DEPARTMENT OF LEATHER TECHNOLOGY  
ANNA UNIVERSITY, CHENNAI

B. TECH. LEATHER TECHNOLOGY (PART TIME)

VISION:
To become a premier centre of learning and research in leather and allied technologies.

MISSION:
MD1 : To provide quality education in the area of leather technology with high professional values.
MD2 : To share and disseminate expertise to provide solutions for the problems faced by the leather industry.
MD3 : To build an expertise based capsule of delivering technology to leather and allied sectors.
MD4 : To provide a learning ambience for innovators, researchers and technologists.
1. PROGRAMME EDUCATIONAL OBJECTIVES (PEOs):
Bachelor of Leather Technology curriculum is designed to prepare the undergraduates

I. To demonstrate core competency in basic mathematics, scientific and engineering fundamental to design, formulate, analyse and solve the problems of leather and allied sectors.

II. To pursue lifelong multidisciplinary learning as professional engineers, researchers and scientists and effectively communicate technical information.

III. To practice values and exhibit leadership qualities and team spirit to promote entrepreneurship and indigenerization.

IV. To nurture among students, the ability to work in teams, in professional and social environments.

V. To develop a global outlook to students to appreciate diversity in the world and in intellectual pursuits and the desire and ability to have continuous learning in life.

2. PROGRAMME OUTCOMES (POs):

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<th>PO's</th>
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<td><strong>Engineering knowledge</strong>: Apply knowledge of mathematics, science and engineering fundamentals and an engineering specification to the solution of complex engineering problems.</td>
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<td><strong>Problem analysis</strong>: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural science and engineering.</td>
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<td><strong>Design/development of solutions</strong>: Design system for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety and the cultural, societal and environmental considerations.</td>
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<td><strong>Conduct investigations of complex problems</strong>: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusion.</td>
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<td><strong>Modern tool usage</strong>: Create, select and apply appropriate techniques, resources and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.</td>
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<td><strong>The Engineer and society</strong>: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.</td>
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<td><strong>Environment and sustainability</strong>: Understand the impact of the professional engineering solutions in societal and environmental context and demonstrate the knowledge of and need for sustainability development.</td>
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<td><strong>Ethics</strong>: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.</td>
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<td><strong>Individual and team work</strong>: Function effectively as an individual and as a member or leader in diverse teams and in multidisciplinary settings.</td>
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| 10   | **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations and give
and receive clear instruction.

| 11 | **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one’s own work, as a member and leader in a team, to manage projects and in multidisciplinary environments. |
| 12 | **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technology change. |

3. **PROGRAM SPECIFIC OUTCOMES (PSOs):**

After completion of Leather Technology program, students will gain core competency skills in domain and the graduates will have the ability to,

- **PSO1**: Understand and apply the foundational knowledge to make a successful career in leather and leather products sector.
- **PSO2**: Identify the problems of the leather sector and provide solutions.
- **PSO3**: To manage leather sector towards its sustainable development.
### MAPPING OF COURSE OUTCOME AND PROGRAMME OUTCOME:

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# ANNA UNIVERSITY, CHENNAI
UNIVERSITY DEPARTMENTS
REGULATIONS – 2023
B. TECH. LEATHER TECHNOLOGY (PART TIME)
CHOICE BASED CREDIT SYSTEM
I TO VIII SEMESTER (PART TIME) CURRICULUM

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Total credits **70.5**

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Total Credits **6**
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**B. TECH. LEATHER TECHNOLOGY - PART TIME**

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| Credits Per Semester | 13 | 15 | 13.5 | 13.5 | 14 | 15 | 15 | 11 | 110 |
COURSE OBJECTIVES:
- To build lexical competency and accuracy that will help learners to use language effectively.
- To comprehend the nuances of spoken and written communication in different contexts.
- To learn and use various language functions required for effective communication.
- To read and write different types of texts and comprehend their connotative and denotative meanings.
- To enhance students' listening skills by using different types of audio materials and help them extract necessary information from those materials.

UNIT I  BASICS OF COMMUNICATION
Listening – Telephone conversation & Writing message, gap filling; **Reading** – Telephone message, bio-note; **Writing** – Personal profile; **Grammar** – Simple present tense, Present continuous tense, Asking questions (wh-questions); **Vocabulary** – One-word substitution, Synonyms.

