DEPARTMENT OF LEATHER TECHNOLOGY
ANNA UNIVERSITY, CHENNAI

VISION OF THE DEPARTMENT

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

MISSION OF THE DEPARTMENT

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

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

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

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

1. PROGRAMME EDUCATIONAL OBJECTIVES (PEOs):

I.	To build an expertise base capsule of delivering technology-based solution to global footwear sectors.
II.	To foster development of advanced human capacity to provide solution in footwear science and engineering.
III.	To equip learners with relevant knowledge and expertise system for professional consultation.
IV.	To enable learners in the areas of pedagogy and advanced research.
V.	To provide a learning ambience for innovators, researchers and professional technology authors.

2. PROGRAMME OUTCOMES (POs):

PO	PROGRAMME OUTCOMES
1.	Ability to independently carry out research/investigation and development work to solve practical problems.
2.	Ability to write and present a substantial technical report/document.
3.	Able to demonstrate a degree of mastery over the area as per the specialization of the programme. The mastery shall be at a level higher than the requirements in the appropriate bachelor programme.
4.	Ability to comprehend, analyze, synthesize for design, develop and delivery of converging solutions for industrial problems.
5.	Ability to independently carry out consultation, self-employment and managing footwear industries.
6.	Ability to demonstrate leadership to manage manpower with necessary social and other skill sets.

4 . PEO/PO Mapping:

PEO						
	PO1	PO2	PO3	PO4	PO5	PO6
I.	3	2	2	3	2	2
II.	2	3	2	2	3	3
III.	3	3	3	2	3	1
IV.	3	3	3	3	2	2
V.	2	3	3	3	2	1

PROGRAM ARTICULATION MATRIX

Year	SEM	Course Name		PO1	PO2	PO3	PO4	PO5	PO6
YEAR I	SEMESTER I	Anatomy and Solid Modelling of Foot		2.8	2	2	1.4	-	-
		Design and Fabrication of Footwear		2	1	2.6	2.6	2.3	-
		Materials for Footwear		3	1	1.4	1	2	-
		Project Management Systems		2	2	1	1.8	2.3	3
		Orientation to Leather Manufacture (Bridge Course for UG students from non-leather stream)		1	1	1.5	2	2	-
		Research Methodology and IPR		1	3	-	1.6	3	-
		Testing of Footwear Materials and Products Lab		-	2	1.6	3	2	-
		Footwear Fabrication Laboratory – I		2	-	2	2	1	-
	SEMESTER II	Footwear Components and Accessories		1	2	2	1	3	-
		Modern Techniques in Footwear Manufacture		2	-	3	1	3	-
		Footwear Machinery		2	-	1.3	2.3	2	-
		Polymers and Auxiliaries for Footwear		2	-	1	1	3	2
		Professional Elective I							
		Footwear Fabrication Laboratory - II		1	2	1.3	2	3	-
		Modern Practices in Footwear Manufacture		2	1	2.5	1	3	-
YEAR II	SEMESTER III	Professional Elective II							
		Professional Elective III							
		Professional Elective V							
		Internship/ Training		-	2	3	1	3	1
		Project Work I		3	-	3	2	2	1
	SEMESTER IV	Project Work II	Continuation of Project Work I (at Institution/Industry)	2	2	2	3	1	1
			Not the continuation of Project Work I (at Industry)	2	2	2.3	1.6	2.5	2

ANNA UNIVERSITY:: CHENNAI - 600 025
UNIVERSITY DEPARTMENTS
M.TECH. FOOTWEAR ENGINEERING AND MANAGEMENT
REGULATIONS – 2023
CHOICE BASED CREDIT SYSTEM (CBCS)
I TO IV SEMESTERS CURRICULA & SYLLABI
SEMESTER I

S.NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	FW3101	Anatomy and Solid Modelling of Foot	FC	2	0	2	4	3
2.	FW3102	Design and Fabrication of Footwear	PCC	3	0	0	3	3
3.	FW3103	Materials for Footwear	PCC	3	0	0	3	3
4.	LE3151	Project Management System	PCC	2	0	2	4	3
5.	LE3152	Orientation to Leather Manufacture (Bridge Course)	PCC	2	0	2	4	0
6.	RM3151	Research Methodology and IPR	RMC	2	1	0	3	3
PRACTICALS								
7.	FW3111	Testing of Footwear Materials and Products Lab	PCC	0	0	6	6	3
8.	FW3112	Footwear Fabrication Laboratory - I	PCC	0	0	6	6	3
			TOTAL	**14**	**1**	**18**	**33**	**21**

SEMESTER II

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	FW3201	Footwear Components and Accessories	PCC	3	0	0	3	3
2.	FW3202	Modern Techniques in Footwear Manufacture	PCC	3	0	0	3	3
3.	FW3203	Footwear Machinery	PCC	3	0	0	3	3
4.	FW3204	Polymers and Auxiliaries for Footwear	PCC	3	0	0	3	3
5.		Professional Elective I	PEC	3	0	0	3	3
PRACTICALS								
6.	FW3211	Footwear Fabrication Laboratory - II	PCC	0	0	6	6	3
7.	FW3212	Modern Practices in Footwear Manufacture	PCC	0	0	6	6	3
			TOTAL	**15**	**0**	**12**	**27**	**21**

SEMESTER III

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.		Professional Elective II	PEC	3	0	0	3	3
2.		Professional Elective III	PEC	3	0	0	3	3
3.		Professional Elective IV	PEC	3	0	0	3	3
PRACTICALS								
4.	FW3311	Internship/Training	EEC	0	0	4	4	2
5.	FW3312	Project Work I	EEC	0	0	12	12	6
TOTAL CREDITS				**9**	**0**	**16**	**25**	**17**

SEMESTER IV

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
PRACTICALS								
1.	FW3411	Project Work II	EEC	0	0	24	24	12
TOTAL CREDITS				**0**	**0**	**24**	**24**	**12**

TOTAL: 71 CREDITS

FOUNDATION COURSES (FC)

S. NO	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			CREDITS
			Lecture	Tutorial	Practical	
1.	FW3101	Anatomy and Solid Modelling of Foot	2	1	0	3
TOTAL CREDITS						**3**

BRIDGE COURSE

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	LE3152	Orientation to Leather Manufacture (For B.E Mechanical, Production, Industrial Engg. Students)	PCC	4	2	0	2	0

***** Compulsory for non-leather graduates

PROFESSIONAL CORE COURSES (PCC)

S. NO.	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			CREDITS
			L	T	P	
1.	FW3102	Design and Fabrication of Footwear	3	0	0	3
2.	FW3103	Materials for Footwear	3	0	0	3
3.	LE3151	Project Management System	3	0	0	3
4.	FW3111	Testing of Footwear Materials and Products Lab	0	0	6	3
5.	FW3112	Footwear Fabrication Laboratory - I	0	0	6	3
6.	FW3201	Footwear Components and Accessories	3	0	0	3
7.	FW3202	Modern Techniques in Footwear Manufacture	3	0	0	3
8.	FW3203	Footwear Machinery	3	0	0	3
9.	FW3204	Polymers and Auxiliaries for Footwear	3	0	0	3
10.	FW3211	Footwear Fabrication Laboratory – II	0	0	6	3
11.	FW3212	Modern Practices in Footwear Manufacture	0	0	6	3
TOTAL CREDITS						**33**

RESEARCH METHODOLOGY AND IPR COURSES (RMC)

S.NO.	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			CREDITS
			Lecture	Tutorial	Practical	
1.	RM3151	Research Methodology and IPR	2	1	0	3
TOTAL CREDITS						**3**

PROFESSIONAL ELECTIVE COURSES (PEC)

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	FW3001	Computational Methods and Computer Graphics	PEC	3	0	0	3	3
2.	FW3002	Regulations and Compliances for Footwear Industry	PEC	3	0	0	3	3
3.	LE3051	Engineering Economics in Production	PEC	3	0	0	3	3
4.	FW3003	Footwear Performance and Customer Services	PEC	3	0	0	3	3
5.	FW3004	Biomechanics for Footwear	PEC	2	1	0	3	3
6.	FW3005	Human Factors in Engineering	PEC	3	0	0	3	3
7.	LE3052	Industrial Safety and Occupational Health	PEC	3	0	0	3	3
8.	FW3006	Marketing Management	PEC	3	0	0	3	3
9.	FW3007	Modern Footwear Styling	PEC	3	0	0	3	3
10.	FW3008	Organization and Management of Footwear Sector	PEC	3	0	0	3	3
11.	FW3009	Pedorthic Footwear	PEC	3	0	0	3	3
12.	FW3010	Production Operations Management	PEC	3	0	0	3	3
13.	FW3011	Quality Control Management in Footwear Industries	PEC	3	0	0	3	3
14.	LE3053	Self-Management and Entrepreneurship	PEC	3	0	0	3	3
15.	FW3012	Athleisure	PEC	3	0	0	3	3
16.	FW3013	Moulded Footwear	PEC	3	0	0	3	3
17.	FW3014	Open Footwear	PEC	3	0	0	3	3
18.	FW3015	Standards for Footwear	PEC	3	0	0	3	3
19.	FW3016	Industrial Engineering in Footwear Industry	PEC	3	0	0	3	3
20.	FW3017	Sustainable Footwear Industry	PEC	3	0	0	3	3
21.	FW3018	Polymer Processing and Rheology	PEC	3	0	0	3	3

EMPLOYABILITY ENHANCEMENT COURSES (EEC)

S. NO	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			CREDITS
			Lecture	Tutorial	Practical	
1.	FW3312	Project Work I	0	0	12	6
2.	FW3311	Industrial Internship	0	0	4	2
3.	FW3411	Project Work II	0	0	24	12
					TOTAL CREDITS	**20**

SUMMARY

Name of the Programme: M.TECH. – FOOTWEAR ENGINEERING AND MANAGEMENT						
	SUBJECT AREA	**CREDITS PER SEMESTER**				**CREDITS TOTAL**
		I	**II**	**III**	**IV**	
1.	FC	3	0	0	0	3
2.	PCC	15	18	0	0	33
3.	PEC	0	3	9	0	12
4.	RMC	3	0	0	0	3
5.	EEC	0	0	8	12	20
6.	**TOTAL CREDIT**	**21**	**21**	**17**	**12**	**71**

SEMESTER I

		L	T	P	C
FW3101	**ANATOMY AND SOLID MODELLING OF FOOT**	**2**	**0**	**2**	**3**

OBJECTIVE

- To provide fundamental knowledge about lower limb and foot
- To provide knowledge about the structure and function of foot and deformities
- To enable the students to gain knowledge on the principles of foot Bio-Mechanics
- To provide the basic knowledge of Gait and its analysis
- To enable the students to understand the fundamentals of data collection and statistical analysis of foot data using solid modelling

UNIT I ANATOMY OF LOWER LIMB AND FOOT 9

Lower limb - bones, muscles, nerves and fascia, their functions in structural stability (static & dynamic) muscles in helping in walking, muscle relate to limb functions like flexion, extension, etc. Science in Shoe Design.

UNIT II FOOT GROWTH AND DEFORMITIES 7

Growth of foot from infancy to maturity, arches of foot, relationship between foot shape and last. Different types of foot deformities like PesCavus, Valgus, Blisters, Gangrene, injuries in sports, methods of prevention etc., Footcare and protection

UNIT III PRINCIPLES OF BIO MECHANICS 7

Reference planes of motion; Kinematics; Limb Movements; Motion of Joints; Kinetics; Force; Momentum; Inertia; Pressure; Torque; Work, Power and Energy. Free body diagram, analysis - biomechanics of walking, running.

UNIT IV FUNDAMENTALS OF GAIT 7

Terminology used in Gait; Gait Parameters Definition; Phases of Gait Cycle; Fundamentals in Gait Analysis; Balance and Posture; Ground Reaction Force. Introduction to gait analysis techniques.

UNIT V SOLID MODELLING 15

Basic principles of solid modelling and surface modelling using contours and geometry. Use of solid modelling in designing and developing modern footwear. Introduction to Foot Anthropometry; Design of anthropometric foot surveys; Data collection and Statistical Analysis of foot data; Establishment of Sizing systems.

Lasts: Different measurement of feet and lasts - methods, units, sizing systems such as English, French, American, German, Japan Mondo-point their conversion and comparison. Materials for last making, manufacturing technique. Model development. Principles of grading - Manual, machine and computer grading.

LIST OF EXPERIMENTS

1. Identification of bones and foot deformities;
2. Anthropometric measurement of the lower limb including foot;
3. 3D foot scanning and extraction of data;
4. Manual, machine, and computer grading
5. Visual Gait and posture analysis

TOTAL: **60 PERIODS**

COURSE OUTCOME

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

CO1 Understand the anatomy of human lower limb and foot.

CO2 Evaluate the foot growth and its deformities.

CO3 Apply the knowledge on principles of biomechanics of foot.

CO4 Gain a basic knowledge of gait analysis.
CO5 Design and develop modern footwear using the solid modelling

REFERENCES:

1. Chaurasia, B.D., "Human Anatomy: Regional and Human Osteology", 7th Edition, CBSPublishers and Distributors, New Delhi. 2016.
2. Hollinshead, H., "Text book of Anatomy", LWW Publishers, 5th Revised Edition (1997) Oxford IBHLondon.
3. Morton, D.J., "The Human Foot", Hafner Publishing Co., New York, London, 1964.
4. Thornton, J.H., "Text book of Footwear Manufacture", National Trade Press Ltd., London, 1970
5. Edwards, C.A., "Orthopaedic shoe technology", Precision Printing Co., Indiana, 1981
6. Whittle, M., "Gait Analysis: An introduction," butterworth – Heinemann Publication, 2007.
7. Vincent G Duffy, "Digital Human Modelling", Springer, July 2011

CO-PO MAPPING

CO	PO					
	1	**2**	**3**	**4**	**5**	**6**
1	2	2	1	1	-	-
2	3	2	1	1	-	-
3	-	-	3	3	-	-
4	3	2	2	1	-	-
5	3	-	3	1	-	-
AVG.	(2+3+3+3)/4 = 2.8	(2+2+2)/3 = 2	(1+1+3+2+3)/5 = 2	(1+1+3+1+1)/5 = 1.4	-	-

1-low, 2-medium, 3-high, "-"-no correlation
Note: The average value of this course to be used for program articulation matrix.

FW3102	DESIGN AND FABRICATION OF FOOTWEAR	L	T	P	C
		3	0	0	3

OBJECTIVE

The objective of this course is to enable the students to understand

- The various unit operations in footwear manufacture
- The Development of fashions & designs in footwear
- The various sequence of operation in a footwear manufacture
- The principles and types of lasting
- The principles and methods of various post lasting and finishing operation

UNIT I DESIGN AND PATTERN DEVELOPMENT 7

Introduction to footwear and shoe – Historical evolution of shoes in different era's — purposes and basic styles in footwear — Development of fashions & designs in footwear — Introduction to Last and its importance - selection criteria for last - Terminologies on the Last and its parts – Preparation of mean forme by using last – Preparation of upper and lining standards – Grading methodology - Designing of Bottom Parts –Insole pattern, Socks, stiffener- Principles of Grading.

