Karagattam, Villu Pattu, Kaniyan Koothu, Oyillattam, Leather puppetry, Silambattam, Valari, Tiger dance - Sports and Games of Tamils.

UNIT IV THINAI CONCEPT OF TAMILS 3

Flora and Fauna of Tamils & Aham and Puram Concept from Tholkappiyam and Sangam Literature - Aram Concept of Tamils - Education and Literacy during Sangam Age - Ancient Cities and Ports of Sangam Age - Export and Import during Sangam Age - Overseas Conquest of Cholas.

UNIT V CONTRIBUTION OF TAMILS TO INDIAN NATIONAL MOVEMENT AND INDIAN CULTURE 3

Contribution of Tamils to Indian Freedom Struggle - The Cultural Influence of Tamils over the other parts of India – Self-Respect Movement - Role of Siddha Medicine in Indigenous Systems of Medicine – Inscriptions & Manuscripts – Print History of Tamil Books.

TOTAL : 15 PERIODS**TEXT-CUM-REFERENCE BOOKS**

1. தமிழக வரலாறு – மக்களும் பண்பாடும் – கே.கே. பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்).
2. கணினித் தமிழ் – முனைவர் இல. சுந்தரம். (விகடன் பிரசுரம்).
3. கீழடி – வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)
4. பொருறை – ஆற்றங்கரை நாகரிகம். (தொல்லியல் துறை வெளியீடு)
5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
6. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies.
7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
9. Keeladi - 'Sangam City Civilization on the banks of river Vaigai' (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services

- Corporation, Tamil Nadu)
10. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Publishedby: The Author)
 11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Bookand Educational Services Corporation, Tamil Nadu)
 12. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

NCC Credit Course Level 1*		L T P C
UC23P01	(ARMY WING) NCC Credit Course Level - I	2 0 0 2
NCC GENERAL		6
NCC 1	Aims, Objectives & Organization of NCC	1
NCC 2	Incentives	2
NCC 3	Duties of NCC Cadet	1
NCC 4	NCC Camps: Types & Conduct	2
NATIONAL INTEGRATION AND AWARENESS		4
NI 1	National Integration: Importance & Necessity	1
NI 2	Factors Affecting National Integration	1
NI 3	Unity in Diversity & Role of NCC in Nation Building	1
NI 4	Threats to National Security	1
PERSONALITY DEVELOPMENT		7
PD 1	Self-Awareness, Empathy, Critical & Creative Thinking, Decision Making and Problem Solving	2
PD 2	Communication Skills	3
PD 3	Group Discussion: Stress & Emotions	2
LEADERSHIP		5
L 1	Leadership Capsule: Traits, Indicators, Motivation, Moral Values, Honour 'Code	3
L 2	Case Studies: Shivaji, Jhasi Ki Rani	2
SOCIAL SERVICE AND COMMUNITY DEVELOPMENT		8
SS 1	Basics, Rural Development Programmes, NGOs, Contribution of Youth	3
SS 4	Protection of Children and Women Safety	1
SS 5	Road / Rail Travel Safety	1
SS 6	New Initiatives	2
SS 7	Cyber and Mobile Security Awareness	1

TOTAL : 30 PERIODS

NCC Credit Course Level 1*

UC23P02	(NAVAL WING) NCC Credit Course Level – I	L T P C
		2 0 0 2
NCC GENERAL		6
NCC 1	Aims, Objectives & Organization of NCC	1
NCC 2	Incentives	2
NCC 3	Duties of NCC Cadet	1
NCC 4	NCC Camps: Types & Conduct	2
NATIONAL INTEGRATION AND AWARENESS		4
NI 1	National Integration: Importance & Necessity	1
NI 2	Factors Affecting National Integration	1
NI 3	Unity in Diversity & Role of NCC in Nation Building	1
NI 4	Threats to National Security	1
PERSONALITY DEVELOPMENT		7
PD 1	Self-Awareness, Empathy, Critical & Creative Thinking, Decision Making and Problem Solving	2
PD 2	Communication Skills	3
PD 3	Group Discussion: Stress & Emotions	2
LEADERSHIP		5
L 1	Leadership Capsule: Traits, Indicators, Motivation, Moral Values, Honour Code	3
L 2	Case Studies: Shivaji, Jhansi Ki Rani	2
SOCIAL SERVICE AND COMMUNITY DEVELOPMENT		8
SS 1	Basics, Rural Development Programmes, NGOs, Contribution of Youth	3
SS 4	Protection of Children and Women Safety	1
SS 5	Road / Rail Travel Safety	1
SS 6	New Initiatives	2
SS 7	Cyber and Mobile Security Awareness	1

TOTAL : 30 PERIODS

NCC Credit Course Level 1*

UC23P03 (AIR FORCE WING) NCC Credit Course Level – I **L T P C**
2 0 0 2

NCC GENERAL **6**

NCC 1	Aims, Objectives & Organization of NCC	1
NCC 2	Incentives	2
NCC 3	Duties of NCC Cadet	1
NCC 4	NCC Camps: Types & Conduct	2

NATIONAL INTEGRATION AND AWARENESS **4**

NI 1	National Integration: Importance & Necessity	1
NI 2	Factors Affecting National Integration	1
NI 3	Unity in Diversity & Role of NCC in Nation Building	1
NI 4	Threats to National Security	1

PERSONALITY DEVELOPMENT **7**

PD 1	Self-Awareness, Empathy, Critical & Creative Thinking, Decision Making and Problem Solving	2
PD 2	Communication Skills	3
PD 3	Group Discussion: Stress & Emotions	2

LEADERSHIP **5**

L 1	Leadership Capsule: Traits, Indicators, Motivation, Moral Values, Honour Code	3
L 2	Case Studies: Shivaji, Jhasi Ki Rani	2

SOCIAL SERVICE AND COMMUNITY DEVELOPMENT **8**

SS 1	Basics, Rural Development Programmes, NGOs, Contribution of Youth	3
SS 4	Protection of Children and Women Safety	1
SS 5	Road / Rail Travel Safety	1
SS 6	New Initiatives	2
SS 7	Cyber and Mobile Security Awareness	1

TOTAL : 30 PERIODS

COURSE OBJECTIVES:

- To read and comprehend different forms of official texts.
- To develop students' writing skills in professional context.
- To actively listen, read and understand written and oral communication in a professional context.
- To comprehend and analyse the visual content in authentic context.
- To write professional documents with clarity and precision

UNIT I CAUSE AND EFFECT 6

Reading – Newspaper articles on Social and Environmental issues; Writing – Instructions, Cause and effect essay; Grammar - Modal verbs; Vocabulary – Cause and effect, Idioms

LAB ACTIVITY: 6

Listening and Speaking – Listen to news reports and summarise in oral form.

UNIT II CLASSIFICATION 6

Reading – An article, social media posts and classifying based on the content; Writing – Definition, Note making, Note taking (Cornell notes etc.) and Summarising; Grammar – Connectives; Vocabulary – Phrasal verbs

LAB ACTIVITY: 6

Listening and speaking: Social interaction (Conversation including small talk)

UNIT III PROBLEM AND SOLUTION 6

Reading – Visual content (Tables/charts/graphs) for comprehension; Writing - Problem and Solution Essay; Grammar – If conditionals; Vocabulary – Sequential words.

LAB ACTIVITY: 6

Listening – Group discussion; Speaking – Participating in a group discussion

UNIT IV REPORT 6

Reading – Formal report on accidents (industrial/engineering); Writing – Industrial Accident report; Grammar – Active and passive voice, Direct and Indirect speech; Vocabulary – Numerical adjectives.

LAB ACTIVITY: 6

Listening / watching – Television documentary and discussing its content, purpose etc.

UNIT V JOB APPLICATION AND INTERVIEW 6

Reading - Job advertisement and company profile; Writing – Job application (cover letter and CV) Grammar – Mixed Tenses; Vocabulary – Collocations related to work environment

LAB ACTIVITY:

6

Listening – Job interview; Speaking – Mock interviews

TOTAL: 60 PERIODS**TEACHING METHODOLOGY**

Interactive lectures, role plays, group discussions, listening and speaking labs, technology enabled language teaching, flipped classroom.

EVALUATION PATTERN

Internal Assessment

Written assessments

Assignment

Lab Assessment

Group discussion (Peer assessment)

Listening

External Assessment

End Semester Examination

LEARNING OUTCOMES

By the end of the courses, students will be able to

- To apply appropriate language structure and vocabulary to enhance both spoken and written communication in formal contexts.
- Comprehend different forms of official documents
- Write professional documents coherently and cohesively.
- Interpret verbal and graphic content in authentic context
- Analyse and evaluate verbal and audio visual materials.

TEXT BOOKS:

1. "English for Engineers and Technologists" Volume 2 by Orient Blackswan, 2022
2. "English for Science & Technology - II" by Cambridge University Press, 2023.

REFERENCES:

1. "Communicative English for Engineers and Professionals" by Bhatnagar Nitin, Pearson India, 2010.
2. "Take Off – Technical English for Engineering" by David Morgan, Garnet Education, 2008.
3. "Advanced Communication Skills" by Mathew Richardson, Charlie Creative Lab, 2020.

4. www.uefap.com

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

MA23C02	ORDINARY DIFFERENTIAL EQUATIONS AND TRANSFORM	L	T	P	C
	TECHNIQUES	3	1	0	4

OBJECTIVES:

- To acquaint the students with Differential Equations which are significantly used in engineering problems.
- To make the students to understand the Laplace transforms techniques.
- To develop the analytic solutions for partial differential equations used in engineering by Fourier series.
- To acquaint the student with Fourier transform techniques used in wide variety of situations in which the functions used are not periodic.
- To develop Z- transform techniques in solving difference equations.

UNIT I ORDINARY DIFFERENTIAL EQUATIONS 9+3

Homogeneous linear ordinary differential equations of second order -superposition principle - general solution- Particular integral - Operator method - Solution by variation of parameters - Method of undetermined coefficients - Homogeneous equations of Euler–Cauchy and Legendre’s type – System of simultaneous linear differential equations with constant coefficients.

UNIT II LAPLACE TRANSFORMS 9+3

Existence theorem - Transform of standard functions – Transform of Unit step function and Dirac delta function – Basic properties - Shifting theorems - Transforms of derivatives and integrals – Transform of periodic functions - Initial and Final value theorem - Inverse Laplace transforms- Convolution theorem (without proof) – Solving Initial value problems by using Laplace Transform techniques.

UNIT III FOURIER SERIES 9+3

Dirichlet’s conditions – General Fourier series – Odd and even functions – Half-range Sine and Cosine series – Complex form of Fourier series – Parseval’s identity – Computation of harmonics.

UNIT IV FOURIER TRANSFORMS 9+3

Fourier integral theorem – Fourier transform pair - Fourier sine and cosine transforms – Properties – Transform of elementary functions – Inverse Fourier Transforms - Convolution theorem (without proof) – Parseval’s identity.

UNIT V Z – TRANSFORM AND DIFFERENCE EQUATIONS 9+3

Z-transform – Properties of Z-transform – Inverse Z-transform – Convolution theorem – Evaluation of Inverse Z transform using partial fraction method and convolution theorem - Initial and final value theorems – Formation of difference equations – Solution of difference equations using Z - transform.

TOTAL: 60 PERIODS

Laboratory based exercises / assignments / assessments will be given to students from the content of the course wherever applicable.

Branch specific / General Engineering applications based on the content of each units will be introduced to students wherever possible.

Suggested Laboratory based exercises / assignments / assessments :

Ordinary differential equations

1. Symbolic computation of linear ordinary differential equations
2. Solving System of simultaneous linear differential equations using ODE SOLVER

Laplace transforms

1. Symbolic computation of Laplace transform and Inverse Laplace transform
2. Plotting Laplace transforms

Fourier Series

1. Symbolic computation of Fourier Coefficients
2. Computation of harmonics
3. Plotting truncated Fourier Series

Fourier Transform

1. Symbolic computation of Fourier Transforms
2. Plotting truncated Fourier Transforms

Z – transform

1. Symbolic computation of Z-Transforms

OUTCOMES:

CO1 :Solve higher order ordinary differential equations which arise in engineering applications.

CO2 :Apply Laplace transform techniques in solving linear differential equations.

CO3 :Apply Fourier series techniques in engineering applications.

CO4 :Understand the Fourier transforms techniques in solving engineering problems.

CO5 :Understand the Z-transforms techniques in solving difference equations.

TEXT BOOKS:

1. Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, 45th Edition, New Delhi, 2020.
2. Erwin Kreyszig, "Advanced Engineering Mathematics", 10th Edition, Wiley India Pvt Ltd., New Delhi, 2018.

REFERENCES:

1. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2008

2. Greenberg M.D., "Advanced Engineering Mathematics", Pearson Education 2nd Edition, 5th Reprint, Delhi, 2009.
3. Jain R.K. and Iyengar S.R.K., "Advanced Engineering Mathematics", Narosa Publications, 5th Edition, New Delhi, 2017.
4. Peter V.O'Neil, "Advanced Engineering Mathematics", Cengage Learning India Pvt., Ltd, 7th Edition, New Delhi, 2012.
5. Ramana B.V., "Higher Engineering Mathematics", Tata McGraw Hill Co. Ltd., 11th Reprint, New Delhi, 2010.

CO – PO Mapping:

Course Outcomes	PROGRAMME OUTCOMES											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	P11	P12
CO 1 :	3	3	2	3	1	2	1	1	1	1	1	3
CO 2 :	3	3	2	3	1	2	1	1	1	1	1	3
CO 3 :	3	3	2	3	1	2	1	1	1	1	1	3
CO 4 :	3	3	2	3	1	2	1	1	1	1	1	3
CO 5 :	3	3	2	3	1	2	1	1	1	1	1	3

UNIT I WATER TECHNOLOGY

Water – sources and impurities – water quality parameters: colour, odour, pH, hardness, alkalinity, TDS, COD, BOD, and heavy metals. Boiler feed water – requirement – troubles (scale & sludge, caustic embrittlement, boiler corrosion and priming & foaming. Internal conditioning – phosphate, Calgon, and carbonate treatment. External conditioning – demineralization. Municipal water treatment (screening, sedimentation, coagulation, filtration, disinfection-ozonolysis, UV treatment, chlorination), Reverse Osmosis – desalination.

PRACTICAL:

- Estimation of HCl using Na_2CO_3 as the primary standard
- Determination of alkalinity in the water sample.
- Determination of hardness of water by EDTA method.
- Determination of DO content of water sample by Winkler's method.

UNIT II NANOCHEMISTRY

Basics-distinction between molecules, nanomaterials and bulk materials; size-dependent properties (optical, electrical, mechanical, magnetic and catalytic). Types –nanoparticle, nanocluster, nanorod, nanowire and nanotube. Preparation of nanomaterials: sol-gel, solvothermal, laser ablation, chemical vapour deposition, electrochemical deposition and electro-spinning. Characterization - Scanning Electron Microscope and Transmission Electron Microscope - Principle and instrumentation (block diagram). Applications of nanomaterials – medicine including AYUSH, automobiles, electronics, and cosmetics.

PRACTICAL:

- Preparation of nanoparticles by Sol-Gel method/sonication method.
- Preparation of nanowire by Electrospinning.
- Study of morphology of nanomaterials by scanning electron microscopy

UNIT III CORROSION SCIENCE

Introduction to corrosion – chemical and electrochemical corrosions – mechanism of electrochemical and galvanic corrosions – concentration cell corrosion-soil, pitting, inter-granular, water line, stress and microbiological corrosions-galvanic series-factors influencing corrosion- measurement of corrosion rate. Electrochemical protection – sacrificial anodic protection and impressed current cathodic protection. Protective coatings-metallic coatings (galvanizing, tinning), organic coatings (paints). Paints: Constituents and functions.

PRACTICAL:

- Corrosion experiment-weight loss method.
- Salt spray test for corrosion study.
- Corrosion prevention by electroplating.
- Estimation of corroded Iron by Potentiometry/UV-visible spectrophotometer

UNIT IV ENERGY SOURCES

Electrochemical cell, redox reaction, electrode potential – oxidation and reduction potential. Batteries – Characteristics; types of batteries; primary battery (dry cell), secondary battery (lead acid, lithium-ion battery) and their applications. Emerging energy sources – metal hydride battery, hydrogen energy, Fuel cells – H₂-O₂ fuel cell. Supercapacitors –Types and Applications, Renewable Energy: solar heating and solar cells. Recycling and disposal of batteries.

PRACTICAL:

- Study of components of Lead acid battery.
- Measurement of voltage in a photovoltaic cell.
- Working of H₂ – O₂ fuel cell

UNIT V POLYMER CHEMISTRY

Introduction: Functionality-degree of polymerization. Classification of polymers (Source, Structure, Synthesis and Intermolecular forces). Mechanism of free radical addition polymerization. Properties of polymers: T_g, tacticity, molecular weight-number average, weight average, viscosity average and polydispersity index (Problems). Techniques of polymerization: Bulk, emulsion, solution and suspension. Compounding and Fabrication Techniques: Injection, Extrusion, Blow and Calendaring. Polyamides, Polycarbonates and Polyurethanes – structure and applications. Recycling of polymers.

PRACTICAL:

- Determination of molecular weight of a polymer using Ostwald viscometer.
- Preparation of a polymer.
- Determination of molecular weight by Gel Permeation Chromatography.

TOTAL: 75 PERIODS

COURSE OUTCOMES:

- CO1:** To demonstrate knowledge of water quality in various industries and develop skills in analyzing water quality parameters for both domestic and industrial purposes.
- CO2:** To identify and apply fundamental concepts of nanoscience and nanotechnology for engineering and technology applications, and to develop skills in synthesizing nanomaterials and studying their morphology.
- CO3:** To apply fundamental knowledge of corrosion protection techniques and develop skills to conduct experiments for measuring and preventing corrosion.
- CO4:** To study the fundamentals of energy storage devices and develop skills in constructing and experimenting with batteries.
- CO5:** To recognize and apply basic knowledge of different types of polymeric materials and develop skills in preparing and determining their applications for futuristic material fabrication needs.

TEXT BOOKS:

1. Jain P. C. & Monica Jain., "Engineering Chemistry", 17th Edition, Dhanpat Rai Publishing Company (P) Ltd, New Delhi, 2015.

2. Sivasankar B., "Engineering Chemistry", Tata McGraw-Hill Publishing Company Ltd, New Delhi, 2012.
3. Dara S.S., "A Textbook of Engineering Chemistry", Chand Publications, 2004.
4. Laboratory Manual - Department of Chemistry, CEGC, Anna University (2023).

REFERENCES:

1. Schdeva M.V., "Basics of Nano Chemistry", Anmol Publications Pvt Ltd, 2011.
2. Friedrich Emich, "Engineering Chemistry", Medtech, 2014.
3. Gowariker V.R., Viswanathan N.V. and Jayadev Sreedhar, "Polymer Science" New AGE International Publishers, 2009.
4. Vogel's Textbook of Quantitative Chemical Analysis (8th edition, 2014).

CO - PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	-	-	-	-	3	-	-	-	-	-
CO2	3	-	2	-	2	-	3	-	-	-	-	-
CO3	3	3	2	-	2	-	3	-	-	-	-	-
CO4	3	3	-	-	-	-	3	-	-	-	-	-
CO5	3	-	-	-	-	-	3	-	-	-	-	-
Avg	3	3	-	-	-	-	3	-	-	-	-	-

1' = Low; '2' = Medium; '3' = High

COURSE OBJECTIVES:

- To understand fundamental structural programming concepts and problem-solving process.
- To solve problems using modular programming and decomposition techniques.
- To solve problems using data structures and abstraction techniques.
- To create programming solutions using libraries and packages.
- To design solutions to domain problems using programming problem-solving techniques.

UNIT I – Structured Programming**9+6**

Problem-Solving Strategies. Basic Problem-Solving Tools: Flowcharts, Pseudocode. Introduction to Programming Languages and Development Environments. Programming. Basic Concepts and Syntax: Variables, Identifiers, Data Types: Primitive Types and Strings, Statements, Operators, Expressions and its evaluation, Operator Precedence, Basic Arithmetic Operations. Principles of Structured Programming – Control Structures: Sequence, Selection, Iteration and Branching.

PRACTICALS:

- Design algorithms for simple computational problems
- Create Pseudo-code and Flow charts for simple computational problems
- Create Python programs using simple and nested selective control statements
- Create Python programs using simple and nested sequence & iterative control statements
- Create Python programs to generate series/patterns using control statements

UNIT II – MODULARITY AND DECOMPOSITION**9+6**

Principles of Modular and Decomposition. Functions: Defining functions –Argument types – Function Name-spaces – Scoping: Global and Non-local. Principles of Recursion: Base case and Recursive cases – Develop and Analyze Recursive functions: Factorial, Fibonacci. Principles of First-Class and Higher-Order functions: Lambda functions – Functions as arguments.

PRACTICALS:

- Create Python programs using functions
- Create python program using recursion
- Create Python programs using lambda functions
- Create Python programs using first-class functions
- Create Python programs using higher-order functions

UNIT III – DATA STRUCTURES AND ABSTRACTIONS

9+6

Principles of Data Structures and Abstractions. String Methods and Manipulations,.Lists: List Operations and Methods, List comprehensions, Nested List comprehensions, Matrix operations using Lists. Tuples and sequences. Sets and Operations. Dictionaries: Dictionary operations, Dictionary comprehensions, Nested Dictionary comprehensions. Comparing Data Structures. Search and Sort Data Structures. Principle of Functional Programming and Tools : map, filter, and reduce.

PRACTICALS:

- Create Python programs for strings manipulations.
- Design Python programs using Lists, Nested Lists and Lists comprehensions
- Create Python programs using Tuples, Nested Tuples, and Tuple comprehensions
- Create Python programs creating Sets and performing set operations
- Create Python programs using Dictionary, Nested Dictionary and comprehensions
- Create Python programs by applying functional programming concepts

UNIT IV - LIBRARIES AND MODULES

9+6

Exceptions: Syntax errors, Exceptions, Exception types, Handling exceptions, Raising exceptions. Files: File Path, Type of files, opening modes, Reading and Writing text files, Handling other format Data files. Modules: Creating Modules, import and from statements, Executing modules as scripts, Standard modules. Packages and Importing from packages

PRACTICALS:

- Design Python programs to handle errors and exceptions
- Create, import, and use pre-defined modules and packages
- Create, import, and use user-defined modules and packages
- Create Python programs to perform various operations on text files
- Create Python programs to perform various operations on other data file formats.

UNIT V – SIMPLE PROBLEM SOLVING TECHNIQUES IN PROGRAMMING 9+6

Data Structures for Problem Solving: Stack, Queue. Principles of Divide and Conquer: Binary Search. Principles of Greedy Algorithms: Minimum Coin Change Problem. Case studies on programming application of problem-solving techniques in different fields of engineering.

PRACTICALS:

- Create python programs to implement stack and queue.
- Create python programs to implement binary search.
- Create python programs to solve minimum coin change problem.
- Case study on developing python solution to a domain specific problems.

TOTAL = 45 + 30 = 75 PERIODS

Course Outcomes

1. Understand fundamental structural programming concepts and problem-solving process.

2. Solve problems using modular programming and decomposition techniques.
3. Solve problems using data structures and abstraction techniques.
4. Create programming solutions using libraries and packages.
5. Design solutions to domain problems using programming problem-solving techniques.

TEXT BOOKS

1. Reema Thareja, Python Programming using Problem Solving Approach, Oxford University Press, First Edition, 2017.
2. S. Sridhar, J. Indumathi, V. M. Hariharan, Python Programming, Pearson Education, First Edition, 2023

REFERENCE BOOKS

1. Paul Deitel, Harvey Deitel, Python for Programmers, Pearson Education, 2020.
2. John V Guttag. Introduction to Computation and Programming Using Python, With Application to Computational Modeling and Understanding Data. Third Edition, The MIT Press, 2021
3. Mark Lutz, Learning Python, 5th Edition, O'Reilly Media, Inc.
4. Python official documentation and tutorial, <https://docs.python.org/3/>
5. Numerical Python official documentation and tutorial, <https://numpy.org/>

CO's-PO's & PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2		2		1								1	1	
2	2		2		1								1	1	
3	2	1	2		1								1	1	
4	2	1	2	1	1								1	1	
5	2	1	2	1	1								1	1	
Avg	2	1	2	1	1								1	1	

1 - low, 2 - medium, 3 - high, '-' - no correlation

COURSE OBJECTIVES:

1. To practice the usage of various tools towards assembly and dis-assembly of different items / equipment.
2. To make simple part / component using welding processes.
3. To train on the basic wiring practices of boards, machines, etc.
4. To provide a hands-on experience on the use of electronic components, equipment, sensors and actuators.
5. To expose to modern computer tools and advanced manufacturing / fabrication processes.

LIST OF ACTIVITIES**1L,4P****(A). Dis-assembly & Assembly Practices**

- i. Tools and its handling techniques.
- ii. Dis-assembly and assembly of home appliances – Grinder Mixer Grinder, Ceiling Fan, Table Fan & Washing Machine.
- iii. Dis-assembly and assembly of Air-Conditioners & Refrigerators.
- iv. Dis-assembly and assembly of a Bicycle.

(B). Welding Practices

- i. Welding Procedure, Selection & Safety Measures.
- ii. Power source of Arc Welding – Gas Metal Arc Welding & Gas Tungsten Arc Welding processes.
- iii. Hands-on session of preparing base material & Joint groove for welding.
- iv. Hands-on session of MAW, GMAW, GTAW, on Carbon Steel & Stainless Steel plates / pipes, for fabrication of a simple part.

(C). Electrical Wiring Practices

- i. Electrical Installation tools, equipment & safety measures.
- ii. Hands-on session of basic electrical connections for Fuses, Miniature Circuit Breakers and Distribution Box,
- iii. Hands-on session of electrical connections for Lightings, Fans, Calling Bells.

- iv. Hands-on session of electrical connections for Motors & Uninterruptible Power Supply.

(D). Electronics Components / Equipment Practices

- i. Electronic components, equipment & safety measures.
- ii. Dis-assembly and assembly of Computers.
- iii. Hands-on session of Soldering Practices in a Printed Circuit Breaker.
- iv. Hands-on session of Bridge Rectifier, Op-Amp and Transimpedance amplifier.
- v. Hands-on session of integration of sensors and actuators with a Microcontroller.
- vi. Demonstration of Programmable Logic Control Circuit.

(E).Contemporary Systems

- i. Demonstration of Solid Modelling of components.
- ii. Demonstration of Assembly Modelling of components.
- iii. Fabrication of simple components / parts using 3D Printers.
- iv. Demonstration of cutting of wood / metal in different complex shapes using Laser Cutting Machine.

TOTAL: 75 Periods (15 Lecture + 60 Practical)

COURSE OUTCOMES:

Upon the successful completion of the course, students will be able to:

- CO1: Assemble and dis-assemble various items / equipment.
- CO2: Make simple parts using suitable welding processes.
- CO3: Setup wiring of distribution boards, machines, etc.
- CO4: Utilise the electronic components to fabricate a simple equipment, aided with sensors and actuators.
- CO5: Take advantage of modern manufacturing practices.

REFERENCES:

1. Stephen Christena, Learn to Weld: Beginning MIG Welding and Metal Fabrication Basics, Crestline Books, 2014.
2. H. Lipson, Fabricated - The New World of 3D Printing, Wiley, 1st edition, 2013.
3. Code of Practice for Electrical Wiring Installations (IS 732:2019)
4. A.S. Sedra and K.C. Smith, Microelectronic Circuits, Oxford University Press, 7th ed. (Indian edition), 2017.

5. Mazidi, Naimi, Naimi, AVR Microcontroller and Embedded Systems: Using Assembly and C, Pearson India, 1st edition 2013.
6. Visualization, Modeling, and Graphics for Engineering Design, D.K. Lieu, S.A. Sorby, Cengage Learning; 2nd edition.

ME23C05	BASICS OF MECHANICAL ENGINEERING	L	T	P	C
		2	0	0	2

UNIT I CASTING, FORMING, AND WELDING PROCESSES 6

Sand casting, lathe machine and its parts, lathe machine operations (turning, taper turning, facing, chamfering, etc.), Drilling, forming process – Bulk Deformation (Forging, Rolling), Sheet metal operation (Blanking, punching) – Demonstration of relevant experiments

UNIT II WELDING AND ADDITIVE MANUFACTURING 6

Welding – types, Shielded Metal Arc Welding, gas welding, MIG and TIG welding, Additive manufacturing : Types and its applications - Demonstration of relevant experiments

UNIT III THERMODYNAMICS 6

Basic Terminologies related to Thermodynamics, zeroth Law, First Law of thermodynamics, Second Law of thermodynamics, Third Law of thermodynamics, Vapor compression cycle , Air Conditioner and Refrigerator-Demonstration of relevant experiments

UNIT IV IC ENGINES AND RECENT DEVELOPMENTS 6

Introduction to IC Engine, 2 stroke Engine, 4 Stroke Engine, Petrol Engine, Diesel Engine –Demonstration Electric Vehicles - Introduction & Challenges –Demonstration of relevant experiments.

UNIT V POWER PLANT ENGINEERING 6

Coal based power plants- working, advantages & disadvantages, Hydro Electric power plants- working, advantages & disadvantages, nuclear power plants- Types, working, advantages & disadvantages, solar power plant- working, advantages & disadvantages, wind-based power generation- working, advantages & disadvantages.

**TOTAL: 30
PERIODS**

COURSE OUTCOMES:

Upon completion of the course, the students will be able to

- CO1** Discuss the basic concepts of casting, forming, and machining processes
- CO2** Explain welding, and Additive manufacturing
- CO3** Discuss the basics laws and application of thermodynamics
- CO4** Summarize the basics of IC engines, electric vehicles.
- CO5** Explain various power generation methods

TEXT BOOKS:

1. Nag, P.K., “Engineering Thermodynamics “, IInd Edition, Tata McGraw Hill Publishing Co., Ltd., 1995.
2. Rajput, R .K, “Thermal Engineering”, Laxmi publications (P) Ltd, 2001.
3. Khurmi R.S., and Gupta J.K, “Theory of Machines”, Eurasia Publishing House (P) Ltd.,

2004.