UNIT II  NARRATION
Listening – Travel podcast / Watching a travel documentary; **Reading** – An excerpt from a travelogue, Newspaper Report; **Writing** – Narrative (Event, personal experience etc.); **Grammar** – Subject – verb agreement, Simple past, Past continuous Tenses; **Vocabulary** – Antonyms, Word formation (Prefix and Suffix).

UNIT III  DESCRIPTION
Listening – Conversation, Radio/TV advertisement; **Reading** – A tourist brochure and planning an itinerary, descriptive article / excerpt from literature; **Writing** – Definitions, Descriptive writing, Checklists; **Grammar** – Future tense, Perfect tenses, Preposition; **Vocabulary** – Adjectives and Adverbs.

UNIT IV  CLASSIFICATION
Listening – Announcements and filling a table; **Reading** – An article, social media posts and classifying (channel conversion – text to table); **Writing** – Note making, Note taking and Summarizing, a classification paragraph; **Grammar** – Connectives, Transition words; **Vocabulary** – Contextual vocabulary, Words used both as noun and verb, Classification related words.

UNIT V  EXPRESSION OF VIEWS
Listening – Debate / Discussion; **Reading** – Formal letters, Letters to Editor, Opinion articles / Blogs; **Writing** – Letter writing/ Email writing (Enquiry / Permission, Letter to Editor); **Grammar** – Question tags, Indirect questions, Yes / No questions; **Vocabulary** – Compound words, Phrasal verbs.

Assessment
- Two Written Assessments: 35% weightage each
- Assignment: 30% weightage
- Designing a tourist brochure / Writing an opinion article / Making a travel podcast
- **End Semester Exam:** 3-hour written exam

**TOTAL: 45 PERIODS**
COURSE OUTCOMES:
At the end of the course the students are expected to,
CO1. Use grammar and vocabulary suitable for general context.
CO2. Comprehend the nuances of spoken and written communication.
CO3. Use descriptive and analytical words, phrases, and sentence structures in written communication.
CO4. Read different types of texts and comprehend their denotative and connotative meanings.
CO5. Write different types of texts using appropriate formats.

TEXT BOOKS:
1. “English for Engineers and Technologists” Volume I by Orient Blackswan, 2022

REFERENCES
4. www.uefap.com

COURSE ARTICULATION MATRIX:

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

PTCY3151 ENGINEERING CHEMISTRY

COURSE OBJECTIVES:
- To introduce the basic concepts of polymers, their properties and some of the important applications.
- To impart knowledge on the basic principles and preparatory methods of nanomaterials.
- To facilitate the understanding of corrosion science and protecting coatings.
- To familiarize the operating principles and applications of energy conversion, its processes and storage devices.
- To inculcate sound understanding of water quality parameters and water treatment techniques.

UNIT I POLYMER CHEMISTRY

Introduction: Functionality-degree of polymerization. Classification of polymers (Source, Structure, Synthesis and Intermolecular forces). Mechanism of free radical addition polymerization. Properties of polymers: Tg, tacticity, molecular weight-

UNIT II NANOCHEMISTRY

UNIT III CORROSION SCIENCE

UNIT IV ENERGY SOURCES
Batteries - Characteristics - types of batteries – primary battery (dry cell), secondary battery (lead acid, lithium-ion-battery)- emerging batteries – nickel-metal hydride battery, aluminum air battery, batteries for automobiles and satellites - Fuel cells (Types) – H₂-O₂ fuel cell - Supercapacitors-Types and Applications, Renewable Energy: Solar- solar cells, DSSC.

UNIT V WATER TECHNOLOGY

TOTAL: 45 PERIODS

COURSE OUTCOMES:
At the end of the course the students are expected to,
CO1. To recognize and apply basic knowledge on different types of polymeric materials, their general preparation methods and applications to futuristic material fabrication needs.
CO2. To identify and apply basic concepts of nanoscience and nanotechnology in designing the synthesis of nanomaterials for engineering and technology applications.
CO3. To recognize and apply basic knowledge on suitable corrosion protection technique for practical problems.
CO4. To recognize different storage devices and apply them for suitable applications in energy sectors.
CO5. To demonstrate the knowledge of water and their quality in using at different industries.

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- 1’ = Low; ‘2’ = Medium; ‘3’ = High

PTLT3101 THEORY OF SKIN PROTEINS AND PRE-TANNING PROCESSES

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

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

UNIT II COLLAGEN: STRUCTURE, FUNCTION, THERMAL TRANSITION AND DEGRADATION
Structure of collagen; Types of collagen; Tropocollagen molecules; Sub-units of collagen; kinetics of fibril formation; Electron microscopy of the collagen fibre; Biosynthesis; Denaturation temperature; Mechanism of denaturation process; Thermal shrinkage; Factors influencing melting transition; Degradation of collagen – collagenase and mechanism of action.