UNIT II CUTTING 7

Introduction and importance - Responsibilities of Clicker - Selection of leathers and non-leather materials for clicking – Layout preparation – Materials Economy - Principles of cutting – Hand, machine, Scope for automation, Standard time – Quality Control – Clicking room design and management. Fabric, rolls and sheet materials cutting technique – Characteristics of Clicking dies

UNIT III PRE-CLOSING AND CLOSING 11

Preparation for closing: Checking incoming work, stitch making, skiving, punching and gimping, heat embossing, toe puff attachment, attaching linings and scrims, trimming linings, finishing off closed seams. Top line and other edge treatments, local reinforcements, attaching fasteners and trims. Threads, needles, Seam and stitch types, Closing: Dealing with thread breakages, automatic stitching, working environment faults and remedies, Types of stitching machines, Designof assembly section and Stitching machine management.

UNIT IV LASTING 9

Introduction to Lasting process –Counter moulding – Insole attaching - Hand lasting / drafting – Quality control in hand lasting -Various methods of conditioning the lasted uppers – Heat setting – Back part moulding - Machine lasting (forepart, side & seat)- Health and Safety control measures follows in shoe manufacturing line – – Quality checking parameters for finished shoe – Quality control measure in lasting operation

UNIT V POST LASTING AND FINISHING 11

Principles and methods of various post lasting and finishing operation; Sole attaching – preparation of lasted margin, upper preparation, sole preparation, sole cementing, upper cementing, halogenations; bottom fillers and shanks adhesive drying, heat activation, spotting, pressing, last slipping, quality control and fault finding problems- solving, recommended bonding systems between upper and outsole. Shoe room techniques.

TOTAL :45 PERIODS

COURSE OUTCOME

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

CO1 Understand the design and pattern development.
CO2 Implement the cutting operation by knowing its importance.
CO3 Have knowledge on pre-closing and closing.
CO4 Design, assemble and construct the full shoe.
CO5 Understand the principles and methods of post lasting and finishing operation.

REFERENCES:

1. Patrick, H.J., "Modern pattern cutting and design", Mobbs and Lewis Ltd., Kettering, England,1990.
2. Lyon, D., "Modern approach to Footwear pattern cutting", 1994.
3. Thornton, J.H., "Text book of Footwear Manufacture", National Trade Press Ltd., London,1970.
4. "Manual of Shoe Making" – Clarks Ltd. (London) 2nd edition, 1989.
5. Wilhelm, A., "Tips for shoe production" Vol. I, II & III, HuthigBuchVerlag, Heidelberg, 1988.

CO-PO MAPPING

CO	PO					
	1	**2**	**3**	**4**	**5**	**6**
1	2	-	3	2	2	-
2	-	1	3	3	3	-
3	-	-	3	3	1	-
4	-	-	2	3	-	-
5	-	-	2	2	3	-
AVG.	2	1	(3+3+3+2+2)/5 = 2.6	(2+3+3+3+2)/5 = 2.6	(2+3+1+3)/4 = 2.3	-

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

Note: The average value of this course to be used for program articulation matrix.

FW3103 MATERIALS FOR FOOTWEAR

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

OBJECTIVES

- To give an overview of materials used for footwear fabrication
- To give insight into the types of materials for various components of footwear
- To provide expertise on the application of leather and leather-like materials for footwear fabrication
- To provide knowledge on physical and mechanical properties of sole materials
- To render exposure to the application of biodegradable materials for the sustainability of the footwear industry

UNIT I ANATOMY OF FOOTWEAR AND FOOTWEAR TYPES 9

History of the shoe – purposes, types, and styles – fashions & designs, Footwear structure, Footwear Components, classification of materials, materials selection and design consideration, Selection of materials for each component based on footwear types.

UNIT II TYPES OF FOOTWEAR MATERIALS AND CHARACTERIZATION TECHNIQUES 9

Leather upper, lining, toe-puff / stiffener, insole and sole, non-leather upper and lining materials and coated fabrics, rigid cellulose, woven and non-woven materials, heel, thread, plasticizers, additives, fillers, adhesives, shoe polishes and pigments.

UNIT III PHYSICAL AND MECHANICAL PROPERTIES OF UPPER MATERIALS 9

Leather and leather-like materials: Tensile strength, modulus of elasticity, elongation, tear strength, viscoelasticity, bond strength, abrasion, flexibility, heat resistance, water absorption and adsorption, and water vapor permeability properties of different footwear materials.

UNIT IV PHYSICAL AND MECHANICAL PROPERTIES OF SOLE MATERIALS 9

Leather and Synthetic Polymers: Tensile strength, modulus of elasticity, elongation, tear strength, compression strength, viscoelasticity, hardness, density, impact strength, bond strength, hydrolysis, abrasion, flexibility, and heat resistance properties of different footwear materials.

UNIT V BIODEGRADABLE MATERIALS AND SUSTAINABILITY 9

Environmental issues in footwear materials, Sustainability of footwear Industries, Application of natural and biodegradable materials in footwear, Application of biodegradable PU materials in footwear, Biodegradability testing methods.

TOTAL : 45 PERIODS

COURSE OUTCOME

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

CO1 Understand the properties of various materials.

CO2 Have knowledge about the various types of footwear materials and methods to characterize them.

CO3 Aware about the selection criteria of synthetic material for footwear industry.

CO4 Analyze and evaluate the properties of various footwear materials.

CO5 Have more knowledge inputs on mechanical behaviour of materials used for footwear production.

REFERENCES:

1. Harvey, A.J., “Footwear Materials and Process Technology”, LASRA Publications, New Zealand, 1982.
2. Thornton, J.H., “Text book of Footwear Materials”, The National Trade Press Ltd., London, 1970.
3. Callister, W.D., Fundamentals of Materials Science and Engineering, Wiley, 2007.
4. Ahuja, S. and Jespersen, N., “Modern Instrumental Analysis”, Elsevier, 2006.
5. Kaufmann, E.N. Characterization of Materials, 2 Volume, Wiley 2003

CO-PO MAPPING

CO	PO					
	1	**2**	**3**	**4**	**5**	**6**
1	3	1	1	1	-	-
2	-	1	1	-	2	-
3	-	-	3	1	-	-
4	-	-	1	-	-	-
5	-	-	1	-	-	-
AVG.	3	(1+1)/2 = 1	(1+1+3+1+1) /5 = 1.4	(1+1)/2 = 1	2	-

1-low, 2-medium, 3-high, “-”-no correlation

Note: The average value of this course to be used for program articulation matrix.

ANNA UNIVERSITY
PROGRESS THROUGH KNOWLEDGE

LE3151 **PROJECT MANAGEMENT SYSTEM** **L T P C**
2 0 2 3

OBJECTIVE

The purpose of this course is to enable the students

- To identify; formulate; foresee or predict problems as possible
- To provide the concept of capital investments
- To learn about the various project appraisal techniques
- To provide the concept of project design and audit
- To provide knowledge ~~on the concepts~~ of project scheduling and schedule compression techniques

UNIT I PROJECT IDENTIFICATION AND FORMULATION 10

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

UNIT II PROJECT BUDGETING AND FINANCING 9

Capital Investments and Difficulties, Types of Capital Investment, Phase of Capital Budgeting, Facets of Project Analysis, Financial Estimates and Deductions, Estimation of Project Cash Flows. Social Cost Benefit Analysis – Rational for SCBA, UNIDO Approach, Multiple Project and Constraints – Linear Programming Model, Financing of Projects – Different Kind of Project Finance.

UNIT III PROJECT APPRAISAL AND RISK ANALYSIS 8

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

UNIT IV PROJECT DESIGN AND EVALUATION 7

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

UNIT V PROJECT SCHEDULING TOOLS AND TECHNIQUES 11

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

LIST OF EXPERIMENTS

1. Payback Period
2. Accounting Rate of Return
3. Net Present Value
4. Internal Rate of Return
5. Benefit Cost Ratio
6. Social Cost Benefit Analysis
7. Effective Rate of Return
8. Decision Tree Analysis
9. Critical Path Method (CPM)
10. Program Evaluation Review Technique (PERT)

11. Schedule Compression Techniques
12. Resource Optimization Techniques

TOTAL : 60 PERIODS

COURSE OUTCOME

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

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

REFERENCES:

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

Course Articulation Matrix:

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	-	1	2	-
CO2	-	-	1	3	3	-
CO3	-	-	-	1	2	3
CO4	1	-	-	-	-	-
CO5	-	-	-	1	2	-
Average	2	2	1	1.8	2.3	3

LE3152 ORIENTATION TO LEATHER MANUFACTURE L T P C
[Bridge Elective Course for Non-Leather UG Graduates] 2 0 2 0

OBJECTIVE

- This course objective is to orient the non-leather students on the fundamental science and technology of leather manufacture
- To understand the Principles and objectives of beam house processes
- To understand the concept of tanning
- To understand the concept of post tanning
- To gain knowledge of various finishing techniques available

UNIT I HIDES, SKINS and PRESERVATION 7

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

UNIT II PRETANNING PROCESSES AND OPERATIONS 8

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

UNIT III TANNING 10

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

UNIT IV POST TANNING PROCESSES AND OPERATIONS 10

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

UNIT V FINISHING TECHNIQUES 10

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

TOTAL : **45 PERIODS**

LIST OF EXPERIMENTS

1. Assortment and Grading of hides and skins
2. Preservation Techniques
3. Manufacture of chrome tanned leather from wet salted sheep skin
4. Manufacture of EI tanned leather from wet salted goat skin
5. Manufacture of upper leather

Course Outcome

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

CO1 Understand the application and alternatives to leather in current global scenario.
CO2 Have knowledge on pre-tanning process.
CO3 Comprehend the process rational for making specific leather through tanning Process.
CO4 Develop Knowledge in post tanning processes.
CO5 Have knowledge in finishing techniques.

REFERENCES:

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

Course Articulation Matrix:

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6
CO1	-	-	2	-	2	-

CO2	1	1	-	2	-	-
CO3	-	-	1	-	-	-
CO4	1	-	-	-	-	-
CO5	-	-	-	-	2	-
Average	1	1	1.5	2	2	-

RM3151 RESEARCH METHODOLOGY AND IPR L T P C

2 1 0 3

OBJECTIVES:

To impart knowledge on

- Formulation of research problems, design of experiment, collection of data, interpretation and presentation of result
- Intellectual property rights, patenting and licensing

UNIT I RESEARCH PROBLEM FORMULATION 9

Objectives of research, types of research, research process, approaches to research; conducting literature review- information sources, information retrieval, tools for identifying literature, Indexing and abstracting services, Citation indexes, summarizing the review, critical review, identifying research gap, conceptualizing and hypothesizing the research gap

UNIT II RESEARCH DESIGN AND DATA COLLECTION 9

Statistical design of experiments- types and principles; data types & classification; data collection - methods and tools

UNIT III DATA ANALYSIS, INTERPRETATION AND REPORTING 9

Sampling, sampling error, measures of central tendency and variation,; test of hypothesis-concepts; data presentation- types of tables and illustrations; guidelines for writing the abstract, introduction, methodology, results and discussion, conclusion sections of a manuscript; guidelines for writing thesis, research proposal; References – Styles and methods, Citation and listing system of documents; plagiarism, ethical considerations in research

UNIT IV INTELLECTUAL PROPERTY RIGHTS 9

Concept of IPR, types of IPR – Patent, Designs, Trademarks and Trade secrets, Geographical indications, Copy rights, applicability of these IPR; , IPR & biodiversity; IPR development process, role of WIPO and WTO in IPR establishments, common rules of IPR practices, types and features of IPR agreement, functions of UNESCO in IPR maintenance.

UNIT V PATENTS 9

Patents – objectives and benefits of patent, concept, features of patent, inventive steps, specifications, types of patent application; patenting process - patent filling, examination of patent, grant of patent, revocation; equitable assignments; Licenses, licensing of patents; patent agents, registration of patent agents.

TOTAL: 45 PERIODS

COURSE OUTCOMES

Upon completion of the course, the student can

CO1: Describe different types of research; identify, review and define the research problem

CO2: Select suitable design of experiment s; describe types of data and the tools for collection of data

CO3: Explain the process of data analysis; interpret and present the result in suitable form

CO4: Explain about Intellectual property rights, types and procedures

CO5: Execute patent filing and licensing

REFERENCES:

1. Cooper Donald R, Schindler Pamela S and Sharma JK, “Business Research Methods”, Tata McGraw Hill Education, 11e (2012).
2. Soumitro Banerjee, “Research methodology for natural sciences”, IISc Press, Kolkata, 2022,
3. Catherine J. Holland, “Intellectual property: Patents, Trademarks, Copyrights, Trade Secrets”, Entrepreneur Press, 2007.
4. David Hunt, Long Nguyen, Matthew Rodgers, “Patent searching: tools & techniques”, Wiley, 2007.
5. The Institute of Company Secretaries of India, Statutory body under an Act of parliament, “Professional Programme Intellectual Property Rights, Law and practice”, September 2013.

FW3111 TESTING OF FOOTWEAR MATERIALS AND PRODUCTS LAB

L	T	P	C
0	0	6	3

OBJECTIVE

To enable the students to

- Analyze the physical properties of leather, lining and soles
- Analyze the chemical properties of materials for footwear applications
- Analyze the footwear accessories and safety shoes

LIST OF EXCERCISES

The objective of this course is provide practical exposure on the testing of footwear materials

- Methods of sampling and conditioning of footwear materials and end products
- Physical analysis of leather upper, lining, toe-puff / stiffener, insole and sole
- Demonstration of Chemical Testing of Leather for Footwear Manufacturing
- Physico-mechanical properties of non-leather upper and lining materials and coated fabrics-pH and chloride content
- Physico - mechanical properties of rigid Cellulose, Woven and Non-Woven
- Testing of Insole
- Visual and physico mechanical tests like seam strength, strap strength, Toe load, Heel pull-off (ladies), top-line strength, water resistance etc.
- Testing of footwear grinderies and accessories
- Testing of safety shoe

TOTAL : 90 PERIODS

COURSE OUTCOME

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

CO1 Understand the importance of testing footwear materials and products.
CO2 Have hands on experience of testing footwear materials and products.
CO3 Aware of various quality standards of various leather, non-leather and shoes.