4. A TEXTBOOK OF MANUFACTURING TECHNOLOGY by RK Rajput, December 2007, Panchu Publisher
5. A Text-Book of Production Technology Volume I by O.P.KHANNA, Dhanpat Rai publications

REFERENCES:

1. Additive Manufacturing Technologies, Ian Gibson, David Rosen, Brent Stucker, Springer New York, NY, <https://doi.org/10.1007/978-1-4939-2113-3>.
2. Electric Vehicles, Modern Technologies and Trends, Nil Patel, Akash Kumar Bhoi, Sanjeevikumar Padmanaban, Jens Bo Holm-Nielsen, Springer Singapore, <https://doi.org/10.1007/978-981-15-9251-5>

Mapping COs and POs:																	
C Os	POs												PSOs				
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4	
CO1	3	-	-	-	2	-	2	-	-	-	-	2	3	-	1	-	
CO2	3	-	-	-	2	-	2	-	-	-	-	2	3	-	1	-	
CO3	3	-	-	-	2	-	2	-	-	-	-	2	3	-	1	-	
CO4	3	-	-	-	2	-	2	-	-	-	-	2	3	-	1	-	
CO5	3	-	-	-	2	-	2	-	-	-	-	2	3	-	1	-	
Avg	3	-	-	-	2	-	2	-	-	-	-	2	3	-	1	-	

அலகு I நெசவு மற்றும் பானைத் தொழில்நுட்பம்: 3

சங்க காலத்தில் நெசவுத் தொழில் – பானைத் தொழில்நுட்பம் – கருப்பு சிவப்பு பாண்டங்கள் – பாண்டங்களில் கீறல் குறியீடுகள்.

அலகு II வடிவமைப்பு மற்றும் கட்டிடத் தொழில்நுட்பம்: 3

சங்க காலத்தில் வடிவமைப்பு மற்றும் கட்டுமானங்கள் & சங்க காலத்தில் வீட்டுப் பொருட்களில் வடிவமைப்பு- சங்க காலத்தில் கட்டுமான பொருட்களும் நடுகல்லும் – சிலப்பதிகாரத்தில் மேடை அமைப்பு பற்றிய விவரங்கள் – மாமல்லபுரச் சிற்பங்களும், கோவில்களும் – சோழர் காலத்துப் பெருங்கோயில்கள் மற்றும் பிற வழிபாட்டுத் தலங்கள் – நாயக்கர் காலக் கோயில்கள் - மாதிரி கட்டமைப்புகள் பற்றி அறிதல், மதுரை மீனாட்சி அம்மன் ஆலயம் மற்றும் திருமலை நாயக்கர் மஹால் – செட்டிநாட்டு வீடுகள் – பிரிட்டிஷ் காலத்தில் சென்னையில் இந்தோ-சாரோசெனிக் கட்டிடக் கலை.

அலகு III உற்பத்தித் தொழில் நுட்பம்: 3

கப்பல் கட்டும் கலை – உலோகவியல் – இரும்புத் தொழிற்சாலை – இரும்பை உருக்குதல், எஃகு – வரலாற்றுச் சான்றுகளாக செம்பு மற்றும் தங்க நாணயங்கள் – நாணயங்கள் அச்சடித்தல் – மணி உருவாக்கும் தொழிற்சாலைகள் – கல்மணிகள், கண்ணாடி மணிகள் – சுடுமண் மணிகள் – சங்கு மணிகள் – எலும்புத்துண்டுகள் – தொல்லியல் சான்றுகள் – சிலப்பதிகாரத்தில் மணிகளின் வகைகள்.

அலகு IV வேளாண்மை மற்றும் நீர்ப்பாசனத் தொழில் நுட்பம்: 3

அணை, ஏரி, குளங்கள், மதகு – சோழர்காலக் குழுழித் தூம்பின் முக்கியத்துவம் – கால்நடை பராமரிப்பு – கால்நடைகளுக்காக வடிவமைக்கப்பட்ட கிணறுகள் – வேளாண்மை மற்றும் வேளாண்மைச் சார்ந்த செயல்பாடுகள் – கடல்சார் அறிவு – மீன்வளம் – முத்து மற்றும் முத்துக்குளித்தல் – பெருங்கடல் குறித்த பண்டைய அறிவு – அறிவுசார் சமூகம்.

அலகு V அறிவியல் தமிழ் மற்றும் கணித்தமிழ்: 3

அறிவியல் தமிழின் வளர்ச்சி – கணித்தமிழ் வளர்ச்சி – தமிழ் நூல்களை மின்பதிப்பு செய்தல் – தமிழ் மென்பொருட்கள் உருவாக்கம் – தமிழ் இணையக் கல்விக்கழகம் – தமிழ் மின் நூலகம் – இணையத்தில் தமிழ் அகராதிகள் – சொற்குவைத் திட்டம்.

TOTAL : 15 PERIODS**TEXT-CUM-REFERENCE BOOKS**

1. தமிழக வரலாறு – மக்களும் பண்பாடும் – கே.கே. பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்).

2. கணினித் தமிழ் – முனைவர் இல. சுந்தரம். (விகடன் பிரசுரம்).
3. கீழடி – வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)
4. பொருளை – ஆற்றங்கரை நாகரிகம். (தொல்லியல் துறை வெளியீடு)
5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
6. Social Life of the Tamils – The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies.
7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
9. Keeladi – ‘Sangam City Civilization on the banks of river Vaigai’ (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
10. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Publishedby: The Author)
11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
12. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

UNIT I WEAVING AND CERAMIC TECHNOLOGY 3

Weaving Industry during Sangam Age – Ceramic technology – Black and Red Ware Potteries (BRW) – Graffiti on Potteries.

UNIT II DESIGN AND CONSTRUCTION TECHNOLOGY 3

Designing and Structural construction House & Designs in household materials during Sangam Age -Building materials and Hero stones of Sangam age – Details of Stage Constructions in Silappathikaram - Sculptures and Temples of Mamallapuram - Great Temples of Cholas and other worship places - Temples of Nayaka Period -Type study (Madurai Meenakshi Temple)- Thirumalai NayakarMahal -ChettiNadu Houses, Indo-Saracenic architecture at Madras during British Period.

UNIT III MANUFACTURING TECHNOLOGY 3

Art of Ship Building - Metallurgical studies -Iron industry - Iron smelting, steel -Copper and gold- Coins as source of history - Minting of Coins – Beads making-industries Stonebeads - Glass beads - Terracotta beads -Shell beads/ bone beats - Archeological evidences - Gem stone types described in Silappathikaram.

UNIT IV AGRICULTURE AND IRRIGATION TECHNOLOGY 3

Dam, Tank, ponds, Sluice, Significance of KumizhiThoompuof Chola Period,Animal Husbandry - Wells designed for cattle use - Agriculture and Agro Processing - KnowledgeofSea -Fisheries – Pearl - Conche diving - Ancient Knowledge ofOcean - KnowledgeSpecificSociety.

UNIT V SCIENTIFIC TAMIL & TAMIL COMPUTING 3

Development of Scientific Tamil - Tamil computing – Digitalization of Tamil Books – Development of Tamil Software – Tamil Virtual Academy – Tamil Digital Library – Online Tamil Dictionaries – Sorkuvai Project.

TOTAL : 15 PERIODS**TEXT-CUM-REFERENCEBOOKS**

1. தமிழக வரலாறு – மக்களும் பண்பாடும் – கே.கே. பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்).
2. கணினித் தமிழ் – முனைவர் இல. சுந்தரம். (விகடன் பிரசுரம்).
3. கீழடி – வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)
4. பொருளை – ஆற்றங்கரை நாகரிகம். (தொல்லியல் துறை வெளியீடு)
5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
6. Social Life of the Tamils – The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies.
7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by:

- International Institute of Tamil Studies.)
9. Keeladi – ‘Sangam City Civilization on the banks of river Vaigai’ (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
 10. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Publishedby: The Author)
 11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Bookand Educational Services Corporation, Tamil Nadu)
 12. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

OBJECTIVES:

- To understand the basics of random variables with emphasis on the standard discrete and continuous distributions.
- To understand the basic probability concepts with respect to two dimensional random variables along with the relationship between the random variables and the significance of the Central Limit theorem.
- To understand the basic concepts of sampling distributions and statistical properties of point and interval estimators.
- To apply the small/ large sample tests through Tests of hypothesis.
- To understand the concept of analysis of variance and use it to investigate factorial dependence.

UNIT I ONE-DIMENSIONAL RANDOM VARIABLES 9+3

Discrete and continuous random variables – Moments – Moment generating functions – Binomial, Poisson, Geometric, Uniform, Exponential, Gamma and Normal distributions – Functions of a random variable.

UNIT II TWO-DIMENSIONAL RANDOM VARIABLES 9+3

Joint distributions – Marginal and conditional distributions – Covariance – Correlation and Linear regression – Transformation of random variables – Central limit theorem (for independent and identically distributed random variables).

UNIT III ESTIMATION THEORY 9+3

Sampling distributions – Characteristics of good estimators – Method of Moments – Maximum Likelihood Estimation – Interval estimates for mean, variance and proportions.

UNIT IV TESTS OF SIGNIFICANCE 9+3

Type I and Type II errors – Tests for single mean, proportion, Difference of means (large and small samples) – Tests for single variance and equality of variances – χ^2 test for goodness of fit – Independence of attributes.

UNIT V DESIGN OF EXPERIMENTS 9+3

Completely Randomized Design – Randomized Block Design – Latin Square Design – 2^2 factorial design.

TOTAL: 60 PERIODS

Laboratory based exercises / assignments / assessments will be given to students from the content of the course wherever applicable.

Branch specific / General Engineering applications based on the content of each units will be introduced to students wherever possible.

SUGGESTED LAB EXERCISES

1. Data exploration using R
2. Visualizing Probability distributions graphically
3. Evaluation of correlation coefficient
4. Creating a Linear regression model in R
5. Maximum Likelihood Estimation in R
6. Hypothesis testing in R programming
7. Chi square goodness of fit test in R
8. Design and Analysis of experiments with R

OUTCOMES:

- CO1: Can analyze the performance in terms of probabilities and distributions achieved by the determined solutions.
- CO2: Will be familiar with some of the commonly encountered two dimensional random variables and be equipped for a possible extension to multivariate analysis.
- CO3: Provides an estimate or a range of values for the population parameter from random samples of population.
- CO4: Helps to evaluate the strength of the claim/assumption on a sample data using hypothesis testing.
- CO5: Equips to study the influence of several input variables on the key output variable.

TEXT BOOKS:

1. Irwin Miller and Marylees Miller, "John E. Freund's Mathematical Statistics with applications", Pearson India Education, Asia, 8th Edition, 2014.
2. Walpole, R.E., Myers R.H., Myres S.L., and Ye, K. "Probability and Statistics for Engineers and Scientists", Pearson Education, Asia, 9th Edition, 2024.

REFERENCES:

1. Richard A. Johnson, Irwin Miller, John Freund "Miller & Freund's Probability and Statistics for Engineers", Person Education, 8th Edition, 2015.
2. Ross, S.M. "Introduction to Probability and Statistics for Engineers and Scientists", Elsevier, New Delhi, 5th Edition, 2014.
3. Spiegel, M.R., Schiller, J., Srinivasan, R.A. and Goswami, D. "Schaum's Outline of Theory and Problems for Probability and Statistics", McGraw Hill Education, 3rd Edition, Reprint, 2017.
4. Devore, J.L. "Probability and Statistics for Engineering and the Sciences", Cengage Learning, 9th Edition, 2016.

CO – PO Mapping:

COURSE OUTCOMES	PROGRAMME OUTCOMES											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	P11	P12
CO1 :	3	3	2	3	1	2	1	1	1	1	1	3
CO2 :	3	3	2	3	1	2	1	1	1	1	1	3
CO3 :	3	3	2	3	1	2	1	1	1	1	1	3
CO4 :	3	3	2	3	1	2	1	1	1	1	1	3
CO5 :	3	3	2	3	1	2	1	1	1	1	1	3

COURSE OBJECTIVE:

- This course aims at introducing fundamental inorganic and organic chemistry required for leather manufacture.

UNIT I INTRODUCTION TO INORGANIC COMPOUNDS 9

The introduction of transition metals and complex formation; Coordination compounds – nomenclature, Characteristics of transition metals, d-d transition, charge transfer complex, back bonding, Theories of Coordination compounds, Ligand field theory.

UNIT II MOLECULAR BONDING 9

Valence bond approach and atomic orbital hybridizations. LCAO-MO theory, Electronic Displacements: Inductive, electromeric, resonance and mesomeric effects, Hyper conjugation and their applications; Dipole moment; Organic acids and bases; their relative strength. Aromaticity: Hückel's rule, Electrophilic and nucleophilic aromatic substitution reactions, Redox reactions.

UNIT III ORGANIC COMPOUNDS AND REACTION INTERMEDIATES 9

Chemistry of oil (triglycerides), fatty acids, and their compounds, sulphonyl chloride, quinone, oxazolidine, phosphonium chloride. Generation and stability of organic reactive intermediates: carbocations, carbanions, free radicals, carbenes, benzyne and nitrenes.

UNIT IV LUBRICANTS 9

Lubricant and its Functions, Classification of lubricants: solid, semisolid and liquid lubricants with examples. Type of lubrications – hydrodynamic and boundary lubrication with illustrative diagrams. Properties of lubricants; Physical properties- viscosity, viscosity index, cloud point, pour point, flash point, fire point, oiliness; Chemical properties- TAN or TAV (Total acid number), emulsification, aniline point and iodine value.

UNIT V COLLOIDS AND SURFACTANTS 9

Introduction to colloids – properties of colloids – coagulation of solutions –Origin of charge on colloidal particles –Determination of size of colloidal particles- Donnan Membrane equilibrium – Emulsions – Gels – Applications of colloids. Chemical and Physico-chemical types, properties; Rheology: Viscosity. Non-Newtonian flow and Viscoelasticity, Birefringence: electrical and streaming; Various Diffusional aspects and applications.

TOTAL: 45 PERIODS**COURSE OUTCOMES:**

On the completion of the course students are expected to,
CO1. Explain the basic chemistry of inorganic compounds.
CO2. Apply the various concepts of various molecular bonding.
CO3. Examine the characteristic of organic compounds.
CO4. Perceive the concepts of lubrication.
CO5. Discuss and construct the colloidal science in leather technology.

TEXT BOOKS AND REFERENCES:

1. J W Huheey, E A Keiter and R L Keiter, 'Inorganic Chemistry' 4th edn, Harper Collins,
2. M J Winter, 'Chemical Bonding' Oxford Primer Series, Oxford University Press, 1994

- N C Norman, 'Periodicity and the p-block Elements' Oxford Primer Series, Oxford University Press, 1994
- R.T. Morrison and R.N. Boyd "Organic Chemistry" VI Edition Prentice Hall Inc (1996) USA
- K.S. Tiwari, N.K. Vishnoi and S.N. Malhotra "A text book of Organic Chemistry" Second Edition, Vikas Publishing House Pvt. Ltd. (1998) New Delhi.
- Puri B.H. Sharma L. R and M.S. Prathama, Principles of Physical Chemistry, S. Chand and Company, Delhi (2001).
- Gordon M. Barrow, Physical Chemistry, Sixth edition, Tata McGraw Hill (1998).
- Introduction to Colloid and Surface Chemistry, Duncan J. Shaw, Butterworth, Hewemann, (1992).

COURSE ARTICULATION MATRIX:

Course Outcome	Program Outcome														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O 3
CO1	3	3	2	1	1	1	1	1	1	2	1	2	3	2	1
CO2	3	3	2	1	1	1	1	1	1	2	1	2	3	2	1
CO3	3	3	2	1	1	1	1	1	1	2	1	2	3	2	1
CO4	3	3	2	2	2	1	2	1	1	2	2	2	3	3	2
CO5	3	3	3	2	2	1	2	1	1	1	2	1	3	3	2

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

COURSE OBJECTIVE:

- This course aims at introducing the fundamentals of chemistry and technology of leather manufacture in response to current market scenario, application avenues and future requirements.

UNIT I APPLICATIONS AND UNIQUENESS OF LEATHER 8

Current and emerging applications of leather; Properties required for key application avenues; Alternative materials to leather and their application avenues; Uniqueness of leather compared to currently available alternative materials.

UNIT II HIDES/SKINS AND PRESERVATION 10

Functions and properties of hides and skins; Histological characteristics of hides and skins - Cow, Buff, Goat and Sheep; Traceability. Chemical constituents of hides and skins; Standard flaying techniques; Various preservation/curing techniques; Defects in hides and skins.

UNIT III PRE-TANNING AND TANNING PROCESSES 10

Objectives of pre-tanning processes viz., soaking, liming, deliming, bating, pickling, depickling, degreasing and repickling. Various types of tannages.

UNIT IV POST TANNING AND FINISHING PROCESSES 8

Objectives of post tanning processes, finishing and various mechanical operations.

UNIT V AN OVERVIEW OF LEATHER INDUSTRY 9

Livestock Availability, Global and Indian Trade, Water and Energy Consumption, Waste management methodologies, value addition to waste, cluster approach. Supply chain logistics.

TOTAL: 45 PERIODS**LIST OF EXPERIMENTS:**

- Assortment of hides and skins, wet blue/EI, crust and finished leather
- Pre tanning and tanning practice*
- Post tanning and finishing practice*
- Introduction to various mechanical operations/processing equipment/devices (demonstration)

*Making Upper and Garment leather using any of the following raw materials cow, buffalo, goat and sheep.

TOTAL: 30 PERIODS**COURSE OUTCOMES:**

- At the end of the course, students are expected to,
- CO1. Illustrate the current global scenario in leather.
- CO2. Identify the various preservation techniques of the skins / hides.
- CO3. Appraise the chemistry of pre-tanning and tanning processes.
- CO4. Explain on post-tanning and finishing processes.
- CO5. Discuss the process rational for making specific leather.

TEXT BOOKS AND REFERENCES:

1. Sarkar, K.T., Theory and Practice of Leather Manufacture, AjoySorcor, Madras, 4th Rev.Ed 1995.
2. Dutta, S.S., An Introduction to the Principles of Leather Manufacture, 4th Edition, Indian Leather Technologists Association, Calcutta, 4th Edition 1999.
3. Sharpouse, J.H., "Leather Technicians Handbook", Leather Producers Association, Northampton NN3 1JD, Reprinted 1995.
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, 1978.
5. Thorstensen, T.C., Practical Leather Technology, Krieger Publications, 1993.

COURSE ARTICULATION MATRIX:

Course Outcome	Program Outcome														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	1	1	1	1	2	3	3	1	-	2	1	2	1	1
CO2	2	2	3	2	1	3	3	1	1	-	1	1	3	2	2
CO3	2	3	3	3	1	2	2	1	1	-	2	1	3	2	2
CO4	2	2	3	2	2	2	3	1	1	-	1	1	3	2	2
CO5	2	2	3	2	2	3	3	1	1	-	2	1	3	1	1

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

COURSE OBJECTIVE:

- To introduce various methods of chemical analysis through sophisticated instruments for accuracy.

UNIT I BASICS OF CHEMICAL ANALYSIS 9+6

Electromagnetic radiation; Various ranges, Dual properties, Various energy levels, Interaction of photons with matter, absorbance, and transmittance and their relationship, permitted energy levels for the electrons of an atom and simple molecules, classification of instrumental methods based on physical properties. Analysis of pretanning chemicals.

UNIT II ANALYSIS OF LEATHER CHEMICALS AND PROCESS LIQUORS 9+6

Principles and methods of analysis of leather chemicals and process liquors – Lime, sodium sulfide, deliming and bating agent; BCS; Vegetable tanning materials and extracts, Syntans, spent chrome liquors. Analysis of tanning and post tanning agents.

UNIT III MOLECULAR SPECTROSCOPY 9+6

UV-Visible-Spectroscopy: Effects of auxochromes and effects of conjugation on the absorption maxima. Beer-Lambert's Law, Limitations, Deviations (Real, Chemical, Instrumental). Application – Cr (VI) estimation, dye content, Analysis of chemicals in leather.

IR spectroscopy: Principle, Theory- Molecular vibrations, Vibrational Frequency- Hook's Law, Number of Fundamental vibrations, Factors affecting vibrational Frequency, Instrumentation.

NMR spectroscopy: Basics of NMR spectroscopy.

UNIT IV ATOMIC SPECTROSCOPY 8+6

Atomic Absorption Spectrophotometry; Principle, Instrumentation and Application, Various interferences observed in AAS (Chemical, radiation and excitation); Flame photometry; Principle, Instrumentation and applications in metal analysis in leather.

UNIT V CHROMATOGRAPHIC METHODS 10+6

Classification of chromatographic methods - Thin layer, paper, Gas, High performance liquid chromatographically methods (principles, mode of separation, instrumentation and technique) for the analysis of leather auxiliaries. Application – Determination of formaldehyde, polychlorinated phenols, azo dyes.

TOTAL: 75 PERIODS**COURSE OUTCOMES:**

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

CO1. Illustrate gain fundamental knowledge about the electromagnetic spectrum and its limitations.

CO2. Develop and understand the underpinning science behind molecular spectroscopy

- CO3. List out the various principles of atomic spectroscopy and its application.
 CO4. Explain the concept of various physico-chemical analytical methods.
 CO5. Elaborate the various chromatographic techniques for leather chemical analysis.

TEXT BOOKS AND REFERENCES:

1. Willard, H.H., Merritt, L.L., Dean J.A., and Settle, F.A., Instrumental methods of analysis, Sixth edition, CBS publishers, 1986.
2. Parikh V.M. Absorption spectroscopy of organic molecules Addison –Wesley Publishing company, 1994.
3. Skoog D.A. and West D.M.M., Fundamentals of Analytical Chemistry, Saunders – college Publishing, 1982.
4. Banwell, G.C., Fundamentals of molecular spectroscopy TMH, 1992.

COURSE ARTICULATION MATRIX:

Course Outcome	Program Outcome														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	3	1	1	-	-	1	1	2	3	2	2
CO2	3	3	2	2	3	1	1	-	-	1	1	2	3	2	2
CO3	3	2	2	2	3	1	1	-	-	1	1	2	3	2	2
CO4	3	2	2	2	3	1	1	-	-	1	1	2	3	3	3
CO5	3	3	2	2	3	1	1	-	-	1	1	2	2	2	2

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

COURSE OBJECTIVE:

- To understand the basic structure and function of skin and its components and to understand the various pre-tanning processes/operations.

UNIT I STRUCTURE, FUNCTION AND COMPONENTS OF SKIN 9

Organization of skin components in different animals; Structure and function of epidermis, dermis, cutaneous and subcutaneous tissues; hair; fat tissue; nerve; erectorpilli muscle; sweat glands; Various constituents of hides and skins; Fibrous and non-fibrous proteins in skin; Structure and properties of complex carbohydrates and proteoglycons; Structure and properties of fatty acids; Structure, function and properties of amino acids.

UNIT II COLLAGEN: STRUCTURE, FUNCTION, THERMAL TRANSITION AND DEGRADATION 9

Structure of collagen; Types of collagen; Tropocollagen molecules; Sub-units of collagen; Kinetics of fibril formation; Electron microscopy of the collagen fibre; Denaturation temperature; Mechanism of denaturation process; Thermal shrinkage; Factors influencing melting transition; Degradation of collagen – collagenase and mechanism of action.

UNIT III PRINCIPLES OF PRESERVATION 9

Hide/skin putrefaction and factors involved. Principles of preservation of hides and skins

UNIT IV PRINCIPLES OF PRE-TANNING PROCESSES 9

Chemistry and principles of different pre-tanning processes - Soaking, liming, deliming, bating, pickling, depickling and degreasing.

UNIT V CLEANER PROCESSING IN BEAMHOUSE PRACTICES 9

Salt-free curing options, sulphide free unhairing systems, ammonia-free deliming, salt free pickling systems, solvent and eco-friendly degreasing systems.

TOTAL: 45 PERIODS**COURSE OUTCOMES:**

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

CO1. Illustrate various structural components and functions of skin/hide.

CO2. Apply the molecular structure of collagen and its supramolecular assemblies and their characteristics.

CO3. List out the various steps in preservation and pre-tanning process.

CO4. Explain the various cleaner pre-tanning processes.

CO5. Elaborate the quality control requirements of pre-tanning process.

TEXT BOOKS AND REFERENCES:

- Lehninger A.L., Nelson D.L., Cox M.M., "Principles of Biochemistry", CBS Publications, 1993.
- Gustavson, K.H., 'The Chemistry and Reactivity of Collagen', Academic Press, New York, 1958.
- Flaherty, O., William Roddy, T. Robert, M. Lollar, 'The Chemistry and Technology of

Leather', Vol.1 Preparation for Tannage, E Robert Krieger Publishing Company, New York, 1978.

4. Bienkiewicz, K., "Physical Chemistry of Leather Manufacture", Krieger, Florida, 1982.
5. Voet D., Voet G., "Biochemistry ", Second Edition, John Wiley and Sons, 1994.
6. Stryer L., "Biochemistry ", Fourth Edition, 1994.
7. Darnell J., Lodish H., Baltimore D., "Molecular Cell Biology ", Freeman W.H., 1990.
8. "Microbes and Enzymes - -Basics and Applied", R. Puvanakrishnan, Former Sc.G. and Head, Dept. of Biotechnology, CLRI.

COURSE ARTICULATION MATRIX:

Course Outcome	Program Outcome														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	-	1	-	1	-	-	1	-	2	-	3	1
CO2	3	2	1	-	-	-	-	-	-	1	-	2	-	3	1
CO3	3	2	1	1	1	1	3	1	1	1	-	2	1	3	2
CO4	3	2	1	2	1	3	3	2	2	1	-	2	2	3	3
CO5	3	2	1	2	1	1	3	2	2	1	-	2	2	3	3

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

COURSE OBJECTIVE:

- To impart knowledge on analytical methods for the analysis of leather, leather chemicals and process liquors generated during processing of leathers.

UNIT I REGULATIONS IN LEATHER AND LEATHER CHEMICALS 9

Registration, Evaluation, Authorization and Restriction of Chemicals (REACH) – Restricted Substances List (RSL) and limits, Substances of Very High Concern (SVHC) and methods of analysis; Zero Discharge of Hazardous Chemicals (ZDHC) norms and methods of analysis in leather and leather chemicals. Certifications in Leather – Eco-mark, Chrome-free, Metal-free, Biodegradable, etc. Sampling position for physical testing of leathers.

UNIT II MICROSCOPY LAB 9+12

- Setting up of a compound microscope
- Preparation of microscopical slides by paraffin embedding method and by freezing method
- Identification of hides and skins from their morphological and histological pattern of Buffalo, Cow, Sheep, Goat, Pig and other species
- Microscopical assessment of fibre structure during the process - Soaking, liming, pickling and tanning and different finished leathers.

UNIT III MICROBIOLOGY FOR LEATHER 9+12

Testing of bacterial action on raw hides and skins and in the different stages of Leather Manufacture. Effect of mould growth during processing of skins/hides, finished leathers, leather goods and during transportation/storage. Testing and prevention of mould growth during processing, storage of finished goods and transportation.

MICROBIOLOGY LAB

- Preparation of various culture media
- Staining of bacteria
- Enumeration of bacteria in hides and skins and in tan liquors
- Isolation and identification of fungi/mold/yeast in raw hides/skins, leathers and tan liquors
- Mildew resistance test for leathers
- Identification of insect and parasitic damages in skins/hides/leathers (Entomology demo only)

UNIT IV NON-DESTRUCTIVE TESTING OF LEATHERS 9

Identification of fibre structure orientation in leather using microscope. Specifications, associated test methods and principles involved in mechanical testing of leather and leather products. Non-destructive testing of leathers.

UNIT V DESTRUCTIVE TESTING OF LEATHERS 9

Static and Dynamic methods, Strength and fastness properties

i. Strength Properties

- Tensile Strength and Elongation at break
- Tongue tear strength

c) Stitch tear and slit tear strengths

ii. Fastness Properties

- a) Rub fastness
- b) Light fastness

TOTAL: 75 PERIODS

COURSE OUTCOMES:

At the end of the course, the student would understand,

CO1. Explain the analytical chemistry behind the testing of leather chemicals and leathers.

CO2. Apply the various techniques for analysing leather chemicals, spent process liquors, and pelts/ leathers.

CO3. Classify the quality Standards of various leather chemicals and leather end products.

CO4. Perceive the importance of microbiology testing techniques of leathers.

CO5. Discuss the various physical testing methods of leathers.

TEXT BOOKS AND REFERENCES:

1. Sarkar, P.K., 'Analytical Chemistry of Leather Manufacture', Indian Leather Technologists Association, Calcutta, 1982.
2. 'Official methods of Analysis', Society of Leather Technologists and Chemists, U.K., 1981.
3. Fred O Flaherty, Roddy, T.W. and Lollar, R.M. 'The Chemistry and Technology of Leather', Vol.IV, Evaluation of leather, Rober E. Krieger Publishing Co., New York, 1978.
4. Dutta, S.S. "An introduction to the principles of physical testing of leather", Indian Leather Technologist's Association, Calcutta, 1991.
5. 'Methods of chemical testing of leathers', IS: 582 - 1970, Bureau of Indian Standards, New Delhi, 1977.
6. "Methods of Physical testing of leathers, IS: 5914-1970, Bureau of Indian Standards, New Delhi, 1971.

COURSE ARTICULATION MATRIX:

Course Outcome	Program Outcome														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	1	1	2	1	1	2	1	1	-	1	1	3	2
CO2	3	1	1	1	2	1	1	-	1	1	-	1	1	2	1
CO3	3	2	1	1	2	1	1	1	1	1	-	1	1	2	1
CO4	3	2	1	1	2	1	1	1	1	1	-	1	1	3	2
CO5	3	2	1	1	2	1	1	1	1	1	-	1	1	3	2

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

LT23401

**SEMESTER IV
LEATHER FROM HIDES**

**L T P C
3 0 2 4**

COURSE OBJECTIVE: This course aims at imparting knowledge in the technology of making different types of light and heavy leathers from hides.

UNIT I PRODUCT BRIEF 7+6

Product brief of various light and heavy leather manufacture from hides. Raw material availability. Usage of imported hides in leather manufacturing.

UNIT II PROCESS TECHNOLOGIES 10+6

Process details to achieve the specifications for the following leathers: Full chrome/Semi chrome/Chrome retan - uppers, suedes, nubuck, lining, nappa, shrunken grain, upholstery, burnishable, printed leathers; Upgradation technologies; Rectification of defects in hides.

UNIT III LIGHT LEATHERS 9+6

Property requirement of upper, garment and other light leathers such as industrial gloves from hides; Process design considerations; Choice of raw material; Standards for light leathers from hides. Manufacture of Hair-on/Fur-on leathers, Upholstery leathers, Upper leathers, Nubuck leathers and Suede leathers.