UNIT III PRESERVATION AND PRE-TANNING PROCESSES
Principles of preservation of hides and skins - Defects due to parasitic diseases of livestock that affect leather quality. Chemistry and principles of different pre-tanning processes - Soaking, liming, deliming, bating, pickling, depickling and degreasing.

UNIT IV CLEANER PROCESSING IN BEAMHOUSE PRACTICES
Salt-free curing options, sulphide free unhairing systems, ammonia-free deliming, salt free pickling systems, solvent and eco-friendly degreasing systems. Strategies to bring down BOD, COD and TDS standards of tannery effluents.
UNIT V  PRACTICE AND QUALITY CONTROL

Different methods of pre-tanning processes as applied to light, heavy and industrial leathers. Process control in pre-tanning operations.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
At the end of the course the students are expected to,
CO1. Illustrate various structural components and functions of skin/hide.
CO2. Apply the molecular structure of collagen and its supramolecular assemblies and their characteristics.
CO3. List out the various steps in preservation and pre-tanning process.
CO4. Explain the various cleaner pre-tanning processes.
CO5. Elaborate the quality control requirements of pre-tanning process.

TEXT BOOKS AND REFERENCES:

COURSE ARTICULATION MATRIX:

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1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively.
UNIT I - BASICS OF C PROGRAMMING
Introduction to programming paradigms — Structure of C program - C programming: Data Types - Constants - Keywords - Operators: Precedence and Associativity - Expressions - Input/Output statements, Assignment statements - Decision making statements - Switch statement.

PRACTICALS:
- Designing programs with algorithms/flowchart
- Programs for i/o operations with different data types
- Programs using various operators
- Programs using decision making and branching statements

UNIT II – LOOP CONTROL STATEMENTS AND ARRAYS
Iteration statements: For, while, Do-while statements, nested loops, break & continue statements - Introduction to Arrays: Declaration, Initialization - One dimensional array - Two dimensional arrays – Searching and sorting in Arrays – Strings – string handling functions - array of strings

PRACTICALS:
- Programs using for, while, do-while loops and nested loops.
- Programs using arrays and operations on arrays.
- Programs implementing searching and sorting using arrays
- Programs implementing string operations on arrays

UNIT III - FUNCTIONS AND POINTERS
Modular programming - Function prototype, function definition, function call, Built-in functions – Recursion – Recursive functions - Pointers - Pointer increment, Pointer arithmetic - Parameter passing: Pass by value, Pass by reference, pointer and arrays, dynamic memory allocation with malloc/calloc

PRACTICALS:
- Programs using functions
- Programs using recursion
- Programs using pointers & strings with pointers
- Programs using Dynamic Memory Allocation

UNIT IV - STRUCTURES AND UNION
Storage class, Structure and union, Features of structures, Declaration and initialization of structures, array of structures, Pointer to structure, structure and functions, typedef, bit fields, enumerated data types, Union.

PRACTICALS:
- Programs using Structures
- Programs using Unions
- Programs using pointers to structures and self-referential structures

UNIT V – MACROS AND FILE PROCESSING

PRACTICALS:
- Programs using pre-processor directives & macros
- Programs to handle file operations
• Programs to handle file with structure

COURSE OUTCOMES:
Upon completion of the course, the students will be able to
- **CO1**: Write simple C programs using basic constructs.
- **CO2**: Design searching and sorting algorithms using arrays and strings.
- **CO3**: Implement modular applications using Functions and pointers.
- **CO4**: Develop and execute applications using structures and Unions.
- **CO5**: Solve real world problem using files.

**Total Hours**: 90 (30+60)

TEXT BOOKS:

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**SEMESTER II**

**PTLT3201**

LEATHER MANUFACTURE I

**L T P C**

3 0 0 3

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

**UNIT I**

PRODUCT BRIEF OF LEATHERS FROM HIDES

Product brief of various light and heavy leather manufacture from hides. Raw material availability. Usage of imported hides in leather manufacturing.
UNIT II  PROCESS TECHNOLOGY FOR LEATHERS FROM HIDES
Process details to achieve the specifications for the following leathers: Full chrome/Semi chrome/Chrome retan - uppers, suedes, nubuck, lining, nappa, shrunken grain, upholstery, burnishable, printed leathers; Upgradation technologies; Rectification of defects in hides.

