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):

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<td>I.</td>
<td>To build an expertise base capsule of delivering technology-based solution to global footwear sectors.</td>
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<td>II.</td>
<td>To foster development of advanced human capacity to provide solution in footwear science and engineering.</td>
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<td>III.</td>
<td>To equip learners with relevant knowledge and expertise system for professional consultation.</td>
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<td>IV.</td>
<td>To enable learners in the areas of pedagogy and advanced research.</td>
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<td>V.</td>
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2. PROGRAMME OUTCOMES (POs):

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<tr>
<td>1.</td>
<td>Ability to independently carry out research/investigation and development work to solve practical problems.</td>
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<td>Ability to write and present a substantial technical report/document.</td>
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<td>3.</td>
<td>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.</td>
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<td>Ability to comprehend, analyze, synthesize for design, develop and delivery of converging solutions for industrial problems.</td>
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<td>5.</td>
<td>Ability to independently carry out consultation, self-employment and managing footwear industries.</td>
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<td>Ability to demonstrate leadership to manage manpower with necessary social and other skill sets.</td>
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3. PROGRAM SPECIFIC OUTCOMES (PSOs):

| PSO1 | Foundation: Knowledge for manning and managing leather industries. |
| PSO2 | Communication: People and social skills required for leadership, consultation and self-employment. |
| PSO3 | Responsibility: Professionally ethical behavior and social responsibility of leather and allied sector. |
| PSO4 | Design: Ability to comprehend, analyze, synthesize for design, develop and delivery of converging solutions for industrial problems. |

4. PEO/PO Mapping:

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## 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
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* Compulsory for non-leather graduates
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### RESEARCH METHODOLOGY AND IPR COURSES (RMC)

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### Employability Enhancement Courses (EEC)

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

OBJECTIVE
- The objective of this course is to provide fundamental knowledge about lower limb and foot
- To understand the structure and function of foot and deformities
- To gain knowledge on the principles of foot Bio-Mechanics
- To provide the basic knowledge of Gait and its analysis
- 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 anatomy of human lower limb and foot.
CO2 Aware of foot growth and deformities.
CO3 Have knowledge on principles of biomechanics of foot.
CO4 Gain a basic knowledge on gait analysis.
CO5 Aware of solid modelling of foot.

REFERENCES:

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

- The objective of this course is to present the students on various unit operations in footwear manufacture.
- To understand the Development of fashions & designs in footwear.
- To understand the various sequence of operation in a footwear manufacture.
- To understand the principles and types of lasting.
- To understand 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

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 scirms, 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

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  Know the importance of cutting and the responsibilities of clickers.
CO3  Have knowledge on pre-closing and closing.
CO4  Understand the construction of a shoe and its components.
CO5  Understand the principles and methods of post lasting and finishing operation.
REFERENCES:

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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 acquire 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**

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**

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 methods to characterize them.
CO3 Aware about the selection criteria of synthetic material for footwear industry.
CO4 Understand the testing properties of various materials.
CO5 Have more knowledge inputs on mechanical behaviour of materials used for footwear production.

REFERENCES:

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

- The purpose of this subject is to identify; formulate; foresee or predict problems as possible
- To understand the concept of capital investments
- To learn about the various project appraisal techniques
- To understand the concept of project design and audit
- To develop the knowledge on the concepts of project scheduling and schedule compression techniques

UNIT I PROJECT IDENTIFICATION AND FORMULATION


UNIT II PROJECT BUDGETING AND FINANCING


UNIT III PROJECT APPRAISAL AND RISK ANALYSIS

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


UNIT V PROJECT SCHEDULING TOOLS AND TECHNIQUES

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)
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:

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LE3152 ORIENTATION TO LEATHER MANUFACTURE
[Bridge Elective Course for Non-Leather UG Graduates]

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
Origin and characteristics of hides and skins; Categories of livestock; Grading systems; Defects in hides and skins; Various preservation techniques and their principles.
UNIT II  PRETANNING PROCESSES AND OPERATIONS  8
Principles and objectives of beam house processes viz., soaking, liming, reliming, deliming, bating, pickling, depickling and degreasing; Various unit operations in pretanning.

UNIT III  TANNING  10
Definition and objectives of tanning; Types and basic chemistry of vegetable tannins; Basic chemistry of basic chromium sulfate; Principles involved in vegetable and chrome tanning and their mechanism in brief; Combination tannages.

UNIT IV  POST TANNING PROCESSES AND OPERATIONS  10
Principles and objectives of post tanning processes viz., 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

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.