UNIT IV HEAVY LEATHERS 10+6

Property requirement of sole, harness, saddle and other industrial leathers from hides; Process design considerations; Choice of raw material; Traditional and modern methods; standards for heavy leathers. Heavy leather for strategic sector. Processing of vegetable tanned and chrome tanned sole leathers. Processing of belting leathers, harness and saddle leathers.

UNIT V SPORTS GOODS LEATHERS 9+6

Different types of raw materials used, physical and chemical properties required and process details to achieve the specifications for the following sports goods leathers: Leathers for football, volley ball, hockey ball and cricket ball. Glove leathers for wicket keepers and boxing. Manufacture of Cricket ball leathers.

TOTAL: 75 PERIODS

COURSE OUTCOMES:

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

CO1. Compare and classify the basic product brief of light and heavy leather manufacture from hides.

CO2. Analyse the property requirement and process design of heavy leather.

CO3. Evaluate the property requirement and process design of light leather.

CO4. Perceive in depth knowledge in process technology for leather from hides.

CO5. Compile the physical and chemical properties of raw materials used in sports goods leathers.

TEXT BOOKS AND REFERENCES:

1. Choichi Ogiwara, 'A practical guide to heavy leather processing', Fuel and Leather Research Centre, Karachi, 1980.
2. Tuck, D.H. 'The manufacture of upper leathers', Tropical Products Institute, London, 1981.
3. Jyotirmay Dey, 'Practical aspects of the manufacture of upper leather', Indian Leather Technologists Association, Calcutta, 1989.

COURSE ARTICULATION MATRIX:

Course Outcome	Program Outcome														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	-	-	1	2	1	2	1	1	1	1	2	1	3	2
CO2	3	2	1	1	2	-	2	1	-	1	1	2	-	3	2
CO3	3	2	1	1	1	1	2	1	1	-	1	2	1	2	1
CO4	3	-	1	-	1	1	1	1	1	1	1	1	1	3	2
CO5	3	2	-	-	2	-	1	1	-	1	-	1	1	-	2

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

COURSE OBJECTIVE:

- At the end of this course, the students will gain comprehensive knowledge on the chemistry of various vegetable and organic tanning agents and the mechanisms of their interaction with the skin protein, collagen. The course will also provide practical orientation on vegetable and organic tanning processes, with a special focus on the production of wet white leather.

UNIT I VEGETABLE TANNINS**6+3**

Definition and classification of vegetable tannins - Occurrence and biosynthesis

Chemistry of hydrolysable tannins: Gallotannins and Ellagitannins - Structural aspects including tannin dimers, trimers, etc. - Chemistry of condensed (flavonoid) tannins: proanthocyanidins, dimers, trimers, and other oligomers - Isolation and characterization of vegetable tannins.

UNIT II VEGETABLE TANNING MATERIALS AND PRACTICE**9+8**

Tannins and non-tannins - Polyphenolic constituents in popular tanning materials: Wattle, Quebracho, Myrobalan, etc. Pit tanning and drum tanning - Manufacture of E.I. leathers - Modern practices in Vegetable tanning

UNIT III MECHANISM AND PRACTICE OF VEGETABLE TANNING**9+8**

Mechanism of reaction of vegetable tannins with collagen - Electrolytic equilibria, diffusion equilibria, fixation, and absorption equilibria - General practices in vegetable tanning. Practice of vegetable and organic tanning processes

UNIT IV OTHER ORGANIC TANNAGES**9+8**

Tanning with Aldehyde, Dialdehydes, Oil, Phosphonium, Triazines, Olive and other organic tanning agents; Wet white leathers - Mechanism of reaction with collagen. production of wet white leather

UNIT V VEGETABLE TANNIN EXTRACTION**9+6**

Methods of preparation of vegetable tannin extracts - Quantitative & qualitative analysis of Tannin. Demonstration and practice sessions on the preparation of vegetable

TOTAL: 75 PERIODS**COURSE OUTCOMES:**

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

CO1. Summarize the basic structure and classification of vegetable tannins.

CO2. Utilize the different constituents of vegetable tanning materials to assess tanning chemistry.

CO3. Comprehend the chemistry of vegetable tannins and the mechanism of vegetable and organic tanning processes.

CO4. Explain the mechanism of various organic tannages and their application in wet white leather production, with practical experience in the production of wet white leathers

CO5. Formulate methods for the preparation of vegetable tannins.

TEXT BOOKS AND REFERENCES:

1. Howes, F.N. "Vegetable tanning materials", Butterworth. London, 1953.
2. Rodd, "Chemistry of carbon compounds", Vol. III-D, Chapter on "Hydrolysable tannins".
3. Haslam, E. "The biochemistry of Plants", Vol.7. Academic Press, 1981, Chapter 18, "Vegetable tannins". "A survey of modern vegetable tannages". Tanning extracts Producers Federation, Switzerland, 1975.
4. Humphreyes, G.H.W. and Jones, C.R. "The manufacture of sole and other heavy leathers". Pergamon Press, 1966. Chapter 5, "Vegetable tannin materials and syntans".
5. O'Flaherty and Roddy, T.W., Lollar, R.M. "The Chemistry and Technology of Leather", Vol. II. Krieger Publishing Corp., New York, 1977.
6. Gustavson, K.H. "Chemistry of Tanning Processes" Academic Press, New York, 1950.
7. Vegetable and Synthetic Tanning agents, Sundara Rao, V.S., et al – The Leather Industry, (ed. Bu Sadulla, S) Kothari Desk book series, H.C. Kothari Group (Publications Division), Madras, p.71, 1995.

COURSE ARTICULATION MATRIX:

Course Outcome	Program Outcome														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	3	1	1	-	-	1	1	2	3	2	2
CO2	3	3	2	2	3	1	1	-	-	1	1	2	3	2	2
CO3	3	2	2	2	3	1	1	-	-	1	1	2	3	2	2
CO4	3	2	2	2	3	1	1	-	-	1	1	2	3	3	3
CO5	3	3	2	2	3	1	1	-	-	1	1	2	2	2	2

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

COURSE OBJECTIVE:

- To impart knowledge on the chemistry and process of chrome and various inorganic tanning materials and systems.

UNIT I INTRODUCTION TO COORDINATION CHEMISTRY; METAL IONS IN TANNING 12

Werner's theory of coordination, origins of coordinative interactions, role of d and f orbitals, definition of ligands, nucleophilicity of ligands and electronegativity of donor atoms, chelation and masking, ligand field stabilisation energy and introduction of factors controlling molecular stability of transition metal complexes. Historical overview of mineral tanning.

UNIT II AQUEOUS CHEMISTRY OF MINERAL TANNING AGENTS 12

Electronic configuration and its implications, common oxidation states, redox stabilities, redox potentials and their interconversion, protolysis, kinetic inertness, basicity, olation, oxolation and polymerisation, Stiasny's series, McClandish precipitation point.

UNIT III FACTORS CONTROLLING MINERAL TANNING 12

Single and double bath chrome tannages and their relative merits and demerits, preparation of mineral tanning agents, reaction parameters influencing composition of BCS, kinetics of chrome tanning, diffusion and complexation, effects of float volume, waterless processing, pH, basicity, masking, temperature, drum speed and ageing.

UNIT IV MECHANISM OF MINERAL TANNING 12

Theories of chrome tanning, aluminium (III), zirconium (IV), titanium (IV) and iron(III); absorption, coating, electrostatic and hydrogen bond interactions and coordinative forces involved in chrome tanning, indirect evidence for chrome binding sites in protein, hydrothermal stability of chrome-collagen compound.

UNIT V OTHER INORGANIC TANNAGES 12

Chemistry of silicates and phosphates and their tanning mechanisms, mechanism and relevance of combination tanning.

TOTAL: 60 PERIODS**COURSE OUTCOMES:**

- At the end of the course, the students will be in the position to,
- CO1. Demonstrate the basics of coordination chemistry involved in inorganic tanning.
 - CO2. Function and relationships of aqueous chemistry of inorganic tannages.
 - CO3. Comprehend the chemistry of chromium and factors controlling chrome tanning.
 - CO4. Appraise the knowledge on mechanism of chrome tanning.
 - CO5. Elaborate the mechanism of various inorganic tannages.

Demonstration: Preparation of BCS

TEXT BOOKS AND REFERENCES:

1. Fred O Flaherty, Roddy, T.W. and Lollar, R.M. 'The Chemistry and Technology of Leather', Vol.III, Type of tannages, RoberE.Krieger Publishing Co.,New York, 1977.
2. Gustavson, K.H. 'Chemistry of Tanning Processes' Academic Press, New York, 1956.
3. Bienkiewicz 'Physical Chemistry of Leather Manufacture' Krieger, Florida 1982.
4. Covington A D, 'Tanning Chemistry' RSC Publishing, Cambridge, UK, 2009.
5. Howes, F.N. "Vegetable tanning materials", Butterworth. London, 1953.
6. Haslam, E. "The biochemistry of Plants", Vol.7. Academic Press, 1981, Chapter 18, "Vegetable tannins". "A survey of modern vegetable tannages". Tanning extracts Producers Federation, Switzerland, 1975.
7. Humphreyes, G.H.W. and Jones, C.R. "The manufacture of sole and other heavy leathers". Pergamon Press, 1966. Chapter 5, "Vegetable tannin materials and syntans".
8. Vegetable and Synthetic Tanning agents, Sundara Rao, V.S., et al – The Leather Industry, (ed. by Sadulla, S) Kothari Desk book series, H.C. Kothari Group (Publications Division), Madras, p.71, 1995.

COURSE ARTICULATION MATRIX:

Course Outcome	Program Outcome														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	-	-	1	-	1	1	-	1	-	1	1	3	1
CO2	3	3	1	-	1	1	3	1	2	1	-	1	1	2	2
CO3	3	2	1	-	1	2	2	1	1	1	-	1	1	3	2
CO4	3	1	-	-	1	-	2	1	-	1	-	1	1	3	2
CO5	3	3	3	-	1	2	2	1	2	1	-	1	1	2	1

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

COURSE OBJECTIVE:

To enlighten the students about

- The analysis & control of manufacturing systems
- The work, motion study & work measurements methods
- The structure and concepts of TQM
- The sequencing, scheduling and advanced optimizing Techniques
- The acquaintance in advanced optimization techniques & computer-aided process planning and control

UNIT I ANALYSIS AND CONTROL OF MANUFACTURING SYSTEMS 6

Production system –Forecasting and its types – Forecasting errors and tracking signals - Inventory costs - Inventory systems – Production Planning - Value stream management for lean office - Lot sizing.

UNIT II WORK DESIGN AND ERGONOMICS 6

Introduction to work study - Productivity – scope of motion and time study - Work methods design - Motion study - process analysis – process flow chart – man and machine chart Micro motion study - Work measurement and its methods - Ergonomics practices – human body measurement –design of controls and compatibility – vision and design of displays - Design of work space.

UNIT III TOTAL QUALITY MANAGEMENT 9

Concepts of quality systems - The total quality management system – Characteristics of the total quality management system - The task of quality department - organizing principles – Structural total quality department - Quality audit – objectives of audit – product auditing – audit methodology – quality rating – audit reporting.

UNIT IV SEQUENCING AND SCHEDULING 9

Introduction to Job Sequencing – sequencing Jobs on Parallel Machines – Minimization of Setup costs - Scheduling function and theory – scheduling problem: objectives - Scheduling of intermittent production: Resource smoothing - Scheduling of continuous production - Line balancing.

UNIT V ADVANCED OPTIMIZATION TECHNIQUES & COMPUTER-AIDED PROCESS PLANNING AND CONTROL 12

Introduction, Classification of optimization problems, Applications of optimization, constrain surface, objective function surfaces and multi- level optimization. Variant of process planning – preparatory stage – production stage – plan editing – parameter selection - forward and backward planning – input format.

TOTAL: 45 PERIODS

COURSE OUTCOME:

Upon completion of this course, the students will be able to:

CO1 Have a basic understanding of production system.

CO2 Acquire knowledge on work design & ergonomics.

CO3 Improve the performance of routine activities by application of appropriate industrial engineering tools.

CO4 Evaluate the functions of a product/service.

CO5 Apply value engineering in real life problems.

REFERENCES:

1. Elsayed A. Elsayed and Thomas O. Boucher, "Analysis and Control of Production Systems, Printice Hall Publ., 1994.
2. Barnes, Raeph.m., "Motion and Time Study – Design and Measurement of Work", John Wiley &sons, New York, 1990.
3. Rose, J.E., "Total Quality Management", Kogan page Ltd ,1993.
4. Michael Pinedoo, Scheduling: theory, algorithms and systems, Prentice Hall, New Delhi, 1995.
5. SingiresuS. Rao, "Engineering optimization – Theory and practices", John Wiley and Sons, 1998.
6. KhabalTaraman, 'CAD/CAM integrates and innovation', Computer and Automated systems association of SME, 2001.

COURSE ARTICULATION MATRIX:

Course Outcome	Program Outcome														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	1	1	-	-	2	3	3	2	-	-	-	2	-	-
CO2	2	1	1	-	-	2	3	3	-	-	-	-	2	-	-
CO3	1	1	1	-	-	2	3	3	-	-	-	-	2	-	-
CO4	1	1	1	-	-	3	3	3	-	-	-	-	2	-	-
CO5	-	-	-	-	-	3	2	2	1	-	-	-	2	-	-

7. 1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively.

COURSE OBJECTIVE:

- At the end of the course, the student would understand the basic concepts of unit operations, material and energy balances, fluid dynamics mass and heat transfer in various unit operations such as distillation, extraction, drying and humidification. The student also would be familiar with size reduction, separation and mixing techniques, Principles and applications of unit processes involved in leather and leather chemicals manufacture.

UNIT I CONCEPTS, TRANSPORTATION & METERING OF FLUIDS 7

Concepts of unit operations and processes; Fundamentals - unit and dimensions; Material and energy balances; Measurement of pressure drop and fluid velocity; Valves, Pumps, Compressor, Blowers; Fluid statics and dynamics; Compressible and incompressible fluids; Newtonian and Non-Newtonian fluids.

UNIT II HEAT AND MASS TRANSFER 14

Fundamentals of heat transfer; Heat transfer equipment; Heat exchangers; HMT evaporators and condensers; Simple design calculations. Diffusion: Binary diffusion, concept of mass transfer coefficients and interface mass transfer and stage wise contact. Distillation: Principle of distillation, Application of distillation in leather chemicals and auxiliaries processing.

Extraction: Extraction principles, Leaching and Extraction equipment and their application in leather chemicals manufacture.

Drying: Drying characteristics, theory and mechanism of drying, estimation of drying rate, design and performance of industrial dryers for leather and chemicals.

Humidification: Humidity charts, methods of humidification and dehumidification; Equipments and their design aspects; Humidity control in leather processing.

UNIT III MECHANICAL OPERATIONS 4

Size reduction; Theory and equipment; Application in leather chemical processing; Types of mills used in pigment manufacture; Clarification - Principles of clarification; Liquid-Liquid; Liquid-solid and Liquid-gas separations; Application in leather processing and effluent treatment; Mixing - Basic theory and application in leather and leather chemical processing.

UNIT IV PRINCIPLES OF UNIT PROCESSES IN LEATHER AND LEATHER CHEMICALS MANUFACTURE 10

General concepts for unit processes; Development of process flow sheets with reference to leather and leather chemical industries design; Principles of halogenations; Esterification; Hydrolysis; Oxidation, Hydrogenation, Polymerization,

Sulphation, Sulphonation, Condensation, Diazotization and Coupling. Manufacture of bulk chemicals used in leather processing.

UNIT V DESIGN OF PROCESS VESSEL AND TANNERY LAYOUT

10

Various aspects governing float reduction, diffusion, time, chemical uptake and energy reduction through process vessel design. Relevance of Tannery layout on productivity.

TOTAL: 45 PERIODS

COURSE OUTCOMES

- CO1. The basic concepts of unit operations, material and energy balances, fluid dynamics
- CO2. Mass and heat transfer in various unit operations such as distillation, extraction, drying and humidification etc.
- CO3. Size reduction, separation and mixing techniques involved in the processing of leather and leather chemicals.
- CO4. Principles of various unit processes in leather and leather chemicals manufacture
- CO5. Application of unit processes in leather and leather chemicals manufacture

TEXT BOOKS

1. McCabe and Smith, J.C., Unit Operations in Chemical Engineering, McGraw Hill, Fourth Ed., 1993.
2. Treybal, R.E., Mass Transfer Operations, McGraw Hill Book Company, Third Ed. 1981.
3. Coulson, J.M., and Richardson, J.F., Chemical Engineering, Vol. I and II Third Ed. Pergamon press, 1978.

REFERENCE

1. Welty, J.R., Wilson, R.E., and Wicks, C.E. Fundamentals of momentum, Heat and Mass Transfer, Third Ed., John Wiley, 1984.
2. Green, D.W. and Perry, J.H., Chemical Engineers Handbook, McGraw Hill, New York, Eighth Ed., 2007.

COURSE ARTICULATION MATRIX:

Course Outcome	Program Outcome														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	1	1	-	-	2	3	3	2	-	-	-	2	-	-
CO2	2	1	1	-	-	2	3	3	-	-	-	-	2	-	-
CO3	1	1	1	-	-	2	3	3	-	-	-	-	2	-	-
CO4	1	1	1	-	-	3	3	3	-	-	-	-	2	-	-
CO5	-	-	-	-	-	3	2	2	1	-	-	-	2	-	-

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

MODULE I –OVERVIEWOF STANDARDS**6**

Basic concepts of standardization; Purpose of Standardization, marking and certification of articles and processes; Importance of standards to industry, policy makers, trade, sustainability and innovation. Objectives, roles and functions of BIS, Bureau of Indian Standards Act, ISO/IEC Directives; WTO Good Practices for Standardization. Important Indian and International Standards.

MODULE II- STANDARDS FOR LEATHER SECTOR**9**

Overview of Indian Standards for Leather Sector; Primary and Complementary Standards; Standards aligned with International Standards; Various Aspects of Standards – Terminology, Code of Practice, Product Specification, Identification and Method(s) of Test(s), Dimension etc. Raw Materials – Slaughtering and Best Practices, Grading and Description of Defects, Chemicals and Assay, Process Chemicals and Specifications, Components for Footwear and Leather Articles and Performance Requirements; Fully Processed or Finished Leather - Specifications concerning Utility, Quality and Performance Requirements; Finished Products like Footwear, Gloves, Garments, Bags and Industrial applications – Specifications and Performance Requirements; Leather Care Products-Wax, Polishes, Lac Products etc.; Restricted Substances List; Screening and Innocuousness Tests; Eco-Compliance and Norms; Water for Tanning Industry and Testing activities; Environmental Management and Effluent Discharge Norms; Wastewater Analysis and Test methods.

COURSE OBJECTIVE:

The objective of the course is four-fold:

1. Development of a holistic perspective based on self-exploration about themselves (human being), family, society and nature/existence.
2. Understanding (or developing clarity) of the harmony in the human being, family, society and nature/existence
3. Strengthening of self-reflection.
4. Development of commitment and courage to act.

Module I: Introduction**(3L,6P)**

Purpose and motivation for the course, recapitulation from Universal Human Values-I, Self-Exploration– Its content and process; ‘Natural acceptance’ and Experiential Validation- as the process for self-exploration Continuous Happiness and Prosperity- A look at basic Human Aspirations Right understanding, Relationship and Physical Facility- the basic requirements for fulfilment of aspirations of every human being with their correct priority Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario, Method to fulfil the above human aspirations: understanding and living in harmony at various levels.

Practical Session: Include sessions to discuss natural acceptance in human being as the innate acceptance for living with responsibility (living in relationship, harmony and co-existence) rather than as arbitrariness in choice based on liking-disliking

Module II: Harmony in the Human Being**(3L,6P)**

Understanding human being as a co-existence of the sentient ‘I’ and the material ‘Body’, Understanding the needs of Self (‘I’) and ‘Body’ - happiness and physical facility, Understanding the Body as an instrument of ‘I’ (I being the doer, seer and enjoyer), Understanding the characteristics and activities of ‘I’ and harmony in ‘I’, Understanding the harmony of I with the Body: Sanyam and Health; correct appraisal of Physical needs, meaning of Prosperity in detail, Programs to ensure Sanyam and Health.

Practical Session: Include sessions to discuss the role others have played in making material goods available to me. Identifying from one’s own life. Differentiate between prosperity and accumulation. Discuss program for ensuring health vs dealing with disease.

Module III: Harmony in the Family and Society**(3L,6P)**

Understanding values in human-human relationship; meaning of Justice (nine universal values in relationships) and program for its fulfilment to ensure mutual happiness; Trust and Respect as the foundational values of relationship, Understanding the meaning of Trust; Difference between intention and competence, Understanding the meaning of

Respect, Difference between respect and differentiation; the other salient values in relationship, Understanding the harmony in the society (society being an extension of family): Resolution, Prosperity, fearlessness (trust) and co-existence as comprehensive Human Goals, Visualizing a universal harmonious order in society- Undivided Society, Universal Order- from family to world family.

Practical Session: *Include sessions to reflect on relationships in family, hostel and institute as extended family, real life examples, teacher-student relationship, goal of education etc. Gratitude as a universal value in relationships. Discuss with scenarios. Elicit examples from students' lives*

Module IV: Harmony in the Nature and Existence (3L,6P)

Understanding the harmony in the Nature, Interconnectedness and mutual fulfilment among the four orders of nature- recyclability and self regulation in nature, Understanding Existence as Co-existence of mutually interacting units in all- pervasive space, Holistic perception of harmony at all levels of existence.

Practical Session: *Include sessions to discuss human being as cause of imbalance in nature (film "Home" can be used), pollution, depletion of resources and role of technology etc.*

Module V: Implications of Harmony on Professional Ethics (3L,6P)

Natural acceptance of human values, Definitiveness of Ethical Human Conduct, Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order, Competence in professional ethics: a. Ability to utilize the professional competence for augmenting universal human order b. Ability to identify the scope and characteristics of people friendly and eco-friendly production systems, c. Ability to identify and develop appropriate technologies and management patterns for above production systems. Case studies of typical holistic technologies, management models and production systems, Strategy for transition from the present state to Universal Human Order: a. At the level of individual: as socially and ecologically responsible engineers, technologists and managers b. At the level of society: as mutually enriching institutions and organizations, Sum up.

Practical Session: *Include Exercises and Case Studies will be taken up in Sessions E.g. To discuss the conduct as an engineer or scientist etc.*

TOTAL: 45 (15 Lectures + 30 Practicals) PERIODS

COURSE OUTCOME:

By the end of the course, the students will be able to:

1. Become more aware of themselves, and their surroundings (family, society, nature);
2. Have more responsible in life, and in handling problems with sustainable solutions, while keeping human relationships and human nature in mind.
3. Have better critical ability.

4. Become sensitive to their commitment towards what they have understood (human values, human relationship and human society).
5. Apply what they have learnt to their own self in different day-to-day settings in real life, at least a beginning would be made in this direction.

REFERENCES:

1. Human Values and Professional Ethics by R R Gaur, R Sangal, G P Bagaria, Excel Books, New Delhi, 3rd revised edition, 2023.
2. Jeevan Vidya: Ek Parichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999.
3. Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
4. The Story of Stuff (Book).
5. The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi
6. Small is Beautiful - E. F Schumacher.
7. Slow is Beautiful - Cecile Andrews.
8. Economy of Permanence - J C Kumarappa
9. Bharat Mein Angreji Raj - PanditSunderlal
10. Rediscovering India - by Dharampal
11. Hind Swaraj or Indian Home Rule - by Mohandas K. Gandhi
12. India Wins Freedom - Maulana Abdul Kalam Azad
13. Vivekananda - Romain Rolland (English)
14. Gandhi - Romain Rolland (English)

Web URLs:

1. Class preparations: <https://fdp-si.aicte-india.org/UHV-II%20Class%20Note.php>
2. Lecture presentations: https://fdp-si.aicte-india.org/UHV-II_Lectures_PPTs.php
3. Practice and Tutorial Sessions: <https://fdp-si.aicte-india.org/UHV-II%20Practice%20Sessions.php>

Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
C01						1	1	1	3			3
C02						1	1	1	3			3
C03						3	3	2	3		1	3
C04						3	3	2	3		1	3
C05						3	3	3	3		2	3

COURSE OBJECTIVE: This course aims at imparting knowledge in the technology of making different types of light leathers from skins.

UNIT I PROPERTIES OF LEATHER 9+6

Classification of leathers, Definition of various leather properties, Understanding and measurement of properties, Relevance and significance of various leather properties in manufacture and usage for different end application. Raw material availability and significance of imported in skins in light leather manufacture. Manufacture of Natural crust from wet blue leathers.

UNIT II UPPER AND LINING LEATHERS 9+6

Shoe upper, lining leathers: Choice of raw materials, relationship between each leather property and process parameter; Rational of preparation of the same. Manufacture of upper and lining leathers

UNIT III GARMENT AND GLOVE LEATHERS 9+6

Garment nappa, fine glove leathers: Choice of raw materials, relationship between each leather property and process parameter; Rational of preparation of the same. Manufacture of garment and glove leathers

UNIT IV SPECIALITY LEATHERS 9+6

Chamois, suede garment, glazed kid leathers, Fur on leather etc: Choice of raw materials, relationship between each leather property and process parameter; Rational of preparation of the same. Manufacture of Mesh leathers, Shrunken grain leathers and Chamois leathers

UNIT V LIGHT LEATHER MANUFACTURE 9+6

Practical aspects associated with manufacture of leathers such as glazed kid, nappa garment, fine glove, suede garment and lining; Quality control aspects with special reference to light leather manufacture.

TOTAL: 75 PERIODS

COURSE OUTCOMES:

At the end of the course, the students will be in a position to,
CO1. Summarize the property variations of different leathers
CO2. Design and Design suitable processing variations that are required to manufacture leather from skin.
CO3. List out the various method to develop specialty leathers from skin
CO4. Explain and understand the leather property and process parameter.
CO5. Comprehend the quality control aspects of light Leather

TEXT BOOKS AND REFERENCES:

1. Briggs, P.S. 'Gloving, clothing and special leathers', Tropical Products Institute, London, 1981.

2. Kartheiz, Fuchs, H.P. 'The Chemistry and technology of Novelty Leathers' FAO, United Nations, Rome.
3. CLRI Process Bulletins.

COURSE ARTICULATION MATRIX:

Course Outcome	Program Outcome														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	1	1	-	-	-	2	-	1	-	1	0	3	2
CO2	3	3	1	1	2	1	2	2	1	1	1	1	0	3	3
CO3	3	3	1	1	2	1	2	2	1	1	1	1	2	3	1
CO4	3	3	1	1	2	1	2	2	1	1	1	1	2	3	3
CO5	3	3	1	1	3	2	2	2	2	1	2	1	1	3	1

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

COURSE OBJECTIVE:

- To impart knowledge on basic aspects of leather products.

UNIT I DESIGN AND DEVELOPMENT 8

Leather Goods & Garments – Classification, Measurement/ sizing for various types of garments, pattern design of leather goods and garments, pattern grading for leather garments. CAD applications. Fashion and material trends.

Footwear- Classification, introduction to last and its importance, measures, sizes, pattern design, pattern grading, CAD Applications.

UNIT II MATERIALS AND COMPONENTS 20

Leather Goods & Garments - Selection of leathers, alternative materials, accessories, grinders, property requirement for leather and other materials.

Footwear-Selection of leather/Non leather materials, upper & lining, insole, counter stiffener, Soles, heels, shank, fitting, grinders.

UNIT III OPERATIONS 18

Leather Goods & Garments - Pre assembly and assembly, sequence of operations, various constructions

Footwear - Cutting, preclosing, closing, lasting operations, various constructions – Cemented, Mc Kay, DVP & DIP

General: Quality control in leather products, finishing & Maintenance of leather products.

UNIT IV MACHINERY 8

Leather Goods & Garments – Clicking, splitting, skiving, sewing machine.

Footwear – Clicking, spilling, skiving, sewing machine, lasting machine.

General: Principles and maintenance of machine.

UNIT V ORGANISATION AND MANAGEMENT 6

Plant lay out, costing and pricing for leather products, occupational health and safety, ISO 9000 and 14000, Human Resource Development.

TOTAL: 60 PERIODS**Course Outcome**

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

CO1. Explain the basic of design and development of leather goods, garments and footwear.

CO2. Identify various materials and components required for leather goods, garments and footwear fabrication process.

CO3. Outline the sequence of operations for manufacturing leather goods, garments and footwear.

CO4. Elaborates the machineries required for the fabrication of leather products.

CO5. Understand the organization and management strategies for the leather product industries.

TEXT BOOKS AND REFERENCES:

1. Cott, N.F., "American Shoe Making", Shoe Trades Publishing Co., Cambridge. 1993.
2. "Shoes and Leather News", Published by bureau of foreign and domestic commerce, Dept of commerce, US, 1940.
3. B. Venkatappaiah, (1997), "Introduction to modern footwear technology" Chennai. - GOTETI GRAPHICS.
4. Pattern Making Manual - Womens Garments, ESMOD, Paris, 1991.
5. Fashion Drawing Method, ESMOD, Paris, 1992.
6. Metric Pattern cutting for Menswear, Winifred Aldrich, BSP Professional Books, London, 1990.
7. Grading Manual, ESMOD, Paris, 1994.
8. Skiving Manual, First Edition, 1994 CLRI, Madras.
9. A course manual on leather garment pattern designing.
10. Leather garments making, NIMI publication, 2012.
11. Leather and sports goods – Pattern and Template marker, NIMI Publications, 2011.

COURSE ARTICULATION MATRIX:

Course Outcome	Program Outcome														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	1	-	-	-	2	-	-	1	-	2	1	3	2
CO2	3	2	2	-	1	-	-	-	-	2	-	2	1	3	1
CO3	2	1	2	-	1	1	1	1	1	2	1	2	1	3	2
CO4	3	2	2	2	1	1	3	2	2	2	-	2	2	3	3
CO5	3	2	1	2	1	1	3	2	2	1	-	2	2	3	3

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

COURSE OBJECTIVE:

- To impart knowledge on materials and processes/operations involved in leather finishing.

UNIT I SURFACE COATING 9+6

Theory of surface coating; Characteristics of various components of coating system; Parameters of the process of coating and its influence on coating characteristics. Finishing of leather components and leather products, Trouble shooting in finishing.

UNIT II PIGMENTS 9+6

Classification of pigments; Inorganic, organic, nacreous (pearlescent) and interference pigments - their representation code in the colour index. Different forms of pigments - powders and pastes. Evaluation and control of their brilliance, opacity, particle size, resistance to solvent, heat and light and colour matching.