UNIT III  LIGHT LEATHER MANUFACTURE FROM HIDES
Property requirement of upper, garment and other light leathers such as industrial gloves from hides; Process design considerations; Choice of raw material; International standards requirements for the light leathers from hides.

UNIT IV  HEAVY LEATHER MANUFACTURE FROM HIDES
Property requirement of sole, harness, saddle and other industrial leathers from hides; Process design considerations; Choice of raw material; Traditional and modern methods; International standards required for the heavy leathers. Heavy lather for strategic sector.

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

TOTAL: 45 PERIODS

COURSE OUTCOMES:
At the end of the course, the students will be in the position to,
CO1. Compare and classify the basic product brief of light and heavy leather manufacture from hides.
CO2. Analyse the property requirement and process design of heavy leather.
CO3. Evaluate the property requirement and process design of light leather.
CO4. Perceive in depth knowledge in process technology for leather from hides.
CO5. Compile the physical and chemical properties of raw materials used in sports goods leathers.

TEXT BOOKS AND REFERENCES:

COURSE ARTICULATION MATRIX:

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PTLT3202 THEOREY INORGANIC TANNAGES

**COURSE OBJECTIVE:**
To impart knowledge on the chemistry and process of chrome and various inorganic tanning materials and systems.

**UNIT I INTRODUCTION TO COORDINATION CHEMISTRY; METAL IONS IN TANNING**
Werner’s theory of coordination, origins of coordinative interactions, role of d and f orbitals, definition of ligands, nucleophilicity of ligands and electronegativity of donor atoms, chelation and masking, ligand field stabilisation energy and introduction of factors controlling molecular stability of transition metal complexes. Historical overview of mineral tanning.

**UNIT II AQUEOUS CHEMISTRY OF CHROMIUM**
Electronic configuration and its implications, common oxidation states of chromium, redox stabilities of chromium (VI) and chromium (III) salts, redox potentials and their interconversion, protolysis, kinetic inertness of chromium (III), basicity, olation, oxolation and polymerisation, Stiasny’s series, Mc Clandish precipitation point.

**UNIT III FACTORS CONTROLLING CHROME TANNING**
Principles of analytical and instrumental methods employed in analysis of various chrome Single and double bath chrome tannages and their relative merits and demerits, preparation of basic chromium sulphate (BCS) salt, reaction parameters influencing composition of BCS, kinetics of chrome tanning, diffusion and complexation, effects of float volume, pH, basicity, masking, temperature, drum speed, ageing chrome tanned substrates.

**UNIT IV MECHANISM OF CHROME TANNAGE**
Theories of chrome tanning; absorption, coating, electrostatic and hydrogen bond interactions and coordinative forces involved in chrome tanning, indirect evidence for chrome binding sites in protein, hydrothermal stability of chrome-collagen compound.

**UNIT V OTHER INORGANIC TANNAGES**
Aqueous chemistry of aluminium (III), zirconium (IV), titanium (IV) and iron(III) and its relevance to mineral tanning, chemistry of silicates and phosphates and their tanning mechanisms, mechanism of inorganic tannages and their relevance to combination tanning.

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

CO1. Understand the basics of coordination chemistry involved in inorganic tanning.
CO2. Understand the aqueous chemistry of inorganic tannages.
CO3. Comprehend the chemistry of chromium and factors controlling chrome tanning.
CO4. Have knowledge on mechanism of chrome tanning.
CO5. Understand the mechanism of various inorganic tannages.

**TOTAL: 45 PERIODS**
TEXT BOOKS AND REFERENCES:

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PTLT3203 PRINCIPLES OF UNIT PROCESSES AND OPERATIONS L T P C 3 0 0 3

COURSE OBJECTIVE: To Impart Basic and Applied Knowledge on Unit Process and Operation Involved in the Leather and Leather Chemicals Manufacture as well as Preparedness for future developments and Environmental compliances for Sustainable development.

UNIT I GENERAL UNIT PROCESS PRINCIPLES AND CONCEPTS WITH RELEVANCE TO LEATHER AND LEATHER CHEMICALS MANUFACTURE

General Principles of Unit Operations and Unit Processes in Leather and Leather Chemicals Processing: Definition of Unit Operation and Unit process; Various Aspects and Parameters; Reactions types with Solis-Liquid-Gases; Development of process flow sheets – BIS Symbols, flow diagrams with reference to Leather & Leather chemical industrial design and processes; Process control and safety; Leather Drying Methods and Principles, Pollution abatement.