REFERENCES:

1. BIS Standards.
2. “Quality manuals of footwear materials”, CLRI publications, 2000.

CO-PO MAPPING

CO	PO					
	1	2	3	4	5	6
1	-	-	1	-	-	-
2	-	2	3	3	2	-

3	-	-	1	-	-	-
AVG.	-	2	(1+3+1)/3 = 1.6	3	2	-

1-low, 2-medium, 3-high, "-"-no correlation
Note: The average value of this course to be used for program articulation matrix.

FW3112 FOOTWEAR FABRICATION LABORATORY - I

L	T	P	C
0	0	6	3

OBJECTIVE
To enable the students to

- Impart practical exposure in pattern developments
- Gain knowledge in leather assortment and cutting operation
- Acquire the ability of upper fabrication

LIST OF EXCERCISES

LAST **30**

Central line drawing – Measurements – Design Insole pattern – Sole pattern – Forming – slotted, Fabric, Tape & Vacuum Method. Men's shoe standard and preparation (Derby, Oxford, Mocassins, Ankle boots, long boots etc.) Ladies & Children's standard and section preparation.

CUTTING AND CLICKING **30**

Leather Assortment — Grading — cuttability etc. Layout preparation on paper &leather. Leather consumption calculation; parallelogram and other methods. Hand and Machine cutting Fabric and other sheet materials.

UPPER FABRICATION **30**

Assessment on cut components, practice in sewing machine – pedal control without thread – Thread –synthetic – leather, practice on pre-closing operation – skiving - splitting-folding, practice on fabrication of – derby - oxford - slip on, practical exposure on upper inspection and assessment practice.

TOTAL: 90 PERIODS

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

CO1 Be in a position to develop patterns of different style of footwear.
CO2 Have practical knowledge on cutting and clicking process.
CO3 Have practical experience in upper fabrication.

CO-PO MAPPING

CO	PO					
	1	**2**	**3**	**4**	**5**	**6**
1	2	-	2	-	-	-
2	-	-	2	-	-	-
3	-	-	2	2	1	-
AVG.	2	-	(2+2+2)/3 = 2	2	1	-

1-low, 2-medium, 3-high, "-"-no correlation
Note: The average value of this course to be used for program articulation matrix.

SEMESTER II

FW3201 FOOTWEAR COMPONENTS AND ACCESSORIES

L	T	P	C
3	0	0	3

OBJECTIVE
To enable the students

- To acquire knowledge on various components used for footwear manufacture
- To understand the role of grinderies in footwear manufacturing
- To inculcate an understanding of fasteners and its types
- To learn about accessories and its manufacturing method
- To know about the importance of reinforcements and non-metallic grinderies

UNIT I COMPONENTS 9

Insole: Raw material - Kind of insoles: Leather Board of stock preparation - Board making. Heel: Injection moulded heels: mould design, raw materials selection - injection moulding and finishing.

UNIT II GRINDERIES 13

Last: Raw material - Manufacture of wooden last, Plastic last and metal last. Constituents and Manufacture of fibre boards. Plastic back part insole and stiffener board. Shank, Raw Material - Wood, Fibre board Steel, combined wooden board or steel and board, manufacture technique. Grinderies: Metallic grinderies - tack, rivet and nails, wires - raw materials - sorting and polishing.

UNIT III FASTENERS 9

Fasteners: Threads, Lace Fabrics: Raw Material – Manufacture Technique and Finishing. Eyelets: Raw materials - designing and manufacturing processes. Slide fasteners: Types of materials used in slide fasteners - manufacturing processes.

UNIT IV ACCESSORIES 5

Ornaments, embellishments, studs, methods of manufacture, moulding, electroplating and polishing.

UNIT V REINFORCEMENTS 9

Toe-puff and Stiffeners: Types of Toe-puff and stiffeners, manufacture techniques - Paint on liquids, impregnated fabrics, print on hot-melt resin, filmic. Recommended use. Non-metallic grinderies: Reinforcement tape - tape preparation - Vulcanization of adhesive. Fibre fastening, Velcro, etc.

TOTAL : 45 PERIODS

COURSE OUTCOME

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

CO1 Understand about various footwear components.

CO2 Analyze and evaluate the characteristics of various footwear grinderies and accessories.

CO3 Know about fasteners and its types.

CO4 Have knowledge on different manufacturing techniques of accessories and are able to design them.

CO5 Know the importance of various reinforcement materials.

REFERENCES:

1. Thornton, J.H., “Text book of Footwear Materials”, The National Trade Press Ltd., London,1970.
2. Harvey, A.J., “Footwear Materials and Process Technology”, N.Z.Shoe Research Association, New Zealand,1982.

CO-PO MAPPING

CO	PO					
	1	2	3	4	5	6
1	-	-	-	1	-	-
2	-	-	1	1	-	-
3	-	-	-	-	-	-

4	1	2	3	1	3	-
5	-	-	-	-	-	-
AVG.	1	2	(1+3)/2 = 2	(1+1+1)/3 = 1	3	-

1-low, 2-medium, 3-high, "-"-no correlation
Note: The average value of this course to be used for program articulation matrix.

FW3202 MODERN TECHNIQUES IN FOOTWEAR MANUFACTURE L T P C
3 0 0 3

OBJECTIVE

The objective of this course is to enable the students

- To project the use of computer assisted designing techniques for making footwear
- To know the concept behind footwear digitization and pattern engineering
- To gain knowledge on virtual prototype development
- To gain student's knowledge about rapid prototyping
- To extrapolate artificial intelligence in footwear manufacturing

UNIT I COMPUTER AIDED DESIGN AND ITS HARDWARE 3

Introduction to CAD - historical development of CAD – central processing unit (CPU) and its components – graphics processing unit (GPU) - input and output devices - interface and storage devices, net-working concepts of LAN and WAN – CAD scope of applications and advantage.

UNIT II FOOTWEAR DIGITIZATION AND PATTERN ENGINEERING 12

Digitization: principles of digital and analog conversion, digital input/output processing systems. 2D; 3D Coordinate extracting

Digitization with 2D digitizer and 3D Last Scanner; manipulation and optimization of digitized DATA; 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.

Pattern engineering techniques – graphical user interface (GUI) and various menus - grading and detailing of footwear patterns, consumption calculations, pattern nesting and costing, stitching and required processes through computerized techniques.

UNIT III VIRTUAL PROTOTYPE DEVELOPMENT 12

Visual Perception - Perception of Depth, Perception of Motion, Perception of Color, Combining Sources of Information - Ray Tracing and Shading Models, Rasterization, Correcting Optical Distortions, Improving Latency and Frame Rates - Rendering - set up a scene - Adding Lighting - create different Lighting types - Placing and adjust virtual camera controls - adjusting Lighting Exposure- apply Materials and create Render Elements - and import geometry - advance texture scanners - add Textures - UVW Maps - augmented reality and VR glasses.

UNIT IV ADVANCED TECHNIQUES USING CAD and RAPID PROTOTYPING 9

Principles and practices of foot scanner; conversion of foot dimensions to last model; creation of still files for last manufacture; 3D Printing and prototyping techniques: Fused Deposition Modelling (FDM) - Powder Bed Fusion (PBF) process - Stereolithography (SLA). - concepts and applications in footwear manufacture.

UNIT V ARTIFICIAL INTELLIGENCE IN FOOTWEAR MANUFACTURING 9

Neural networks - Object recognition - simulation – concepts and applications; CNC devices for computer aided cutting including dieless, laser and water jet - computer aided manufacturing using robotics: three-axis and five-axis machines - generate roughing milling tool paths - finishing milling tool paths - concepts and applications in footwear manufacture.

TOTAL : 45 PERIODS

COURSE OUTCOME

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

CO1 Understand the concepts of basic computer applications in footwear sector.

CO2 Have knowledge on CAD for pattern engineering.

CO3 Design virtual prototype development for footwear sector.

CO4 Have knowledge in advanced computational techniques in CAD, rapid prototyping, simulation, 3D printing and robotics.

CO5 Have knowledge of imparting the artificial intelligence in footwear manufacturing.

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

CO-PO MAPPING

CO	PO					
	1	**2**	**3**	**4**	**5**	**6**
1	-	-	2	1	-	-
2	-	-	1	-	-	-
3	2	-	1	-	-	-
4	-	-	3	-	-	-
5	-	-	2	-	3	-
AVG.	2	-	(2+1+1+3+2) /3 = 3	1	3	-

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

Note: The average value of this course to be used for program articulation matrix.

FW3203	FOOTWEAR MACHINERY	L	T	P	C
		3	0	0	3

OBJECTIVE

To enable the students

- To learn about preclosing and closing operations using various machineries
- To gain knowledge in lasting and bottoming department
- To explore knowledge in advanced machineries and transport system in footwear engineering
- To design optimal machinery layout in footwear unit
- To gain knowledge on preventive maintenance and safety while using footwear machineries

UNIT I MACHINERIES USED IN PRECLOSING AND CLOSING DEPARTMENT 9

Clicking machineries – Mechanical clicking press – Hydraulic clicking press – Hytronic clicking press – Press knife - Strap Cutting Machine. Splitting machine, Skiving Machine, edge – folding,stamping, and Sewing Machine – Flat bed – Post bed – Cylinder bed Twin needle flat machine – Different Feed Mechanism. Zigzag Machine, Punching, Crimping, Eyeleting, Seam – rubbing and taping

UNIT II MACHINERIES USED IN LASTING AND BOTTOMING DEPARTMENT 9

Counter Moulding, Insole attaching, Toe puff activator, Mulling chamber, thermo-cementing, preforming, Toe lasting, side lasting, seat lasting , Heel crowing , heat setter, Hot air blower, Roughing machine, Heat Reactivator, Sole Pressing machine, Delasting machine, Polishing machine

UNIT III ADVANCED FOOTWEAR MACHINES AND TRANSPORT SYSTEM 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 FOOTWEAR UNIT 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 footwear industry.

UNIT V PREVENTIVE MAINTENANCE AND SAFETY 6

Preventive maintenance and safety in the use of footwear machinery

TOTAL :**45 PERIODS**

COURSE OUTCOME

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

CO1 Understand the general principles involved in various machineries used in preclosing and closing department.

CO2 Know the salient features and purpose of the various machinery used in lasting and bottoming department.

CO3 Gain knowledge about advanced machineries for footwear processing and transport system.

CO4 Design an optimal machinery layout in footwear unit.

CO5 Know the importance of preventive maintenance and safety in the use of footwear machinery.

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 AngloAmerican Technical Co. Ltd., London,1924.

CO-PO MAPPING

CO	PO					
	1	2	3	4	5	6
1	-	-	1	-	2	-
2	-	-	-	-	2	-
3	-	-	1	2	2	-
4	2	-	2	2	2	-
5	-	-	1	3	-	-
AVG.	2	-	(1+1+2+1)/4 = 1.3	(2+2+3)/3 = 2.3	(2+2+2+2)/4 = 2	-

1-low, 2-medium, 3-high, "-"-no correlation
Note: The average value of this course to be used for program articulation matrix.

FW3204 POLYMERS AND AUXILIARIES FOR FOOTWEAR L T P C
3 0 0 3

OBJECTIVE
To enable the students to
- Have a basic understanding on polymer and its preparations
- Understand the concept of blending and fabrication of Polymers
- Provide knowledge on applications of polymers in various footwear components
- Study the enhancement of footwear performance using various polymeric materials
- Gain knowledge on adhesives and use of polymeric materials in footwear

UNIT I PRINCIPLES FOR PREPARATION OF POLYMERIC MATERIALS 9
Definition and classification of polymers - Chemistry and mechanism involved in different polymerisation processes such as Stepwise, Addition, Ring opening, Free Radical polymerisations (Bulk, solution, suspension and emulsion polymerisations) — Copolymerisation - Anionic and Cationic polymerisations.

UNIT II MODIFICATIONS OF POLYMERIC MATERIALS FOR DIFFERENT FOOTWEAR COMPONENTS 8
Polymer Blending: High polymer blends - Plasticization — Other additives, fillers, Antioxidants, flame retardants, stabilizers, colorants and pigments - Post reactions of polymers ii. Moulding techniques and equipment used in fabrication of polymer products such as: Injection moulding, calendering, Reaction Injection moulding (RIM), Blow moulding etc.

UNIT III PROPERTIES, SPECIFIC USES AND TESTING OF DIFFERENT POLYMER MATERIALS 8
Properties and test procedures for polymer materials such as rheological, mechanical, electrical, thermal, chemical and comfort -suitability of polymer materials for different components of footwearsuch as upper, lining, shank, insole, outer sole, heel, thread etc.

UNIT IV CHEMISTRY AND TECHNOLOGY IN MANUFACTURING POLYMERIC MATERIALS 8
Natural &synthetic rubber PVC - Polystyrene - PU, LDPE & HDPE Polypropylene - Nylon — EPDM Polyesters- Polyamines - EVA-ABS - Acrylics - Fibre Reinforced Plastics - Poromerics / PVC or PU coated fabrics. Formulation and properties of polymeric materials such as shoe polishes, upper dressings, glazing materials, lacquers, binders, resins.

UNIT V ADHESIVES AND FOOTWEAR DRESSING CHEMICALS **8**

Adhesive formulations involving starch, glue, latex, rubber solutions, chloroprene, PU etc. Properties of adhesives & their choice for different purposes and in construction as in DIP, DVP, cemented etc. Mechanism of adhesion. Application of polymeric materials in footwear industry. Manufacture of shoe finishes.

TOTAL : 45 PERIODS

COURSE OUTCOME

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

CO1 Have knowledge on preparation of polymers.
CO2 Successfully modify polymers suitable for footwear components.
CO3 Aware of using polymeric materials for various components in footwear industry.
CO4 Understand the chemistry and technology for manufacturing various soles used for footwear.
CO5 Understand the importance of dressing materials and adhesives used in footwear components.

REFERENCES:

1. Miles, D.C. and Briston, J.H., "Polymer Technology", Temple Press, London, 1965.
2. Flory, P.R., "Principles of Polymer Chemistry", Cornell University Press, Ithaca, New York,1953.
3. Kaufman, H.S. and Falcetta, J.J., "Introduction to Polymer Science and Technology",John Wiley & Sons, New York, 1978.
4. Harvey, A.J., "Footwear Materials and Process Technology", LASRA Publications, New Zealand,1982

CO-PO MAPPING

CO	PO					
	1	**2**	**3**	**4**	**5**	**6**
1	3	-	1	-	-	-
2	2	-	1	-	-	-
3	-	-	1	-	3	-
4	1	-	1	1	-	2
5	-	-	1	-	-	-
AVG.	(3+2+1)/3= 2	-	(1+1+1+1+1) /5 = 1	1	3	2

1-low, 2-medium, 3-high, "-"-no correlation
Note: The average value of this course to be used for program articulation matrix.