UNIT III POLYMERIC MATERIALS AND THEIR DISPERSION FORMS 9+6

Resins binders - acrylics, vinyls and urethanes, protein binders, cellulose nitrate, cellulose acetate butyrate, - protein binders - lacquers - emulsion and emulsifiers - evaluation and control - solvents and thinners. Water repellent finishing, Patent finishing, Wax /oil coated leathers, Finishing of split leathers.

UNIT IV PRINCIPLES OF FINISHING, FINISH FORMULATIONS AND THEIR APPLICATION 9+6

Selection, formulation and application of various components of finished system for different types of leathers. Preparation of formulations for base coat, season coat and top coat

UNIT V FINISHING METHODS AND TECHNIQUES 9+6

HVLP spray, Roller coats, Continuous embossing machines, Finiflex, etc. Methods and techniques of various finishing such as oil pull-up, waxy, burnishable, antique, grain suede, screen printing, roller printing, tie and dye finishing. Pearl finishing, easy-care and patent finishing, cationic finishing, foam finishing, transfer foil, lamination, transfer coating, texture modification/creation using perforation, scaling, engraving and foil transfer. Practise on Modern methods of finishing - Roller coating, Transfer coating, Lamination finish, Embossing, scaling and perforation of leathers. Cationic and foam finishing techniques.

TOTAL: 75 PERIODS**COURSE OUTCOMES:**

On the completion of the course students are expected to,
CO1. Demonstrate the role of various finishing agents and auxiliaries used in leather finishing.
CO2. Inspect the various strategies for finishing different types of leathers.
CO3. Categorize the various upgradation technologies for enhancing value to low grade substrates.

CO4. Perceive the application of different machineries used in leather finishing.

CO5. Discuss the principles of finishing mechanisms.

TEXT BOOKS AND REFERENCES:

1. Pattern. T.E., Pigment Hand Book, vol.3 ed. W.J., New York, 1973.
2. Patterson, P., Pigments - An Introduction to Theory of Physical Chemistry, Elsevier Publishing Co. Ltd., Amsterdam, 1967.
3. Treatise on coating, Misers and Long Ed., Marcel Dekker, New York (5 Vol.).
4. Sharphouse, J.H., "Leather Technicians Handbook", Leather Producers Association, Northampton NN3 1JD, Reprinted 1995.

COURSE ARTICULATION MATRIX:

Course Outcome	Program Outcome														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	-	-	2	1	-	1	1	1	-	2	2	3	2
CO2	3	1	-	-	-	-	-	1	1	1	-	2	1	3	2
CO3	3	2	1	-	2	-	1	1	1	1	-	2	-	3	2
CO4	3	3	2	-	3	2	2	1	1	1	-	2	1	3	1
CO5	3	3	2	-	3	2	2	1	1	1	-	2	1	3	3

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

OBJECTIVE:

- To educate students about the importance of studying environmental science and engineering in course curriculum and to create awareness in protection of environment.

UNIT I ENVIRONMENT, ECOSYSTEMS, BIODIVERSITY AND SUSTAINABLE DEVELOPMENT 8

Definition of environment and components in the environment- definition of an ecosystem, concept and functions of different ecosystems like (a) forest ecosystem (b) grassland ecosystem (c) desert ecosystem (d) aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)- biodiversity, threats to biodiversity and conservation of biodiversity- sustainable development and significance of sustainable development in environmental related issues.

UNIT II ENVIRONMENTAL POLLUTION AND CHEMISTRY 14

Definition of pollution- different types of environmental pollution- classification of pollutants in water and wastewater – characterization of pollutants in water and wastewater - environmental significance - types of sampling, significance of sampling, precautions to be taken while sampling and preservation of samples.

Atmospheric structure and composition - definition of air pollution – sources and classification of air pollutants and their effect on human health, vegetation, animals, property, aesthetic value and visibility- ambient air quality and emission standards –photochemical smog, ozone layer depletion, greenhouse gases, global warming, acid rain and their effect on environment. Definition, types and sources of solid and hazardous wastes - need for solid and hazardous waste management – elements of integrated waste management and role of stakeholders – definition, types and sources of nuclear and radioactive wastes – waste management and disposal.

UNIT III WASTEWATER TREATMENT AND DISPOSAL 10

Unit operations and processes- principles of physical treatment: screening, mixing, equalization, sedimentation, filtration - principles of chemical treatment: coagulation, flocculation, precipitation, flotation - objectives of biological wastewater treatment and various process- need for tertiary treatment, Membrane Process including Reject Management. Field visits to water treatment plant, Sewage Treatment Plant and Common Effluent Treatment Plant.

UNIT IV ENVIRONMENTAL IMPACT & RISK ASSESSMENT 9

Definition and over view of Environmental Impact Assessment (EIA), key issues in EIA, legal and regulatory aspects in India – types and limitations of EIA –public participation in EIA- EIA process: screening, scope, setting, analysis – risk analysis - sources of environmental risks – risk management - risk communication and risk perception- emergency preparedness.

UNIT V ENVIRONMENTAL POLICIES AND LEGISLATION

4

Environmental legislations in India- environment protection act – air (prevention and control of pollution) act – water (prevention and control of pollution) act – wildlife protection act – forest conservation act – solid and hazardous waste management rules - biomedical waste rules – responsibilities of generators- role and responsibility of pollution control boards.

REFERENCES:

1. Gilbert M.Masters, 'Introduction to Environmental Engineering and Science', 2nd edition, Pearson Education (2004).
2. Sawyer,C.N., MacCarty, P.L. and Parkin, G.F., Chemistry for Environmental Engineering and Science, Tata McGraw – Hill, Fifth edition, New Delhi 2003.
3. Metcalf and Eddy, Wastewater Engineering, Treatment and Reuse, Tata McGraw Hill, New Delhi, 2003.
4. Peavy HS, Rowe DR, Tchobanoglous G (1985) Environmental Engineering. (Eds: McGraw-Hill International Editions), Civil Engineering Series, 577.
5. Petts, J., Handbook of Environmental Impact Assessment, Vol., I and II, Blackwell Science, London, 1999.

Each student is expected to undertake 1-month practical training on aspects associated with leather manufacture in Tanneries and or Leather Chemical supplier units as a part of Industrial Internship – I during the summer vacation after fourth semester. The evaluation for this course will be carried out in fifth semester. During fifth semester the student should submit (to assigned faculty) an industrial training report on practical internship undertaken. The report should be based on the practical experience gained at the industry, which should be duly certified by the production in- charge of the industry. The objective of the training is to enhance the practical knowledge of the students on various aspects associated with leather manufacture. Faculty will assess the students to judge the level of proficiency, originality and capacity for application of the practical knowledge attained by the student during the training period.

TOTAL: 4 WEEKS**COURSE OUTCOMES:**

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

CO1. Relate the industry-based work experience

CO2. Apply and compare classroom knowledge with industrial exposure

CO3. Develop professional skills and competencies

COURSE ARTICULATION MATRIX:

Course Outcome	Program Outcome														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	2	-	2	2	2	2	3	2	1	3	2	3	3
CO2	2	2	2	-	2	2	2	2	3	2	1	3	-	3	3
CO3	2	2	2	-	2	2	2	2	3	3	1	3	1	3	3

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

COURSE OBJECTIVES:

1. Learn basic concepts in entrepreneurship, develop mind-set and skills necessary to explore entrepreneurship
2. Apply process of problem - opportunity identification and validation through human centred approach to design thinking in building solutions as part of engineering projects
3. Analyse market types, conduct market estimation, identify customers, create customer persona, develop the skills to create a compelling value proposition and build a Minimum Viable Product
4. Explore business models, create business plan, conduct financial analysis and feasibility analysis to assess the financial viability of a venture ideas & solutions built with domain expertise
5. Prepare and present an investible pitch deck of their practice venture to attract stakeholders

MODULE – I: ENTREPRENEURIAL MINDSET 4L,8P

Introduction to Entrepreneurship: Definition – Types of Entrepreneurs – Emerging Economies – Developing and Understanding an Entrepreneurial Mindset – Importance of Technology Entrepreneurship – Benefits to the Society.

Case Analysis: Study cases of successful & failed engineering entrepreneurs - Foster Creative Thinking: Engage in a series of Problem-Identification and Problem-Solving tasks

MODULE – II: OPPORTUNITIES 4L,8P

Problems and Opportunities – Ideas and Opportunities – Identifying problems in society – Creation of opportunities – Exploring Market Types – Estimating the Market Size, - Knowing the Customer and Consumer - Customer Segmentation - Identifying niche markets – Customer discovery and validation; Market research techniques, tools for validation of ideas and opportunities

Activity Session: Identify emerging sectors / potential opportunities in existing markets - Customer Interviews: Conduct preliminary interviews with potential customers for Opportunity Validation - Analyse feedback to refine the opportunity.

MODULE – III: PROTOTYPING & ITERATION 4L,8P

Prototyping – Importance in entrepreneurial process – Types of Prototypes - Different methods – Tools & Techniques.

Hands-on sessions on prototyping tools (3D printing, electronics, software), Develop a prototype based on identified opportunities; Receive feedback and iterate on the prototypes.

MODULE – IV: BUSINESS MODELS & PITCHING 4L,8P

Business Model and Types - Lean Approach - 9 block Lean Canvas Model - Riskiest Assumptions in Business Model Design – Using Business Model Canvas as a Tool – Pitching Techniques:

Importance of pitching - Types of pitches - crafting a compelling pitch – pitch presentation skills - using storytelling to gain investor/customer attention.

Activity Session: Develop a business model canvas for the prototype; present and receive feedback from peers and mentors - Prepare and practice pitching the business ideas- Participate in a Pitching Competition and present to a panel of judges - receive & reflect feedback

MODULE – V: ENTREPRENEURIAL ECOSYSTEM

4L,8P

Understanding the Entrepreneurial Ecosystem – Components: Angels, Venture Capitalists, Maker Spaces, Incubators, Accelerators, Investors. Financing models – equity, debt, crowdfunding, etc, Support from the government and corporates. Navigating Ecosystem Support: Searching & Identifying the Right Ecosystem Partner – Leveraging the Ecosystem - Building the right stakeholder network

Activity Session: Arrangement of Guest Speaker Sessions by successful entrepreneurs and entrepreneurial ecosystem leaders (incubation managers; angels; etc), Visit one or two entrepreneurial ecosystem players (Travel and visit a research park or incubator or makerspace or interact with startup founders).

TOTAL: 60 PERIODS

COURSE OUTCOMES:

Upon the successful completion of the course, students will be able to:

- CO1: Develop an Entrepreneurial Mind-set and Understand the Entrepreneurial Ecosystem Components and Funding types
- CO2: Comprehend the process of opportunity identification through design thinking, identify market potential and customers
- CO3: Generate and develop creative ideas through ideation techniques
- CO4: Create prototypes to materialize design concepts and conduct testing to gather feedback and refine prototypes to build a validated MVP
- CO5: Analyse and refine business models to ensure sustainability and profitability Prepare and deliver an investible pitch deck of their practice venture to attract stakeholders

REFERENCES:

7. Robert D. Hisrich, Michael P. Peters, Dean A. Shepherd, Sabyasachi Sinha (2020). Entrepreneurship, McGrawHill, 11th Edition
8. Bill Aulet (2024). Disciplined Entrepreneurship: 24 Steps to a Successful Startup. John Wiley & Sons.
9. Bill Aulet (2017). Disciplined Entrepreneurship Workbook. John Wiley & Sons.
10. Ries, E. (2011). The Lean Startup: How Today's Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses. Crown Business
11. Blank, S. G., & Dorf, B. (2012). The Startup Owner's Manual: The Step-by-Step Guide for Building a Great Company. K&S Ranch

12. Osterwalder, A., & Pigneur, Y. (2010). *Business Model Generation: A Handbook for Visionaries, Game Changers, and Challengers*. John Wiley & Sons
13. Marc Gruber & Sharon Tal (2019). *Where to Play: 3 Steps for Discovering Your Most Valuable Market Opportunities*. Pearson.

LT23701

**SEMESTER VII
REDUCE, REUSE AND RECYCLE**

**L T P C
3 0 0 3**

COURSE OBJECTIVE:

- To impart knowledge on reduce, reuse and recycle concepts in leather and leather products manufacture

UNIT I INTRODUCTION 10

What is Waste? Waste Management Hierarchy and 3R Principle of Reduce, Reuse and Recycle. Waste minimization – reducing waste generation at source. Principles of Waste Utilization and waste as a resource and recovery from waste. Types of waste. Characterization & Classification of waste. Concept of–Zero Waste–Zero Pollution–Zero Landfill. General methods of attaining zero pollution. Economics of zero pollution.

UNIT II WASTE TO ENERGY 8

Introduction to waste production in different sectors such as slaughterhouse, tannery, goods and garments manufacture and footwear. Waste-to-Energy – combustion, gasification, pyrolysis, biomethanation, bio-refineries. Landfill gas generation, collection conversion to fuels for useful energy applications-engine, compressors, burners, lamps etc.

UNIT III WASTE RECYCLING 8

Waste recycling to recover resources –Slaughter house, tannery, goods and garment and footwear industry

UNIT IV WASTE UTILIZATION 10

Technologies for Waste Utilization and cleaner production processes in Leather manufacture (Beam house, Tanning, Post tanning and finishing)

UNIT V BIO-BASED CHEMICALS AND PROCESSES 9

Shift towards bio-based and biodegradable chemicals, leather and leather products

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1. Explain waste as a resource aspect.

CO2. Identify and analyse different waste generation methods in different product sectors.

CO3. Perceive knowledge on waste recycling and develop new products.

CO4. Justify the different methods of waste utilization and cleaner leather processing techniques.

CO5. Elaborate the effect of implementation of RRR in the industry

TEXT BOOKS AND 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.

COURSE ARTICULATION MATRIX:

Course Outcomes	Program Outcome														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PS O1	PS O2	PSO 3
CO1	2	-	1	-	2	2	3	2	1	1	1	2	2	3	1
CO2	2	-	1	-	2	2	3	2	1	1	-	2	1	3	3
CO3	3	3	2	3	3	2	3	3	2	1	3	3	-	3	2
CO4	2	2	1	2	2	2	3	2	1	1	1	2	1	3	2
CO5	1	-	-	-	-	2	3	1	-	1	-	1	1	3	2

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

COURSE OBJECTIVES:

- Teach the need for quality, its evolution, basic concepts, contribution of quality gurus, TQM framework, Barriers and Benefits of TQM.
- Explain the TQM Principles for application.
- Define the basics of Six Sigma and apply Traditional tools, New tools, Benchmarking and FMEA.
- Describe Taguchi's Quality Loss Function, Performance Measures and apply Techniques like QFD, TPM, COQ and BPR.
- Illustrate and apply QMS and EMS in any organization.

UNIT I INTRODUCTION**9**

Introduction - Need for quality - Evolution of quality - Definition of quality - Dimensions of product and service quality –Definition of TQM-- Basic concepts of TQM --Gurus of TQM (Brief introduction) -- TQM Framework- Barriers to TQM –Benefits of TQM.

UNIT II TQM PRINCIPLES**9**

Leadership - Deming Philosophy, Quality Council, Quality statements and Strategic planning Customer Satisfaction –Customer Perception of Quality, Feedback, Customer complaints, Service Quality, Kano Model and Customer retention – Employee involvement – Motivation, Empowerment, Team and Teamwork, Recognition & Reward and Performance Appraisal-- Continuous process improvement – Juran Trilogy, PDSA cycle, 5S and Kaizen - Supplier partnership – Partnering, Supplier selection, Supplier Rating and Relationship development.

UNIT III TQM TOOLS & TECHNIQUES I**9**

The seven traditional tools of quality - New management tools - Six-sigma Process Capability; Bench marking - Reasons to benchmark, Benchmarking process, what to Bench Mark, Understanding Current Performance, Planning, Studying Others, learning from the data, Using the findings, Pitfalls and Criticisms of Benchmarking - FMEA - Intent, Documentation, Stages: Design FMEA and Process FMEA.

UNIT IV TQM TOOLS & TECHNIQUES II**9**

Quality circles – Quality Function Deployment (QFD) - Taguchi quality loss function – TPM – Concepts, improvement needs – Performance measures- Cost of Quality - BPR.

UNIT V QUALITY MANAGEMENT SYSTEM**9**

Introduction-Benefits of ISO Registration-ISO 9000 Series of Standards-Sector-Specific Standards - AS 9100, TS16949 and TL 9000-- ISO 9001 Requirements-Implementation-Documentation Internal Audits-Registration-ENVIRONMENTAL MANAGEMENT SYSTEM: Introduction—ISO 14000 Series Standards—Concepts of ISO 14001—Requirements of ISO 14001-Benefits of EMS.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1. Explain the TQM concepts in a selected enterprise.

CO2. Summarize the TQM principles in a selected enterprise.

CO3. Apply the six sigma, traditional tools, new tools, benchmarking and FMEA as TQM tools in leather manufacturing.

CO4. Analyze Taguchi's Quality Loss Function and Performance Measures on leather manufacturing sector and apply QFD, TPM, COQ and BPR.

CO5. Adapt QMS and EMS in leather-based organization.

TEXT BOOKS AND REFERENCES:

1. Dale H. Besterfield, Carol B. Michna, Glen H. Besterfield, Mary B. Sacre, Hemant Urdhwaresh and Rashmi Urdhwaresh, "Total Quality Management", Pearson Education Asia, Revised Third Edition, Indian Reprint, Sixth Impression, 2013.
2. Joel E. Ross, "Total Quality Management – Text and Cases", Routledge, 2017.
3. Kiran D. R, "Total Quality Management: Key concepts and case studies, Butterworth – Heinemann Ltd, 2016.
4. Oakland, J.S. "TQM – Text with Cases", Butterworth – Heinemann Ltd., Oxford, Third Edition, 2003.
5. Suganthi, L and Anand Samuel, "Total Quality Management", Prentice Hall (India) Pvt. Ltd., 2006.

COURSE ARTICULATION MATRIX:

Course Outcome	Program Outcome														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1	2	2	2	2	1	3	3	1	2	2	-	-	3
CO2	-	1	2	1	-	2	1	2	3	2	1	3	2	2	3
CO3	1	1	2	2	3	2	1	2	3	2	1	2	1	2	3
CO4	2	2	3	1	2	1	1	2	3	1	2	2	1	3	3
CO5	2	2	2	2	2	2	2	2	3	1	1	2	2	3	3

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

LT23702

SUMMER INTERNSHIP II

L T P C
0 0 4 2

Each student is expected to undertake 1-month practical training on aspects associated with leather or leather products manufacture as a part of Industrial Internship – II during the summer vacation after sixth semester. The evaluation of this programme will be carried out in seventh semester. During seventh semester the student should submit (to assigned faculty) an industrial training report on practical internship undertaken. The report should be based on the practical experience gained at the industry, which should be duly certified by the production in-charge of the industry. The objective of the training is to enhance the practical knowledge of the students on various aspects associated with leather manufacture. Faculty will assess the students to judge the level of proficiency, originality and capacity for application of the practical knowledge attained by the student during the training period.

TOTAL: 4 WEEKS

COURSE OUTCOMES:

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

CO1. Relate the industry-based work experience.

CO2. Apply and compare the classroom knowledge and theory with industrial exposure.

CO3. Develop professional skills and competencies.

COURSE ARTICULATION MATRIX:

Course Outcome	Program Outcome														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	2	2	2	2	2	3	1	1	3	1	2	3
CO2	3	2	2	2	2	3	2	2	3	1	1	3	1	1	3
CO3	3	1	3	2	2	-	2	2	3	1	1	3	2	2	3

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

LT23801

SEMESTER VIII
PROJECT WORK / SEMESTER LONG INTERNSHIP

L T P C
0 0 16 8

COURSE OBJECTIVE: 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. Each student is required to submit a report on the project undertaken by and assigned to him by the Department. The report should be based on the information available in the literature, plan of work, experimental details, data determined in the laboratory/industry, results, discussion of the data presented, conclusion and future work. Proper bibliographic details are necessary in the report.

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: 240 PERIODS

COURSE OUTCOMES:

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

CO1. identify a problem and define project objectives.

CO2. Plan and execute the project work.

CO3. Compare data and compile results.

CO4. Analyse and discuss the results.

CO5. Develop the skill to present and communicate the findings effectively.

COURSE ARTICULATION MATRIX:

Course Outcome	Program Outcome														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	3	3	2	3	3	3	3	1	2	3
CO2	3	3	3	3	2	2	1	2	3	3	3	3	1	1	3
CO3	3	3	3	3	2	2	1	2	3	3	3	3	2	2	3
CO4	3	3	3	3	2	2	-	2	3	3	3	3	3	2	3
CO5	3	3	3	3	2	2	-	2	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.

PROFESSIONAL ELECTIVE COURSES

**LT23001 COMPUTER APPLICATIONS FOR APPAREL AND GOODS L T P C
3 0 0 3**

COURSE OBJECTIVE:

- The objective of this course is projecting the use of computer assisted designing techniques for making apparels and goods.

UNIT I COMPUTER APPLICATION IN DESIGNING 7

CAD definition, Fundamentals of CAD – Introduction, general process of design, application of computers for design, Benefits of CAD, Computers & the Fashion Industry, Quick response technology, CAD in Today 's Fashion Industry.

UNIT II HARDWARES IN COMPUTER APPLICATION 11

Introduction, Principles, Capabilities and operation of graphical workstations, central processing units, graphic terminals, input/output devices, interface and storage devices, networking concepts of LAN and WAN. Digitization: 2D & 3D Coordinate extracting, principles of digital and analog conversion, digital input/output processing systems. CNC devices for computer aided cutting including laser and water jet, computer aided manufacturing.

UNIT III PATTERN ENGINEERING USING CAD 9

Computerized techniques for pattern generation, grading and assessment of apparel and goods patterns, consumption calculations, pattern nesting and costing, stitching etc. through computerized techniques. Data Conversion techniques, DXF.

UNIT IV PROTOTYPE MODELLING 9

Sketching, Manual Designing, Demonstrating – Aesthetic Appearance, Functionality; Digitization; Accessories; Detailing; Prototyping; Compiling Specifications; Sampling; Testing; Final Product.

UNIT V RAPID PROTOTYPING AND PRODUCTION TECHNIQUES 9

Pattern Designing – Measurements – Grading - Plotting/Cutting – Standard Blocks – Enlargements – Components and Accessories – CNC Stitching Process.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On completion of the course students are expected to,

CO1. Explain the concepts of computer applications in leather goods and garments manufacturing.

CO2. Identify different hardware used for the computational leather goods manufacturing.

CO3. Apply CAD pattern engineering for the leather goods manufacturing.

CO4. Justify the computer application in prototype modelling.

CO5. Examine advanced computational techniques in CAD, rapid prototyping, simulation, 3D printing and robotics.

REFERENCES:

1. Groover, M.P. and Zinimers, M.P., "CAD/CAM, Computer Aided Design and Manufacturing", Prentice Hall of India, 1984.
2. Newman and Sul, S.P., "Introduction to Computer Graphics", Published by Morgan Kaufmann,1995
3. Zandi, "Computer Aided Design and drafting", Published by Delmer,1985.
4. Pratt, W., "Digital Image Processing", 1978.
5. Desai and Abel, "Introduction to FEM".
6. Rapidprototyping; AU – FRG publications, 1984.
7. Buchner, J., "Simulation: QUEST manual": EDS Technologies, Published by Springer, 2003.

COURSE ARTICULATION MATRIX:

Course Outcome	Program Outcome														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	1	1	-	-	-	1	-	-	-	-	-	1	-
CO2	3	2	1	-	1	-	-	1	-	-	3	1	1	3	1
CO3	3	2	1	3	1	1	-	-	-	-	-	-	-	1	2
CO4	3	1	1	-	1	-	-	-	-	1	-	-	-	1	-
CO5	3	1	1	-	-	-	1	2	-	-	-	-	1	-	2

1, 2and3arecorrelation levelswithweightings asSlight (Low),Moderate (Medium)andSubstantial(High)respectively.

COURSE OBJECTIVE:

- The objective of this course is to present the students on basic concepts in industrial automation.

UNIT I FUNDAMENTAL CONCEPTS OF INDUSTRIAL AUTOMATION 9

Fundamental concepts in manufacturing and automation, definition of automation, reasons for automating. Types of production and types of automation, automation strategies, levels of automation.

UNIT II MANUFACTURING OPERATIONS 9

Automation in production systems, principles and strategies, Product/Production Relationships, Production concepts and Mathematical models, Manufacturing Economies.

UNIT III NUMERICAL CONTROL AND ROBOTICS 9

NC – CNC – Part programming – DNC – Adaptive Control – Robot Anatomy – Specifications – Industrial Applications.

UNIT IV AUTOMATION FOR APPAREL AND GOODS INDUSTRY 9

Raw Material Maintenance - Designing & Pattern Development – Material Area Calculations – Cutting/Clicking – Texture Mapping – Intelligent Sewing Machines - Online Seam Quality Assessment – Checking – Ironing – Bar Code – Conveyor.

UNIT V PREVENTIVE MAINTENANCE AND SAFETY USING SOFTWARES 9

Apparel and Goods Industry - Preventive maintenance, Safety & Security Maintenance, Hospitality, Data Collection, Data Analyzation, Disaster Prediction, Administration Protocols, Employee Management.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1. Summarize the requirements of automation in manufacturing systems.

CO2. Identify the techniques of machinery automation and shop floor automation.

CO3. Apply basic numeric control used for automation process.

CO4. Design the process of automation in apparel and goods manufacturing process.

CO5. Interpret required preventive maintenance and safety in the apparel and goods industry.

TEXT BOOKS AND REFERENCES:

1. Bolton W, "Mechanics", Pearson Education, 1999.
2. Mikell P Groover, "Automation Production Systems and Computer – Integrated Manufacturing", Pearson Education, New York, USA, 2000.
3. Mikell P Groover, "Industrial Robots – Technology Programmes and Applications", McGraw Hill, New Delhi, 2001.
4. Steve F Krar, "Computer Numerical Control Simplified", Industrial Press, 2001.

COURSE ARTICULATION MATRIX:

Course Outcome	Program Outcome														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	-	3	3	-	3	-	-	-	-	-	-	2	-	-
CO2	2	-	3	3	-	3	-	-	-	-	-	-	2	-	-
CO3	2	-	3	3	-	3	-	-	-	-	-	-	2	-	-
CO4	2	-	3	3	-	3	-	-	-	-	-	-	2	-	-
CO5	2	-	3	3	-	3	-	-	-	-	-	-	2	-	-

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

LT23003 MARKET TRENDS, FASHION FORECASTING AND PRODUCT L T P C
MERCHANDISING FOR GARMENTS AND GOODS INDUSTRY 3 0 0 3

COURSE OBJECTIVE:

- The objective of this course is to impart knowledge on Market Trends and Fashion for successful product development and Domestic and Global Leather product Merchandising

UNIT I INTERNATIONAL TRENDS, ELEMENTS OF DESIGN AND DESIGN 9
METHODOLOGY

Elements and theories of design and its Application, Ergonomics, and interactive scenario of the design elements- Global Trend Analysis and Product Decision -The life cycle of fashion. Brainstorming method of idea generation, Understanding the consumer need and demand, Concept of space and patterns in nature, Product usage and its categories and Design process for accessories. Types, categories, and usage of leather and non-leather Goods and Garments.

UNIT II FASHION TREND AND FORECAST ANALYSIS 9

Definition and entomology of fashion, trend, style, and elements of trend direction, Types of trend direction review process, Development of forecast and Concept of styling, Direction of fashion trends in apparel and goods production and marketing. Preparation of art portfolios and organization of shows; advertising; effect of foreign languages in the presentation.

UNIT III PRINCIPLES AND PRACTICES OF MERCHANDISING 9

Merchandising concepts, Functions of Merchandiser -Technology, systems, planning - Merchandise pricing and budgeting, sample handling- Managing Merchandise Assortments- Developing and presenting product line-Introduction to shipping operation.

UNIT IV RETAIL SECTOR OF LEATHER 9

Overview of retailing; Changing retail environment - Understanding the consumer-Competitive strategies in the retail industry- Retail location strategy; Store layout and Design - Product planning and selection; Inventory management - Retail pricing; Retail communication - Customer Service.

UNIT V GLOBAL SOURCING STRATEGY 9

Globalization and its influences - The role and importance of global sourcing - Global sourcing process and strategy - Investigation and tendering - Supplier selection and development - Operationalization of global sourcing strategy - Performance Measurement - The benefits and challenges of global sourcing - Coping with custom clearance uncertainties - Sourcing on the Internet - Supplier relationship development.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

- At the end of this course, the students will be in the position to understand,
- CO1. To understand the factors contributing to the fashion trends in leather goods industry.
 - CO2. Elucidate the different methods on design and new product development.
 - CO3. Have learned about the preparation of art portfolios and presentation techniques.
 - CO4. Gain knowledge on the fashion trend and forecasting analysis.
 - CO5. Understand the basic principles of merchandising.
 - CO6. Basic knowledge of retail sector.
 - CO7. Knowledge of global marketing and global sourcing.

TEXTBOOKS AND REFERENCES:

1. Apparel Product Design and Merchandising Strategies by Cynthia L. Regan. Publisher: Prentice Hall
2. "Apparel International" Published by P.F collier and sons, U.K, 1961.
3. Integrated Retail Management by James R. Ogden & Denise T. Ogden, 2007, Biztantra Retail Management – Levy &Weitz-TMH 5th Edition 2002.
4. Charles W L Hill. And Arun Kumar Jain. International Business: competing in the global market place, Mc Graw-Hill, 2007.
5. John D. Daniels Lee H Radebaugh, International Business: Environments and Operations Addison Wesley, 2007.
6. Justin Paul – International Business – Prentice Hall of India, 2007
OdedShenkarYadong Luo: International Business – John Wiley & Co., 2006.

COURSE ARTICULATION MATRIX:

Course Outcome	Program Outcome														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	2	3	2	3	-	-	-	-	-	-	-	-	-	-
CO2	-	2	3	2	3	-	-	-	-	-	-	-	-	-	-
CO3	-	2	3	2	3	-	-	-	-	-	-	-	-	-	-
CO4	-	2	3	2	3	-	-	-	-	-	-	-	-	-	-
CO5	-	2	3	2	3	-	-	-	-	-	-	-	-	-	-

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

COURSE OBJECTIVE:

- The objective of this course is present students on the quality control and management aspects associated with manufacturing apparel and goods.

UNIT I MODELING AND STATISTICAL INFERENCE 9

Modelling 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.