UNIT II PRINCIPLES OF UNIT OPERATIONS: METERING OF FLUIDS, HEAT TRANSFER AND MASS TRANSFER

**Diffusion**: Binary diffusion, concept of mass transfer coefficients and interface mass transfer and stage wise contact.

**Distillation**: Principle of distillation, Application of distillation in leather chemicals and auxiliaries processing.

**Extraction**: Extraction principles, Leaching and Extraction equipments. General theory and Practice.

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

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

**UNIT III MECHANICAL SEPARATIONS**

**Size reduction**: Theory and equipment; application in leather chemical processing.

**Clarification**: Principles of clarification, Liquid-Liquid, Liquid-solid and Liquid-gas separations, Application in leather processing and effluent treatment Mixing: Basic theory and application in leather and leather chemical processing.

**UNIT IV PRINCIPLES OF UNIT PROCESSES**

General Principles of Esterification, Hydrolysis, Oxidation, Reduction, Hydrogenation, Halogenation, Polymerization, Nitration, Sulphation and Sulphonation, Condensation Reaction, Diazotization and Coupling.


**Oils, Fats and Detergents Industries**: Fatliquor Manufacture: Preparation of Fatliquor from oils/fats and imparting charge characteristics; Anionic, Cationic and Non-ionic fatliquors and Leather auxiliaries. Raw materials; Process Flow diagram. Oils and fats; their nature and products derived from oils and fats, Fatty Acids and Alcohols, waxes and fatliquors.

**Syntan Manufacture**: General Concepts of Syntans; Phenol-Aldehyde Condensation Reaction and Product as Anionic Syntan. Process Flow diagram.

**Dyes and Dyes Intermediates**: Concept of Color, Chromophores, Auxochromes, Raw materials; Diazotization and Coupling reaction for the Manufacture Dyes and Dyes Intermediates. Process Flow diagram.


**Recent Developments Leather and Leather Chemicals Manufacture for sustainable development**: Recent developments like REACH, UN’s SDG’s, Eco-Lables, Chemicals/ Process Safety Standards and Compliances; and their implications on leather & leather chemicals for sustainable development; Alternate eco-benign leather chemicals and auxiliaries for leather manufacture.

**UNIT V WATER AND INORGANIC CHEMICALS**

Treatment of water for domestic and industrial purposes – Soda-Lime, Ion-Exchange, Zeolite processes, Manufacture of Sodium chloride, Sodium sulphide, Sodium sulphite and Bisulphite, Sodium carbonate, Caustic soda, Lime, Sulphuric and Hydrochloric acids.

TOTAL: 45 PERIODS
COURSE OUTCOMES:
At the end of the course, the student would understand,
CO1. Explain the basic concepts of unit operations and unit processes in leather and leather chemicals processing.
CO2. Make use of the concept of material and energy balances and fluid dynamics mass and heat transfer in various unit operations such as distillation, extraction, drying and humidification.
CO3. Examine the size reduction and separation and mixing techniques technology of organic and inorganic chemicals involved in the processing of leather and leather chemicals.
CO4. Interpret the principle of various unit processes in leather chemical processing.
CO5. Elaborate About the use of water and manufacture of inorganic chemicals used in leather manufacture.

TEXT BOOKS AND REFERENCES:
8. Dutta, S.S., An introduction to the principles of leather manufacture, ILTA.

COURSE ARTICULATION MATRIX:

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PTMA3352 PROBABILITY AND STATISTICS L T P C 3 1 0 4

UNIT I ONE-DIMENSIONAL RANDOM VARIABLES
Discrete and continuous random variables – Moments – Moment generating functions – Binomial, Poisson, Geometric, Uniform, Exponential, Gamma and Normal distributions – Functions of a random variable.
UNIT II  TWO-DIMENSIONAL RANDOM VARIABLES  (9+3)
Joint distributions – Marginal and conditional distributions – Covariance – Correlation and
Linear regression – Transformation of random variables – Central limit theorem (for
independent and identically distributed random variables).

UNIT III  ESTIMATION THEORY  (9+3)
Sampling distributions – Characteristics of good estimators – Method of Moments – Maximum
Likelihood Estimation – Interval estimates for mean, variance and proportions.