FW3211 FOOTWEAR FABRICATION LABORATORY - II

L	**T**	**P**	**C**
0	**0**	**6**	**3**

OBJECTIVE

- To impart practical exposure in bottom stock preparation of full shoe manufacture
- To enable the students to learn about the fabrication process of lasting and finishing
- To train students on non-leather shoe manufacturing techniques

LIST OF EXCERCISES

BOTTOM STOCK PREPARATION **40**

Insole cutting - Sole cutting and cutting other sections/components. Leather/Rubber Sole preparation - Heel attaching - Heel treatment - Edge Treatment - Finishing.

LASTING AND FINISHING **10**

Insole attachment - base strap lasting – vamp lasting – full strap lasting (Manual practice), handdrafting – practice on lasting machine – practice on fabrication of different styles of footwear - shoe dressing and finishing

NON-LEATHER SHOE MANUFACTURING TECHNIQUES **40**

Preparation of strobel sewn upper, usage of polymer materials, practice on injection of molten material, solidification process into the cavity/mould and health and safety practices concerning DIM process, completion of injection moulded footwear.

TOTAL : 90 PERIODS

COURSE OUTCOME

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

CO1 Prepare the bottom stock and to fabricate upper.
CO2 Have practical knowledge on lasting and finishing process.
CO3 Gain skill set to handle non-leather shoe manufacturing techniques.

REFERENCES:

1. Bordoli, B., “The Boot and Shoe Maker”, (4 volumes) The Gresham Publishing Co. Ltd., London,4th edition, 1966.
2. Katz, R.J., “Footwear: Shoes and Socks You can make Yourself” Reinhold, New York, 1979.
3. “Manual of shoe designing ”, CLRI Publications, 1999.

CO-PO MAPPING

CO	PO					
	1	**2**	**3**	**4**	**5**	**6**
1	1	-	1	2	-	-
2	-	2	1	2	-	-
3	-	-	2	2	3	-
AVG.	1	2	(1+1+2)/3 = 1.3	(2+2+2)/3 = 2	3	-

1-low, 2-medium, 3-high, “-”-no correlation

Note: The average value of this course to be used for program articulation matrix.

FW3212 MODERN PRACTICES IN FOOTWEAR MANUFACTURE

L	T	P	C
0	0	6	3

OBJECTIVE

- To provide students a practical knowledge on the use of computer assisted designing techniquesfor making footwear
- To acquaint with pattern creation and engineering
- To prepare the student to be an effective user of standards in CAD system

LIST OF EXCERCISES:

- 2D and 3D shell and pattern digitization
- Style line Manipulation techniques
- Patter creation using CAD
- Pattern detailing and engineering
- Normal and restricted pattern size grading in CAD/CAM
- Concept of e-last and its management
- Sole design
- Texture creation
- Virtual shoe prototyping
- Rendering to get photorealistic footwear

TOTAL : 90 PERIODS

COURSE OUTCOME

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

CO1 Understand the basic concepts and technique of CAD in footwear industry processing.

CO2 Learn about the concept of e-last.

CO3 Carryout grading and sole mould design.

CO-PO MAPPING

CO	PO					
	1	2	3	4	5	6
1	-	1	2	1	-	-
2	2	-	3	-	-	-
3	-	-	-	1	3	-
AVG.	2	1	(2+3)/2 = 2.5	(1+1)/2 = 1	3	-

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

Note: The average value of this course to be used for program articulation matrix.

SEMESTER III

FW3311 INTERNSHIP / TRAINING

L	T	P	C
0	0	4	2

OBJECTIVE

- The industrial internship is expected to enhance the technical employability skills of the students
- To develop skills in handling industrial equipment
- To interact with industry and society in a professional and ethical manner

Students are expected to undertake industrial internship programme during the summer vacation. Minimum duration of this should be 1 month. During their internship programme, the students are expected to at least resolve one of the problems faced by the industry. Students pursuing R&D elective stream will be allowed to take up their internship at a

research lab. As a part of this course students are expected to make presentations and report on the work they have carried out during their internship.

COURSE OUTCOME

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

CO1 Have confidence in handling practical aspects in footwear and allied sector.
CO2 Become expertise in handling respective training sector.
CO3 Improve the presentation skills.

CO-PO MAPPING

CO	PO					
	1	**2**	**3**	**4**	**5**	**6**
1	-	1	3	1	-	-
2	-	2	3	-	3	-
3	-	3	3	-	-	1
AVG.	-	(1+2+3)/3 = 2	(3+3+3)/3 = 3	1	3	1

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

Note: The average value of this course to be used for program articulation matrix.

FW3312 PROJECT WORK I

L	**T**	**P**	**C**
0	**0**	**12**	**6**

OBJECTIVES:

The course aims to enable the students to identify the research problem relevant to their field of interest, search databases to define the problem, design experiment, conduct preliminary study and report the findings.

COURSE CONTENT

Individual students will identify a research problem relevant to his/her field of study with the approval of project review committee. The student will collect, and analyze the literature and design the experiment. The student will carry out preliminary study, collect data, interpret the result, prepare the project report and present before the committee.

TOTAL: 180 PERIODS

OUTCOMES:

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

CO1: Identify the research problem
CO2: Collect, analyze the relevant literature and finalize the research problem
CO3: Design the experiment, conduct preliminary experiment, analyse the data and conclude
CO4: Prepare project report and present

CO-PO MAPPING

CO	PO					
	1	**2**	**3**	**4**	**5**	**6**
CO1	3	-	2	2	2	2
CO2	1	1	3	2	-	-
CO3	2	2	2	1	3	2
CO4	-	3	2	-	-	-
Average	2	2	2.3	1.6	2.5	2

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

Note: The average value of this course to be used for program articulation matrix.

SEMESTER IV

		L	T	P	C
FW3411	**PROJECT WORK II**	**0**	**0**	**24**	**12**

I. Continuation of Project Work I (at Institution/Industry)

OBJECTIVES:

The course aims to enable the students to conduct experiment as per the plan submitted in Project work I to find solution for the research problem identified.

COURSE CONTENT

The student shall continue Project work I as per the formulated methodology and findings of preliminary study. The student shall conduct experiment, collect data, interpret the result and provide solution for the identified research problem. The student shall prepare the project report and present before the committee.

TOTAL: 360 PERIODS

OUTCOMES:

At the end of the course the students will be able to
CO1: Conduct the experiment and collect data
CO2: Analyze the data, interpret the results and conclude
CO3: Prepare project report and present

Course articulation Matrix

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	-	2	3	1	1
CO2	3	3	2	-	-	-
CO3	-	3	2	-	-	-
Average	2	2	2	3	1	1

II. Not the continuation of Project Work I (at Industry)

OBJECTIVES:

The course aims to enable the students to identify the research problem at the company, search databases to define the problem, design experiment, and conduct experiment to find the solution.

COURSE CONTENT

Individual students will identify a research problem relevant to his/her field of study at the company and get approval of project review committee. The student will collect, and analyze the literature and design the experiment. The student will carry out the experiment, collect data, interpret the result, prepare the project report and present before the committee.

TOTAL: 360 PERIODS

OUTCOMES:

At the end of the course the students will be able to
CO1: Identify the research problem
CO2: Collect, analyze the relevant literature and finalize the research problem
CO3: Design and conduct the experiment, analyse the data and conclude
CO4: Prepare project report and present

CO-PO MAPPING

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	-	2	2	2	2
CO2	1	1	3	2	-	-
CO3	2	2	2	1	3	2
CO4	-	3	2	-	-	-
Average	2	2	2.3	1.6	2.5	2

1-low, 2-medium, 3-high, "-"-no correlation
Note: The average value of this course to be used for program articulation matrix.

Professional Elective Courses (PEC)

FW3001 COMPUTATIONAL METHODS AND COMPUTER GRAPHICS L T P C
3 0 0 3

OBJECTIVE

The objective of this course is

- To provide knowledge on various theories on computation methods and graphics.
- To enable the students to know the concepts of initial and B.VP for ODE
- To enable the students to understand the FEM and its core working principles
- To provide knowledge in two-dimensional graphics
- To provide knowledge in three-dimensional graphics

UNIT I SOLUTION OF LINEAR EQUATION AND INTERPOLATION 9

Solution of a linear system by Gaussian, Gauss-Hordon, Jacobi and Gauss- seidal methods. Interpolation with Newton divided differences – Lagrange's polynomial – numerical differentiation with interpolation polynomials. Numerical integration by trapezoidal, Simpsons rule and two-point Gaussian quadrature.

UNIT II INITIAL AND B. VP FOR ODE 9

Taylor series, Euler, Modified Euler, Runge Kutta method of Fourth order for First and Second orderdifferential equations – Finite difference solution for the second order ordinary differential equation.

UNIT III FINITE ELEMENT METHOD 9

Integral Formulation and variational methods – Mathematical concepts, weak formulation of BVP, variational methods of approximation, Two dimensional BVP – Model equation, Finite element discretization, Interpolation – function, Assembly of element equation, Axisymmetric problems- Mesh generation and interposition of Boundary condition.

UNIT IV TWO-DIMENSIONAL GRAPHICS 9

Line, circle, ellipse drawing algorithim, line attributes, curve attributes, character generation, line clipping algorithm, two dimensional geometric transformations.

UNIT V THREE-DIMENSIONAL GRAPHICS 9

Bezier curves, Bezier surfaces, generation of quadric surfaces, three dimensional geometric transformations, viewing transformations– projections.

TOTAL :45 PERIODS

COURSE OUTCOME

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

CO1 Have knowledge on linear equation and interpolation.

CO2 Analyze and evaluate the different theories in mathematical analysis on computation methods.
CO3 Comprehend the application aspects of finite element method.
CO4 Design two-dimensional graphics.
CO5 Understand three-dimensional graphics.

REFERENCES:

1. Grewal, B.S. and Grewal J.S." numerical methods in Engineering & Sciences", KhannPublications, New Delhi 2015.
2. Reddy, J.N."An Introduction to Finite Element Methods", Third Edition, McGraw Hill Inc.NewYork, 2017.
3. Hearn and Bakes, "Computer Graphics" (2nd Edition), Prentice Hall, 1994.

CO-PO MAPPING

CO	PO					
	1	**2**	**3**	**4**	**5**	**6**
1	2	-	1	-	1	-
2	-	2	-	-	-	-
3	-	-	-	-	1	-
4	-	-	1	1	-	-
5	-	-	1	1	-	-
AVG.	2	2	(1+1+1)/3 = 1	(1+1)/2 = 1	(1+1)/2 = 1	-

1-low, 2-medium, 3-high, "-"-no correlation
Note: The average value of this course to be used for program articulation matrix.

FW3002 REGULATIONS AND COMPLIANCES FOR FOOTWEAR INDUSTRY L T P C 3 0 0 3

OBJECTIVE

- To give a global insight into the requirements of the leather and footwear industry
- To provide detailed knowledge on the standards of quality, quantity and safety
- To inculcate the students about product safety and legislation in footwear industry
- To provide knowledge in supply chain management in the footwear industry
- To equip students with knowledge and skills undertaking corporate social responsibility

UNIT I INTRODUCTION TO FOOTWEAR REGULATIONS AND COMPLIANCE 8

Overview of the footwear industry and environmental protection act - Key compliance requirements for footwear manufacturing and distribution - Understanding the role of regulations and compliance in ensuring product safety and quality - Introduction to international, regional, and national regulatory bodies governing the footwear industry - Current Regulatory Requirements - Key Components of Leather Manufacturing Regulations - Introduction to international and national regulation of leather/ footwear

UNIT II PRODUCT SAFETY AND QUANTITY AND QUALITY STANDARDS IN LEATHER INDUSTRY 12

Quality standards of fast-fashion and slow-fashion products – Management of production – Consumer product safety – Adult and Children footwear regulations – Registration, Evaluation, Authorization and restriction of Chemical substances (REACH) norms – Lists of banned and restricted chemicals used in footwear chemicals - Substances of Very High Concern (SVHC) – Zero Discharge of Hazardous Chemicals (ZDHC)

UNIT III PRODUCT SAFETY AND LEGISLATION APPLYING TO FOOTWEAR INDUSTRY 7

Labeling requirements for footwear composition and products (country of origin, import/export considerations, material composition, care instructions, etc.) - REACH norms to footwear - BIS regulation in India - General product safety directive - Packaging and Packaging waste - Intellectual property protection and trademarks in the footwear industry - Packaging regulations and waste management considerations – Eco-marking and eco-labeling requirements for environmentally-friendly footwear and components

UNIT IV SUPPLY CHAIN, WORKPLACE SAFETY AND SOCIAL COMPLIANCE 8

Overview of supply chain management in the footwear industry - Supply chain transparency and responsible sourcing of materials - Occupational health and safety regulations in footwear manufacturing facilities - Ethical considerations and labor rights in the production process - Social compliance standards (e.g., fair trade, fair wages, working conditions)

UNIT V ENVIRONMENTAL REGULATIONS, SUSTAINABILITY AND CORPORATE SOCIAL RESPONSIBILITY 10

Non-renewable and renewable resource depletion – Biodegradability and non-biodegradability – Energy intensive and energy-saving production processes – Compliance to global regulations with reference to the Indian market – Providing safe environment for manpower in footwear industry - Circular economy principles and eco-friendly practices in footwear production - Compliance with chemical restrictions and hazardous substance regulations – Non-compliance and recall procedures - Corrective actions in case of non-compliance

TOTAL : **45 PERIODS**

COURSE OUTCOME

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

CO1 Understand the importance of regulatory requirements in footwear manufacturing.

CO2 Have knowledge towards competent and quality accordance on a global level in pre-operational and post-operational regulations.

CO3 Overview on product safety and legislation for footwear industry.

CO4 Handle work area in terms of supply chain, safety and social compliance.

CO5 Have knowledge on environmental regulations, sustainability and corporate social responsibility.

REFERENCES:

1. "Footwear Regulations Handbook" by Institute of Quality Assurance
2. IS 17011: 2018, “Chemical requirements for footwear and footwear materials”
3. "Footwear Regulations Handbook" by World Footwear Congress
4. "Global Footwear Compliance Manual" by Footwear Distributors and Retailers of America (FDRA)
5. "Sustainable Footwear Manufacturing" by Subramanian SM
6. Industry reports, articles, and updates from regulatory bodies and trade associations

CO-PO MAPPING

CO	PO					
	1	**2**	**3**	**4**	**5**	**6**
1	-	-	-	-	-	-
2	1	-	-	-	-	-
3	-	-	1	1	-	-
4	-	-	1	1	2	-
5	-	2	-	1	-	-
AVG.	1	2	(1+1)/2 = 1	(1+1+1)/3 = 1	2	-

1-low, 2-medium, 3-high, "-"-no correlation
Note: The average value of this course to be used for program articulation matrix.