UNIT II CONCEPTS OF QUALITY 9

Definition of quality, quality control theory, fundamentals of statistics and probability, confidence intervals, testing significance, statistical process control techniques, analysis, defect diagnosis and prevention. **Significance of Calibration**

UNIT III TESTING STANDARDIZATION 9

Significance of Testing for assessment of Apparel and Goods Performance; List of testing and their methodology.

UNIT IV QUALITY TESTING IMPROVEMENT 9

Concepts of TQM, TQC, KANBAN, Zero defects, JIT – continuous improvement – HRD in quality management – quality grades, Dr. Deming's 14 points management concept, TQA.

UNIT V QUALITY ASSURANCE SYSTEM 9

Introduction to ISO – 9000 and 14000 and related international /national standards, case study.

TOTAL: 45 PERIODS**COURSE OUTCOMES:**

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

CO1. Outline various statistical methods for leather goods sector.

CO2. Apply the concept of quality.

CO3. Analyze various Testing standards.

CO4. Improve the quality management system.

CO5. Apply ISO-9000 and 14000 for leather product industry.

TEXT BOOKS AND REFERENCES:

1. A. J. Duncan, "Quality Control and Industrial Statistics", Homewood, Illinois, Published by Irwin, 1986.
2. "International Organization for Standardization" case postale 56, CH-1211-Geneva – 20, Switzerland.
3. "Bureau of Indian Standards", New Delhi.

COURSE ARTICULATION MATRIX:

Course Outcome	Program Outcome														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	2	3	-	2	-	-	-	-	-	2	-	2	-	-
CO2	-	2	3	-	2	-	-	-	-	-	2	-	2	-	-
CO3	-	2	3	-	2	-	-	-	-	-	2	-	2	-	-
CO4	-	2	3	-	2	-	-	-	-	-	2	-	2	-	-
CO5	-	2	3	-	2	-	-	-	-	-	2	-	2	-	-

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

LT23005 MACHINERIES FOR APPARELS AND GOODS MANUFACTURE L T P C
3 0 0 3

COURSE OBJECTIVE: To impart theory and practical knowledge on the working principles, use and maintenance of machineries used in manufacturing apparels and goods.

UNIT I MACHINERIES FOR APPARELS MANUFACTURING 9

Fabric Inspection Machine – Plotter Printing Machine – Cutting Machine – Fusing Machine – Embroidery Machine – Various Sewing Machine – Thread Trimmer Machine – Thread Sucking Machine – Iron Machine – Pull Test Machine – Metal Detector Machine – Barcode Scanning Machine – Heat Seal Joining Machine – Case Label Printing Machine – Moisture Checking Machine – Digital Hygrometer – Air Compressor Machine – Boiler Machine – Generator – Water Pump.

UNIT II MACHINERIES FOR GOODS MANUFACTURING 9

Cutting Machine; Coloring Machine – Vertical Coloring Machine, Box Roller Coloring Machine, Horizontal Coloring Machine; Production – Spray Gluing Machine, Folding Machine, Ultra Sonic Machine, Different Sewing Machines, Thread Burning Tool, Folding Machine, Creasing Machine, Embossing Machine, Screw Driving Machine, Roller Gluing Machine, Roller Pressing Machine, Post Hammering Machine.

UNIT III ADVANCEMENT IN MACHINERIES 10

Dieless cutting, Water jet cutting, CAM for automatic stitching. Different types of material handling system – Manual, semi – automatic and automatic conveyor.

UNIT IV MODULAR MANUFACTURING AND PLANT LAYOUT 11

Productivity improvements: scheduling, simulation, Toyota and lean manufacturing system. Factor affecting plant location and construction of factory building for balancing the production line in apparel and goods industry.

UNIT V PREVENTIVE MAINTENANCE AND SAFETY 6

Preventive maintenance and safety in the use of apparel and goods machinery.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of this course, the students will be able to understand the working principles of machineries used in apparel and goods manufacture and their use and maintenance.

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

CO1. Explain various machineries used in apparel and goods manufacture.

CO2. Identify the features and purpose of the various machinery used.

CO3. Interpret the preventive maintenance and safety in the use of apparel and goods machinery.

- CO4. Examine the malfunction of various product machineries.
 CO5. Design of optimal machinery layout in apparel and goods unit.

TEXT BOOKS AND REFERENCES:

1. G. H. Ryder, M. D. Bennett; "Mechanics of Machines", Royal Military College of Science, Shrivenham, UK.
2. Dr. Mahmoud Mostafa; "Mechanics of Machinery", CRC Press Inc.
3. Steve Krar, Mario Rapisarda, Albert F. Check, "Machine Tool and Manufacturing Technology", S.Chand (G/L) & Company Ltd.

COURSE ARTICULATION MATRIX:

Course Outcome	Program Outcome														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	-	3	3	-	3	-	-	-	-	-	-	2	-	-
CO2	2	-	3	3	-	3	-	-	-	-	-	-	2	-	-
CO3	2	-	3	3	-	3	-	-	-	-	-	-	2	-	-
CO4	2	-	3	3	-	3	-	-	-	-	-	-	2	-	-
CO5	2	-	3	3	-	3	-	-	-	-	-	-	2	-	-

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

COURSE OBJECTIVE:

- To provide practical training in fabrication of various leather goods and garments.

Practical training to students in the following areas:

- Free hand object drawing practice
- Leather goods and garments working sketch practice
- Fashion illustration and color application
- Good's and garment's leather assortment
- Physical observation of goods and garments accessories and reinforcement materials
- Practice in various kinds of tools and machineries operation and its function
- Goods and garments pattern preparation and pattern laying on leather
- Goods and garments leather and reinforcement material cutting and lining material cutting
- Pre-assembly and stitching operations
- Pattern design for leather goods and garments
- Practice in goods and garments making
- Goods and garments quality control checking
- Pattern grading and practice in CAD/CAM

TOTAL: 90 PERIODS

COURSE OUTCOMES:

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

CO1.Explain the practical experience in designing of leather goods and garments.

CO2.Examine the practical knowledge in fabrication of leather goods and garments.

CO3.Discuss the computer applications involved in developing leather goods and garments.

COURSE ARTICULATION MATRIX:

Course Outcome	Program Outcome														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	2	3	2	1	1	1	2	1	1	2	1	3	1
CO2	2	3	2	2	2	2	2	1	2	1	2	2	1	3	3
CO3	2	3	2	1	2	-	-	1	2	1	-	2	1	3	2

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

COURSE OBJECTIVE:

- The objective of this course is project the use of computer assisted designing techniques for making footwear.

UNIT I INTRODUCTION FOR CAD IN FOOTWEAR MANUFACTURE 9

Definition, historical development, scope of applications and advantage - Introduction to computer hardware - central processing units - principles, capabilities and operation of graphical workstations - graphic terminals - input/output devices - interface and storage devices - net-working concepts of LAN and WAN.

UNIT II CAD FOR PATTERN MAKING 8

Introduction Digitization - different types tool bar in footwear cad - draw tools, designing tools, pattern tools, grading tools, editing tools and making marking and other output related tools - ideas about geometric primitives - Digitization 2D - Create pattern, general elements - exchange shell, pattern properties, detailing and pattern editing.

UNIT III LAST MODELLING 10

Digitization with 3D Scanner - manipulation and optimization of digitized last - use of macros; last comparison - grading wizard – flattening - 3D visualization of last and styles - concept of e-last - introduction to sole and sole mould design.

UNIT IV ADVANCED COMPUTATIONAL TECHNIQUES 8

Principles and practice of foot scanner - conversion of foot dimensions to last model - creation of still files for last manufacture - simulation – concepts and applications - robotics: concepts and applications in footwear manufacture - 3D Printing: concepts and applications in footwear manufacture.

UNIT V COMPUTER AIDED MEASUREMENT AND CONTROL SYSTEMS 10

Role of computers in measurement and control, Elements of computer aided measurement and control, man-machine interface, computer aided process control hardware, process related interfaces, Communication and networking, Industrial communication systems, Data transfer techniques, Computer aided process control software, Computer based data acquisition system, Internet of things (IoT) for plant automation.

TOTAL: 45 PERIODS**COURSE OUTCOMES:**

On completion of the course students are expected to,

CO1. Explain the concepts of computer applications in footwear sector.

CO2. Apply CAD for pattern engineering for footwear pattern making.

CO3. Analyze the computer application in sole modelling for footwear.

CO4. Examine the advanced computational techniques in footwear application.

CO5. Recommend the application of computer in measurement and control systems.

TEXT BOOKS AND REFERENCES:

1. Groover, M.P. and Zinimers, M.P., "CAD/CAM, Computer Aided Design and Manufacturing", Prentice Hall of India, 1984.
2. Newman and Sul, S.P., "Introduction to Computer Graphics", Published by Morgan Kaufmann,1995
3. Zandi, "Computer Aided Design and drafting", Published by Delmer,1985.
4. Pratt, W., "Digital Image Processing", 1978.
5. Desai and Abel, "Introduction to FEM".
6. "Step by Step guide to CAD for footwear": CAD Centre, SDDC, CLRI.
7. Rapidprototyping; AU – FRG publications, 1984.
8. Buchner, J., "Simulation: QUEST manual": EDS Technologies, Published by Springer, 2003.
9. Mass Customization and Footwear: Myth, Salvation or Reality? A Comprehensive Analysis Of The Adoption Of The Mass Customization Paradigm In Footwear by Claudio R.Bor, Sergio Dulio;SpringerVerlag, 2007.

COURSE ARTICULATION MATRIX:

Course Outcome	Program Outcome														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	1	1	-	-	-	1	-	-	-	-	-	1	-
CO2	3	2	1	-	1	-	-	1	-	-	3	1	1	3	1
CO3	3	2	1	3	1	1	-	-	-	-	-	-	-	1	2
CO4	3	1	1	-	1	-	-	-	-	1	-	-	-	1	-
CO5	3	1	1	-	-	-	1	2	-	-	-	-	1	-	2

1, 2and3arecorrelation levelswithweightings asSlight (Low),Moderate (Medium)andSubstantial(High)respectively.

COURSE OBJECTIVE:

- The objective of this course is to present the students on basic concepts in industrial automation.

UNIT I INTRODUCTION TO AUTOMATION 9

Automation overview - Requirement of automation systems - Architecture of Industrial Automation system - Introduction of PLC and supervisory control and data acquisition (SCADA) - Industrial bus systems: Modbus & Profibus.

UNIT II INTRODUCTION TO MACHINE LEARNING 9

Philosophy of learning in computers - Overview of different forms of learning - Classifications vs. Regression - Evaluation metrics and loss functions in Classification - Evaluation metrics and loss functions in Regression - Applications of AI in Robotics.

UNIT III AUTOMATION COMPONENTS 9

Sensors for temperature, pressure, force, displacement, speed, flow, level, humidity and pH measurement - Actuators - process control valves - power electronics devices DIAC, TRIAC, power MOSFET and IGBT - Introduction of DC and AC servo drives for motion control.

UNIT IV TOTALLY INTEGRATED AUTOMATION 9

Need - components of TIA systems - advantages - Programmable Automation Controllers (PAC) - Vertical Integration structure.

UNIT V AUTOMATION FOR FOOTWEAR INDUSTRY 9

Raw Material Maintenance - Designing & Pattern Development – Material Area Calculations – Cutting/Clicking – Pre-Closing – Closing – Lasting – Post Lasting – Finishing – Metal Detecting - Packing.

TOTAL: 45 PERIODS**COURSE OUTCOMES:**

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

CO1. Explain the basics of automation in manufacturing systems.

CO2. Summarize the basic knowledge on machine learning.

CO3. Apply the techniques of machinery automation and shop floor automation in footwear manufacturing.

CO4. Analyze the totally integrated automation system in the manufacturing unit.

CO5. Design the process of automation in footwear manufacturing process.

TEXT BOOKS AND REFERENCES:

1. Bolton W, "Mechanics", Pearson Education, 1999.
2. Mikell P Groover, "Automation Production Systems and Computer – Integrated Manufacturing", Pearson Education, New York, USA, 2000.

3. Mikell P Groover, "Industrial Robots – Technology Programmes and Applications", McGraw Hill, New Delhi, 2001.

4. Steve F Krar, "Computer Numerical Control Simplified", Industrial Press, 2001.

COURSE ARTICULATION MATRIX:

Course Outcome	Program Outcome														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	-	3	3	-	3	-	-	-	-	-	-	2	-	-
CO2	2	-	3	3	-	3	-	-	-	-	-	-	2	-	-
CO3	2	-	3	3	-	3	-	-	-	-	-	-	2	-	-
CO4	2	-	3	3	-	3	-	-	-	-	-	-	2	-	-
CO5	2	-	3	3	-	3	-	-	-	-	-	-	2	-	-

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

COURSE OBJECTIVE:

- The objective of this course is to present to the students the principles and process of footwear fashion trends forecasting and impart knowledge on merchandising

UNIT I INTRODUCTION TO FORECASTING AND MERCHANDISING 6

Historical evaluation of footwear styling. - Seasonal influences on fashion, cultural and geographical instances on footwear fashion. Market research and track record. Principles of Merchandising - Terms Pertaining to Merchandising.

UNIT II PRINCIPLES OF TREND FORECASTING AND MARKETING MANAGEMENT 9

Trend forecasting: Importance of forecasting, Elements of forecasting, Principles of forecasting, Theories explaining forecasting, Steps in forecasting, Major areas of forecasting, Advantages and disadvantages in forecasting. - Elements of Marketing - Functions of Marketing Management - Marketing Organizations - Qualities of Marketing Manager

UNIT III FASHION FORECASTING and PROCESS 12

Fashion forecasting: Role of fashion forecaster, Long- term and Short- term - Direction of fashion change, Forecasting with Trend, Seasonality and Cycles, Time series and Trends, Constant pattern, Linear pattern. Role of internet in fashion forecasting. Market research - Colour forecasting and sales forecasting. Fashion services and resources- Collection reports, Colour Trend reports, Dimensions of Colour, Colours in Marketing, Consumers and the Psychology of Colours. Forecasting with Colour Cycles, Colour Research, Sources for Colour Ideas and Palettes.

UNIT IV PRACTICE OF MERCHANDISING 9

Functions of a Merchandiser - Types of Samples - Sample Quality and Sample Order - Expediting Procedures - Record Maintenance - Approval, Types of Approvals - Check Points for a Proper Approval - Pattern Approval - Size Set Approval Procedures – Pre-Inspection (Pilot Run Inspection) - Order Execution Procedures - Inventory Management: Techniques for effective inventory management - Balancing inventory levels with demand.

UNIT V RETAIL MERCHANDISING 9

Fashion Merchandising vs. Retail Merchandising - Job Objectives of Retail Merchandising - Definition of Promotional Merchandising - Visual Merchandising Techniques, Sales Focused Merchandising - Outlet Vs. Retail, SWOT Analysis for Retail - Advantages of Retail Outlets.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of this course, the students are expected to have knowledge in,
CO1. Understanding the forecasting and the principles of merchandising.
CO2. Applying the knowledge gained in the principles of trend forecasting and understanding the concepts of marketing management

CO3. Applying and analysing the process involved in the fashion forecasting.

CO4. Understanding and analyzing practices on merchandising

CO5. Remembering and applying the knowledge on retail merchandising

TEXT BOOKS AND REFERENCES:

1. Cott, N.F., "American Shoe Making", Shoe Trades Publishing Co., Cambridge. 1993.
2. "Apparel International" Published by P.F collier and sons, U.K, 1961.
3. "Shoes and Leather News",Published by bureau of foreign and domestic commerce, Dept of commerce, US, 1940.
4. Apparel Product Design and Merchandising Strategies by Cynthia L. Regan. Publisher: Prentice Hall.
5. Integrated Retail Management by James R. Ogden & Denise T. Ogden, 2007, Biztantra Retail Management – Levy &Weitz-TMH 5th Edition 2002.
6. Charles W L Hill. And Arun Kumar Jain. International Business: competing in the global market place, Mc Graw-Hill, 2007.
7. John D. Daniels Lee H Radebaugh, International Business: Environments and Operations Addison Wesley, 2007.
8. Justin Paul – International Business – Prentice Hall of India, 2007
OdedShenkarYadong Luo: International Business – John Wiley & Co., 2006.

COURSE ARTICULATION MATRIX:

Course Outcome	Program Outcome														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	2	3	2	3	-	-	-	-	-	-	-	-	-	-
CO2	-	2	3	2	3	-	-	-	-	-	-	-	-	-	-
CO3	-	2	3	2	3	-	-	-	-	-	-	-	-	-	-
CO4	-	2	3	2	3	-	-	-	-	-	-	-	-	-	-
CO5	-	2	3	2	3	-	-	-	-	-	-	-	-	-	-

1, 2and3arecorrelation levelswithweightings asSlight (Low),Moderate (Medium)andSubstantial(High)respectively.

LT23010 PRINCIPLES OF TESTING FOR FOOTWEAR AND COMPONENTS L T P C
3 0 0 3

COURSE OBJECTIVE:

- To impart knowledge on Types of Footwear, their components, material characterization – Physical and chemical analytical methods.

UNIT I INTRODUCTION TO LEATHER AND NON-LEATHER FOOTWEAR AND COMPONENTS AND STANDARDS IN TESTING 9

Types of footwear - Boots, Pumps shoes, Slippers, Trainers, Sports footwear, Sandals, Casuals.

Types of Footwear components - Whole shoe, Upper – Vamp, Quarter – Tongue, Toe Puff, Lining – Vamp lining, Quarter lining, Counter stiffeners, Heels and heel grips, shanks, Insole, Insock, Top-piece attachments, Elastics and Velcros, Adhesives, Laces, Metallic components - Buckles, Eyelets, Fasteners, Outsoles.

Types of Footwear Materials - Leathers used in soles, insoles, outsoles, Leather Fiber boards – Cellulose textiles - Synthetic textiles, Polymers and coatings – PVC/PVC Coatings, PU/PU Coatings, Polyesters – Metals - Rubbers, MCR, TPR – Adhesives - Polymeric Foams.

Indian and International Footwear testing standards and specifications and implementations.

UNIT II PHYSICAL TESTING OF FOOTWEAR COMPONENTS – LEATHER AND NON-LEATHER 9

Components and materials specific mechanical tests - Quantitative and Qualitative assessment –Tensile strength, Flex resistance, Upper-outsole bond, Attachment strength, Lastometer, Burst strength, Seam and Stitch tear strength, Sole Slip, Flexing, Density and Abrasion resistance, Hardness, Color fastness properties, Tests for Zips, Touch and close fasteners, Eyelets and other metallic and non-metallic components testing, Waterproofness and Comfort properties, Safety footwear types and their test methods

UNIT III CHEMICAL TESTING OF FOOTWEAR COMPONENTS - LEATHER 9

Restricted substance list (RSL) - Aromatic amines released from Azo dyes - Chromium (VI) estimation - Polychlorophenols estimation - Formaldehyde estimation- Dimethyl fumarate (DMFu) estimation - Organotin estimation - Phthalate (If Coated leather) estimation - pH value.

UNIT IV CHEMICAL TESTING OF FOOTWEAR COMPONENTS - TEXTILE 9

Aromatic amines released from Azo dyes- Allergenic and carcinogenic disperse dyes Determination-Formaldehyde estimation- Dimethyl fumarate (DMFu) Estimation-Organotin Estimation-Phthalate estimation-pH value.

UNIT V CHEMICAL TESTING OF FOOTWEAR COMPONENTS - POLYMERIC MATERIAL AND METAL COMPONENT 9

Polymeric material: Dimethyl fumarate (DMFu) Estimation-Organotin estimation - Phthalate estimation. Metal component: Nickel, on skin contact.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

- CO1. Explain basic on leather and non-leather footwear and footwear components.
- CO2. Identify the physical testing standards for the leather and non-leather footwear components.
- CO3. Analyze the various chemical testing standards of leather footwear components.
- CO4. Appraise various chemical testing standards of textile footwear components.
- CO5. Aware of various chemical testing standards of the polymeric and metal based footwear components.

TEXT BOOKS AND REFERENCES:

1. Footwear Materials and Process Technology, A. J. Harvey, Lasra, 1982.
2. Encyclopedia of Polymer Applications Ed. Munmaya Mishra, Chapter: Footwear, S. Gnanasundaram, M. Ranganathan, CRC Press, Taylor & Francis, Pg 1444.
3. Personal Protective Equipment, IS 15298 (PART1).
4. IS 15844: SPORTS FOOTWEAR – SPECIFICATION.

COURSE ARTICULATION MATRIX:

Course Outcome	Program Outcome														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	2	3	-	2	-	-	-	-	-	2	-	2	-	-
CO2	-	2	3	-	2	-	-	-	-	-	2	-	2	-	-
CO3	-	2	3	-	2	-	-	-	-	-	2	-	2	-	-
CO4	-	2	3	-	2	-	-	-	-	-	2	-	2	-	-
CO5	-	2	3	-	2	-	-	-	-	-	2	-	2	-	-

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

COURSE OBJECTIVE:

- To impart theory and practical knowledge on the working principles, use and maintenance of machineries used in Footwear manufacture.

UNIT I MACHINERIES FOR PRECLOSING 10

Types of Clicking (Manual, Machine) - Manual Clicking - Machine clicking - Mechanical clicking press - Hydraulic clicking press - Hydronic Clicking Press - Other Modern Clicking Machine - Comparison of Manual & Machine clicking - features of the Clicking Machine - Introduction to Die-less cutting system, Operation, and Machine adjustment. Splitting machine, Skiving Machine.

UNIT II MACHINERIES FOR CLOSING 10

Needle: Parts of Needle and their role - Needle Finishes; Needle systems; Needle Size - Classification of Needle on the basis of Needle Point - Number of Needles - Direction of Needle-bar movements - Material transportation Systems in Stitching machines - Stitching machine Construction; Parts of Stitching Machine and their functions - Types of stitching Machines: - Flat Bed, Post Bed, Cylinder Bed, Variable Stitch, Length Flat Machine, Under Edge Trimmer, Twin Needle flat machine, Zig-Zag Machine - Computerized Stitching Machine. Introduction and Operation.

UNIT III MACHINERIES FOR LASTING 8

Counter Moulding - Insole attaching - Toe puff activator - mulling chamber - thermo-cementing - Toe lasting - side lasting - seat lasting,

UNIT IV MACHINERIES FOR SOLE ATTACHMENT 8

Heel crowing - heat setter - Hot air blower - roughing machine - Heat Reactivator - Sole Pressing machine - Delasting machine - Polishing machine.

UNIT V MODULAR MANUFACTURING AND PLANT LAYOUT 9

Plant layout for productivity improvements – Scheduling and simulation - Factor affecting plant location - construction of factory building - balancing the production line footwear manufacture.

TOTAL: 45 PERIODS**COURSE OUTCOMES:**

At the end of this course, the students will be able to understand the working principles of machineries used in footwear manufacture and their use and maintenance.

The students also understand the following

CO1. Explain the general principles involved in various preclosing machineries used in footwear manufacture.

CO2. Identify the features and purpose of the various closing machineries.

CO3. Summarize the principle involved in lasting machineries.

CO4. Identify the features of the sole attachment machineries.

CO5. Design of optimal machinery layout in footwear unit.

TEXT BOOKS AND REFERENCES:

1. Thornton, J.H, "Text Book of Footwear Manufacture", National Trade Press Ltd., London, 1970.
2. Blakeman, J., "An Introduction to applied Science for Boot and Shoe Manufacture", The Anglo American Technical Co.Ltd., London,1924.

COURSE ARTICULATION MATRIX:

Course Outcome	Program Outcome														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	-	3	3	-	3	-	-	-	-	-	-	2	-	-
CO2	2	-	3	3	-	3	-	-	-	-	-	-	2	-	-
CO3	2	-	3	3	-	3	-	-	-	-	-	-	2	-	-
CO4	2	-	3	3	-	3	-	-	-	-	-	-	2	-	-
CO5	2	-	3	3	-	3	-	-	-	-	-	-	2	-	-

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

COURSE OBJECTIVE:

- To provide practical training in fabrication of leather footwear.

DESIGNING AND PATTERN MAKING

An introduction to fashion, style and design. Basic Shoe Styles and its geometry. Product Range Building System. Shoe Craftsmanship. Basic Styles in Footwear: Ladies Court Shoe, Oxford, Derby, Slip on, Moccasin, Boots. Open type footwear. Last Parameters: Length of Last, Fitting Girth, Instep Girth, Heel Girth, Ankle Girth. Pattern Making: Style line sketching, Taping of last, Preparation of Upper Standard, Extraction of component patterns of upper, Preparation of Lining Standard, Extraction of component patterns of lining, Details of Allowances.

CUTTING AND CLICKING

Hand and Machine cutting, Basic Pattern cutting practice, Fabric and other materials, Leather cutting practice, Pattern nesting practice, cutting practice of Footwear components, Pattern area Assessment practice, Knowledge on Clicking machine and Cutting Dies, Quality of Footwear components.

PRE-CLOSING AND CLOSING

Pre-Assemble Operation: Splitting, Skiving, Folding, Reinforcement attachments. Upper Preparation: Sewing practice on Paper and Leather, Assembling cut components, Sewing components, Fabrication of uppers with quality control.

LASTING AND FINISHING

Bottom Stock Preparation: Insole cutting and preparation, Toe and Counter Stiffener cutting and preparation, Rubber and Leather Bottom Sole cutting and preparation. Hand Lasting practice and Machine Lasting practice for Cemented construction, Sole attaching and Finishing, Quality control of full shoe.

TOTAL: 90 PERIODS**COURSE OUTCOMES:**

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

CO1. Design pattern making of basic footwear models.

CO2. Develop the skills on cutting and clicking operations of various footwear materials.

CO3. Demonstrate the preclosing, closing, lasting and finishing operations of footwear manufacturing.

COURSE ARTICULATION MATRIX:

Course Outcome	Program Outcome														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	1	2	2	-	1	-	-	2	-	3	1	1	2
CO2	2	1	1	-	2	-	-	-	-	2	1	3	1	1	2
CO3	2	1	1	1	1	1	2	-	1	2	-	3	1	1	2

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

2. Gustavson, K.H., "The Chemistry and Reactivity of Collagen", Academic Press, New York, 1958.
3. Ramachandran, G.N., "Treatise on the Biology of Collagen", Academic Press, New York, 1967.
4. Krishnan, V, Ed., "Trends in Collagen", Proceedings of the Indian Academy of Sciences (Chemical Sciences), Vol. 111, No. 1, Indian Academy of Sciences, Bangalore, 1999.
5. Fratzl, P. (Ed.), "Collagen: Structure and Mechanics", Springer, New York, 2008.
6. Brodsky B, Persikov AV. Molecular structure of the collagen triple helix. Adv Protein Chem. 2005;70:301-39.
7. Brinckmann, J., Notbohm, H., Müller, P.K. (Eds.), "Collagen: Primer in Structure, Processing and Assembly", Springer; Berlin, Heidelberg: 2005.

COURSE ARTICULATION MATRIX:

Course Outcome	Program Outcome														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	1	1	1	1	2	3	1	1	1	2	3	1	1
CO2	3	3	2	1	1	-	2	2	1	1	1	2	3	1	1
CO3	3	3	1	1	1	1	2	2	1	1	1	2	3	2	1
CO4	3	3	1	1	1	2	2	1	1	1	1	2	3	3	1
CO5	3	3	-	1	1	1	2	2	1	1	1	2	3	3	1

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

COURSE OBJECTIVE:

- The course aims to provide students with a comprehensive understanding of the principles and applications of biotechnology in industrial processes. It covers the use of biological systems for the production of bio-based products, environmental sustainability, and advancements in biotechnological innovations.

UNIT I: INTRODUCTION TO INDUSTRIAL BIOTECHNOLOGY 9

Overview of industrial biotechnology: Definition, history, and scope - Key components of industrial biotechnology: Microorganisms, enzymes, and bioprocesses - Industrial applications of biotechnology: Pharmaceuticals, food and beverages, agriculture, and biofuels - Introduction to bioreactors: Types, design, and operation - Regulatory and ethical aspects of industrial biotechnology

UNIT II: MICROBIAL BIOTECHNOLOGY AND FERMENTATION 9

Microbial growth kinetics and metabolism - Types of fermentation: Batch, fed-batch, and continuous - Industrial microorganisms: Isolation, screening, and improvement - Fermentation technology: Media formulation, sterilization, and scale-up - Downstream processing: Separation, purification, and recovery of products

UNIT III: ENZYME TECHNOLOGY 9

Introduction to enzymes: Classification, structure, and function - Enzyme kinetics: Michaelis-Menten equation, inhibition, and regulation - Industrial enzymes: Production, immobilization, and applications - Enzyme engineering: Directed evolution and rational design

UNIT IV: BIO-BASED PRODUCTS AND BIOREFINERIES 9

Bio-based products: Bioplastics, biofuels, biochemicals, and biopolymers - Biomass conversion technologies: Pretreatment, hydrolysis, and fermentation - Biorefineries: Concept, design, and operation - Sustainable production of bio-based products - Life cycle assessment and environmental impact of bio-based products

UNIT V: ADVANCES IN INDUSTRIAL BIOTECHNOLOGY 9

Genetic engineering and synthetic biology in industrial biotechnology - Metabolic engineering for the production of value-added products - Bioprocess optimization and control - Biotechnology in waste management and environmental remediation - Recent trends and future prospects in industrial biotechnology

TOTAL: 45 PERIODS**COURSE OUTCOMES:**

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

- CO1. Understand the fundamental principles of industrial biotechnology.
 CO2. Apply biotechnological techniques in industrial processes.
 CO3. Analyze the production and application of bio-based products.
 CO4. Evaluate the role of biotechnology in environmental sustainability.
 CO5. Comprehend recent advancements and innovations in industrial biotechnology.

TEXT BOOKS AND REFERENCES:

1. Crueger, W., &Crueger, A. (1984). Biotechnology: A Textbook of Industrial Microbiology. Sinauer Associates Inc., U.S.
2. Shuler, M.L., &Kargi, F. 3rd Edition. (2017). Bioprocess Engineering: Basic Concepts. Prentice Hall, USA
3. Rohm, H.J. and Reed, G. "A Comprehensive treatise on Biotechnology", VerlagChemie, Iecinheim,1983.
4. Puvanakrishnan, R and Dhar, S.C."Enzyme Technology in Beamhouse practices" CLRI Publication.

COURSE ARTICULATION MATRIX:

Course Outcome	Program Outcome														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	1	1	3	1	3	3	1	1	-	1	2	3	1
CO2	3	-	1	1	1	1	3	1	1	1	-	1	-	3	3
CO3	3	2	1	1	2	1	3	2	1	1	-	1	1	3	2
CO4	3	1	1	1	2	1	3	2	1	1	-	1	1	3	2
CO5	3	1	1	1	2	1	3	2	1	1	-	1	1	3	2

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

COURSE OBJECTIVE:

- The course aims to provide students with a comprehensive understanding of the physical principles underlying protein structure, dynamics, and function. This foundational knowledge will enable students to pursue advanced research in biological sciences, particularly in the fields of biophysics, structural biology, and bioinformatics.