UNIT IV  TESTS OF SIGNIFICANCE  (9+3)
Type I and Type II errors – Tests for single mean, proportion, Difference of means (large and
small samples) – Tests for single variance and equality of variances – $\chi^2$ test for goodness of
fit – Independence of attributes.

UNIT V  DESIGN OF EXPERIMENTS  (9+3)
Completely Randomized Design – Randomized Block Design – Latin Square Design – $2^2$
factorial design.

TOTAL: 60 PERIODS

COURSE OUTCOMES:
On completion of the course, the students will be able to:

- **CO1:** To analyze the performance in terms of probabilities and distributions achieved by the
determined solutions.
- **CO2:** To be familiar with some of the commonly encountered two dimensional random
variables and be equipped for a possible extension to multivariate analysis.
- **CO3:** To apply the basic principles of the estimation theory to practical situations.
- **CO4:** To demonstrate the knowledge of large / small sample theory in statistical inference.
- **CO5:** To obtain a better understanding of the importance of the methods in modern industrial
processes.

TEXT BOOKS:
1. Irwin Miller and Marylees Miller “John E. Freund’s Mathematical Statistics with

REFERENCES:
2. Ross, S.M. “Introduction to Probability and Statistics for Engineers and Scientists”,
Reprint, 2017.
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1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively.

PTCY3251 ENVIRONMENTAL SCIENCE AND SUSTAINABILITY L T P C 2 0 0 2

UNIT I ENVIRONMENT AND BIODIVERSITY 6

UNIT II ENVIRONMENTAL POLLUTION 6

UNIT III RENEWABLE SOURCES OF ENERGY 6
Energy management and conservation, New Energy Sources: Need of new sources. Different types new energy sources. Applications of- Hydrogen energy, Ocean energy resources, Tidal energy conversion. Concept, origin and power plants of geothermal energy.

UNIT IV SUSTAINABILITY AND MANAGEMENT 6
Development , GDP ,Sustainability- concept, needs and challenges-economic, social and aspects of sustainability-from unsustainability to sustainability-millennium development goals, and protocolsSustainable Development Goals-targets, indicators and intervention areas Climate change- Global, Regional and local environmental issues and possible solutions-case studies. Concept of Carbon Credit, Carbon Footprint. Environmental management in industry-A case study.

UNIT V SUSTAINABILITY PRACTICES 6

TOTAL : 30 PERIODS

COURSE OUTCOMES:
CO1 To recognize and understand the functions of environment, ecosystems and biodiversity and their conservation.
CO2 To identify the causes, effects of environmental pollution and natural disasters and contribute to the preventive measures in the society.

CO3 To identify and apply the understanding of renewable and non-renewable resources and contribute to the sustainable measures to preserve them for future generations.

CO4 To recognize the different goals of sustainable development and apply them for suitable technological advancement and societal development.

CO5 To demonstrate the knowledge of sustainability practices and identify green materials, energy cycles and the role of sustainable urbanization.

TEXTBOOKS:

REFERENCES:

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* 1’ = Low; ‘2’ = Medium; ‘3’ = High
COURSE OBJECTIVE:
This course aims at imparting knowledge in the technology of making different types of light leathers from skins.

UNIT I PROPERTIES OF LEATHER
Classification of leathers, Definition of various leather properties, Understanding and measurement of properties, Relevance and significance of various leather properties in manufacture and usage for different end application. Raw material availability and significance of imported in skins in light leather manufacture.

UNIT II UPPER AND LINING LEATHERS
Shoe upper, lining leathers: Choice of raw materials, relationship between each leather property and process parameter; Rational of preparation of the same.

UNIT III GARMENT AND GLOVE LEATHERS
Garment nappa, fine glove leathers: Choice of raw materials, relationship between each leather property and process parameter; Rational of preparation of the same.

UNIT IV OTHER SPECIALITY LEATHERS
Chamois, suede garment, glazed kid leathers, Fur on leather etc: Choice of raw materials, relationship between each leather property and process parameter; Rational of preparation of the same.

UNIT V LIGHT LEATHER MANUFACTURE
Process of manufacture of leathers such as glazed kid, nappa garment, fine glove, suede garment and lining; Quality control aspects with special reference to light leather manufacture.

COURSE OUTCOMES:
CO1. Summarize the property variations of different leathers.
CO2. Design and Design suitable processing variations that are required to manufacture leather from skin.
CO3. List out the various method to develop specialty leathers from skin.
CO4. Explain and understand the leather property and process parameter.
CO5. Comprehend the quality control aspects of light Leather.