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

REFERENCES:

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**RM3151  RESEARCH METHODOLOGY AND IPR**

**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 filing, examination of patent, grant of patent, revocation; equitable assignments; Licenses, licensing of patents; patent agents, registration of patent agents.

**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

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REFERENCES:
2. Soumitro Banerjee, “Research methodology for natural sciences”, IISc Press, Kolkata, 2022,

FW3111 TESTING OF FOOTWEAR MATERIALS AND PRODUCTS LAB

OBJECTIVE
- To analyse the physical properties of leather, lining and soles
- To analyse the chemical properties of materials for footwear applications
- To analyse 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 Gain 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.

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FW3112 FOOTWEAR FABRICATION LABORATORY - I

OBJECTIVE
- To impart practical exposure in pattern developments
- To gain knowledge in leather assortment and cutting operation
- To acquire the ability of upper fabrication

LIST OF EXERCISES
LAST

CUTTING AND CLICKING

UPPER FABRICATION

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 Gain experience in upper fabrication.

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Note: The average value of this course to be used for program articulation matrix.
SEMMESTER II
FW3201 FOOTWEAR COMPONENTS AND ACCESSORIES L T P C
3 0 0 3

OBJECTIVE
- To acquire knowledge on various components used for footwear manufacture
- To understand the role of grinderies in footwear manufacturing
- To inculcate 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

UNIT II GRINDERIES 13

UNIT III FASTENERS 9

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 Have practical knowledge on characteristics of various footwear grinderies and accessories.
CO3 Know about fasteners and its types.
CO4 Have knowledge on different manufacturing techniques of accessories.
CO5 Know the importance of various reinforcement materials.

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

FW3202 MODERN TECHNIQUES IN FOOTWEAR MANUFACTURE

OBJECTIVE
- The objective of this course is projecting 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 enhance the student’s knowledge about rapid prototyping
- To extrapolate artificial intelligence in footwear manufacturing

UNIT I COMPUTER AIDED DESIGN AND ITS HARDWARE
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
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

UNIT IV ADVANCED TECHNIQUES USING CAD and RAPID PROTOTYPING
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
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** Have deep understanding in virtual prototype development for footwear sector.

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

**CO5** Gain knowledge of imparting the artificial intelligence in footwear manufacturing.

REFERENCES:

5. Desai and Abel, “Introduction to FEM”.
6. “Step by Step guide to CAD for footwear”: CAD Centre, SDDC, CLRI.
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

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

- To learn about preclosing and closing operations using various machineries
- To gain knowledge in lasting and botoming department
- To enhance and explore the student’s knowledge in advanced machineries and transport system in footwear engineering
- To design optimal machinery layout in footwear unit
- To provide comprehensive knowledge on preventive maintenance and safety while using footwear machineries

UNIT I  MACHINERIES USED IN PRECLOSING AND CLOSING DEPARTMENT  9

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

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 botoming 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.

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

FW3204 POLYMERS AND AUXILIARIES FOR FOOTWEAR

OBJECTIVE
- To have a basic understanding on polymer and its preparations
- To understand the concept of blending and fabrication of Polymers
- To provide knowledge on applications of polymers in various footwear components
- To study the enhancement of footwear performance using various polymeric materials
- To 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,

**COURSE OUTCOME**

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

- **CO1** Gain 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:**

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

**FW3211 FOOTWEAR FABRICATION LABORATORY - II**

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**OBJECTIVE**
- To impart practical exposure in bottom stock preparation of full shoe manufacture
- To analyze and observe the fabrication process of lasting and finishing
- To train students on non-leather shoe manufacturing techniques

**LIST OF EXERCISES**

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

**LASTING AND FINISHING**
- 10

**NON-LEATHER SHOE MANUFACTURING TECHNIQUES**

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** Have knowledge on bottom stock preparation and upper fabrication.
- **CO2** Have practical knowledge on lasting and finishing process.
- **CO3** Gain skill set to handle non-leather shoe manufacturing techniques.

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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

OBJECTIVE
- To provide students a practical knowledge on the use of computer assisted designing techniques for 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 EXERCISES:
- 2D and 3D shell and pattern digitization
- Style line Manipulation techniques
- Pattern 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 Have practical knowledge on grading and sole mould design.

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

SEMESTER III
FW3311 INTERNSHIP / TRAINING

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.