UNIT I: PROTEIN STRUCTURE AND FOLDING (9 hours)

- Introduction to proteins: Amino acids, peptide bonds, primary, secondary, tertiary, and quaternary structures
- Principles of protein folding: Anfinsen's dogma, folding pathways, and energy landscapes
- Forces involved in protein folding: Hydrophobic interactions, hydrogen bonding, van der Waals forces, electrostatic interactions
- Protein stability and denaturation: Thermodynamic and kinetic aspects

UNIT II: PROTEIN-PROTEIN INTERACTIONS (9 hours)

- Types of protein-protein interactions: Homomeric and heteromeric complexes
- Methods to study protein-protein interactions: Co-immunoprecipitation, yeast two-hybrid, surface plasmon resonance, isothermal titration calorimetry
- Binding kinetics and thermodynamics: Association and dissociation constants, Gibbs free energy, enthalpy, and entropy changes
- Case studies of protein-protein interactions in biological processes

UNIT III: BIOPHYSICAL TECHNIQUES FOR PROTEIN STUDY (9 hours)

- Spectroscopic techniques: UV-Vis, fluorescence, circular dichroism, and NMR spectroscopy
- X-ray crystallography: Principles, crystallization methods, and structure determination
- Cryo-electron microscopy (Cryo-EM): Sample preparation, data collection, and image processing
- Mass spectrometry: Protein identification, sequencing, and post-translational modifications analysis

UNIT IV: PROTEIN DYNAMICS AND FUNCTION (9 hours)

- Protein dynamics: Conformational changes, allostery, and molecular motions
- Enzyme kinetics: Michaelis-Menten kinetics, inhibition, and regulation
- Protein folding diseases: Amyloidosis, prion diseases, and other misfolding disorders
- Computational methods: Molecular dynamics simulations and bioinformatics tools for protein analysis

UNIT V: ADVANCED TOPICS IN PROTEIN BIOPHYSICS (9 hours)

- Protein engineering and design: Rational design and directed evolution
- Membrane proteins: Structure, function, and biophysical characterization
- Protein-nucleic acid interactions: DNA/RNA binding proteins, ribosomes, and transcription factors
- Recent advances in protein biophysics: Current research trends and future directions

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

- CO1. Understand the basic principles of protein structure and folding.
 CO2. Analyze the physical interactions and forces that stabilize protein structures.
 CO3. Apply various biophysical techniques to study protein dynamics and functions.
 CO4. Interpret experimental data related to protein biophysics and structure-function relationships.
 CO5. Develop a strong foundation for pursuing research in protein biophysics and related areas.

TEXTBOOKS AND REFERENCES:

1. Branden, C., & Tooze, J. (1999). Introduction to Protein Structure. Garland Publishing.
2. Schulz, G. E., & Schirmer, R. H. (1979). Principles of Protein Structure. Springer.
3. Cantor, C. R., & Schimmel, P. R. (1980). Biophysical Chemistry: Part I: The Conformation of Biological Macromolecules. W. H. Freeman.
4. Alberts, B., Johnson, A., Lewis, J., Raff, M., Roberts, K., & Walter, P. (2002). Molecular Biology of the Cell. Garland Science.
5. Voet, D., Voet, J. G., & Pratt, C. W. (2016). Fundamentals of Biochemistry: Life at the Molecular Level. Wiley.
6. Creighton, T. E. (1993). Proteins: Structures and Molecular Properties. W. H. Freeman.
7. Petsko, G. A., & Ringe, D. (2004). Protein Structure and Function. New Science Press.
8. Research articles and reviews from scientific journals such as Journal of Molecular Biology, Biophysical Journal, and Nature Structural & Molecular Biology.

COURSE ARTICULATION MATRIX:

Course Outcome	Program Outcome														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	1	1	1	1	2	3	1	1	1	2	3	1	1
CO2	3	3	2	1	1	-	2	2	1	1	1	2	3	1	1
CO3	3	3	1	1	1	1	2	2	1	1	1	2	3	2	1
CO4	3	3	1	1	1	2	2	1	1	1	1	2	3	3	1
CO5	3	3	-	1	1	1	2	2	1	1	1	2	3	3	1

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

COURSE OBJECTIVES:

The course aims to,

- Develop an understanding of the concepts in different fermentation and sterilisation process.
- Study the kinetics involved in growth and sterilisation of micro-organisms.

UNIT I OVERVIEW OF FERMENTATION PROCESSES 6

Overview of fermentation industry, general requirements of fermentation processes, basic configuration of fermenter and ancillaries, main parameters to be monitored and controlled in fermentation processes.

UNIT II RAW MATERIALS AND MEDIA DESIGN FOR FERMENTATION PROCESS 10

Criteria for good medium, medium requirements for fermentation processes, carbon, nitrogen, minerals, vitamins and other complex nutrients, oxygen requirements, medium formulation of optimal growth and product formation, examples of simple and complex media, design of various commercial media for industrial fermentations – medium optimization methods.

UNIT III STERILIZATION KINETICS 6

Thermal death kinetics of microorganisms, batch and continuous heat sterilization of liquid media, filter sterilization of liquid media, air sterilization and design of sterilization equipment - batch and continuous.

UNIT IV METABOLIC STOICHIOMETRY AND ENERGETICS 12

Stoichiometry of cell growth and product formation, elemental balances, degrees of reduction of substrate and biomass, available electron balances, yield coefficients of biomass and product formation, maintenance coefficients energetic analysis of microbial growth and product formation, oxygen consumption and heat evolution in aerobic cultures, thermodynamic efficiency of growth.

UNIT V KINETICS OF MICROBIAL GROWTH AND PRODUCT FORMATION 11

Batch cultivation and continuous cultivation. Simple unstructured models for microbial growth, Monod model, growth of filamentous organisms, product formation kinetics - Leudeking- Piret models, substrate and product inhibition on cell growth and product formation. Biomass estimation – Direct and Indirect methods.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On the completion of the course students are expected to

CO1. Explore the fundamental configuration of fermenter.

CO2. Develop knowledge on the design and optimization of fermentation process.

CO3. Elucidate various sterilization techniques for the fermentation processes.

- CO4. Comprehend the metabolic stoichiometry and energetics of the microbial cell.
 CO5. Acquire knowledge on kinetics of the microbial growth and product formation.

TEXT BOOKS AND REFERENCES:

1. Schuler, Michael L. and Fikret Kargi, "Bioprocess Engineering ", Prentice Hall, 1992.
2. Doran, Pauline "of Bioprocess Engineering Principles ". Elsevier, Academic Press 1995
3. Lydersen, Bjorn K. "Bioprocess Engineering Systems, Equipment and Facilities" John Wiley, 1994.
4. Bailey, James E. and David F. Ollis, "Biochemical Engineering Fundamentals", 11nd Edition. McGraw Hill, 1986.
5. Peter F. Stanbury, Stephen J. Hall & A. Whitaker, Principles of Fermentation Technology, Science & Technology Books.
6. Harvey W. Blanch, Douglas S. Clark, Biochemical Engineering, Marcel Dekker, Inc.

COURSE ARTICULATION MATRIX:

Course Outcome	Program Outcome														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	3	2	-	-	-	-	-	-	-	3	2	3	1
CO2	2	3	3	2	-	-	-	-	-	-	-	3	-	3	3
CO3	2	3	3	2	-	-	-	-	-	-	-	3	1	3	2
CO4	2	3	3	3	-	2	2	-	-	-	-	3	1	3	2
CO5	3	2	-	2	-	-	-	-	-	-	-	3	1	3	2

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

COURSE OBJECTIVE:

- To introduce fundamental concepts related to biomaterials, their types, and the applications in medicine.

UNIT I BIOMATERIALS – AN INTRODUCTION 6

History of biomaterials; Classes of biomaterials – metals, ceramics, polymers, carbons, and composites

UNIT II PHYSICOCHEMICAL PROPERTIES AND THEIR CHARACTERIZATION 12

Mechanical properties - Stress-Strain behavior, Mechanical failure, Viscoelasticity; Mechanical characterization - tensile, compressive, dynamic mechanical analysis; Surface properties - Surface energy, Wettability; Surface characterization - Optical tensiometry, Electron microscopy, Atomic force microscopy, FT-IR spectroscopy.

UNIT III HOST RESPONSE 9

Inflammation; wound healing; foreign body response; immune response; toxicity; hypersensitivity; cell-material interactions; blood-material interactions; tumorigenesis; biofilms and infections; evaluation and testing of these host reactions

UNIT IV APPLICATIONS OF BIOMATERIALS 12

Implants - Cardiovascular devices, orthopedic and dental implants, ophthalmologic implants; Drug delivery systems - Conventional, controlled, sustained and targeted delivery; Tissue engineering - Scaffolds, Skin tissue engineering, Osteochondral tissue engineering, Regenerative medicine; Biosensors - conductive polymers and their applications in sensors

UNIT V EMERGING TOPICS IN BIOMATERIALS 6

Smart biomaterials; Nanomaterials in medicine; Stem cells and biomaterials; 3D printing; Personalized medicine

TOTAL: 45 PERIODS**COURSE OUTCOMES:**

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

- CO1. Acquire comprehensive knowledge on biomaterials
- CO2. Analyze and understand the physicochemical properties of biomaterials
- CO3. Gain in-depth knowledge of the biological response to biomaterials
- CO4. Understand the various applications of biomaterials in medicine
- CO5. Get introduced to current trends in the field of biomaterials

TEXT BOOKS AND REFERENCES:

- William R Wagner, Shelly E. Sakiyama-Elbert, Guigen Zhang, Michael J. Yaszemski, Biomaterials Science: An Introduction to Materials in Medicine, 4th Edition, 2020, Academic Press
- Joon B. Park, R. S. Lakes, Biomaterials: An Introduction, 3rd Edition, 2010, Springer
- Johnna Temenoff, Antonios Mikos, Biomaterials: The Intersection of Biology and

- Materials Science, 1st Edition, 2008, Pearson
4. AshimMitra, Chi H. Lee and Kun Cheng, Advanced Drug Delivery, 1st Edition, Wiley, 2014.
 5. Robert Lanza, Robert Langer, Joseph P. Vacanti, Anthony Atala, Principles of Tissue Engineering, 5th Edition, Academic Press, 2020

COURSE ARTICULATION MATRIX:

Course Outcome	Program Outcome														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	3	2	-	-	-	-	-	-	-	3	2	3	1
CO2	2	3	3	2	-	-	-	-	-	-	-	3	-	3	3
CO3	2	3	3	2	-	-	-	-	-	-	-	3	1	3	2
CO4	2	3	3	3	-	2	2	-	-	-	-	3	1	3	2
CO5	3	2	-	2	-	-	-	-	-	-	-	3	1	3	2

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

COURSE OBJECTIVE:

- The Objective of this course is to provide knowledge to the students on various materials other than leather which have the same properties as leather.

UNIT I POLYMER BASED MATERIALS 9

Polyurethane based materials/Pleather – Rubber based materials – Polyethylene based materials – Synthetic Fibers. Manufacturing Methods– Applications – Properties.

UNIT II NATURAL FIBERS BASED MATERIALS 9

Cotton fibers – wool based materials – Jute fibers – Silk fibers – Bamboo fibers – Hemp fibers – Sisal fibers – Palm fibers – Coir Fibers - Rice Husk based materials. Manufacturing Methods – Applications – Properties.Principles of combination Products using natural fibers with leathers - Application in Product sector.

UNIT III BIO BASED MATERIALS 9**Starch, Cellulose, Alginate, Carragenan, Pectin, Lignin**

Bio-based polymers – Microbial Origin Materials – Microbial Cellulose – Fungal composites. Synthetic biotechnology based artificial skin based approaches.

UNIT IV FRUIT / VEGETABLE BASED MATERIALS 9

Cactus – Pineapple – Mango Leather – Grape Leather – Banana peel Leather – Flower based leather – Apple Leather: Principles – Extraction - Manufacturing Methods– Applications – Properties.

UNIT V RECYCLED MATERIALS 9

Tannery Waste: Buffing dust based materials – Leather trimming based materials – Collagen based materials – Agricultural wastes. Manufacturing Methods - Applications – Properties.

TOTAL: 45 PERIODS**COURSE OUTCOMES:**

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

CO1. Explore various polymers used in developing like leather materials.

CO2. Comprehend the various natural fibers in making sheets.

CO3. Analyse the different biological origin materials.

CO4. Acquire in depth knowledge on various fruit and vegetable sources used to prepare leather like materials.

CO5. Develop various methods for recovering and recycling leather waste materials.

TEXT BOOKS AND REFERENCES:

1. <https://www.daryatamin.com/wp-content/uploads/2019/12/Szychers-Handbook-of-Polyurethanes.pdf>

2. Alvanas, H. (2021). Polyurethane Fabric: Fabric Made In Traditional Polyurethane: Polyurethane Fabric. (n.p.): Independently Published.
3. Faux Real: Genuine Leather and 200 Years of Inspired Fakes. United States: University of Pennsylvania Press, Incorporated.
4. Gilroy, D. (2023). Fashion Bags and Accessories: Creative Design and Production. United Kingdom: Quercus Publishing

COURSE ARTICULATION MATRIX:

Course Outcome	Program Outcome														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	1	1	3	1	3	3	1	1	-	1	2	3	1
CO2	3	-	1	1	1	1	3	1	1	1	-	1	-	3	3
CO3	3	2	1	1	2	1	3	2	1	1	-	1	1	3	2
CO4	3	1	1	1	2	1	3	2	1	1	-	1	1	3	2
CO5	3	1	1	1	2	1	3	2	1	1	-	1	1	3	2

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

COURSE OBJECTIVE:

- To train students with the skill of designing the ETP/ CETPs for treatment of Tannery Wastewater including Solid Waste Management

UNIT I INTRODUCTION 9

Details of leather processing with water and chemical input, water requirement based on type of process and wastewater generation, need for wastewater treatment, nature of pollutants, characteristics of pollutants, environmental significance of pollutants, standards for discharge of treated effluents, concept of individual Effluent Treatment Plants (ETPs) and Common Effluent Treatment Plants (CETPs), planning for segregation and collection of liquid and solid waste.

UNIT II PHYSICO- CHEMICAL TREATMENT OF WASTEWATER 9

Concept of unit operations and processes, Physical treatment with principle of the process and design criteria- basis for selection of treatment units- screening – flotation, mixing, equalization –sedimentation – filtration – evaporation– incineration, adsorption, membrane separation, stripping and crystallization– recent advances, Preparation of process flow diagram

Chemical treatment with principle of the process and design criteria- basis for selection of treatment units- Coagulation - flocculation–Precipitation –Disinfection, advanced oxidation process –Preparation of process flow diagram

UNIT III BIOLOGICAL WASTEWATER TREATMENT 9

Principles of Biological treatment with process and design criteria – Role of microorganisms in wastewater treatment, Introduction to microbial metabolism – Bacterial growth, Assessment of biodegradability of waste, classification of biological treatment processes, Suspended and attached growth systems, Activated Sludge Process, Membrane Bioreactors, Upflow Anaerobic sludge Blanket (UASB) Reactor, Waste Stabilization Ponds, basis for selection of treatment units- Preparation of process flow diagram

UNIT IV TERTIARY TREATMENT AND SOLID WASTE MANAGEMENT 9

Principles of Tertiary treatment with process and design criteria – Need and objectives of Tertiary Treatment, removal of residual organics, removal of Colour, polishing treatment, basis for selection of treatment units, sources of solids and solid waste generation, methods of solid waste disposal and treatment, criteria for design of Tertiary Treatment units and solid waste management facilities

UNIT V DESIGN OF ETPS/ CETPS 9

Design concepts for ETps/ CETps, freezing of treatment process, arriving the sizes of treatment units, Selection and arriving the capacity of Electro Mechanical items, arriving energy requirement, layout Design, preparation of layout, preparation of Hydraulic Flow Diagram, Preparation of P & I diagram. construction requirements for Civil, mechanical, electrical and instrumentation items, Pre-commissioning activities, O & M of CETps/ ETps.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1. Explain the significance of various pollutants present in water, wastewater and develop the kinetics for reactor design.

CO2. Articulate physico-chemical systems for effective water and wastewater treatment

CO3. Develop Biological Wastewater Treatment

CO4. Evaluate the various Tertiary Treatment and Solid Waste Management

CO5. Design of ETP/CETPs

REFERENCES:

1. Metcalf & Eddy, Inc., George Tchobanoglous, Franklin L. Burton and H. David Stensel, Wastewater engineering, treatment and reuse, Fourth Edition, McGraw-Hill, 2017.
2. Lee, C.C. and Shun dar Lin, "Handbook of Environmental Engineering Calculations", McGraw Hill, New York, 1999.
3. Qasim.S.R., Guang Zhu., "Wastewater Treatment and Reuse" – Volume 1& 2 2018.
4. CPHEEO manual – "Manual for sewerage and sewage treatment systems" – Part A,B,C, Ministry of Urban development, New Delhi,2013.
5. CPHEEO manual – "Manual for water supply and treatment" –Ministry of Urban development, New Delhi, 1999.
6. Soli J Arceivala- Wastewater Treatment for Pollution Control – Tata McGraw- Hill Publishing Company Limited, New Delhi

COURSE ARTICULATION MATRIX:

Course Outcomes	Program Outcome														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PS O1	PS O2	PSO 3
CO1	2	-	1	-	2	2	3	2	1	1	1	2	2	3	1
CO2	2	-	1	-	2	2	3	2	1	1	-	2	1	3	3
CO3	3	3	2	3	3	2	3	3	2	1	3	3	-	3	2
CO4	2	2	1	2	2	2	3	2	1	1	1	2	1	3	2
CO5	1	-	-	-	-	2	3	1	-	1	-	1	1	3	2

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

COURSE OBJECTIVE:

- To gain knowledge on the value addition to the by-products produced by the leather sector as a waste to wealth concept.

UNIT 1 INTRODUCTION TO TANNERY WASTE 9

Definition of pollution, Classification of pollutants from leather sector Solid- Liquid- Gaseous.

UNIT II TANNERY BYPRODUCTS CHARACTERISTICS 9

Classification of solid wastes from tannery; composition and characteristics – raw trimmings, fleshings, hair wastes, shavings, wetblue/crust/finished leather trimmings, buffing waste.

UNIT III SOLID WASTE DISPOSAL 9

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

UNIT IV UNTANNED SOLID WASTE UTILIZATION 9

Technologies for utilization of raw trimmings – High end collagen products, glue, gelatin; Fleshing waste – Glue, energy recovery; Hair waste – Composite, keratin hydrolysate.

UNIT V TANNED SOLID WASTE UTILIZATION 9

Chrome and vegetable tanned shavings – leather board, protein fillers; utilization of crust/finished leather trimmings.

TOTAL: 45 PERIODS**OUTCOME:**

On Completion of the course, the student is expected to be able to,

CO1. Acquire the knowledge of the waste produced in leather sector.

CO2. Explore the characteristics of tannery by-products.

CO3. Elucidate the solid waste disposal methods practiced in industries

CO4. Acquire knowledge on the untanned waste utilization.

CO5. Elucidate the tanned waste utilization methods.

REFERENCES:

- Arceivala S.J. "Waste water treatment and disposal" Marcel Dekkar Inc., New York, 1981.
- Besselievie, B.E. and Schwartz, M. "The Treatment of Industrial wastes", 2nd edn., McGraw Hill.
- McCarty, P., Parkin, G.F. and Sawyer, C.N., "Chemistry for Environmental Engineering 4th Edition", McGraw Hill, 1994.

COURSE ARTICULATION MATRIX:

Course Outcomes	Program Outcome														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	-	1	-	2	2	3	2	1	1	1	2	2	3	1
CO2	2	-	1	-	2	2	3	2	1	1	-	2	1	3	3
CO3	3	3	2	3	3	2	3	3	2	1	3	3	-	3	2
CO4	2	2	1	2	2	2	3	2	1	1	1	2	1	3	2
CO5	1	-	-	-	-	2	3	1	-	1	-	1	1	3	2

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

COURSE OBJECTIVE:

- To impart knowledge on Occupational Safety and Hazard aspects in leather manufacture.

UNIT I SAFETY PHILOSOPHY, HAZARD IDENTIFICATION AND ASSESSMENT

9

Legal framework of safety and health in India International conventions and trends; Responsibilities and enforcement mechanism. Need for safety and health (cost/benefit rational; safety, environment and productivity triangle); Role of industrial hygiene, Hazard classification (hazard categories and groups), Hazard identification and assessment (tools and methods).

UNIT II SAFETY IN USE OF HAZARDOUS SUBSTANCES AT WORK

10

Chemical and biological hazards in the work place in the leather industry; Health effects of chemical and biological exposure Hazard information systems on hazardous substances (material safety data sheets, labelling), workplace exposure monitoring and evaluation, hazard prevention and control measures (storage, handling and disposal) in the leather industry.

UNIT III PRODUCTIVE MACHINE SAFETY IN THE LEATHER INDUSTRY, WORK ECOLOGY AND ERGONOMICS

10

Safety hazards of machinery, machine tools and electrical installations ; Hazard prevention and safeguarding of machinery (guards, machine controls, ergonomics) ; Role of preventive maintenance; Safe workstation design and layout, Manual handling of material; Lighting (standards, use of natural and artificial illumination); Climate control (standards, temperature/humidity, improving general ventilation); Noise management (standards, prevention and protection); Safety of factory premises and installations (railings, flooring, safe structures); Welfare measures; Personal protection and hygiene (selection, use, maintenance).

UNIT IV EMERGENCY PREVENTION AND PREPAREDNESS

8

Planning for emergencies; Control of fire and explosion; Dealing with medical emergencies.

UNIT V SAFETY AND HEALTH MANAGEMENT AND PROMOTION

8

Promoting safety and health practices at the workplace (training, safety and warning signs); Role and responsibilities of managers, supervisors and workers.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, the students will be in the position to,
CO1. Acquire knowledge on legal framework of safety and health, hazard identification and assessment methods

- CO2. Analyse and understand Chemical and biological hazards in the work place.
 CO3. Acquire knowledge on machinery safety, work ecology and ergonomics in the leather industry.
 CO4. Comprehensive knowledge on emergency prevention and preparedness.
 CO5. Acquire knowledge on safety and health management.

TEXT BOOKS AND REFERENCES:

1. Jeannie MagerStellmann, Encyclopaedia of Occupational Safety and Health, 4th edition, International Labour Office, Geneva 1999.
2. J. Buljan, A Sahasranaman, J Hannak, Occupational Safety and Health Aspects of Leather Manufacture, 1st edition, United Nations Industrial Development Organization, Chennai, 1998.
3. CLRI, Safety Manual on Leather Processing, 1st edition, Central Leather Research Institute, Chennai, 1999.

COURSE ARTICULATION MATRIX:

Course Outcomes	Program Outcome														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	-	1	-	2	2	3	2	1	1	1	2	2	3	1
CO2	2	-	1	-	2	2	3	2	1	1	-	2	1	3	3
CO3	3	3	2	3	3	2	3	3	2	1	3	3	-	3	2
CO4	2	2	1	2	2	2	3	2	1	1	1	2	1	3	2
CO5	1	-	-	-	-	2	3	1	-	1	-	1	1	3	2

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

COURSE OBJECTIVE:

- To train the students to understand and implement quality assurance system in the leather manufacturing unit.

UNIT I INTRODUCCION TO QUALITY ASSURANCE 8

Definition of quality, fundamentals of statistics and probability, confidence intervals, testing significance, statistical process control techniques, analysis, defect diagnosis and prevention. Quality assurance- Definition, Importance of quality assurance, Quality Assurance vs. Quality Control, Pros and cons of QA, History of ISO and QA, QA standards.

UNIT II RAW MATERIAL QUALITY 9

Importance of raw material quality assessment in leather processing, Pre-tanning raw material assessment, tanning raw material assessment, post tanning raw material assessment, finishing raw material assessment.

UNIT III PROCESS CONTROL IN LEATHER PROCESSING 9

Process flow charts; In-process control check; Responsibilities; Calibration, validation and qualification of the pre-tanning, tanning, post tanning and finishing processes.

UNIT IV INTERMITTENT QUALITY CONTROL 9

Calibration, validation and qualification of the pelt/leather at intermittent stages – Limed pelt, pickled pelt, tanned leather, crust leather, finished leather.

UNIT V CASE STUDY 10

Implementation of the quality assurance system in the leather manufacturing unit.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1. Comprehend the importance of quality assurance in the leather sector.

CO2. Explore and understand the importance of the quality of raw materials for leather processing.

CO3. Acquire knowledge of the in process control of leather manufacturing.

CO4. Elucidate the qualification of the interment products.

CO5. Explore and analyse the implementation of the quality assurance for leather manufacturing.

TEXT BOOKS AND REFERENCES:

1. A. J. Duncan, "Quality Control and Industrial Statistics", Homewood, Illinois, Published by Irwin, 1986.
2. "International Organization for Standardization" case postale 56, CH-1211-Geneva – 20, Switzerland.
3. "Bureau of Indian Standards", New Delhi.

4. Dale H.Besterfield, Carol B.Michna,Glen H. Besterfield,MaryB.Sacre,HemantUrdhwareshe and RashmiUrdhwareshe, "Total Quality Management", Pearson Education Asia, Revised Third Edition, Indian Reprint, Sixth Impression,2013.
5. Joel.E. Ross, "Total Quality Management – Text and Cases",Routledge.,2017.
6. Kiran.D.R, "Total Quality Management: Key concepts and case studies, Butterworth – Heinemann Ltd, 2016.
7. Oakland, J.S. "TQM – Text with Cases", Butterworth – Heinemann Ltd., Oxford, Third Edition, 2003.
8. Suganthi,L and Anand Samuel, "Total Quality Management", Prentice Hall (India) Pvt. Ltd., 2006 .

COURSE ARTICULATION MATRIX:

Course Outcomes	Program Outcome														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	-	1	-	2	2	3	2	1	1	1	2	2	3	1
CO2	2	-	1	-	2	2	3	2	1	1	-	2	1	3	3
CO3	3	3	2	3	3	2	3	3	2	1	3	3	-	3	2
CO4	2	2	1	2	2	2	3	2	1	1	1	2	1	3	2
CO5	1	-	-	-	-	2	3	1	-	1	-	1	1	3	2

1, 2and3arecorrelation levelswithweightings asSlight (Low),Moderate (Medium)andSubstantial(High)respectively.

COURSE OBJECTIVE:

- To understand the importance of eco-labelling and practice on implementation of the eco-labelling standards in leather sector.

UNIT I INTRODUCTION TO ECO-LABELLING 8

Eco-labelling, significance of labelling, history of eco-labelling. Benefit of environmental labelling, demerits of labelling. LCA Concepts.

UNIT II TYPES OF ECO-LABELLING 8

Type I – The ‘classic’ ecolabel, gold standard of eco-labelling; Type II – Self-declaration claims; Type III – Environmental declarations (report cards/information labels).

UNIT III GLOBAL STANDARDS AND FRAMEWORK FOR ECOLABELLING 11

Principles and procedures for developing Type I environmental labelling programmes; Selection of product categories, product environmental criteria and product function characteristics, and for assessing and demonstrating compliance. ISO 1450:2020 Environmental management — Vocabulary; ISO 14020:2022 Environmental statements and programmes for products — Principles and general requirements; ISO 14021:2016 Environmental labels and declarations — Self-declared environmental claims (Type II environmental labelling); ISO 14024:2018 Environmental labels and declarations — Type I environmental labelling — Principles and procedures; ISO 14025:2006 Environmental labels and declarations — Type III environmental declarations — Principles and procedures; ISO 14040:2006 Environmental management — Life cycle assessment — Principles and framework; ISO 14044:2006 Environmental management — Life cycle assessment — Requirements and guidelines

UNIT IV LEATHER SECTOR ECO-LABELLING 8

Impediment in the eco-labelling of leather sector. Technologies for leather sector to achieve environment friendly approaches.

UNIT V CASE STUDY 10

Implementation of eco-labelling standards in leather and leather allied sectors: Eco-labelling of tanneries, Eco labelling of leather products sectors; Leather allied sectors – Eco-labelling of leather allied sectors.

TOTAL: 45 PERIODS**COURSE OUTCOMES:**

At the end of the course, the students are expected to,
 CO1. Analyse eco-labelling significance in the leather sector.
 CO2. Classify the types of eco- labelling.
 CO3. Acquire knowledge of ISO 14024:2018.
 CO4. Elucidate the requirement for the qualification of leather sector to eco-labelling.
 CO5. Explore the implementation of the eco-labelling for leather sector.

TEXT BOOKS AND REFERENCES:

1. Ecolabelling and international trade, Simonetta Zarrilli, VeenaJha, Rene Vossenaar.
2. Green Marketing as a Positive Driver Toward Business Sustainability, Anitha Acharya.

COURSE ARTICULATION MATRIX:

Course Outcome s	Program Outcome														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	-	1	-	2	2	3	2	1	1	1	2	2	3	1
CO2	2	-	1	-	2	2	3	2	1	1	-	2	1	3	3
CO3	3	3	2	3	3	2	3	3	2	1	3	3	-	3	2
CO4	2	2	1	2	2	2	3	2	1	1	1	2	1	3	2
CO5	1	-	-	-	-	2	3	1	-	1	-	1	1	3	2

1, 2and3arecorrelation levelswithweightings asSlight (Low),Moderate (Medium)andSubstantial(High)respectively.

COURSE OBJECTIVE:

- To impart knowledge on the chemistry and properties of various auxiliaries used in leather processing.

UNIT I INTRODUCTION 8

Leather Auxiliaries – Roles and Functions, Classification of Auxiliaries based on applications and chemistry.

Leather chemicals – Roles and functions, classification of leather chemicals based on application.

UNIT II SYNTANS 10

Syntans – Introduction to raw materials and background to relevant chemistries of production such as sulfonation, condensation, polymerisation etc. Technology for preparation of aromatic sulfonic acid – formaldehyde /urea-formaldehyde and sulfone based syntans. Role of syntan product chemistries in obtaining desired feel in leather.

UNIT III FATLIQUORS 9

Physical chemistry of colloids. Chemistry of emulsifying agents. Stability and Efficiency of emulsions. Chemistry of oils and fats – Differences, chemical structure of fatty acids, classification of oils, differences between animal, vegetable and mineral oils. Chemical modification of oils for applications in leather. Differences between natural and synthetic fatliquors.