TEXT BOOKS AND REFERENCES:
3. CLRI Process Bulletins.

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PTLT3302 THEORY OF ORGANIC TANNAGES L T P C 3 0 0 3

COURSE OBJECTIVE: At the end of this course, the students will have knowledge on the chemistry of various vegetable and organic tanning agents and the mechanism of their interaction with the skin protein - Collagen.

UNIT I VEGETABLE TANNINS 14
Vegetable tannins - definition and classification, Occurrence, Biosynthesis; Chemistry of hydrolysable tannins - gallotannins, ellagi tannins - their structural aspects including tannin dimers, trimers, etc., Chemistry of condensed (flavanoid) tannins proanthocyanidins, dimers, trimers and other oligomers - Isolation and characterization of vegetable tannins.

UNIT II CONSTITUENTS OF VEGETABLE TANNING MATERIALS 7
Tannins as well as non-tannins, polyphenolic constituents present in popular tanning materials like avaram, konnam, wattle, cutch, babul, myrobalan, etc., and their physicochemical properties and their effect on the physical properties of leathers.

UNIT III MECHANISM AND PRACTICE OF VEGETABLE TANNING 10

UNIT IV OTHER ORGANIC TANNAGES 8
Mechanism of tanning with Aldehyde, Dialdehydes, oil, Sulphonyl chloride, Quinone, oxazolidine, phosphonium and other organic tanning agents; wet white leathers; Synthetic tannins - Classification - properties, uses in leather industry - Mechanism of reaction with collagen.

UNIT V PREPARATION OF VEGETABLE TANNIN EXTRACTS AND SYNTHETIC TANNING AGENTS 6
Methods of preparation of vegetable tannin extracts, spray dried vegetable tannins, synthetic and other organic tannages.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
At the end of the course, the students will be in the position to,
CO1. Summarize the basic structure and classification of veg tannins.
CO2. Make use of different constituents of veg-tannages to assess the tanning chemistry.
CO3. Comprehend the chemistry of vegetable tannins and mechanism of vegetable and organic tanning.
CO4. Explain the mechanism of various organic tannages.
CO5. Formulate the method of preparation of the veg tannins and syntans.
TEXT BOOKS AND REFERENCES:
2. Rodd, “Chemistry of carbon compounds”, Vol. III-D, Chapter on “Hydrolizable tannins”.

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PTLT3303 PRINCIPLES OF TESTING FOR LEATHER

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

UNIT I ANALYSIS OF LEATHER CHEMICALS
Principles of analytical methods employed in analysis of pretanning chemicals – Lime, unhauling, deliming and bating agents; Vegetable tanning materials and extracts; Aldehydes; Chrome extracts and liquors; Principles of analytical and instrumental methods employed in analysis of syntans, dyes, oils and fats, fatliquor, finishing auxiliaries. Specifications recommended by standards organizations.

UNIT II ANALYSIS OF PROCESS LIQUORS AND EMISSIONS
Principles of analytical methods employed in analysis of pretanning chemicals – Lime, unhauling, deliming and bating agents; Vegetable tanning materials and extracts; Aldehydes; Chrome extracts and liquors; Principles of analytical and instrumental
methods employed in analysis of syntans, dyes, oils and fats, fatliquor, finishing auxiliaries. Specifications recommended by standards organizations.

UNIT III ANALYSIS OF LEATHERS
Principles of analytical and instrumental methods employed in analysis of various chrome leathers, vegetable tanned leathers; Specifications recommended by standards organizations. Principles of analytical and instrumental methods employed in analysis of eco-sensitive substances- Pentachlorophenol (PCP), Formaldehyde, Hexavalent chromium [Cr(VI)], azodyes etc., present in finished leathers.

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

UNIT V PHYSICAL TESTING OF LEATHERS
Orientation of fibre structure of skins/hides and leathers using various microscopes; Sampling position for physical testing of leathers. Different physical testing methods - principles involved. Static and Dynamic methods, Non-destructive testing of leathers.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
At the end of the course, the student would understand,
CO1. Explain the analytical chemistry behind the testing of leather chemicals and leathers.
CO2. Apply the various techniques for analysing leather chemicals, spent process liquors, and pelts/leathers.
CO3. Classify the quality Standards of various leather chemicals and leather end products.
CO4. Perceive the importance of microbiology testing techniques of leathers.
CO5. Discuss the various physical testing methods of leathers.