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**FW3312 PROJECT WORK I**

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**OBJECTIVE**
- The objective of this course is to facilitate the students to identify innovative projects that promotes creativity
- To identify the problems associated with their respective field of research
- To enhance the communication and presentation skills

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

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

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

- CO1 Have conceptual thinking in their field.
- CO2 Apply the concepts to relevant research problems or practical applications.
- CO3 Defend their phase I project successfully with some leads towards project phase
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SEMESTER IV
FW3411
PROJECT WORK II
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OBJECTIVE
- The objective of the project is to make use of the knowledge gained by the student at various stages of the degree programme
- To judge the level of proficiency, originality and capacity for application of the knowledge attained by the student at the end of the programme
- To gain knowledge and expertise in the area of research and development

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

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

TOTAL: 360 PERIODS

COURSE OUTCOME
At the end of the course, the students are expected to
- CO1 Think originally, plan/execute the work properly.
- CO2 Develop their analytical and problem solving abilities.
- CO3 Improve documenting, reporting and communication skills.

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Professional Elective Courses (PEC)
FW3001  COMPUTATIONAL METHODS AND COMPUTER GRAPHICS  L T P C
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OBJECTIVE
• The objective of this course is to provide various theories on computation methods and graphics.
• To know the concepts of initial and B.VP for ODE
• To understand the FEM and its core working principles
• To gain knowledge in two-dimensional graphics
• To gain knowledge in three-dimensional graphics

UNIT I  SOLUTION OF LINEAR EQUATION AND INTERPOLATION  9

UNIT II  INITIAL AND B. VP FOR ODE  9
Taylor series, Euler, Modified Euler, Runge Kutta method of Fourth order for First and Second order differential 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 algorithm, 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  Understand different theories in mathematical analysis on computation methods.
CO3  Comprehend the application aspects of finite element method.
CO4  Understand two-dimensional graphics.
CO5  Understand three-dimensional graphics.

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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

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 acquire knowledge in supply chain management in the footwear industry
- To equip individuals with knowledge and skills undertaking corporate social responsibility

UNIT I  INTRODUCTION TO FOOTWEAR REGULATIONS AND COMPLIANCE

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


UNIT III  PRODUCT SAFETY AND LEGISLATION APPLYING TO FOOTWEAR INDUSTRY

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

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**

- 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

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Note: The average value of this course to be used for program articulation matrix.
OBJECTIVE
- The objective of this course is to present students on project identification and preparations
- To understand the principles of Investment appraisal and financial analysis
- To understand the risk and uncertainty of the implementation and management
- To develop knowledge in handling finances
- To gain 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

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  Develop knowledge in budgeting.

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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 present the students on the footwear performance and customer services
- How to handle customer complaints
- To understand the various types of customer services
- To develop knowledge in the testing for assessment of footwear performance
- To 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 attitude and international obligations.

UNIT III CUSTOMER SERVICES 9
Product Liability; Different types of customer services; Settlement of complaints; Declaration of Services; 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.

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FW3004 BIOMECHANICS FOR FOOTWEAR

OBJECTIVE
- To understand the anatomy and physiology of lower limb
- To impart knowledge about biomechanics concept
- To understand the kinetics and kinematics of GAIT
- To gain knowledge about how footwear influence on GAIT
- To provide knowledge and demonstration of GAIT analysis techniques

UNIT I LOWER LIMB ANATOMY
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
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
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
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
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 Appreciate the use of GAIT in footwear design.
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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

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OBJECTIVE
- To understand the ergonomics and anatomy of an employee in an industry
- Studying the work procedure and understanding the human behaviour
- To study the applications of ergonomic principles and physiology of workers
- To know the concepts of man-machine relationship and manual handling tasks
- To understand the human skill, control and virtual environments

UNIT I ERGONOMICS AND ANATOMY
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

UNIT III  ANTHROPOMETRY AND WORK DESIGN FOR STANDING AND SEAT WORKS
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
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 workplace, design of manual handling tasks, carrying, postural stability

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

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:

TOTAL : 45 PERIODS
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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
- To gain knowledge about the accident occurrence theories and its prevention
- To gain knowledge about productive machine safety in footwear industry
- To acquire deeper insights about fire hazards and control
- To 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. Factors impeding 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

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


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.

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FW3006 MARKETING MANAGEMENT

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OBJECTIVE
- To facilitate understanding of the conceptual framework of marketing and its applications in decision making under various environmental constraints
- To familiarize the students in creating and managing products
- 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**

**UNIT II  CREATING AND MANAGING PRODUCT**

**UNIT III  PRICING DECISIONS**

**UNIT IV  DELIVERING AND PROMOTING PRODUCT**

**UNIT V  EMERGING TRENDS IN MARKETING**

**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.

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

FW3007 MODERN FOOTWEAR STYLING

OBJECTIVE:
- The objective of this course is to present the students on the historical and international trends
- To gain insights on consumer preferences and market demands with respect to footwear designs
- To help in analyzing 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 geographical instances 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
Brainstorming 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