LE3051 ENGINEERING ECONOMICS IN PRODUCTION L T P C
3 0 0 3

OBJECTIVE

- The objective of this course is to present students on project identification and preparations
- To enable the students to understand the principles of Investment appraisal and financial analysis
- To enable the students to understand the risk and uncertainty of the implementation and management
- To provide knowledge in handling finances
- To provide knowledge in the budget and its various methods

UNIT I PROJECT IDENTIFICATION AND PREPARATION 10

General considerations - choice of project between alternative propositions - engineering aspects-cost estimates and demand forecasting for footwear industry.

UNIT II PRINCIPLES OF PROJECT APPRAISAL 10

Investment appraisal and financial analysis through the measurement of project return –by discounted cash flow method - net present value of a project - internal rate of return - project payback period - cash flows accounting profit - intangible returns - Inflation and project appraisal.

UNIT III IMPLEMENTATION AND MANAGEMENT 9

Methodological and organizational aspects of implementation - pert and other methods - risk and uncertainty - probability theory.

UNIT IV SOURCES OF FINANCE AND BUDGETING 9

Different sources of finance - ownership finance - ordinary share-, short-, medium- and long-term loan - budget preparation - annual cost, variable costs - allocation of costs.

UNIT V METHODS OF BUDGETING 7

Marketability method - benefit method - use of facilities method - special cost method, alternative single purpose expenditure method.

TOTAL: 45 PERIODS

COURSE OUTCOME

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

CO1 Understand the project identification and preparation in the footwear industry.
CO2 Understand the principles of project analysis in footwear sector.
CO3 Have knowledge in organizational aspects of implementation.
CO4 Understand finances and ownerships.
CO5 Carryout budgeting.

REFERENCES:

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

4. Price Gittinger J., “Economic Analysis of agricultural projects”, The World Bank, 1984.

CO-PO MAPPING

CO	PO					
	1	**2**	**3**	**4**	**5**	**6**
1	-	-	1	1	-	-
2	-	-	-	-	2	-
3	-	2	-	1	-	2
4	-	-	-	-	1	-
5	1	-	-	-	2	-
AVG.	1	2	1	(1+1)/2 = 1	(2+1+2)/3 = 1.6	2

1-low, 2-medium, 3-high, “-”-no correlation

Note: The average value of this course to be used for program articulation matrix.

FW3003 FOOTWEAR PERFORMANCE AND CUSTOMER SERVICES L T P C
3 0 0 3

OBJECTIVE

The objective of this course is to enable the students to

- Know about the footwear performance and customerservices
- Handle customer complaints
- Understand the various types of customer services
- Develop knowledge in the testing for assessment of footwear performance
- Understand shoe maintenance for avoidance of complaints

UNIT I FOOTWEAR PERFORMANCE 9

Definition of Footwear Performance; Customer Expectations; Comparative measurement of Performance for Footwear.

UNIT II CUSTOMER COMPLAINTS 9

Customer Complaints and its classification; Justified and unjustified complaints; Customer attitudeand international obligations.

UNIT III CUSTOMER SERVICES 9

Product Liability; Different types of customer services; Settlement of complaints; Declaration ofServices; Guarantee & Warranty.

UNIT IV IMPORTANCE OF TESTING 9

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

UNIT V AVOIDANCE OF COMPLAINTS 9

Fashion Vs. Suitability; Taking care of Footwear; Shoe care products; Defects check list & maintaining quality in production.

TOTAL :**45 PERIODS**

COURSE OUTCOME

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

CO1 Enhance external and internal customer relationships by delivering a consistent superior customer experience.

CO2 Efficiently & successfully resolve queries.

CO3 Supply relevant information & conclude every interaction on a positive note.

CO4 Test the footwear performance.

CO5 Develop a defect checklist for avoiding complaints.

REFERENCES:

1. Thornton, J.H., "Text book of footwear Manufacture", National Trade Press Book Ltd., London,1970.
2. David G. Owen., John E. Montgomery., Mary J. Davis., "Product liability and safety", cases andmaterial, Fifth Edition. 2007.

CO-PO MAPPING

CO	PO					
	1	2	3	4	5	6
1	-	-	-	-	-	-
2	-	2	-	-	-	-
3	-	-	1	-	-	-
4	-	-	2	-	2	-
5	-	-	1	3	-	-
AVG.	-	2	(1+2+1)/3 = 1.3	3	2	-

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

Note: The average value of this course to be used for program articulation matrix.

FW3004 BIOMECHANICS FOR FOOTWEAR

L	T	P	C
2	1	0	3

OBJECTIVE

To enable the students to

- Understand the anatomy and physiology of lower limb
- Gain knowledge about biomechanics concept
- Understand the kinetics and kinematics of GAIT
- Gain knowledge about how footwear influence on GAIT
- Provide knowledge and demonstration of GAIT analysis techniques

UNIT I LOWER LIMB ANATOMY **9**

Basic anatomical terms; Anatomy of bones, Ligaments, Muscles, Tendons, and Joints. Neuromuscular anatomy; Joints of pelvis and lower limb; Anatomy of foot;

UNIT II BIOMECHANICS CONCEPT **9**

Basic biomechanical terms and laws; Planes and axes of motion; Kinematics of linear and angular motion; Kinetics of linear and angular motion; Muscle and joint kinematics and kinetics; Ground reaction force.

UNIT III GAIT **9**

Gait cycle; Phases of Gait; parameters of Gait; Kinetics and Kinematics of Gait; Energy consumption; Gait of Adults; Gait of Children; Normal and Pathological Gait.

UNIT IV INFLUENCE OF FOOTWEAR ON GAIT **9**

Influence of footwear on hip, knee, ankle and foot movement; Abnormal walking base; Common pathologies affecting gait and corrective measures using footwear.

UNIT V GAIT ANALYSIS TECHNIQUE **9**

Visual/observational gait analysis; 2D video analysis; 3D motion analysis; Inertial sensors; Electro goniometers; Force platforms; Wearable sensors; Pressure platforms; In-shoe plantar pressure analysis; Electromyography; Instrumented treadmill analysis; Energy expenditure analysis.

TOTAL : **45 PERIODS**

COURSE OUTCOME

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

CO1 Gain knowledge in anatomy and physiology of lower limb.
CO2 Obtain knowledge on biomechanics.
CO3 Understand principle and techniques of GAIT analysis.
CO4 Have knowledge on influence of footwear on human being.
CO5 Design customized footwear using GAIT analysis techniques.

REFERENCES:

1. Gait Analysis – An Introduction; Editor(s): Levine & Richards & Whittle, Release Date: 10 Jul 2012, Churchill Livingstone Print Book, ISBN:9780702042652, eBook ISBN:9780702051999, Pages: 192, Dimensions: 246 X 189
2. Basic biomechanics. Susan. J.Hall. Sixth edition 2011, McGraw-Hill Humanities/Social Sciences/Languages; ISBN-10: 0073376442 ISBN-13: 978-0073376448
3. Fundamentals of Biomechanics, Duane knudson. Springer; Second edition (2007) ISBN10: 0387493115ISBN-13: 978-0387493114
4. Kinesiology — The mechanics and patho mechanics of human movement. Carol A. Oatis. Edition 2, Lippincott Williams & Wilkins, 2009 ISBN 0781774225, 9780781774222
5. Gait Analysis – Normal and pathological function. Jacquelinperpy& Judith M.Burnfield. SLACK Incorporated; 2nd Revised edition (15 March 2010) ISBN-10: 1556427662, ISBN-13: 9781556427664,
6. Clinical Gait analysis — Theory and Practice. Chris Kirtley, Churchill Livingstone; 1 edition 2005; ISBN-10: 0443100098, ISBN-13: 978-0443100093.
7. Chaurasia, B.D., "Human Anatomy: Regional and Human Osteology", CBS, New Delhi. 2004

CO-PO MAPPING

CO	PO					
	1	**2**	**3**	**4**	**5**	**6**
1	1	-	1	-	-	-
2	1	1	1	-	-	-
3	1	-	1	3	-	-
4	-	-	1	-	-	-
5	1	-	2	-	3	-
AVG.	(1+1+1+1)/4 = 1	1	(1+1+1+1+2) /5 = 1.2	3	3	-

1-low, 2-medium, 3-high, "-"-no correlation
Note: The average value of this course to be used for program articulation matrix.

FW3005 **HUMAN FACTORS IN ENGINEERING** **L T P C**
3 0 0 3

OBJECTIVE

To enable the students to

- Understand the ergonomics and anatomy of an employee in an industry
- Study the work procedure and understanding the human behaviour
- Learn about the applications of ergonomic principles and physiology of workers
- Know the concepts of man-machine relationship and manual handling tasks
- Understand the human skill, control and virtual environments

UNIT I ERGONOMICS AND ANATOMY 9

Introduction to ergonomics: The focus of ergonomics, ergonomics and its areas of application in the work system, a brief history of ergonomics, attempts to humanize work, modern ergonomics, future directions for ergonomics, Anatomy, Posture and Body Mechanics: Some basic body mechanics, anatomy of the spine and pelvis related to posture, posture stability and posture adaptation, low back pain, risk factors for musculoskeletal disorders in the workplace, behavioural aspects of posture, effectiveness and cost effectiveness, research directions

UNIT II HUMAN BEHAVIOR 9

Individual differences, Factors contributing to personality, Fitting the man to the job, Influence of difference on safety, Method of measuring characteristics, Accident Proneness. Motivation, Complexity of Motivation, Job satisfaction. Management theories of motivation, Job enrichment theory. Frustration and Conflicts, Reaction to frustration, Emotion and Frustration. Attitudes Determination of attitudes, changing attitudes Learning, Principles of Learning, Forgetting, Motivational requirements.

UNIT III ANTHROPOMETRY AND WORK DESIGN FOR STANDING AND SEAT WORKS 9

Designing for a population of users, percentile, sources of human variability, anthropometry and its uses in ergonomics, principals of applied anthropometry in ergonomics, application of anthropometry in design, design for everyone, anthropometry and personal space, effectiveness and cost effectiveness, Fundamental aspects of standing and sitting, an ergonomics approach to work station design, design for standing workers, design for seated workers, work surface design, visual display units, guidelines for design of static work, effectiveness and cost effectiveness, research directions

UNIT IV MAN - MACHINE SYSTEM AND REPETITIVE WORKS AND MANUAL HANDLING TASK 9

Applications of human factors engineering, man as a sensor, man as information processor, man as controller — Man vs Machine. Ergonomics interventions in Repetitive works, handle design, key board design- measures for preventing in work related musculoskeletal disorders (WMSDs), reduction and controlling, training Anatomy and biomechanics of manual handling, prevention of manual handling injuries in the work place, design of manual handling tasks, carrying, postural stability

UNIT V HUMAN SKILL AND PERFORMANCE AND DISPLAY, CONTROLS AND VIRTUAL ENVIRONMENTS 9

A general information-processing model of the users, cognitive system, problem solving, effectiveness. Principles for the design of visual displays- auditory displays- design of controls- combining displays and controls- virtual (synthetic) environments, research issues.

TOTAL : **45 PERIODS**

COURSE OUTCOME

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

CO1 Have the knowledge of ergonomics in work places.

CO2 Gain knowledge in human behaviour in work environment.

CO3 Know about the anthropometry and work design for standing and seat works.

CO4 Know the risk factors, guide lines for safe design of man machine systems considering human factors.

CO5 Acquire problem solving ability and provide spontaneous solution to solve the problems.

REFERENCES:

1. R.S. Bridger, Taylor and Francis, "Introduction to Ergonomics" 2nd Edition, 2003
2. Michael O'Neill, "Ergonomic design for organizational effectiveness", 1998
3. Mark S. Sanders, "The Ergonomics manual guidebook for managers, supervisors, and ergonomic team members", Dan Mc Leod, Philip Jacobs and Nancy Larson,1990

CO-PO MAPPING

CO	PO					
	1	2	3	4	5	6
1	-	-	1	-	-	-
2	-	-	-	-	-	-
3	-	-	1	-	-	-
4	-	1	-	-	-	-
5	-	-	1	3	-	3
AVG.	-	1	(1+1+1)/3 = 1	3	-	3

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

Note: The average value of this course to be used for program articulation matrix.

LE3052 INDUSTRIAL SAFETY AND OCCUPATIONAL HEALTH L T P C
3 0 0 3

OBJECTIVE

This course will make the students to

- Understand the regulations and practices associated with safety and occupational health
- Gain knowledge about the accident occurrence theories and its prevention
- Gain knowledge about productive machine safety in footwear industry
- Acquire deeper insights about fire hazards and control
- Learn about the occupational health

UNIT I SAFETY PHILOSOPHY 9

Place of industry in society Industrial management role – supervisor's role - role of workers – role of trade unions - role of govt. and various other agencies - Factory Act 1948 and the rules. Hazardous Industry - need for safety, legal humanitarian, economic safety and productivity. Factorsimpeding safety.

UNIT II ACCIDENT PREVENTION AND SAFETY TRAINING 9

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

PREVENTION – ACCIDENT INVESTIGATION

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

UNIT III SAFE GUARDING OF MACHINERY AND MATERIAL HANDLING 9

Principle of machine guarding. Ergonomics of machine guarding. Type of guards - guarding of different types of machinery. Material& construction of guards. Maintenance & repair of

guards, lifts & lifting tables, chairs, rope slings, rings, hooks, shackle, eyebolts power tracks and tractors, safety features.

UNIT IV FIRE HAZARDS AND CONTROL 9

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

UNIT V OCCUPATIONAL HEALTH 9

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

TOTAL : 45 PERIODS

COURSE OUTCOME

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

CO1 Acquire knowledge on legal framework of safety and health in India and international conventions.

CO2 Attain knowledge on hazard identification and assessment for accident prevention and safety training.

CO3 Have knowledge on productive machine safety in the footwear industry.

CO4 Gain spontaneous thinking in prevention and preparedness safety for fire hazards.

CO5 Obtain knowledge of physical hazards, chemical hazards as well as its prevention and control measures for occupational health.

REFERENCES:

1. William Handley, Industrial Safety - Hand Book, 2nd Edition, McGraw Hill Book Company, 1969.
2. H.W.Heinrich, P.E. Dan Peterson and Nester, Road Industrial Accident Prevention,McGrawHill Book Co., 1980.
3. R.P.Blake, Industrial Safety, II Edn., Prentice Hall Inc., New Jersey, 1963.
4. Frank P. Lees, Loss Prevention in the process industries, Butterworth Heinemann, 2004,Vol. 1 to 3.
5. V.C. Marshall, Major Chemical hazards, John Wiley & Sons, New York, 1987.
6. Guidelines for Chemical Process Quantitative Risk Analysis prepared for centre for Chemical Process Safety of the American Institute of Chemical Engineering, 1999.