UNIT IV DYE AND PIGMENTS 10

Theory of colour. Fundamentals of colour matching. Particle size. Relevance of particle size of colour. Chemical constituents of dyes. Classification of dye and introduction to chromophores. Structural features of dyes.

Pigments – classification, relevance of particle size to colour. Introduction to various types of pigments and their chemistries. Differences between dyes and pigments.

UNIT V FINISHING CHEMICALS 8

Classification of finishes. Chemistry of film formation and theory of adhesion. Binders – chemical classification, General understanding of polymeric, protein and other types of binders. General understanding of the chemistries of plasticizers, feel modifiers, waxes, slip agents.

TOTAL: 45 PERIODS**COURSE OUTCOMES:**

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

CO1. Classify and explore leather auxiliaries and leather chemicals.

CO2. Acquire in-depth knowledge on synthetic tanning agents.

CO3. Comprehend chemistry of oil and oil modification for the leather lubrication.

CO4.Explore the physical chemistry of colloids.
CO5.Analyse the chemistry of finishing chemicals.

TEXT BOOKS AND 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, 1978.
2. Gustavson, K.H. `Chemistry of Tanning Processes' Academic Press, New York, 1958.
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.

COURSE ARTICULATION MATRIX:

Course Outcome	Program Outcome														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	1	-	2	1	3	1	1	1	1	1	-	3	2
CO2	3	1	1	-	3	-	2	1	1	1	2	1	-	3	2
CO3	3	1	1	-	1	2	1	1	1	1	-	1	2	3	2
CO4	3	1	1	-	2	1	2	1	1	1	1	1	2	3	2
CO5	3	1	1	-	2	1	2	1	1	1	1	1	1	3	2

1, 2and3arecorrelation levelswithweightings asSlight (Low),Moderate (Medium)andSubstantial(High)respectively.

COURSE OBJECTIVE:

- To impart human resource management skills to the students.

UNIT I MANAGEMENT AND GENERAL EMPLOYMENT PRACTICES 9

HRM and HRD – Concept and Need; Motivation, Leadership, Employee involvement vs engagement, Employee empowerment; Performance management, Performance and potential appraisals; HR Accounting and HR Audit; Workplace ethics and behaviour, Healthy work-life balance and stress management; International HRM and cross-cultural diversity management, Case Discussion.

UNIT II STRUCTURE, STAFFING, CULTURE AND CLIMATE 9

Organizational design, Human Resource Planning; Job design, Job Analysis - Job description and job specification; Equal Employment Opportunity; Recruitment, Selection, Placement, Induction and Socialization; Organizational culture – Creating and sustaining culture, Concept and determinants of Organizational climate; Employee retention; Organizational exit, Case study.

UNIT III HUMAN RESOURCE DEVELOPMENT 9

HRD role clusters: Analysis/Assessment roles- Evaluator, Needs analyst, Researcher Development roles - Evaluator, HRD materials developer, Program designer.

Strategic roles – HRD manager, Marketer, Organization – Change agent, Individual – Career development advisor, Instructor/Facilitator, Administrator.

Types of competencies and Competency development; Training and Development; Organizational Development for conflict management and change management; Career Planning and Development, Succession planning.

Contemporary issues: Strategic talent management, Knowledge management and learning organizations, Intellectual capital management, HR Outsourcing, HR Benchmarking, HR Information System, Case study.

UNIT IV EMPLOYEE COMPENSATION 9

Job evaluation, Pay Structures, Competency based and Performance based pay systems, Benefit programs, Pay delivery administration.

UNIT V HEALTH, SAFETY, SECURITY AND LABOUR RELATIONS 9

Introduction to occupational Safety-Employee assistance programs, safety management and approaches, theft, fraud, investigations, corrections; Labour laws in India, unfair labour practices, collective bargaining, Case study.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On the completion of course students are expected to

CO1. Acquire knowledge on human resource management and development of general employment practices.

CO2. Design organizational structure, staffing, culture and climate.

CO3. Acquire indepth knowledge on HRD role clusters, developmental interventions from HRD perspective and contemporary issues.

CO4. Elucidate employee compensation and compensation administration.

CO5. Analyse occupational health, safety, security, labour laws and labour relations.

TEXT BOOKS AND REFERENCES:

1. Mathis, R. L. and Jackson, J. H. (2003). Human Resource Management, (10th ed.), Mason, Ohio: Thomson-Southwestern.
2. Rao, T.V., (1996) "Human Resources Development: Experiences. Interventions. Strategies", Sage Publications, New Delhi.

COURSE ARTICULATION MATRIX:

Course Outcome	Program Outcome														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1	2	2	2	2	1	3	3	1	2	2	-	-	3
CO2	-	1	2	1	-	2	1	2	3	2	1	3	2	2	3
CO3	1	1	2	2	3	2	1	2	3	2	1	2	1	2	3
CO4	2	2	3	1	2	1	1	2	3	1	2	2	1	3	3
CO5	2	2	2	2	2	2	2	2	3	1	1	2	2	3	3

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

COURSE OBJECTIVE:

- To provide skills and knowledge on organization and management for leather sector.

UNIT I RAW MATERIAL RESOURCE MANAGEMENT 10

Basic Resource – Livestock: Management systems - Population distribution and trends in India and World – Relative importance - Supply of meat animals – Projections for future. Raw materials – Hides and skins: Meat consumption pattern – Slaughter and mortality rates – Availability of hides and skins in India and world – Storage and grading systems – Pricing and other marketing factors - Major markets and sources of supply from India and world – Scenarios for future, Case study.

UNIT II INDUSTRY MANAGEMENT 10

Social relevance and historical growth of leather sector. Processing Industry – Tanning: Structure of the Industry in India and the World – Capacity, Production, Environmental management - Exclusive complexes and CETPs – Sustainability challenges. Fabrication Industries – Products: Structure and Distribution of Product industries in India and World - Pattern of Leather utilization – Capacity, Production, Employment pattern - Components of design and fashion, Case study.

UNIT III DOMESTIC TRADE MANAGEMENT 8

Domestic Trade – India: Production and Consumption pattern of Footwear in India – Market demand for Leather and Synthetic (non- leather) footwear - Market for Leather goods, garments, gloves and other leather articles in India – Import of Footwear and Products into India – Emerging market scenario in India. Export Trade – India: Export and Import policy - Export trends of leather and products – major markets for India - Importance of Brands, Fashion, Certification issues – Priorities for Future, Case study.

UNIT IV INTERNATIONAL TRADE MANAGEMENT 7

International Trade – Global: Major exporting and importing countries in the world – Significance of African region in the world market - Changes in the pattern of demand at global level - Role of Market network, Brands and Fashion– Impact of E- Commerce.

Ecological and Social labelling /certification systems - Traceability, Ethical, Resource conservation issues – Role of WTO - Future challenges for leather trade, Case study.

UNIT V DEVELOPMENT STRATEGY 10

Planning and Trade Promotion strategies – India: Planning of Material, Manpower, Financial resources – Potential for non- conventional raw-material resources and product categories – Role of various Organisations – Trade promotion measures – Market surveys and building market intelligence – Measures for India’s sustainability in world trade, Case study.

TOTAL: 45 PERIODS**COURSE OUTCOMES:**

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

CO1. Elucidate raw material resource management.

CO2. Explore about leather industry in India and world.

CO3. Analyse and understand the domestic trade management in leather.

CO4. Analyse and understand the international trade management in leather.

CO5. Explore industry, trade management and development strategy in leather.

TEXT BOOKS AND REFERENCES:

1. Report of All India Survey on Raw Hides and Skins, CLRI, 1987 and 2004.
2. Report on Capacity Utilisation and Scope for modernization of Indian tanning industry, CLRI, 1990.
3. Report of the Committee on The Development of Leather and Leather Manufactures for Exports (Seetharamaiah Committee Report), Govt of India 1972.
4. Report of the Nationwide Survey on Leather Product Units in India, CLRI, 1997.
5. Thyagarajan, G, Srinivasan, A.V. and Amudeswari, A., "Indian Leather 2010, A technology, Industry and Trade Forecast', CLRI, Madras 1994.
6. Bulletins of India's Foreign Trade in Leather and Leather Products, CLRI.
7. Sadulla, S. The Leather Industry Kothari's Desk Book Series, H.C.Kothari Group (Publications Division), Madras 1995.

COURSE ARTICULATION MATRIX:

Course Outcome	Program Outcome														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	1	1	1	3	1	1	2	1	1	1	-	3	3
CO2	1	1	1	-	1	3	1	1	1	1	3	1	-	3	3
CO3	1	1	1	2	1	3	1	1	3	1	2	1	1	3	3
CO4	1	1	1	1	1	3	1	1	2	1	2	1	2	3	3
CO5	-	1	1	1	1	3	1	1	2	1	2	1	2	3	3

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

COURSE OBJECTIVE:

- This course aims to provide necessary knowledge and attitude to understand and appreciate the process of starting and developing a new venture.

UNIT I QUALITY OF ENTREPRENEURS 8

Entrepreneurs – Mindset, character, motivation. Types of entrepreneurs. Competencies - creativity, innovation, risk taking, resilience, leadership, communication, negotiation and networking; Design thinking for entrepreneurs. Myths about entrepreneurs; benefits and drawbacks of entrepreneurship. Managerial concerns specific to growing ventures; Reasons for a venture failure. Successful first-generation entrepreneurs in leather sector – case study.

UNIT II PLANNING AND DEVELOPMENT 8

Business Plan - Generating idea; converting an idea into business venture, vision, mission and strategy formulation. Conducting feasibility analysis – Financial, Commercial, Technical, Environmental and Legal. Developing a business plan for leather and leathers products. Presenting a business plan to investors to pitch for funds, Case study.

UNIT III FINANCIAL MANAGEMENT 10

Business Finance – Forms of ownership, Financial projections and pro- forma of profit and loss account, cash flow statements; production and marketing budgets. Capital budgeting and investment analysis, breakeven point and sensitivity analysis to decide on a tannery proposal. Source of funds – own funds, banks, long term development financial institutions, Angel investors, Venture Capitalist, Public issue (IPO). Taxes - VAT, Service Taxes, Excise and Customs duties, CST, GST (proposed), tax exemptions for exports and SEZ, Government schemes for financial assistance to startups in India. Controlling business - working capital control and cost control; inventory, procurement and receivables control. Quality control. Sales and marketing expenses control. SCM for leather sector, Case study.

UNIT IV ORGANIZATIONAL MANAGEMENT 9

Building Team – creating growth oriented organizational culture. Employee motivation, retention strategies. Organizational structure with clear roles, responsibilities, authorities and accountabilities. Attracting talent with ESOP and other incentives and benefits. Training and development to enhance the quality of operators, supervisors and managers of the tannery, Case study.

UNIT V BUSINESS DEVELOPMENT STRATEGIES 10

Building Business – Market plan, market research, competitive analysis, formulating competitive marketing strategy. Segmenting, Targeting and Positioning of the brand. Formulating marketing mix – 4 Ps of Product Marketing and 7 Ps of Service Marketing. Personal selling, advertising and sales promotion, managing a sales team. Distribution and CRM Strategy. New Product development. E-commerce fundamentals; strategy for expansion. Franchising - benefits and drawbacks of franchising. Global marketing – overseas marketing strategies; export documentation. Mergers and Acquisitions – synergy and

valuation. Intellectual Property - patterns, trademarks, copy rights and trade secrets to grow the business in leather sector. Embryonic Companies and Spin off's – Opportunities in Emerging/Transition/Decline industries – Porter's five forces model – Startup India – Make in India – Govt. Support Schemes for Startups, Case study.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

- CO1. Acquire conceptual and theoretical knowledge about entrepreneurs and entrepreneurship
- CO2. Design and development of Business Plan.
- CO3. Acquire basic knowledge in financial management.
- CO4. Explore the various organizational management aspects to attract, retain and develop talented workforce.
- CO5. Acquire knowledge on business development strategies.

TEXT BOOKS AND REFERENCES:

1. Entrepreneurship - D.F. Kuratko and T.V.Rao – Cengage Learning -2012 ; ISBN – 978-81315- 1716-1.
2. Entrepreneurial Development – Dr. S.S. Khanna - S. Chand -2012 ISBN – 81- 219-1801-4.
3. Handbook for New Entrepreneurs – P.C. Jain – Entrepreneurship Development Institute of India – 2010; ISBN:13 : 978-0-19-565224-6.
4. Essentials of Entrepreneurship and Small Business Management – Thomas W. Zimmerer, Norman M. Scarborough – PHI Learning Ltd New Delhi. ISBN : 978 – 81-203-3911-8.
5. <http://smallb.in/entrepreneurship> - A SIDBI initiative.
6. <http://business.gov.in/> - Business Knowledge Resources for SMEs.
7. <http://www.dcmsme.gov.in/> - Development Commissionaire (MSME) Ministry of Small Micro Medium Industries.
8. https://www.startupindiahub.org.in/content/sih/en/learning-and-development_v2.html

COURSE ARTICULATION MATRIX:

Course Outcome	Program Outcome														
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CO1	-	1	2	2	-	2	1	2	3	3	2	2	2	1	3
CO2	2	2	2	2	2	2	1	2	3	1	1	2	-	3	3
CO3	-	1	2	1	-	2	1	2	3	1	3	3	-	2	3
CO4	1	1	2	1	2		1		3		1		1	2	3
CO5	1	1	2	1	3	2	1	2	3	1	1	2	2	3	3

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

COURSE OBJECTIVE:

- To impart knowledge on leather and leather products costing

UNIT I	COSTING METHODS	10
Cost accounting, elements of cost, classification of cost elements – examples from leather industry, Modern tools for cost analysis, methods of costing, Case study.		
UNIT II	COST ANALYSIS	8
Cost profit volume analysis, breakeven analysis; standard costing, analysis of variance, Case study.		
UNIT III	LEATHER AND LEATHER PRODUCT COSTING	9
Costing of leather and leather products – material, labour, power and overhead expenses, Case Discussion.		
UNIT IV	RISK ANALYSIS OF FOREIGN EXCHANGE	10
Foreign exchange mechanisms, exchange rates; foreign exchange exposure management – risks, strategies to reduce risk, Case Discussion.		
UNIT V	BUDGET MANAGEMENT	8
Budget, types of budgets, budgeting and control in tanneries and leather products industry, Case Discussion.		

TOTAL: 45 PERIODS**COURSE OUTCOMES:**

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

CO1. Acquire basic knowledge on costing.

CO2. Elucidate costing analysis.

CO3. Acquire in-depth knowledge on costing of leather and leather products.

CO4. Explore the risk analysis of foreign exchange.

CO5. Elucidate budget management and types.

TEXT BOOKS AND REFERENCES:

- “Costing in leather processing industry”, ICWAI, 2001.
- Bulijan, J., “Costs of tannery waste treatment”, UNIDO, 2005.
- “World statistical compendium for raw hides and skins, leather and leather footwear”, Food and Agriculture Organization of the United Nation, 2016.
- James C., Van Home., “Financial Management and Policy”, Prentice Hall of India Pvt. Ltd, New Delhi, 1980.
- Thukaram Rao M.E., “Cost and Management Accounting” New Age International, Bangalore, 2004.

COURSE ARTICULATION MATRIX:

Course Outcome	Program Outcome														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO1 1	PO 12	PS O1	PSO 2	PSO 3
CO1	2	1	-	-	1	2	2	1	1	1	-	2	1	3	-
CO2	2	2	3	-	3	-	1	1	1	1	2	2	1	3	-
CO3	3	2	-	-	3	1	-	1	1	1	-	2	-	3	2
CO4	2	3	2	-	2	1	1	1	1	1	3	2	-	3	3
CO5	3	2	1	-	1	1	1	1	1	1	-	2	3	3	3

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

COURSE OBJECTIVES:

- To understand the changing business environment
- To identify the indicators of management thoughts and practices
- To understand fundamental premise underlying market driven strategies

UNIT I INTRODUCTION**9**

Marketing – Definitions - Conceptual frame work – Marketing environment: Internal and External - Marketing interface with other functional areas – Production, Finance, Human Relations. Management, Information System. Marketing in global environment – Prospects and Challenges. The Nature and Sources of Data; Data Collection, Problems, and Quality; Web/Internet and Commercial Database Services; Database Management Systems in Decision Support Systems/ Business Intelligence; Database Organization and Structures; Data Warehousing; Data Marts. Case study

UNIT II MARKETING STRATEGY**9**

Marketing strategy formulations – Key Drivers of Marketing Strategies - Strategies for Industrial. Marketing – Consumer Marketing — Services marketing – Competitor analysis - Analysis of consumer and industrial markets – Strategic Marketing Mix components. Case study

UNIT III MARKETING MIX DECISIONS**9**

Product planning and development – Product life cycle – New product Development and Management – Market Segmentation – Targeting and Positioning – Channel Management - Advertising and sales promotions – Pricing Objectives, Policies and methods. Case study

UNIT IV MARKETING RESEARCH & TRENDS IN MARKETING**9**

Marketing Information System – Research Process – Concepts and applications: Product – Advertising – Promotion – Consumer Behaviour – Retail research – Customer driven organizations - Cause related marketing - Ethics in marketing –Online marketing trends. Case study

UNIT V BUYER BEHAVIOUR AND DIGITAL MARKETING**9**

Understanding industrial and individual buyer behavior - Influencing factors – Buyer Behaviour. Models – Online buyer behaviour - Building and measuring customer satisfaction – Customer relationships management – Customer acquisition, Retaining, Defection. Case study

Strategies in Digital Marketing - Aligning Internet with Business Objectives - User Behaviour & Navigation - Branding & User Experience - Stakeholders in Search - Customer Insights - On & off-page Optimization - Meta Tags, Layout, Content Updates - Inbound Links & Link Building.

Best Practice Examples & case Studies. Case study

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1. Acquire basic knowledge on the marketing management.

CO2. Explore and analyse different marketing strategies.

CO3. Comprehend decision making skills for a business.

CO4. Articulate the buyers behaviour.

CO5. Elucidate the marketing research methods and trends.

TEXT BOOKS AND REFERENCES:

1. Philip Kotler and Kevin Lane Keller, Marketing Management, PHI 14th Edition, 2012.
2. KS Chandrasekar, "Marketing Management-Text and Cases", Tata McGrawHill-Vijaynicole, First edition, 2010.
3. Paul Baines, Chris Fill and Kelly Page, Marketing, Oxford University Press, 2nd Edition, 2011.
4. Lamb, hair, Sharma, Mc Daniel– Marketing – An Innovative approach to learning and teaching A south Asian perspective, Cengage Learning — 2012.
5. Micheal R. Czinkota & Masaaki Kotabe, Marketing Management, Vikas Thomson Learning, 2000.
6. Douglas, J. Darymple, Marketing Management, John Wiley & Sons, 2008. NAG, Marketing successfully- A Professional Perspective, Macmillan 2008.
7. Boyd Walker, Marketing Management, McGraw Hill, 2002.
8. Paul Baines, Chriss Fill Kelly Pagb, Marketing, II edition, Asian edition.

COURSE ARTICULATION MATRIX:

Course Outcome	Program Outcome														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	2	2	2	2	1	2	3	1	1	2	-	-	3
CO2	-	1	2	1	-	2	1	2	3	1	1	3	-	2	3
CO3	1	1	2	1	3	2	1	2	3	1	1	1	1	2	3
CO4	1	1	2	1	2	2	1	2	3	1	1	2	2	3	3
CO5	1	1	2	1	2	2	1	2	3	1	1	2	2	3	3

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

COURSE OBJECTIVE:

- To impart knowledge on international marketing and foreign trade aspects of leather industry.

UNIT I INTRODUCTION 9

Basics of International trade - India's trade policy, International trade and Monetary Systems- Marketing Services in International Trade Pricing and trade cycles- Precautionary measures to prevent fraud in International trade - International Trade Multimodal Transport Operations- Consumer Behavior and Role of international Marketing- Indian Market Analysis. Case study

UNIT II MANAGEMENT OF IMPORT AND EXPORT 9

Introduction-Import to India-An over view, Import and the Customs in India-Importation of Goods, Customs Duty and Exemptions-Valuation of Goods under Customs, Clearance of Imported Goods and Goods in Transit-Warehousing of Goods, Import into India. India's new foreign trade Policy -Legal frame work of foreign trade Policy-Special focus. General provision on Import and Export-Promotional Measures- Duty exemption/ Duty remission scheme EPCG Scheme -EOU/ EHTP/ STP/ BTP- SEZs. Case study

UNIT III DOMESTIC AND IMPORT TRADE MANAGEMENT 10

Marketing concepts and Import-Forms of organization in Import and domestic Trade- Products, Sales forecasting and sales Management-pricing, Promotion, Branding and Advertising. Retail Management - Introduction to Logistics - Parameters of Supply Chain Management - Management of logistics and Supply Chain - Consumer Supply Chain Relationship. Case study

UNIT IV IMPORT&EXPORT POLICY 8

The Customs Tariff Act-Exemptions in Import and Export-by UN and its agencies and their Officials-Import and Export by UN or international organizations for execution of projects in India- Imports and Export by Government Diplomats, Trade representatives etc.-Customs Tariff. Case study

UNIT V MARKETING STRATEGY 9

Marketing Management in the Indian Context Introduction-concept-process functions- Role of Marketing in modern Organization- Marketing environment-Socio economic forces- Marketing Planning-Understanding Buyer and Organizational behavior- - Product Management -Pricing Decisions-Promotion Decisions. Case study

TOTAL: 45 PERIODS**COURSE OUTCOMES:**

- At the end of this course, the students are expected to,
- CO1. Acquire basic knowledge on international trade.
 - CO2. Elucidate import export management.
 - CO3. Elucidate domestic and import trade management.

- CO4. Analyse import policy
CO5. Explore marketing strategies.

TEXT BOOKS AND REFERENCES:

1. Wagdre, H. International Marketing Management, Adhyayan Publisher, 2007
2. Datey, V. S. Foreign Trade Policy, Taxmann Publishers, 2008.
3. Bhat, M. K. international marketing management with special reference to India, king publishers, 2001.

COURSE ARTICULATION MATRIX:

Course Outcome	Program Outcome														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	2	3	3	3	-	3	-	-	-	3	3	2	3
CO2	-	-	2	3	3	3	-	3	-	-	-	3	3	2	3
CO3	-	-	2	3	3	3	-	3	-	-	-	3	3	2	3
CO4	-	-	2	3	3	3	-	3	-	-	-	3	3	2	3
CO5	-	-	2	3	3	3	-	3	-	-	-	3	3	2	3

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

COURSE OBJECTIVE:

- Understand the scope and practice of business logistics and supply chain in service oriented firms.

UNIT I INTRODUCTION 9

Business logistics and supply chain – importance, objectives, study approach, strategy – planning, selecting proper channel, performance measuring. Outsourcing- Make vs buy approach – sourcing strategy.

UNIT II MANAGING FLOWS 9

Planning Networks – Decision making under risk – Decision trees – Decision making under uncertainty. Distribution Network Design – Role - Factors Influencing Options, Value Addition. Supply Chain Network optimization models. Logistics information system - Role of IT – Framework for IT adoption, Case Discussion.

UNIT III INVENTORY 9

Policy Decisions–objectives-control -Retail Discounting Model, Newsvendor Model; EOQ and EBQ models for uniform and variable demand – With and without shortages -Quantity discount models. Probabilistic inventory models, Case Discussion.

UNIT IV TRANSPORTATION 9

Transportation – Drivers, Modes, Measures - Strategies for Transportation – Vehicle Scheduling – Vehicle Routing and Scheduling-Transportations Models (Maximizing and Minimizing)- Initial Basic Feasible Solutions – Test for Optimality – Iteration towards optimality. Assignment Models (Minimizing and Maximizing) – Solution thro' Hungarian Algorithm – Traveling Salesmen models – Crew assignment problems, Case Discussion.

UNIT V ORGANISATION AND CONTROL 9

Organisation Structure – need and development. Organizational – Choices, Orientation and positioning. Inter-functional and inter-organisational management – alliances and partnerships. Control – Process framework, system details, information, measurement and interpretation, Case Discussion.

TOTAL: 45 PERIODS**COURSE OUTCOMES:**

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

CO1. Acquire basic knowledge on logistics and supply chain management.

CO2. Explore the tools and practices for managing an organisation.

CO3. Analyse the importance and management of the inventory.

CO4. Elucidate the importance of transportation and strategies.

CO5. Elucidate on the organization structure and responsibilities for the supply chain management.

TEXT BOOKS AND REFERENCES:

1. Ronald H. Ballou and Samir K. Srivastava, Business Logistics and Supply Chain Management, Pearson education, Fifth Edition.
2. Janat Shah, Supply Chain Management, Pearson Education, 2008.
3. Sunil Chopra and Peter Meindl, Supply Chain Management-Strategy Planning and Operation, PHI Learning / Pearson Education, 2007.
4. Mohanty R.P and Deshmukh S.G, Supply chain theories and practices, Biztantra. publications, 2007.
5. Leenders, Johnson, Flynn, Fearon, Purchasing and supply management, Tata McGraw Hill, 2010.
6. Vinod V. Sople, Logistics Management-The Supply Chain Imperative, Pearson. 3rd edition, 2012.

COURSE ARTICULATION MATRIX:

Course Outcome	Program Outcome														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	2	2	2	2	1	2	3	1	1	2	-	-	3
CO2	-	1	2	1	-	2	1	2	3	1	1	3	-	2	3
CO3	1	1	2	1	3	2	1	2	3	1	1	1	1	2	3
CO4	1	1	2	1	2	2	1	2	3	1	1	2	2	3	3
CO5	1	1	2	1	2	2	1	2	3	1	1	2	2	3	3

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

COURSE OBJECTIVE:

- The objective of this course is to teach the principles of ERP technologies involved in enterprise resource and various case studies in the pre and post implementation of ERP's that will enable the students to perform as an efficient entrepreneur.

UNIT I INTRODUCTION 8

What is ERP? - Need of ERP - Advantages of ERP - Growth of ERP.

UNIT II ERP AND RELATED TECHNOLOGIES 9

Business process Reengineering (BPR) - Management Information System (MIS) - Decision Support Systems (DSS) - Executive Support Systems (ESS) - Data Warehousing, Data Mining - Online Analytical Processing (OLTP) - Supply Chain Management (SCM) - Customer Relationship Management (CRM).

UNIT III ERP MODULES AND VENDORS 10

Finance - Production planning, control and maintenance - Sales and Distribution - Human Resource Management (HRM) - Inventory Control System - Quality Management - ERP Market.

UNIT IV ERP IMPLEMENTATION LIFE CYCLES 10

Evaluation and selection of ERP package - Project planning - Implementation team training and testing - End user training and Going Live - Post Evaluation and Maintenance.

UNIT V ERP CASE STUDIES 8

Post implementation review of ERP Packages in Manufacturing, Services, and other Organizations.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1. Acquire basic knowledge on ERP.

CO2. Explore and analyse various ERP technologies.

CO3. Articulate ERP modules.

CO4. Develop ERP implementation lifecycles.

CO5. Explore the inferences of POST implementation ERP.

TEXT BOOKS AND REFERENCES:

- Leon, A. Enterprise Resource Planning, Tata Mcgraw-hill, 1999.
- Garg, V.K. and Venkitakrishnan, N.K. ERP Ware: ERP Implementation Framework, Prentice Hall, 1999.
- Garg, V.K. and Venkitakrishnan, N.K. Enterprise Resource Planning Concepts and Practice, PHI Learning Pvt. Ltd., 2004.

COURSE ARTICULATION MATRIX:

Course Outcome	Program Outcome														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	1	-	1	-	-	-	-	-	-	-	1	-	-
CO2	3	2	1	1	1	-	-	1	-	-	1	-	1	2	1
CO3	3	2	1	-	-	-	-	-	1	-	-	1	1	2	2
CO4	3	1	1	1	-	-	-	1	1	--	2	-	1	2	3
CO5	3	1	1	2	-	-	-	1	-	-	-	-	1	3	2

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

COURSE OBJECTIVE:

- To understand and gain knowledge on several mathematical and software tools helpful for operational research.

UNIT I MATHEMATICAL PROGRAMMING 12

Introduction, Linear Programming, Solution by simplex method, Duality, Sensitivity analysis, Dual simplex method, Integer Programming, Branch and bound method, Geometric programming and its application.

UNIT II DYNAMIC PROGRAMMING 10

Elements of DP models, Bellman's optimality criteria, Recursion formula, Solution of multistage decision problem by DP method. Application is Heat Exchange Extraction systems.

UNIT III PERT, CPM and GERT 9

Network representation of projects, Critical path calculation, construction of the time-chart and resource leveling, Probability and cost consideration in project scheduling, Project control. Graphical Evaluation and Review Techniques.

UNIT IV ELEMENTS OF QUEUING THEORY 7

Basic elements of the Queuing model, M/M/1 and M/M/C Queues.

UNIT V ELEMENTS OF RELIABILITY THEORY 7

General failure distribution, for components, Exponential failure distributions, General model, Maintained and Non-maintained systems, Safety Analysis.

TOTAL: 45 PERIODS**COURSE OUTCOMES:**

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

- CO1. Acquire basic knowledge on the mathematical programming.
- CO2. Acquire basic knowledge on the dynamic programming.
- CO3. Analyze the methods for the calculation involved in business.
- CO4. Elucidate the elements of queuing theory.
- CO5. Comprehend reliability theory.

TEXT BOOKS AND REFERENCES:

- Carter, M. W. and Price, C. C., Operations Research: A Practical Introduction Contributor, CRC Press, 2001.
- Edgar, T. F., Himmelblau, D. M. and Ladson, L. S., "Optimization of Chemical Processes", 2nd Ed., McGraw Hill, New York, 2003.
- Hillier, F. S., and Lieberman, G. J., Introduction to Operations Research, McGraw-Hill, 2005.
- Taha, H. A., "Operations Research, An introduction", 6th Ed., Prentice Hall of India, New Delhi, 2006.

COURSE ARTICULATION MATRIX:

Course Outcome	Program Outcome														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	1	-	1	-	-	-	-	-	-	-	1	-	-
CO2	3	2	1	1	1	-	-	1	-	-	1	-	1	2	1
CO3	3	2	1	-	-	-	-	-	1	-	-	1	1	2	2
CO4	3	1	1	1	-	-	-	1	1	--	2	-	1	2	3
CO5	3	1	1	2	-	-	-	1	-	-	-	-	1	3	2

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

LT23S02

**SKILL DEVELOPMENT COURSES I, II and III
PARCHMENT LEATHER AND ITS APPLICATIONS**

**L T P C
0 0 4 2**

COURSE OBJECTIVE:

- After the completion of the course, the students will gain skills in making parchment leather and understand its applications.