41
COURSE OUTCOME
At the end of the course, the students are expected to

CO1 Have knowledge on historical and international trends.
CO2 Have understood the factors contributing to the fashion trends in footwear industry.
CO3 about the preparation of 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:
3. “Shoes and Leather News”, Published by bureau of foreign and domestic commerce, Dept of commerce, US, 1940

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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

OBJECTIVE:
• The objective of this course is present students on various aspects on production management
• To understand the nature of marketing strategy of a footwear industry
• To explore the unique challenges in managing human resources within the footwear industry
• To analyze the principles, practices and challenges involved in ergonomics and communication
• To explore the trade policies associated with footwear industry

UNIT I PRODUCTION MANAGEMENT
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 equipments selection. Specified layout for footwear industries - Supply chain management - case study

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

UNIT III PERSONNEL MANAGEMENT

UNIT IV ERGONOMICS AND COMMUNICATION

UNIT V FOOTWEAR TRADE AND INDUSTRY IN INDIA
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.

COURSE OUTCOME
At the end of the course, the students are expected to
CO1 Understand the production management associated with footwear sector.
CO2 Understand the marketing strategy techniques.
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.

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TOTAL: 45 PERIODS
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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 understand and identify and determine 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
Pedorthics – Role of Pedorthist – Pedorthic evaluation – Patient management -implementation and Practice management.

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

UNIT III FOOT COMPLICATIONS AND LIFESTYLE DISEASES
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
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
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 Understand 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 Have knowledge on fabrication techniques of corrective footwear.

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FW3010 PRODUCTION OPERATIONS MANAGEMENT

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 learn the alignment of production, planning and control of the production management
- To emphasize the principles and techniques of quality management
- To engage into different productivity techniques and its applications

UNIT I MODELLING AND OPERATIONS
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
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
Production Planning & Control: Production planning techniques for various process choices, techniques of production control, aggregate planning techniques,

UNIT IV QUALITY MANAGEMENT
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
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 operations
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 Application of different productivity techniques for the production.

REFERENCES:
Production and Operations Management (Vikas)
6. Haleem A- Production and Operations Management (Galgotia books, 2005)
7. Shanker Ravi- Industrial Engineering (Galgotia Publications, 2000)

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FW3011 QUALITY CONTROL MANAGEMENT IN FOOTWEAR INDUSTRIES L T P C 3 0 0 3

OBJECTIVE:
• The objective of this course is to present students on the concepts of quality control
• To focus on the principles and techniques of quality improvement for the footwear industry
• To learn about the importance of quality control and its standardization
• To study on the quality assurance system through different standards
• To understand the accreditation and certification bodies

UNIT I CONCEPTS OF QUALITY
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
quality management – quality grades, Dr. Deming’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 the
leather 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.

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Note: The average value of this course to be used for program articulation matrix.
OBJECTIVE:
- To provide understanding on the need to self-manage and other management competency for a successful entrepreneurship
- To focus on business development and entrepreneurial skills necessary for success in self-management
- To understand the financial management and documentations
- To learn basic time management concepts to assessing health of business
- To concentrate on marketing aspects of footwear products

UNIT I SELF-MANAGEMENT
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
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
Pricing your work & budgeting; Building an online portfolio; Branding; Networking and Partnership building; The elevator pitch Fundraising; Establishing a value network

UNIT IV TIME MANAGEMENT
Time management; Project management; Time map and project management plan; Reflection on perfectionism

UNIT V MARKETING MANAGEMENT
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 Have knowledge on marketing and advertising the footwear products

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

FW3012 ATHLEISURE

OBJECTIVE:
- To give an overview of athleisure
- Understand the consumer preferences in the athleisure
- Understand the fundamentals of athleisure shoe design and functionality
- Understand Materials and Manufacturing Techniques for Athleisure
- Identify and apply testing methods to ensure product quality and performance

UNIT I HISTORY OF ATHLEISURE

UNIT II CONSUMER PSYCHOLOGY AND PREFERENCES

UNIT III DESIGN ELEMENTS OF ATHLEISURE
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

UNIT V FABRICATION PROCESS AND TESTING
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.

**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 behavior and need.
**CO3** Understand the design elements of athleisure.
**CO4** Understand the materials and technology of athleisure products.
**CO5** Apply knowledge on fabrication process and testing methods.