CO-PO MAPPING

CO	PO					
	1	**2**	**3**	**4**	**5**	**6**
1	-	2	-	-	-	-
2	1	-	-	1	-	-
3	-	-	3	2	-	-
4	-	-	3	3	-	-
5	1	-	-	-	-	-
AVG.	(1+1)/2 = 1	2	(3+3)/2 = 3	(1+2+3)/3 = 2	-	-

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

Note: The average value of this course to be used for program articulation matrix.

FW3006	MARKETING MANAGEMENT	L	T	P	C
		3	0	0	3

OBJECTIVE

This course will enable the students

- To facilitate understanding of the conceptual framework of marketing and its applications indecision making under various environmental constraints
- To familiarize in creating and managing products
- To Acquire a reasonable knowledge in pricing decision
- To refine their understanding in supply chain management
- To comprehend about emerging trends in marketing

UNIT I UNDERSTANDING MARKETING AND CONSUMERS 9

Definition, Importance, Scope, Various Marketing Concepts, Marketing Mix, Marketing vs Selling, Effect of Liberalization and Globalization, Creating Customer Value. Analyzing Marketing Environment- Micro, Macro Corporate Strategic Planning: defining role marketing strategies, Marketing planning process. Marketing Information System: Concept and Components. Understanding Consumer Behaviour, Factors Influencing Consumer Buying Behaviour,Business Buying Process, Understanding Business Buyer Behaviour.

UNIT II CREATING AND MANAGING PRODUCT 9

Market Segmentation & Targeting. Differentiation & Positioning, Competitors Analysis. Product Decisions: Product Mix, Packaging and Labelling Decisions, Branding & Brand Equity, Services Marketing, New Product Development, Consumer Adoption Process, Product Life Cycle and Strategies.

UNIT III PRICING DECISIONS 9

Objectives, Factors Affecting Pricing Decisions, Pricing Methods, Price Changes, Pricing Strategies.

UNIT IV DELIVERING AND PROMOTING PRODUCT 9

Supply Chain Decisions: Nature, Types, Channel Design and Channel Management Decisions,Retailing, Wholesaling, Managing Logistics and Supply Chain. Promotion Decisions: Communication Process, Promotion Mix, Advertising, Sales Promotion,Public Relations, Direct Selling and Online Marketing. Personal Selling: Personal Selling Process, Managing the Sales Force, Designing Quota & Territories, Evaluating Performance.

UNIT V EMERGING TRENDS IN MARKETING 9

Green Marketing, Event Marketing, Network Marketing, Direct Marketing, Social Marketing, Buzz Marketing/ Viral Marketing, Consumerism, Customer Relationship Management (CRM), Customer Satisfaction, Loyalty, Retention, Global Marketing, Rural Marketing, E-Commerce: Marketing in the Digital Age

TOTAL :45 PERIODS

COURSE OUTCOME

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

CO1 Examine and discuss the key concepts and principles of marketing.
CO2 Identify and explain the main factors involved in creating and managing product.
CO3 Demonstrate an integrative understanding of the steps involved in pricing decisions.
CO4 Possess ability to promote and deliver a product.
CO5 Analyze the components of the marketing mix.

REFERENCES:

1. Kotlar, Philip, Marketing Management, Prentice Hall, New Delhi, 2006
2. Stanton, Etzel, Walker, Fundamentals of Marketing, Tata-McGraw Hill, New Delhi,1994

3. Saxena, Rajan, Marketing Management, Tata-McGraw Hill, New Delhi, 2010
4. McCarthy, E.J., Basic Marketing: A managerial approach, Irwin, New York, 1995

CO-PO MAPPING

CO	PO					
	1	2	3	4	5	6
1	-	-	-	-	1	-
2	-	1	-	1	-	1
3	-	-	3	-	1	-
4	-	-	-	-	1	-
5	2	-	-	1	-	1
AVG.	2	1	3	(1+1)/2 = 1	(1+1+1)/3 = 1	(1+1)/2 = 1

1-low, 2-medium, 3-high, "-"-no correlation
Note: The average value of this course to be used for program articulation matrix.

FW3007 MODERN FOOTWEAR STYLING L T P C
3 0 0 3

OBJECTIVE:
This course will enable the students

- To understand the historical evaluation and international trends of footwear
- To gain insights on consumer preferences and market demands with respect to footwear designs
- To analyse the market research and consumer insights to develop footwear styles
- To improve skills of presenting and communicating design concepts
- To explore the trends of fashion and forecast analysis

UNIT I HISTORICAL EVALUATION AND INTERNATIONAL TRENDS 6
Historical evaluation of footwear styling. Seasonal influences on fashion, cultural and geographicalinstances on footwear fashion. Market research and track record.

UNIT II ELEMENTS OF DESIGN AND FASHION CONSIDERATIONS 9
Elements and theories of design, Application of the basic elements of design, Ergonomics and interactive scenario of the design elements, Design Criteria through effect of shape, colour, pattern, texture and decorative materials. Life cycle of fashion

UNIT III DESIGN METHODOLOGY AND PRODUCT DEVELOPMENT 12
Brain storming method of idea generation, Understanding the consumer need and demand, Concept of space and patterns in nature, Product usage and its categories, Product mix and innovation, Design process for accessories, Types, categories and usage of footwear and leather goods. Market Strategy - Prototype Development - Field test and evaluation - Standard preparation- Second prototype - Final run. Costing

UNIT IV PRESENTATION TECHNIQUES 8
Organization of shows and preparation of art portfolios; advertising; effect of foreign languages in the presentation and promotional activities.

UNIT V FASHION TREND AND FORECAST ANALYSIS 10
Definition and entomology of fashion, trend, style and elements of trend direction, Types of trend direction review process, Development of forecast and understanding of styling, Direction of fashion trends in footwear production and marketing.

TOTAL :45 PERIODS

COURSE OUTCOME

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

CO1 Have knowledge on historical and international trends.

CO2 Analyze and evaluate the factors contributing to the fashion trends in footwear industry.

CO3 Prepare art portfolios and product development.

CO4 Have knowledge on analyzing the presentation techniques.

CO5 Aware on various insights of fashion trends and forecast analysis.

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 ofcommerce, US, 1940

CO-PO MAPPING

CO	PO					
	1	2	3	4	5	6
1	3	-	3	1	3	-
2	-	-	1	-	-	-
3	-	-	-	-	-	-
4	-	-	2	-	-	-
5	-	-	-	1	-	2
AVG.	3	-	(3+1+2)/3 = 2	(1+1)/2 = 1	3	2

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

Note: The average value of this course to be used for program articulation matrix.

FW3008 ORGANIZATION AND MANAGEMENT OF FOOTWEAR SECTOR **L T P C**

3 0 0 3

OBJECTIVE:

This course will enable the students to

- Gain knowledge on various aspects on production management
- Understand the nature of marketing strategy of a footwear industry
- Explore the unique challenges in managing human resources within the footwear industry
- Analyze the principles, practices and challenges involved in ergonomics and communication
- Explore the trade policies associated with footwear industry

UNIT I PRODUCTION MANAGEMENT **12**

Overview of Production Management in footwear industries: Planning of materials, machines required, line arrangements, packaging and production cost - Introduction to work study. Method study and work measurement, materials handling, Manpower planning lay outing equipment selection. Specified layout for footwear industries - Supply chain management - case study

UNIT II MARKETING STRATEGY **10**

Consumer psychology - factors affecting supply and demand - Market channels in the domestic market - Export Import policy. Product Development: Style creation - Prototype preparation -

Market feedback - pilotproduction - specification - Final prototype - Bill of Materials.

UNIT III PERSONNEL MANAGEMENT 10

Principles of 5S in Work area - Principles - Motivation, Daily meeting, Employee training and development - Job analysis, Recruitments. Performance Evaluation Technique, wages and salary, labour laws and factory acts in footwear industry.

UNIT IV ERGONOMICS AND COMMUNICATION 7

Basic man/machine relationship - Machine organization in industrial environment - Line setting and planning for the production flow - Recording, Storage & retrieval of information - instruction - reporting information feedback process - telephone and other communication means - memoranda.

UNIT V FOOTWEAR TRADE AND INDUSTRY IN INDIA 6

Structure and concentration of the industry, production, employment, sub-contracting systems and trade practices in different sectors of industry. Origin of industry and its growth trends. Industrial / trade policies and role of various developmental organizations. Entrepreneurship and leadership qualities –Creation of uniqueness in products - International trade in footwear in relation to leather manufactures, export procedures, incentives, duties and major importing countries and competitors.

TOTAL :45 PERIODS

COURSE OUTCOME

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

CO1 Understand the production management associated with footwear sector.
CO2 Carryout strategic marketing.
CO3 Have knowledge on personnel management.
CO4 Have knowledge on ergonomics and communication in footwear sector.
CO5 Have knowledge on Footwear trade and industry in India.

REFERENCES:

1. Boon, G.K., “Technology and employment Footwear Manufacturing”, Sijthoff and Noordhoff,Published by BRILL,1980.
2. Mehta, P., “Managerial Economics”, Sultan Chand Co., 1985.
3. Shukla, M.C., “Business Organization & Management”, Sultan Chand & Co, Published byProgoti publishers,1969.
4. Rugman, A.M. “International Business Firm Environment”, Mcgraw-Hill.,NewYork,Published byTaylor and Francis, 2002.
5. “Employment and working conditions and Competitiveness in the Leather and FootwearIndustry”, ILO, Report II, Published by international labour organization, Geneva, 1995.
6. Kanawaty,G., “Introduction to work study”,Published by International LabourOrganisation,1992.

CO-PO MAPPING

CO	PO					
	1	**2**	**3**	**4**	**5**	**6**
1	-	-	-	-	2	-
2	1	-	-	1	3	-
3	-	-	-	-	2	-
4	-	-	1	-	-	3
5	-	-	-	3	1	-
AVG.	1	-	1	(1+3)/2 = 2	(2+3+2+1)/4 = 2	3

1-low, 2-medium, 3-high, “-”-no correlation

Note: The average value of this course to be used for program articulation matrix.

FW3009	**PEDORTHIC FOOTWEAR**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

OBJECTIVE:

To enable the students

- To understand the basic pedorthic interventions
- To address foot-related problems and conditions by analysing the gait parameters
- To present the complications associated with foot and lifestyle diseases
- To focus on the specialized field of pedorthic, which involves the assessment, design, fitting and modification of therapeutic footwear
- To learn how to integrate orthotics into pedorthic footwear for addressing biomechanical imbalances and provide corrective footwear fabrication technology

UNIT I INTRODUCTION **5**

Pedorthics – Role of Pedorthist – Pedorthic evaluation – Patient management - implementation and Practice management.

UNIT II FOOT DEFORMITIES **10**

Descriptive knowledge on High arches; Flat foot; Foot pronation and supination; Forefoot varus; Calluses; Plantar fascitis; Metatarsalgia; Mortons neuroma; Hallux valgus; Hallux rigidus; Hammer toe; Claw toes; Heel spur; Frequent ankle sprains.

UNIT III FOOT COMPLICATIONS AND LIFESTYLE DISEASES **10**

Enumeration of Lifestyle diseases such as Diabetes, Arthritis, Obesity etc; Foot related complications; Risk levels of the foot.

UNIT IV THERAPEUTIC FOOTWEAR AND FOOT ORTHOSES **7**

Principles of therapeutic footwear and Bio-mechanical principles in design and development of footwear; Orthoses; Raw materials; Kind of foot orthoses; Fabrication techniques and Finishing; Clinical management.

UNIT V CORRECTIVE FOOTWEAR FABRICATION TECHNOLOGY **13**

Foot Anthropometry; Customized last; Overview of Footwear modifications; Outsole modifications; Insole modifications; Heel modifications; Heel and Sole wedges; Upper modifications; Selection of design and materials; Customization of fit parameters; Footwear alterations including rebuilding, relasting; Shoe repair and shoe refurbishing.

TOTAL : 45 PERIODS

COURSE OUTCOME

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

CO1 Have basic knowledge on pedorthics and its applications.
CO2 Identify the foot deformities.
CO3 Have clear view of various foot complications and lifestyle diseases.
CO4 Understand the concept of gait/bio-mechanics for therapeutic footwear.
CO5 Fabricate corrective footwear.

REFERENCES:

1. D.J.Morton, The Human Foot, Hafner Publishing Co, New York, London, 1964.
2. C A Edwards, Orthopaedic shoe Technology, Precision Printing Co., Indiana,1981
3. Micheal W Whittle, “Gait Analysis: An introduction,” Butter wolrth- Heinemann Publication.
4. J.H. Thornton, Text book of Footwear Manufacture-National trade Press Ltd, London,1970.

CO-PO MAPPING

CO	PO					
	1	**2**	**3**	**4**	**5**	**6**
1	-	1	1	-	-	-
2	-	-	2	1	-	-
3	1	-	-	-	-	2
4	1	-	3	-	-	-
5	1	-	2	-	3	-
AVG.	(1+1+1)/3 = 1	1	(1+2+3+2)/4 = 2	1	3	2

1-low, 2-medium, 3-high, "-"-no correlation
Note: The average value of this course to be used for program articulation matrix.

FW3010 PRODUCTION OPERATIONS MANAGEMENT L T P C
3 0 0 3

OBJECTIVE:

- To enable the students to learn the modelling and operations in production management
- To provide students with comprehensive understanding of process flow structure
- To enable the students to learn the alignment of production, planning and control of the production management
- To enable the students to learn about the principles and techniques of quality management
- To enable the students to engage into different productivity techniques and its applications

UNIT I MODELLING AND OPERATIONS 7

Transformation process model: Inputs, process and outputs; Classification of operations; Responsibilities of Operations Manager; New Product Development, Selection and Design of Product / Services.

UNIT II PROCESS FLOW STRUCTURE 8

Process types in manufacturing: project, jobbing, batch, line, mass, continuous; Process types in services: professional services, services shops, mass services; Plant location; Layout planning.

UNIT III PRODUCTION, PLANNING AND CONTROL 10

Production Planning & Control: Production planning techniques for various process choices, techniques of production control, aggregate planning techniques,

UNIT IV QUALITY MANAGEMENT 10

Quality management: Introduction; Meaning; Quality characteristics of goods and services; Tools and techniques for quality improvement: check sheet, histogram, scatter diagram, cause and effect diagram, Pareto chart, process diagram, statistical process control chart; Quality assurance; Total quality management (TQM) model; Service quality, concept of Six Sigma and its application.