CONTENT

- Introduction to parchment leather: History, origin, and differences from other types of leather.
- Selection and preparation of raw hides and skins.
- Liming and dehairing processes.
- Stretching and drying techniques.
- Treatments for enhancing durability.
- Techniques for preventing microbial degradation and preserving parchment leather.
- Applications of parchment leather in art, bookbinding, and musical instruments.
- Case studies on innovative uses of parchment leather.

TOTAL: 60 PERIODS

Course Outcomes:

CO1: Demonstrate the process of making parchment leather.

CO2: Apply techniques for treating and preserving parchment leather.

CO3: Identify various applications of parchment leather.

COURSE ARTICULATION MATRIX:

Course Outcome	Program Outcome														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	1	2	1	2	1	2	2	1	2	3	2	2
CO2	3	3	2	2	3	1	2	2	2	3	1	2	3	1	3
CO3	2	2	3	2	2	2	3	2	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.

COURSE OBJECTIVE:

- After the completion of the course, the students will gain appreciation and skills in making and using traditional leather percussion musical instruments such as Parai.

CONTENT

- Historical background and evolution of leather musical instruments.
- Types of leather used in musical instruments and their preparation.
- Construction techniques for traditional leather percussion instruments.
- Tuning techniques for leather drumheads.
- Maintenance and preservation of leather instruments.
- Common issues and troubleshooting.
- Role of leather instruments in various cultures and traditions.
- Applications in contemporary music.
- Case studies on the use of leather percussion instruments.

TOTAL: 60 PERIODS**Course Outcomes:**

CO1: Explain the historical and cultural significance of leather in musical instruments.

CO2: Demonstrate the process of making traditional leather percussion instruments.

CO3: Apply skills to tune and maintain leather percussion instruments.

COURSE ARTICULATION MATRIX:

Course Outcome	Program Outcome														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	2	1	2	3	3	1	2	2	1	2	3	2	2
CO2	3	3	3	2	3	3	3	2	3	3	2	2	3	3	3
CO3	2	2	3	2	3	2	3	2	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.

COURSE OBJECTIVE:

- After the completion of the course, the students will gain skills in making toys from leather and leather scraps.

CONTENT

- Overview of leather toy making.
- Types of leather and scraps suitable for toy making.
- Tools and materials required for leather toy making.
- Cutting and shaping techniques.
- Stitching and assembly methods.
- Decoration and finishing techniques.
- Designing patterns for leather toys.
- Creating various types of leather toys such as animals, dolls, etc.
- Quality control and safety standards for leather toys.
- Techniques for testing toy safety.

TOTAL: 60 PERIODS**Course Outcomes:**

CO1: Identify suitable leather materials and scraps for toy making.

CO2: Demonstrate the techniques involved in crafting leather toys.

CO3: Design and create various types of leather toys.

COURSE ARTICULATION MATRIX:

Course Outcome	Program Outcome														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	3	2	2	1	3	3	2	3	3	3	3
CO2	3	3	3	3	3	3	3	2	3	3	3	3	3	3	3
CO3	3	3	3	3	3	3	3	2	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.

COURSE OBJECTIVE:

- At the end of the course, students will gain appreciable skills associated with the handicraft of making traditional Indian footwear such as Juthi or Kolhapurichappals.

CONTENT

- History and cultural significance of traditional Indian footwear.
- Types of traditional footwear: Juthi, Kolhapurichappals, etc.
- Materials used in traditional footwear making.
- Cutting and shaping leather for footwear.
- Stitching and assembly techniques.
- Decoration and finishing methods.
- Quality control measures in traditional footwear manufacturing.
- Market analysis and potential for traditional footwear.
- Strategies for branding and marketing traditional footwear.

TOTAL: 60 PERIODS**Course Outcomes:**

CO1: Explain the historical and cultural significance of traditional Indian footwear.

CO2: Demonstrate the process of making traditional footwear.

CO3: Apply techniques to enhance the durability and aesthetics of traditional footwear.

COURSE ARTICULATION MATRIX:

Course Outcome	Program Outcome														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	1	2	2	2	1	2	3	1	2	3	3	3
CO2	3	3	3	2	3	3	3	2	3	3	2	2	3	3	3
CO3	3	3	3	3	3	3	3	2	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.

COURSE OBJECTIVE:

- To provide practical training in the preparation of leather chemicals.

CONTENT

Preparation of Chemicals

1. Manufacture of BCS
2. Manufacture of Synthetic fatliquor
3. Manufacture of Pigments
4. Preparation of Protein Binder
5. Preparation of Aromatic Syntan
6. Preparation of Polymeric Syntan

TOTAL: 60 PERIODS**Course Outcomes:**

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

CO1. Apply theoretical knowledge of leather chemical product manufacturing practically.

CO2. Analyze the manufactured leather chemical products.

CO3. Design the leather chemical manufacturing process.

COURSE ARTICULATION MATRIX:

Course Outcome	Program Outcome														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	2	2	1	1	-	2	-	-	2	-	3	1	1	2
CO2	2	2	1	-	2	-	-	-	-	2	1	3	1	1	2
CO3	2	2	1	1	1	1	2	-	1	2	-	3	1	1	2

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

COURSE OBJECTIVE:

- After the course, the students will gain skills in manufacturing various types of leather from different kinds of exotic raw materials.

CONTENT

1. Introduction to exotic leathers
2. Selection and preparation of exotic skins
3. Processing of exotic leathers – Pre-tanning, Tanning, Post-tanning and Finishing
4. Applications of exotic leathers for various products.
5. Durability and care for exotic leathers.
6. Sustainable sourcing and ethical practices for making exotic leathers.
7. Case Studies on Innovative Uses of Exotic Leathers.

TOTAL: 60 PERIODS**Course Outcomes:**

CO1. Identification of various raw materials for exotic leather manufacture.

CO2. Demonstrate the process for manufacturing different kinds of exotic leathers.

CO3. Understanding the utilization of exotic leathers for different product manufacture.

COURSE ARTICULATION MATRIX:

Course Outcome	Program Outcome														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1	2	1	2	1	3	1	2	1	2	2	2	2
CO2	3	2	3	2	3	3	3	1	2	3	2	2	3	2	3
CO3	3	3	3	2	2	2	2	2	2	2	2	2	3	3	3

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

COURSE OBJECTIVE:

- After completing the course, the students will gain skills in making saddlery and harness leather and understanding its applications.

Content

1. Basic knowledge of types and uses of saddlery and harness leather.
2. Special characteristics of saddlery and harness leather.
3. Selection of raw materials for the production of these leather.
4. Understanding the process strategy requirements for the production of these leather.
5. Requirements of various machinery operations in the production of these leathers.
6. Knowledge of various physical and chemical testing of these leathers according to BIS requirements.

TOTAL: 60 PERIODS**Course Outcomes:**

CO1. To gain knowledge in property requirements of saddlery and harness leathers

CO2. Demonstrate the process of making saddlery and harness leather

CO3. Identify various applications of saddlery and harness leather.

COURSE ARTICULATION MATRIX:

Course Outcome	Program Outcome														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	1	2	1	2	1	2	2	1	2	3	2	2
CO2	3	3	2	2	3	1	2	2	2	3	1	2	3	1	3
CO3	2	2	3	2	2	2	3	2	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.

COURSE OBJECTIVE:

- After completing the course, the students will gain skills in curative technologies that are essential for maintaining the quality and longevity of leather products.

Content

1. Common issues and challenges in maintenance of leather products.
2. Introduction to curative technologies
3. Types of leather products and their care needs
4. Leather cleaning techniques
5. Basic leather repair techniques
6. Techniques for mold and mildew removal from leather surfaces
7. Techniques for recolouring the damaged leather surfaces
8. Preventive measures and care to avoid further damage

TOTAL: 60 PERIODS**Course Outcomes:**

CO1. Understand the basic concepts of curative technologies.

CO2. Methods and processes available to restore, repair, and maintain leather products.

CO3. Knowledge of Preventive measures to avoid leather surface damage

COURSE ARTICULATION MATRIX:

Course Outcome	Program Outcome														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	2	1	2	3	3	1	2	2	1	2	3	2	2
CO2	3	3	3	2	3	3	3	2	3	3	2	2	3	3	3
CO3	2	2	3	2	3	2	3	2	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.

COURSE OBJECTIVE:

- After the course, the students will gain skills in manufacturing hair on leather from different kinds of raw materials.

CONTENT

1. Introduction to Hair on leather: Properties and its difference from conventional leathers.
2. Selection of raw material for hair on leather manufacture.
3. Process strategy for making Hair on Leathers – Pre-tanning, Tanning, Post-tanning and finishing
4. Role of mechanical operations in making hair on leathers.
5. Applications of hair on leathers for various products.
6. Durability and maintenance of Hair on leathers.

TOTAL: 60 PERIODS**Course Outcomes:**

CO1. Identification of raw materials for making hair on leathers.

CO2. Demonstrate the process of manufacturing hair on leather.

CO3. Understanding the utilization of hair on leathers in various product manufacture.

COURSE ARTICULATION MATRIX:

Course Outcome	Program Outcome														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1	2	2	2	1	3	2	2	1	2	3	2	2
CO2	3	3	3	2	3	2	2	1	3	3	2	3	3	2	3
CO3	3	2	2	3	2	2	3	2	2	2	2	3	3	3	3

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

COURSE OBJECTIVES:

- To introduce basic machine learning techniques such as regression, classification.
- To learn about clustering and segmentation.
- To learn about fuzzy logic, fuzzification and defuzzification.
- To learn about basics of neural networks and neuro fuzzy networks.
- To learn about Reinforcement learning.

UNIT II INTRODUCTION TO MACHINE LEARNING 9

Philosophy of learning in computers, Overview of different forms of learning, Classifications vs. Regression, Evaluation metrics and loss functions in Classification, Evaluation metrics and loss functions in Regression, Applications of AI in Robotics.

UNIT II CLUSTERING AND SEGMENTATION METHODS 9

Introduction to clustering, Types of Clustering, Agglomerative clustering, K-means clustering, Mean Shift clustering, K-means clustering application study, Introduction to recognition, Knearest neighbor algorithm, KNN Application case study, Principal component analysis (PCA), PCA Application case study in Feature Selection for Robot Guidance.

UNIT III FUZZY LOGIC 9

Introduction to Fuzzy Sets, Classical and Fuzzy Sets, Overview of Classical Sets, Membership Function, Fuzzy rule generation, Fuzzy rule generation, Operations on Fuzzy Sets, Numerical examples, Fuzzy Arithmetic, Numerical examples, Fuzzy Logic, Fuzzification, Fuzzy Sets, Defuzzification, Application Case Study of Fuzzy Logic for Robotics Application.

UNIT IV NEURAL NETWORKS 9

Mathematical Models of Neurons, ANN architecture, Learning rules, Multi-layer Perceptrons, Back propagation, Introduction of Neuro-Fuzzy Systems, Architecture of Neuro Fuzzy Networks, Application Case Study of Neural Networks in Robotics.

UNIT V RNN AND REINFORCEMENT LEARNING 9

Unfolding Computational Graphs, Recurrent neural networks, Application Case Study of recurrent networks in Robotics, Reinforcement learning, Examples for reinforcement learning, Markov decision process, Major components of RL, Q-learning. Application Case Study of reinforcement learning in Robotics.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Upon successful completion of the course, students should be able to:

- CO1. Know about the concepts in basic machine learning techniques such as regression, Classification.
- CO2. Recognize the methods in clustering and segmentation.
- CO3. Model a fuzzy logic system with fuzzification and defuzzification.
- CO4. Recognize the concepts of neural networks and neuro fuzzy networks.

CO5. Gain knowledge on Reinforcement learning.

TEXT BOOKS AND REFERENCE:

1. MichealNegnevitsky, Artificial Intelligence: A Guide to Intelligent Systems, 3rd Edition, Addison Wesley, England, 2011
2. Bruno Siciliano, OussamaKhatib, "Handbook of Robotics", 2016 2nd Edition, Springer
3. Simon Haykin, "Neural Networks and Learning Machines: A Comprehensive Foundation", Third Edition, Pearson, 2016.
4. Timothy J Ross, "Fuzzy Logic with Engineering Applications", 4th Edition, Chichester, 2011, Sussex Wiley.

COURSE ARTICULATION MATRIX:

Course Outcome	Program Outcome														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	1	1	-	-	-	1	-	-	-	-	-	1	-
CO2	3	2	1	-	1	-	-	1	-	-	3	1	1	3	1
CO3	3	2	1	3	1	1	-	-	-	-	-	-	-	1	2
CO4	3	1	1	-	1	-	-	-	-	1	-	-	-	1	-
CO5	3	1	1	-	-	-	1	2	-	-	-	-	1	-	2

1, 2and3arecorrelation levelswithweightings asSlight (Low),Moderate (Medium)andSubstantial(High)respectively.

COURSE OBJECTIVES:

- To understand smart objects and IoT Architectures.
- To learn about various IoT related protocols.
- To build simple IoT systems using open hardware such as Arduino and Raspberry Pi.
- To understand data analytics and cloud in the context of IoT.
- To build IoT based smart systems.

UNIT I FUNDAMENTALS OF IoT 9

Evolution of Internet of Things – Enabling Technologies – IoT Architectures: oneM2M, IoT World Forum (IoTWF) and Alternative IoT Models – Simplified IoT Architecture and Core IoT Functional Stack – Fog, Edge and Cloud in IoT – Functional Blocks of an IoT Ecosystem – Sensors, Actuators, and Smart Objects – Open Hardware Platforms for IoT.

UNIT II IoT PROTOCOLS - I 9

IoT Access Technologies: Physical and MAC Layers, Topology and Security of IEEE 802.15.4, 1901.2a, 802.11ah and LoRaWAN – Network Layer: Constrained Nodes and Constrained Networks – Optimizing IP for IoT: From 6LoWPAN to 6Lo.

UNIT III IoT PROTOCOLS - II 9

Routing over Low Power and Lossy Networks (RPL) – Application Transport Methods: Application Layer Not Present, Supervisory Control and Data Acquisition (SCADA) – Application Layer Protocols: CoAP and MQTT – Service discovery – mDNS.

UNIT IV CLOUD, FOG AND DATA ANALYTICS FRAMEWORKS 9

Cloud and Fog Topologies – Cloud Services Model – Fog Computing – Structured versus Unstructured Data and Data in Motion Vs Data in Rest – Role of Machine Learning – No SQL Databases – Hadoop Ecosystem – Apache Kafka, Apache Spark – Edge Streaming Analytics and Network Analytics – Security in IoT – CISCO IoT System – IBM Watson IoT Platform.

UNIT V APPLICATIONS 9

Smart and Connected Cities: Street Layer, City Layer, Data Center Layer and Services Layer, Street Lighting, Smart Parking Architecture and Smart Traffic Control – Smart Transportation – Connected Cars.

TOTAL: 45 PERIODS**COURSE OUTCOMES:**

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

- CO1. Explain the concept and architecture of IoT.
- CO2. Choose the right sensors and actuators for an application.
- CO3. Analyze various protocols for IoT.
- CO4. Apply data analytics and use cloud/fog offerings related to IoT.
- CO5. Analyze applications of IoT in real time scenario.

TEXTBOOKS AND REFERENCES:

1. David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Rob Barton, Jerome Henry, "IoT Fundamentals: Networking Technologies, Protocols and Use Cases for Internet of Things", CISCO Press, 2017.
2. Perry Lea, "Internet of things for architects", Packt, 2018.
3. Jan Ho"ller, VlasiosTsiatsis, Catherine Mulligan, Stamatis, Karnouskos, Stefan Avesand, David Boyle, "From Machine-to-Machine to the Internet of Things – Introduction to a New Age of Intelligence", Elsevier, 2014.
4. Olivier Hersent, David Boswarthick, Omar Elloumi , "The Internet of Things – Key Applications and Protocols", Wiley, 2012.
5. Dieter Uckelmann, Mark Harrison, Michahelles, Florian (Eds), "Architecting the Internet of Things", Springer, 2011.
6. ArshdeepBahga, Vijay Madiseti, "Internet of Things – A hands-on approach", Universities Press, 2015
7. <https://www.arduino.cc/>
8. https://www.ibm.com/smarterplanet/us/en/?ca=v_smarterplanet

COURSE ARTICULATION MATRIX:

Course Outcome	Program Outcome														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	1	1	-	-	-	1	-	-	-	-	-	1	-
CO2	3	2	1	-	1	-	-	1	-	-	3	1	1	3	1
CO3	3	2	1	3	1	1	-	-	-	-	-	-	-	1	2
CO4	3	1	1	-	1	-	-	-	-	1	-	-	-	1	-
CO5	3	1	1	-	-	-	1	2	-	-	-	-	1	-	2

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

COURSE OBJECTIVES:

- To present the Digital fundamentals, Boolean algebra and its applications in digital systems
- To understand the concepts of measurement technology.
- To know about the basic concepts in industrial automation
- To introduce the functional elements of Robotics
- To design automated systems.

UNIT I BASIC PRINCIPLES OF ROBOTICS 9

Brief history-Types of Robot–Technology-Robot classifications and specifications-Design and control issues- Various manipulators – Sensors - work cell - Programming languages.

UNIT II DIGITAL FUNDAMENTALS 9

Number Systems – Decimal, Binary, Octal, Hexadecimal, 1's and 2's complements, Codes – Binary, BCD, Excess 3, Gray, Alphanumeric codes, Boolean theorems, Logic gates, Universal gates, Sum of products and product of sums, Minterms and Maxterms, Karnaugh map Minimization and Quine-McCluskey method of minimization.

UNIT III SENSORS AND INSTRUMENTATION 9

Basics of Measurement – Classification of errors – Error analysis – Static and dynamic characteristics of transducers – Performance measures of sensors – Classification of sensors – Sensor calibration techniques – Sensor Output Signal Types - Motion, proximity and ranging sensors - Force, magnetic and heading sensors - Optical, pressure and temperature sensors - Signal conditioning and DAQ systems

UNIT IV FUNDAMENTAL CONCEPTS OF INDUSTRIAL AUTOMATION 9

Fundamental concepts in manufacturing and automation, definition of automation, reasons for automating. Types of production and types of automation, automation strategies, levels of automation. Automated flow lines with storage buffers. AS/RS, RFID system, AGVs, modular fixturing. Flow line balancing.

UNIT V PROGRAMMABLE AUTOMATION 9

Special design features of CNC systems and features for lathes and machining centers. Drive system for CNC machine tools. Introduction to CIM; condition monitoring of manufacturing systems.

TOTAL: 45 PERIODS**COURSE OUTCOMES:**

At the end of the course:

CO1. Use digital electronics in the present contemporary world.

CO2. Ability to design an automated system.

CO3. Ability to understand basic concept of robotics.

CO4. Knowledge of industrial automation by transfer lines.

CO5. Familiar with various calibration techniques and signal types for sensors.

TEXT BOOK:

1. M. Morris Mano and Michael D. Ciletti, "Digital Design", 5th Edition, Pearson, 2014.
2. Mikell P Groover, "Automation Production Systems and Computer- Integrated Manufacturing" Pearson Education, New Delhi, 2001.
3. Bolton W, "Mechatronics", Pearson Education, 1999.
4. R.K.Mittal and I.J.Nagrath, Robotics and Control, Tata McGraw Hill, New Delhi, 4th Reprint, 2005.
5. John J. Craig, Introduction to Robotics Mechanics and Control, Third edition, Pearson Education, 3. 2009.
6. Ernest O Doebelin, "Measurement Systems – Applications and Design", Tata McGraw-Hill, 2009.
7. Sawney A K and Puneet Sawney, "A Course in Mechanical Measurements and Instrumentation and Control", 12th edition, Dhanpat Rai & Co, New Delhi, 2013.

REFERENCES:

1. Thomas L. Floyd, "Digital Fundamentals", 10th Edition, Pearson Education Inc, 2011.
2. Mikell P Groover, "Industrial Robots – Technology Programmes and Applications" , McGraw Hill , New York, USA. 2000.
3. Steve F Krar, "Computer Numerical Control Simplified", Industrial Press, 2001.
4. Joffrey Boothroyd, Peter Dewhurst and Winston A. Knight, "Product Design for manufacture and Assembly", CRC Press, 2011.
5. Ashitava Ghoshal, Robotics-Fundamental Concepts and Analysis', Oxford University Press, Sixth impression, 2010.

COURSE ARTICULATION MATRIX:

Course Outcome	Program Outcome														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	1	1	-	-	-	1	-	-	-	-	-	1	-
CO2	3	2	1	-	1	-	-	1	-	-	3	1	1	3	1
CO3	3	2	1	3	1	1	-	-	-	-	-	-	-	1	2
CO4	3	1	1	-	1	-	-	-	-	1	-	-	-	1	-
CO5	3	1	1	-	-	-	1	2	-	-	-	-	1	-	2

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

COURSE OBJECTIVES:

- To introduce various image processing and preprocessing techniques.
- To learn about feature detection and matching using Image processing
- To learn about segmentation using Image processing techniques.
- To learn about computational photography.
- To learn about image recognition using Image processing techniques.

UNIT I IMAGE FORMATION AND PROCESSING 9

Introduction - Geometric primitives and Transformations - Photometric Image formation – The digital camera. Introduction to image processing - point - spatial - Fourier Transform – Pyramids and wavelets - Geometric transformations - global optimization.

UNIT II FEATURE DETECTION AND MATCHING 9

Introduction - Points and patches - Feature detectors - Feature Descriptors - SIFT - PCA SIFT - Gradient location orientation histogram.

UNIT III SEGMENTATION 9

Introduction - Active contours - Snakes - Scissors - Level sets - Split and merge - Watershed – Region splitting - region merging - and graph based segmentation - mean shift and mode finding - Normalized cuts – graph cuts and energy based methods – application.

UNIT IV COMPUTATIONAL PHOTOGRAPHY 9

Photometric calibration - Radiometric response function - Noise level estimation - Vignetting - Optical blur - High dynamic range imaging - Super resolution and blur removal - Color image demosaicing – application.

UNIT V IMAGE RECOGNITION 9

Object detection - Face recognition - Instance recognition - category recognition - Bag of words - Part based models - context and scene understanding- Application: Image search.

TOTAL: 45 PERIODS**COURSE OUTCOMES:**

Upon successful completion of the course, students should be able to:

- CO1. Understand various image processing and preprocessing techniques.
- CO2. Design a feature detection algorithm for given application
- CO3. Design a segmentation algorithm for given application.
- CO4. Understand and recognize various computational photography techniques.
- CO5. Design an image recognition for given application.

TEXT BOOKS AND REFERENCES:

1. Richard Szeliski, "Computer Vision: Algorithms and Applications", Springer, 2010.
2. Hartley R, Zisserman A, "Multiple View Geometry in Computer Vision", Cambridge University Press, 2019.

3. Forsyth D A, Ponce J, "Computer Vision: A Modern Approach", 2nd Edition Boston Pearson, 2015.
4. Duda R O, Hart P E, Stork D G, "Pattern Classification", Wiley, 2001.
5. Richard Sc "Computer Vision: Algorithms and Applications", Springer, 2010.
6. Simon J. D. Prince "Computer Vision: Models, Learning and Inference", Cambridge University Press, New York, 2014.

COURSE ARTICULATION MATRIX:

Course Outcome	Program Outcome														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	1	1	1	1	2	3	1	1	1	2	3	1	1
CO2	3	3	2	1	1	-	2	2	1	1	1	2	3	1	1
CO3	3	3	1	1	1	1	2	2	1	1	1	2	3	2	1
CO4	3	3	1	1	1	2	2	1	1	1	1	2	3	3	1
CO5	3	3	-	1	1	1	2	2	1	1	1	2	3	3	1

7. 1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively.

COURSE OBJECTIVES:

- To study about the mechanics involved with musculoskeletal systems.
- To gain knowledge in deriving the mathematical models related to dynamics of human locomotion.

UNIT I INTRODUCTION**9**

Scope of mechanics in medicine, Principles of Biomechanics, mechanics of solids; Tension, Compression and Shear Stresses; Deformation of rigid and non rigid bodies; Reference planes of motion; Kinematics; principles of Motion; centre of mass; centre of gravity, Kinetics; Force; Momentum; Inertia; Pressure; Torque; Work, Power and Energy.

UNIT II MECHANICS OF PHYSIOLOGICAL SYSTEMS**9**

Fluids – density – pressure – blood pressure and gravity –Newton's laws of viscosity – Definitions and simple problems on Newtonian fluid, Non-Newtonian fluid, Viscoelasticity, Displacements, Velocity and acceleration, their relationship – Relative motion – Newton's laws of motion – Work Energy Equation– Friction force – Laws of sliding friction – equilibrium analysis of simple systems with sliding friction.

UNIT III ORTHOPAEDIC MECHANICS**9**

Mechanical properties of cartilage, diffusion properties of articular cartilage, mechanical properties of bone, Mechanics of skeletal muscles, kinetics and kinematics of joints, Lubrication of joints.

UNIT IV MATHEMATICAL MODELS**9**

Introduction to Finite Element Analysis, Mathematical models, determination of in-vivo elasticity.

UNIT V ORTHOPAEDIC APPLICATIONS**9**

Dynamics and analysis of human locomotion - Gait analysis (determination of instantaneous ground reaction forces), Mechanics of lower limb joints during standing and walking, application of footwear as an orthopedic device to correct lower limb biomechanics

TOTAL: 45 PERIODS**COURSE OUTCOMES:**

At the end of the course, the student will be able to

CO1: Understand the use of mechanics in medicine.

CO2: Understand the mechanics of musculoskeletal systems.

CO3: Distinguish the reason for abnormal patterns.

CO4: Analyze the biomechanical systems using mathematical models.

CO5: Design and develop the models specific to orthopedic applications.

TEXT BOOKS AND REFERENCES:

1. Y.C.Fung,—Bio-Mechanics, “Mechanical Properties ofTissues”,Springer-Verilog,1998.
2. C. Ross Ether and Craig A.Simmons, “Introductory Biomechanics from cells to organisms”, Cambridge University Press, New Delhi, 2009.
3. Susan J Hall, “Basics of Biomechanics”, Mc Graw Hill Publishing.co. New York, 5th Edition, 2007.
4. DhanjooN.Ghista, “Orthopaedic Mechanics”, Academic Press, 1990.
5. Joseph D.Bronzino, “Biomedical Engineering Fundamentals”, Taylor& Francis, 2006.
6. John Enderle, Susanblanchard, Joseph Bronzino, “Introduction to Biomedical Engineering”, Elsevier, 2005.
7. B.H.Brown, PV Lawford, RH Small wood, DR Hose, Dc Barber, “Medical Physics and Biomedical Engineering”, CRC Press, 1999.
8. DhanjooN.Ghista, “Bio-mechanics of Medical Devices”, Marcel Dekker, 1980.
9. HaufredClynes, “Bio-medical Engineering Systems”, McGrawHill,1998.

COURSE ARTICULATION MATRIX:

Course Outcome	Program Outcome														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	1	1	1	1	2	3	1	1	1	2	3	1	1
CO2	3	3	2	1	1	-	2	2	1	1	1	2	3	1	1
CO3	3	3	1	1	1	1	2	2	1	1	1	2	3	2	1
CO4	3	3	1	1	1	2	2	1	1	1	1	2	3	3	1
CO5	3	3	-	1	1	1	2	2	1	1	1	2	3	3	1

1, 2and3arecorrelation levelswithweightings asSlight (Low),Moderate (Medium)andSubstantial(High)respectively.

COURSE OBJECTIVES:

- To discuss on basics of 3D printing
- To explain the principles of 3D printing technique
- To explain and illustrate inkjet technology
- To explain and illustrate laser technology
- To discuss the applications of 3D printing

UNIT I INTRODUCTION 9

Introduction; Design considerations – Material, Size, Resolution, Process; Modelling and viewing - 3D; Scanning; Model preparation – Digital; Slicing; Software; File formats

UNIT II PRINCIPLE 9

Processes – Extrusion, Wire, Granular, Lamination, Photopolymerisation; Materials - Paper, Plastics, Metals, Ceramics, Glass, Wood, Fiber, Sand, Biological Tissues, Hydrogels, Graphene; Material Selection - Processes, applications, limitations.

UNIT III INKJET TECHNOLOGY 9

Printer - Working Principle, Positioning System, Print head, Print bed, Frames, Motion control; Print head Considerations – Continuous Inkjet, Thermal Inkjet, Piezoelectric Drop-On-Demand; Material Formulation for jetting; Liquid based fabrication – Continuous jet, Multijet; Powder based fabrication – Colourjet.

UNIT IV LASER TECHNOLOGY 9

Light Sources – Types, Characteristics; Optics – Deflection, Modulation; Material feeding and flow – Liquid, powder; Printing machines – Types, Working Principle, Build Platform, Print bed Movement, Support structures.

UNIT V INDUSTRIAL APPLICATIONS 9

Product Models, manufacturing – Printed electronics, Biopolymers, Packaging, Healthcare, Food, Medical, Biotechnology, Displays; Future trends.

TOTAL: 45 PERIODS**COURSE OUTCOMES:**

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

- Outline and examine the basic concepts of 3D printing technology
- Outline 3D printing workflow
- Explain and categorise the concepts and working principles of 3D printing using inkjet technique
- Explain and categorise the working principles of 3D printing using laser technique
- Explain various method for designing and modeling for industrial applications

TEXT BOOKS:

1. Christopher Barnatt, 3D Printing: The Next Industrial Revolution, CreateSpace Independent Publishing Platform, 2013.
2. Ian M. Hutchings, Graham D. Martin, Inkjet Technology for Digital Fabrication, John Wiley & Sons, 2013.

REFERENCES:

1. Chua, C.K., Leong K.F. and Lim C.S., Rapid prototyping: Principles and applications, second edition, World Scientific Publishers, 2010.
2. Ibrahim Zeid, Mastering CAD CAM Tata McGraw-Hill Publishing Co., 2007
3. Joan Horvath, Mastering 3D Printing, APress, 2014.

COURSE ARTICULATION MATRIX:

Course Outcome	Program Outcome														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	1	1	1	1	2	3	1	1	1	2	3	1	1
CO2	3	3	2	1	1	-	2	2	1	1	1	2	3	1	1
CO3	3	3	1	1	1	1	2	2	1	1	1	2	3	2	1
CO4	3	3	1	1	1	2	2	1	1	1	1	2	3	3	1
CO5	3	3	-	1	1	1	2	2	1	1	1	2	3	3	1

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