**REFERENCES:**
1. Materials and Technology for Sportwear and Performance Apparel, Steven George Hayes, Praburaj Venkatraman, CRC Press; 2017

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

**FW3013 MOULDED FOOTWEAR**

**OBJECTIVE:**
- To give an overview of Different types of moulded Footwear
- To enlighten the different Materials used for making Moulded footwear
- To give insight into the types of construction & Techniques for making
- To focus on basic concepts of mould designing
- To have exposure to Testing methods & standards for Moulded footwear

**UNIT I BASICS OF MOULDED FOOTWEAR**
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

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

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 Set up the layout for the production & to provide knowledge for testings & standards of moulded footwear.

REFERENCES:
2. G. Holden, “Understanding Thermoplastic Elastomers”.
6. Venkatappaiah B. -Introduction to the Modern Footwear Technology
9. Comprehensive Footwear Technology by S.N.Ganguly
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FW3014 OPEN FOOTWEAR

OBJECTIVE:
- The objective of this course is to impart complete understanding and the complications associated with open footwear fabrication techniques
- To learn basic of elemental design and fashion consideration
- To acquire knowledge about the materials used for open footwear
- To understand the different types of construction practiced in open footwear
- To concentrate on quality and testing for open footwear

UNIT I TYPES OF OPEN FOOTWEAR
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
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
Upper materials – Leather & Non Leathers, Soling materials, Reinforcement, Lining, Abrasives & Grinderries, 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
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
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 Have a basic understanding on 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 Have knowledge on different construction techniques for open footwear.
CO5 Have knowledge on different standards required for evaluating the quality of open footwear.

REFERENCES:
4. Comprehensive Footwear Technology by S.N.Ganguly

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

FW3015 STANDARDS FOR FOOTWEAR

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 know about Indian standards and specification for footwear
- To have knowledge on safety, protective and occupational footwear
- To inculcate in chemical testing standard for footwear
UNIT I CURRENT ORGANIZATION OF FOOTWEAR TESTING ACTIVITIES 7

UNIT II INTERNATIONAL STANDARDS FOR FOOTWEAR 10

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 footwear 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

TOTAL: 45 PERIODS

COURSE OUTCOME
Upon completion of this course, the students will be able to:
CO1 Have knowledge towards 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 Know 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:
4. BIS Standards
5. WWW.ISO.ORG
6. WWW.IULTCS.ORG
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FW3016 INDUSTRIAL ENGINEERING IN FOOTWEAR INDUSTRY

OBJECTIVE:
- To enlighten the analysis & control of manufacturing systems
- To give insight on work, motion study & work measurements methods
- To understand the structure and concepts of TQM
- To have exposure about sequencing, scheduling and advanced optimizing Techniques
- To provide acquaintance in advanced optimization techniques & computer-aided process planning and control

UNIT I ANALYSIS AND CONTROL OF MANUFACTURING SYSTEMS
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
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

UNIT IV SEQUENCING AND SCHEDULING

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

TOTAL : 45 PERIODS
COURSE OUTCOME
Upon completion of this course, the students will be able to:
CO1 Have a basic understanding about production system.
CO2 Impart knowledge on work design & ergonomics.
CO3 Improve the performance of routine activities by application of appropriate industrial engineering tools.
CO4 Determine functions of a product/service.
CO5 Apply value engineering in real life problems.

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

FW3017 SUSTAINABLE FOOTWEAR INDUSTRY L T P C
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OBJECTIVE:
• To understand sustainability and development goals
• To know about modern advancements and technology for sustaining footwear industry
• To know the importance of sustainable development and economics in footwear industry
• To guide towards sustainable development as a corporation, as an industry, as an individual
• To gain knowledge on 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 EXISTING FOOTWEAR INDUSTRY TO SUSTAINABILITY


UNIT III  FOOTWEAR INDUSTRY AND ECONOMICS OF SUSTAINABILITY

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


**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


TOTAL : 45 PERIODS

COURSE OUTCOME

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

**CO1** Recognize basics about sustainability and goals

**CO2** Learn about different sustainability and relevant technology

**CO3** Know the economics of footwear industry and opportunity to achieve sustainability

**CO4** Know about footwear waste recycling and waste management

**CO5** Understand about footwear sustainability and its effects on brands

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.
4. Leather and Footwear Sustainability, Manufacturing, Supply Chain, and Product Level Issues, Editors: Subramanian Senthilkannan Muthu, Publisher Springer Singapore.
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FW3018 POLYMER PROCESSING AND RHEOLOGY

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

UNIT I INJECTION MOULDING 7

UNIT II EXTRUSION 7

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
UNIT V  RHEOLOGY OF POLYMERS, POLYMER BLENDS AND ALLOYS


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 Assess the behaviour of rubber compounding and processing.
CO5 Attain knowledge in rheology of polymers, polymer blends and alloys.

REFERENCES:
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

CO-PO MAPPING

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

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