UNIT V PRODUCTIVITY IMPROVEMENT TECHNIQUES 10

Productivity Improvement Techniques: Work study; Method study; Work measurement: time study: stop watch time study; Work sampling.Maintenance: maintenance policies for facilities and equipment; Time of failure; Preventive versus breakdown maintenance; Procedure for maintenance, total productive maintenance (TPM)

TOTAL :45 PERIODS

COURSE OUTCOME

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

CO1 Understand the concepts involved in modelling and create new product

CO2 Understand the importance of process flow structure and able to apply mathematical forecasting techniques

CO3 Have knowledge in analyzing the production strategies for footwear industries

CO4 Apply techniques to measure quality control

CO5 Evaluate different productivity techniques for the production.

REFERENCES:

1. Adam Jr Everetl E. R J — Production and Operations Management (Prentice-Hall, 1992),2000 5th ed.
2. Chary- Production and Operations Management (Tata McGraw-Hill, 2006 3rd edition)
3. Hill T- Operations Management (Palgrave McMillan, 2006, 2nd Edition)
4. Johnston R et al – Cases in Operations Management (Prentice Hall, 2002, 3rd edition)
5. McGregor D — Operations Management (McGraw-Hill, 1960) Morton- Production andOperations Management (Vikas)
6. Haleem A- Production and Operations Management (Galgotia books, 2005)
7. Shanker Ravi- Industrial Engineering (Galgotia Publications, 2000)
8. Chase - Production and operation Management, Irwin Professional Publishing, 1995, 6thedition.
9. Kanishka Bedi - Production & Operations Management. (Oxford University Press, 3rd edition,2013)

CO-PO MAPPING

CO	PO					
	1	**2**	**3**	**4**	**5**	**6**
1	-	1	-	-	-	1
2	-	-	2	-	-	-
3	-	-	2	3	-	-
4	-	-	-	-	3	-
5	-	-	-	-	-	-
AVG.	-	1	(2+2)/2 = 2	3	3	1

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

Note: The average value of this course to be used for program articulation matrix.

FW3011 QUALITY CONTROL MANAGEMENT IN FOOTWEAR INDUSTRIES **L T P C**

3 0 0 3

OBJECTIVE:

To enable the students to learn about

- The concepts of quality control
- The principles and techniques of quality improvement for the footwear industry
- The importance of quality control and its standardization
- The quality assurance system through different standards
- The accreditation and certification bodies

UNIT I 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.

UNIT II QUALITY IMPROVEMENT 9

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

UNIT III STANDARDIZATION 9

Historical development of standards, aims techniques, management, formulations, implementation of international and national standards – economic benefits.

UNIT IV QUALITY ASSURANCE SYSTEM 9

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

UNIT V ACCREDITATION AND CERTIFICATION BODIES 9

Relevant standards, internal and external audit, corrective action, remedies.

TOTAL : 45 PERIODS

COURSE OUTCOME

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

CO1 Understand the requirement of different quality control theory and its concepts

CO2 Apply structured problem-solving statistical techniques and tools to improve quality in theleather sector

CO3 Analyze different quality control techniques and knowledge of its applications

CO4 Have knowledge on ISO-9000 and 14000 and other standards

CO5 Aware of various accreditation and certification bodies

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.

CO-PO MAPPING

CO	PO					
	1	2	3	4	5	6
1	-	-	-	1	-	-
2	-	-	3	1	-	-
3	-	-	-	-	-	-
4	-	1	3	-	2	-
5	-	-	-	-	-	1
AVG.	-	1	(3+3)/2 = 3	(1+1)/2 = 1	2	1

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

Note: The average value of this course to be used for program articulation matrix.

LE3053 SELF- MANAGEMENT AND ENTREPRENEURSHIP L T P C
3 0 0 3

OBJECTIVE:

To enable the students to understand about

- The need for self-management and other management competencies for a successful entrepreneurship
- The business development and entrepreneurial skills necessary for success in self-management
- The financial management and documentation
- The basic time management concepts to assessing health of business
- The marketing aspects of footwear products

UNIT I SELF-MANAGEMENT 12

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

UNIT II BUSINESS DEVELOPMENT 9

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

UNIT III FINANCE MANAGEMENT 9

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

UNIT IV TIME MANAGEMENT 6

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

UNIT V MARKETING MANAGEMENT 9

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

TOTAL : **45 PERIODS**

COURSE OUTCOME

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

CO1 Understand the concept of self-management
CO2 Recognize the various roles of managers and types of business management
CO3 Understand the basic finance management concepts
CO4 Identify the fundamentals of managing the time and finance
CO5 Evaluate and formulate suitable marketing management for the footwear products

REFERENCES:

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

CO-PO MAPPING

CO	PO					
	1	**2**	**3**	**4**	**5**	**6**
1	1	-	-	-	-	3
2	-	-	1	-	3	2
3	-	2	-	-	2	-
4	-	-	-	-	1	1
5	-	-	-	-	2	-
AVG.	1	2	1	-	(3+2+1+2)/4 = 2	(3+2+1)/3 = 2

1-low, 2-medium, 3-high, "-"-no correlation
Note: The average value of this course to be used for program articulation matrix.

FW3012 ATHLEISURE

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

OBJECTIVE:
To enable the students to learn about

- athleisure
- consumer preferences in the athleisure
- fundamentals of athleisure shoe design and functionality
- Materials and Manufacturing Techniques for Athleisure
- Testing methods to ensure product quality and performance

UNIT I HISTORY OF ATHLEISURE 9

Origin and Evolution of Athleisure products – Characteristics of Athleisure - Athleisure in 21st century and impact - Global scenario of the athleisure products - Rise of athleisure products and its impact on the product manufacturing industry.

UNIT II CONSUMER PSYCHOLOGY AND PREFERENCES 9

Factors influencing consumer choice in athleisure products - Impact on the lifestyle and adaptation - Role of customer reviews in shaping product development - Colour, texture and finishes associated with Athleisure products - Social, Environmental impact of new trend on athleisure products.

UNIT III DESIGN ELEMENTS OF ATHLEISURE 9

Functionality vs. aesthetics - Style trends for different demographics and activities (Example: yoga, casual wear and others) - Performance-oriented features for fitness and leisure activities - Importance of ergonomic design on athleisure products.

UNIT IV MATERIAL AND TECHNOLOGY 9

Selection of materials for Athleisure products - Material selection and their role in product fabrication - Technical wear based on the material selection - Lightweight materials for enhanced comfort - Intervention of recycle materials in product development. Natural materials in product development.

UNIT V FABRICATION PROCESS AND TESTING 9

Forecast for Product Design and Development - Methodology for prototype development - Fit trial and analysis - Techniques and machinery - Quality control and assurance - Process failure

mode and effect analysis (PFMEA) for the process involved in development. Standards and Test methods for athleisure products.

TOTAL :45 PERIODS

COURSE OUTCOME

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

CO1 Know about the evolution and history of athleisure products.
CO2 Understand the consumer behaviour and need.
CO3 Understand the design elements of athleisure.
CO4 Evaluate the materials suitable for athleisure products.
CO5 Fabricate athleisure shoes.

REFERENCES:

1. Materials and Technology for Sportswear and Performance Apparel, Steven George Hayes, Praburaj Venkatraman, CRC Press; 2017
2. Textiles for Sportswear, Woodhead Publishing, 2015
3. Functional Clothing Design, From Sportswear to Spacesuits, Susan Watkins, Lucy Dunne, Bloomsbury Publishing, 2017
4. "Athleisure: A Comprehensive Guide to Activewear and Athleisure Apparel" by Kathleen Fasanella.

CO-PO MAPPING

CO	PO					
	1	2	3	4	5	6
1	-	-	-	-	-	-
2	-	-	-	-	3	2
3	-	-	-	-	-	-
4	-	-	2	-	1	1
5	-	-	-	1	2	-
AVG.	-	-	2	1	(3+1+2)/3 = 2	(2+1)/3 = 2

1-low, 2-medium, 3-high, "-"-no correlation
Note: The average value of this course to be used for program articulation matrix.

FW3013 MOULDED FOOTWEAR

L	T	P	C
3	0	0	3

OBJECTIVE:

- To provide an overview of Different types of moulded Footwear
- To enlighten the students about the different Materials used for making Moulded footwear
- To give insight into the types of construction & Techniques for making
- To inculcate knowledge about the basic concepts of mould designing
- To enable the students to have exposure to Testing methods & standards for Moulded footwear.

UNIT I BASICS OF MOULDED FOOTWEAR **9**

Moulded footwear and their importance, Types of Moulded footwear, Various moulded components used in footwear manufacturing, **Stress and Strain:** Elementary definition of stress and strain, stress- strain relationship, elastic, plastic and Visco-elastic behavior of common materials in tension and compression test, stress-strain curves, Hooke's law, Poisson's ratio, Tension, compression, shearing stress and strain, thermal stresses.

UNIT II MATERIALS CHARACTERISTICS 9

Introduction to Thermoplastic Elastomers (TPE), Classification of Thermoplastic Elastomers, Basic structure, Manufacture, Morphology, Commercial grades and Applications for PVC, PU, EVA and Rubber blends **-** Fillers, Antioxidants, Thermal Stabilizers, Lubricants, Plasticizers, Toughening-agents, Colourants, Fire retardants, coupling agents, blowing agents, Ultraviolet stabilizer, Antistatic agents, Anti blocking agents, Slip and antislip agents, processing aids, mould releasing agents.

UNIT III CONSTRUCTION & TECHNIQUES USED 9

Principles and methodology of Moulded footwear, finishing and machinery, Product Design, Injection Moulding, Blow Moulding, Extrusion Die Design, Compression Moulding, Transfer Moulding, Secondary Process/Post mouding/Joining & assembling, Rotational Moulding/Surface treatment/Metallization.

UNIT IV MOULD MAKING 9

Basic concept of mould designing, Materials used for dies and moulds and their characteristics - Mould clamping – direct, indirect, Parting surface – Types of parting surface, selection of parting surface, Feed system - Runners – Sprue, Ejection system - Cooling system, Types of Moulds, Mould assembly-check list for mould assembly-fitting .

UNIT V PLANT LAYOUT, QUALITY, TESTING & STANDARDS 9

Plant Layout: Types of plant layout-production, process layout, **Quality:** Definition of quality and quality control, important terminology used in quality control, quality function, quality planning, and improvement, parameters for fitness for use, Zero defects, **Testing & Standards:** International Standards, national standards, Method of sampling & conditioning Test methods for whole footwear.

TOTAL : **45 PERIODS**

COURSE OUTCOME

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

CO1 Understand the basic concepts of moulded footwear.
CO2 Understand the characteristics of materials used for moulded footwear.
CO3 Impart knowledge on construction and techniques practised for footwear making.
CO4 Know the process of mould making.
CO5 Design a layout for the production & to provide knowledge for testings & standards of moulded footwear.

REFERENCES:

1. Jiri George Drobny, “Handbook of Thermoplastic Elastomers Book”.
2. G. Holden, “Understanding Thermoplastic Elastomers”.
3. Stoeckhert & Menning, “Mold making handbook”, 2nd edition, Carl Hanser Verlag GmbH & Company KG, 2013.
4. George Menges& Paul Mohren, “How to Make Injection Molds”, Hanser Publishers,2001
5. Murphy; John, “Additives for Plastics Handbook”, 2nd edition, Elsevier Advanced Technology, Oxford, 2001.
6. Venkatappaiah B. -Introduction to the Modern Footwear Technology
7. Thomton, J.H., “Text book of footwear Manufacture”, National Trade Press Book Ltd., London, 1970.
8. Miller R.G., “Manual of Shoe Making”, Clarks Ltd., London, 1978.
9. Comprehensive Footwear Technology by S.N.Ganguly
10. Juran J.M, Gryna F.M - *Juran’s Quality Control Hand Book.* McGraw-Hill Book Company.

11. UNIDO, Acceptable Quality standards in the Leather and Footwear Industry.
12. Sinha.B.P. “Mechanical Estimating and Costing”, Tata McGraw-Hill, Publishing Co.,1995.
13. Crawford, R.J & Throne, J.L., “Basic Principle of rotational molding”.
14. Rauwedaal, Chris, “Polymer Extrusion”, 2014.

CO-PO MAPPING

CO	PO					
	1	2	3	4	5	6
1	-	-	-	-	-	-
2	-	-	3	-	-	-
3	-	-	2	-	1	-
4	-	-	1	1	1	-
5	-	-	1	1	2	2
AVG.	-	-	(3+2+1+1)/4 = 1.8	(1+1)/2 = 1	(1+1+2)/3 = 1.3	2

1-low, 2-medium, 3-high, “-”-no correlation
Note: The average value of this course to be used for program articulation matrix.

FW3014 OPEN FOOTWEAR

L	T	P	C
3	0	0	3

OBJECTIVE:
The objective of this course is

- To impart complete understanding and the complications associated with open footwear fabrication techniques
- To inculcate the knowledge about elemental design and fashion consideration
- To provide knowledge about the materials used for open footwear
- To enable the students to understand the different types of construction practiced in open footwear
- To provide knowledge on quality and testing for open footwear

UNIT I TYPES OF OPEN FOOTWEAR 9

Making of open footwear (Chappal & Sandals) of various style reflecting Men’s/Women’s & Children, Preparation of Production Guide for each design. Preparation of Sequence of Operation (SOP) for making the various aforesaid Open type Footwear, Therapeutic and orthopedic Footwear.

UNIT II ELEMENTS OF DESIGN AND FASHION CONSIDERATIONS 9

Elements and theories of design, Application of the basic elements of design, Ergonomics and interactive scenario of the design elements, Design Criteria through effect of shape, colour, pattern, texture and decorative materials. Life cycle of fashion. Brain storming method of idea generation, Understanding the consumer need and demand.

UNIT III MATERIALS FOR OPEN FOOTWEAR 9

Upper materials – Leather & Non Leathers, Soling materials, Reinforcement, Lining, Abrasives & Grinderies, Trims for Decorative, Heels. Material Costing Procedure for open footwear, allowances for open footwear, components and effects on these allowances of material used, materials conditioning during manufacture, constructional details, shape and

size of individual components. The incorporation of material cost factors in open footwear fabrication.

UNIT IV DIFFERENT CONSTRUCTIONS 9

Cutting operation, Pre- closing & Closing operations, Principals of Lasting and various bottoming operations. Different types of construction and its principles, Strobel, Cemented, Stitchdown, and Direct Injection moulding Constructions.

UNIT V QUALITY AND TESTING FOR OPEN FOOTWEAR 9

Quality: Quality Definition, Quality parameters in Process, Policy of Zero defects, Final Product Quality.

Testing's: Methods of sampling, testing procedure for upper materials, Soles and other components, Testing Standards.

TOTAL :45 PERIODS

COURSE OUTCOME

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

CO1 Understand about different types of open footwear.
CO2 Understand the design and fashion trends for open footwear.
CO3 Understand about different materials used for processing open footwear.
CO4 Analyse, evaluate and construct open footwear.
CO5 Have knowledge on different standards required for evaluating the quality of open footwear.

REFERENCES:

1. Shoe designing Manual-Leather Technology Mission-CLRI
2. Thomton, J.H., "Text book of footwear Manufacture", National Trade Press Book Ltd.,
3. Miller R.G., "Manual of Shoe Making", Clarks Ltd., London, 1978.
4. Comprehensive Footwear Technology by S.N.Ganguly
5. Juran J.M, Gryna F.M - Juran's Quality Control Hand Book. McGraw-Hill Book Company.
6. UNIDO, Acceptable Quality standards in the Leather and Footwear Industry.

CO-PO MAPPING

CO	PO					
	1	2	3	4	5	6
1	-	-	-	-	-	2
2	-	-	1	-	2	-
3	-	-	2	3	-	-
4	-	-	3	-	-	-
5	-	-	1	-	2	-
AVG.	-	-	(1+2+3+1)/4 = 1.8	3	(2+2)/2 = 2	2

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

Note: The average value of this course to be used for program articulation matrix.

FW3015 STANDARDS FOR FOOTWEAR

L	T	P	C
3	0	0	3

OBJECTIVE:

- To provide knowledge on the overall need to follow an internationally recognized standard for testing both for footwear products as a whole and for their components
- This course will give an orientation for non-leather/footwear entrants in order to inculcate the need for standards and specifications and the link they have with quality management systems
- To enlighten the students about the Indian standards and specification for footwear
- To provide knowledge on safety, protective and occupational footwear
- To inculcate in chemical testing standard for footwear

UNIT I CURRENT ORGANIZATION OF FOOTWEAR TESTING ACTIVITIES 7

Defining self-management - Writing a mission statement - Self-discipline - Self-evaluation - Self- analysis by personal SWOT; Planning & Goal setting; Developing a career plan Difference between standards and specifications – Different types of international standards – ISO-IULTCS-ASTM-AATCC-BS-EN-Other institutional standards - The role of ISO and IULTCS in Footwear industry. CEN-ISO-PPE-CE – Marking and Certifications – International Footwear Regulations – Introduction to ISO 17025.

UNIT II INTERNATIONAL STANDARDS FOR FOOTWEAR 10

ISO/TC 216 & 94 - ISO standards for Safety Footwear-EN ISO 20344-5-6-7 – ISO standards for Casual footwear and footwear components -ASTM-ISO-Other Institutional standards – Need for standards for footwear conditioning before and during testing.

UNIT III INDIAN STANDARDS AND SPECIFICATIONS FOR FOOTWEAR 12

Standards for footwear made from Leather and other materials – Footwear made from all-rubber and all-polymeric materials – Footwear as Personal protective equipment – CHD 17 &

19. Industrial and protective rubber knee and ankle boots-Moulded solid rubber soles and heels-Rubber microcellular sheets for soles and heels-Rubber Hawai Chappal-PVC Industrial Boots-Moulded rubber boots-Moulded plastics footwear-Footwear for municipal scavenging work-Leather safety boots and shoes-for Miners and Heavy metal industries-Sports footwear-Antiriot shoes-Derby shoes-All rubber gum boots and ankle boots-occupational purposes-Other MCR, PVC footwears and components.

UNIT IV PERSONAL PROTECTIVE FOOTWEAR – INDIAN STANDARDS 8

IS 15298 (Part 2, 3, 4) – Safety footwear-Protective footwear-Occupational Footwear – Basic and Additional requirements - Tests for strength, comfort, durability, resistance to different surfaces, breathability, ergonomics, thermal rating and special protection.

UNIT V CHEMICAL TESTING STANDARD FOR FOOTWEAR 8

ISO Standard – Footwear - Critical substances potentially present in footwear and footwear Components - Lists of critical chemical substances. Indian standard-Chemical Requirements for Footwear and Footwear Materials.

TOTAL: 45 PERIODS

COURSE OUTCOME

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

CO1 Understand the significance of internationally recognized standards.

CO2 Build capability towards establishment of a new quality testing facility based on the testing standards.

CO3 Develop new standards and specifications based on the ever-changing market requirement.

CO4 Evaluate the standard operating protocol and the outcome in the form of test reports and results. This course will provide him that knowledge as to why SOP is necessary.

CO5 Have knowledge on chemical testing standard for footwear.

REFERENCES:

1. Harvey, A.J., “Footwear Materials and Process Technology”, LASRA Publications, New Zealand, 1982
2. Thornton, J.H., “Text book of footwear Manufacture”, National Trade Press Book Ltd., London, 1970.
3. Skoggard, I.A., “Modern Shoe Making– Lasting”, SATRA Publication, Sharpe,1996
4. BIS Standards
5. WWW.ISO.ORG
6. WWW.IULTCS.ORG

CO-PO MAPPING

CO	PO					
	1	**2**	**3**	**4**	**5**	**6**
1	-	2	-	2	1	-
2	-	-	1	1	3	-
3	3	-	-	-	-	-
4	-	-	-	-	1	-
5	2	-	3	-	-	-
AVG.	(3+2)/2 = 2.5	2	(1+3)/2 = 2	(2+1)/2 = 1.5	(1+3+1)/3 = 1.6	-

1-low, 2-medium, 3-high, “-”-no correlation

Note: The average value of this course to be used for program articulation matrix.

FW3016 INDUSTRIAL ENGINEERING IN FOOTWEAR INDUSTRY L T P C

3 0 0 3

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 9

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 Publn., 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. Singiresu S.Rao, “Engineering optimization – Theory and practices”, John Wiley and Sons, 1998.
6. Khabal Taraman, ‘CAD/CAM integrates and innovation’, Computer and Automated systems association of SME, 2001.

CO-PO MAPPING

CO	PO					
	1	2	3	4	5	6
1	-	3	1	-	-	-
2	-	-	1	3	-	-
3	-	-	-	2	-	-
4	-	-	-	-	2	-
5	-	-	-	1	-	-
AVG.	-	3	(1+1)/2 = 1	(3+2+1)/3 = 2	2	-

1-low, 2-medium, 3-high, “-”-no correlation

Note: The average value of this course to be used for program articulation matrix.

FW3017 SUSTAINABLE FOOTWEAR INDUSTRY L T P C
3 0 0 3

OBJECTIVE:

To render insights to the students about

- Sustainability and development goals
- Modern advancements and technology for sustaining footwear industry
- Sustainable development and economics in footwear industry
- Sustainable development as a corporation, as an industry, as an individual
- Branding in terms of sustainability

UNIT I INTRODUCTION TO SUSTAINABILITY AND GOALS 7

Sustainability - sustainable development goals (SDGS) - natural resources management- ecological systems - waste / water / energy – Biodiversity - climate change - carbon footprint - alternative futures - Corporate Social Responsibility - accountability and ethics - health and well-being.

UNIT II TRANSFORMING EXISITING FOOTWEAR INDUSTRY TO SUSTAINABILITY 11

Sustainable Development Plans for footwear industry- application of innovative - modern thinking and technologies - Energy efficiency, waste reduction, and water conservation in footwear factories - Lifecycle assessment and carbon footprint analysis for footwear products and best practices - mobilizing financing - public-private partnerships - consumerism and trade - international development - sustainable communities - sustainability in the built environment - travel, transport and mobility.

Sustainable Shoe Materials, Certifications, and Standards: Introduction to materials - leather - synthetic upper materials - bio-based upper materials - sole materials – certification.

UNIT III FOOTWEAR INDUSTRY AND ECONOMICS OF SUSTAINABILITY 9

Fundamental elements of microeconomic and macroeconomic – economics, social, and ecological interdependence of footwear industry - economic development - creating opportunities for the people - skilled laborers and sustainability - training session - employment opportunities and economic development - globalization of economy - policy and economic implications.

UNIT IV SUSTAINABLE SHOE ENDINGS 9

Recycling, Waste Management & Circularity: Footwear Waste - Mapping and Tracking Waste Streams - sole of the recycled footwear - discarded cork - insole - upper part - understanding mechanical recycling - understanding chemical recycling - understanding biodegradation and composting - organize and finance a take back system.

Sustainable Shoe Design, Construction, and Production: Designing the lifecycle - resourceful design - digital design and development - design for recycling - design for durability - production on demand - local manufacturing.

UNIT V FOOTWEAR SUSTAINABILITY AND BRANDS 9

Environmental impact- brands and sustainability - decrease in animal exploitation - reduction in the usage of water - lower production costs - raw materials – making process - demand for recycled footwear - working on high-demand products - brand and revenue - creating a reputation - Trends and future directions in the sustainable footwear industry.

TOTAL : 45 PERIODS

COURSE OUTCOME

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

CO1 Define basics about sustainability and goals.

CO2 Understand the different sustainability and relevant technology.

CO3 Analyze the economics of footwear industry and opportunity to achieve sustainability.
CO4 Evaluate the footwear waste recycling and waste management.
CO5 Create a direction for sustainable footwear industry.

REFERENCES:

1. School Environment and Sustainable Development Goals Beyond 2030: Fourth Edition, by Princewill I Egwuasi Ph D, Jake M Laguador Ph D, Emad K Hussein Ph D, Published by Author House.
2. Sustainable Development Goals: An Indian Perspective (Sustainable Development Goals Series), Edited by Anindya Bhukta, Somnath Hazra, Publisher: Springer Nature Switzerland AG; 1st ed. 2020 edition.
3. Sustainability Science for Social, Economic, and Environmental Development (Practice, Progress, and Proficiency in Sustainability), by Nilanjan Ghosh, Anandajit Goswami, Published by: Idea Group, U.S.; 1st edition.
4. Leather and Footwear Sustainability, Manufacturing, Supply Chain, and Product Level Issues, Editors: Subramanian Senthilkannan Muthu, PublisherSpringer Singapore.

CO-PO MAPPING

CO	PO					
	1	**2**	**3**	**4**	**5**	**6**
1	1	-	-	-	-	-
2	-	-	2	-	-	-
3	-	-	-	-	3	-
4	-	-	1	-	3	3
5	1	2	-	-	-	-
AVG.	(1+1)/2 = 1	2	(2+1)/2 = 1.5	-	(3+3)/2 = 3	3

1-low, 2-medium, 3-high, "-"-no correlation
Note: The average value of this course to be used for program articulation matrix.

FW3018 POLYMER PROCESSING AND RHEOLOGY

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

OBJECTIVE:

- To give an overview of injection moulding and processing techniques
- To enable the students to understand the principle of extrusion and different polymers
- To provide understanding of different techniques in moulding
- To render exposure to compounding of rubber and its process
- To provide understanding of deformation and flow behaviour of polymers

UNIT I INJECTION MOULDING **7**

Introduction to polymer processing – Plastics process techniques– Injection moulding– Principles–Types of injection unit– Classification of screw – Classification and functions of moulds – Clamping unit – Trouble shooting operations – Non conventional injection moulding – Microinjection moulding – Co-injection moulding – Reaction injection moulding (RIM) of Polyurethane (PU) – Insole – Reinforced reaction injection moulding (RRIM) – PU – Footwear Components – Sole and Heel Units.

UNIT II EXTRUSION 7

Extrusion – Principle – Types of extruders – Single screw and twin-screw – Counter and co-rotating – Thermoplastics: PVC, EVA, and Polystyrene. Biodegradable Polymers – PLA, Polyester, PHA/PHB mixing with other footwear additives – Role of breaker plate – Screen pack – Types of extrusion dyes – Extrusion of Filaments, Profiles, Cables, Blown Films and Sheets and wire coating – Trouble shooting operations.

UNIT III OTHER MOULDING TECHNIQUES 7

Compression moulding – Transfer moulding – Blow moulding – Filament winding, SMC, BMC, DMC, pultrusion, calendaring, rotational moulding, thermoforming, powder coating, rubber processing in two-roll mill (open mill) dispersive and distributive mixing – milling operations – Microcellular rubber (MCR) – internal batch mixers and continuous mixers – master batching forming operations.

UNIT IV RUBBER COMPOUNDING AND PROCESSING 12

Compounding Ingredients – Processing aids – Fillers – Mastication and principles of mixing – Reclaimed rubber – Coating process – Viscoelasticity – Creep and stress relaxations – rate of deformation – Control of rheological characteristics through compounding, rubber curing in parallel plate viscometer, ODR, and MDR – Mooney Viscometer. Rubber – vulcanization – conventional – semi-EV and EV systems. Rubber curing of synthetic rubbers in industrial footwear.

UNIT V RHEOLOGY OF POLYMERS, POLYMER BLENDS AND ALLOYS 12

Introduction – Polymers and importance of rheology – Rheology of Miscible and Immiscible blends – Applications – Footwear – Toe puff – Outsole. Newtonian and non – Newtonian fluids – Viscosity, steady shear, and dynamic shear rheology, storage modulus and loss modulus rheology – Measurements of rheological parameters by capillary rotating, parallel plate, cone-plate rheometer – Dynamic Mechanical analyser – Mechanical models.

TOTAL : 45 PERIODS

COURSE OUTCOME

Upon completion of the course student will be able to:

CO1 Identify the techniques of injection moulding techniques for footwear components.
CO2 Explore extrusion process in various footwear components and product.
CO3 Understand the different moulding techniques for footwear components.
CO4 Evaluate the behaviour of rubber compounding and processing.
CO5 Attain knowledge in rheology of polymers, polymer blends and alloys.

REFERENCES:

1. Manas Chanda and Salil K Roy; Plastics Technology Handbook (4th ed.) CRC Press; Taylor and Francis Group; 2007.
2. Montgomery T. Shaw; Introduction to Polymer Rheology, Pub: A John Wiley and Sons. Inc., 2012.
3. Arthur N. Wilkinson and Anthony J. Ryan; Polymer Processing and Structure Development; Kluwer Academic Publishers, London; 1999.
4. L. A. Utracki, Polymer Blends Hand Book; Kluwer Academic Publishers, UK; 2002.
5. A. K. Bhowmick, M. M. Hall and H. A. Benany; Rubber Products Manufacturing Technology; Marcel Dekker Inc; New York; 1994.
6. Somenath Ganguly; Comprehensive Footwear Technology (First ed); ILTA, Kolkata Publication
7. Malkin, Alexander Y., and Avraam I. Isayev; Rheology: concepts, methods, and applications. Elsevier; 2022.

CO-PO MAPPING

CO	PO					
	1	**2**	**3**	**4**	**5**	**6**
1	-	-	2	-	-	-
2	1	-	-	3	1	-
3	-	-	2	-	-	2
4	2	-	-	-	-	-
5	1	1	1	-	-	-
AVG.	(1+2+1)/3 = 1.3	1	(2+2+1)/3 = 1.6	3	1	2

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

Note: The average value of this course to be used for program articulation matrix.