TEXT BOOKS AND REFERENCES:

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PTLT3304 INSTRUMENTAL METHODS OF ANALYSIS

COURSE OBJECTIVE: To introduce various methods of chemical analysis through sophisticated instruments for accuracy.

UNIT I INTRODUCTION TO SPECTROSCOPICAL METHODS OF ANALYSIS

Electromagnetic radiation; Various ranges, Dual properties, Various energy levels, Interaction of photons with matter, absorbance, and transmittance and their relationship, permitted energy levels for the electrons of an atom and simple molecules, classification of instrumental methods based on physical properties. Various transitions in organic and inorganic compounds effected by UV, visible and infrared radiations, various energy level diagrams of saturated, unsaturated and carbonyl compounds, excitation by UV and Visible radiations.

UNIT II MOLECULAR SPECTROSCOPY


1H NMR Spectroscopy: Introduction to NMR; isotope ratios, nuclear spin; chemical shifts, coupling constants and integration; Fourier transform technique. Chemical shifts, coupling constants and correlation with structure and stereochemistry. Long range coupling; magnetic and chemical shift equivalence; first and second order spectra.

UNIT III ATOMIC SPECTROSCOPY

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

UNIT IV POLARIMETRY, REFRACTOMETRY AND THERMAL ANALYSIS

Polarimetry and refractometry Principle, instrumentation and Applications. Thermogravimetry: Instrumentation, applications, thermograms of some important compounds; Differential thermal analysis: principle, Instrumentation and applications, Principles and applications of DSC, DTA in leather and leather chemicals.

UNIT V CHROMATOGRAPHIC METHODS

Classification of chromatographic methods, column, Thin layer, paper, Gas, GPC, High performance liquid chromatographical methods (principles, mode of separation, instrumentation and technique) for the analysis of leather auxiliaries.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1. Illustrate gain fundamental knowledge about the electromagnetic spectrum and its limitations.
CO2. Develop and understand the underpinning science behind molecular spectroscopy.

CO3. List out the various principles of atomic spectroscopy and its application.

CO4. Explain the concept of various physico-chemical analytical methods.

CO5. Elaborate the various chromatographic techniques for leather chemical analysis.

**TEXT BOOKS AND REFERENCES:**

**COURSE ARTICULATION MATRIX:**

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**PTLT3311 CHEMICAL TESTING AND ANALYSIS LABORATORY**

**COURSE OBJECTIVE:** To provide practical knowledge and the skill on chemical analyses of various leather chemicals, process liquors, effluent and pelts/leathers at various stages of processing and eco-sensitive chemicals present in leather.

**Analysis of Lime**
- Purity of lime
- Total bases

**Analysis of Deliming Agents**
- Analysis of ammonium salts
- Analysis of boric acid

**Analysis of Bate Agent**

**Enzyme Assay**

**Analysis of Vegetable Tanning Materials**
- Qualitative analysis
- Quantitative analysis
- Acids and salts in vegetable tannin extracts by different methods

**Analysis of Chrome tanning agents**
- Moisture
- Cr2O3 content
- Acid combined with chromium
- Basicity: Proctor and Lehigh basicities
- Degree of olation
Analysis of Syntans
Quantification of phenolic content and free formaldehyde

Analysis of Oils and fatliquors
a. Moisture
b. Acid value
c. Saponification value
d. Iodine value
e. Free fatty acids
f. Un-saponifiables
g. Total alkalinity

Chemical Analysis of pelts and leathers

**COURSE OUTCOMES:**
CO1. Illustrate the practical experience and understanding on the analysis of various leather chemicals.
CO2. Determine the practical knowledge on pelts/leathers analysis.
CO3. Solve and propose to understand the challenges of eco-sensitive substances and their qualitative and quantitative analytical methods.

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**SEMESTER IV**
**PTLT3401**
**LEATHER CHEMICALS**

**L T P C**
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**COURSE OBJECTIVE:** To impart knowledge on the chemistry and properties of various auxiliaries used in leather processing.

**UNIT I**
**INTRODUCTION**
8
Leather Auxiliaries – Roles and Functions, Classification of Auxiliaries based on applications and chemistry.
Leather chemicals – Roles and functions, classification of leather chemicals based on application.

**UNIT II**
**SYNTANS**
10
Syntans – Introduction to raw materials and background to relevant chemistries of production such as sulfonation, condensation, polymerisation etc. Technology for preparation of aromatic sulfonic acid – formaldehyde /urea-formaldehyde and sulfone based syntans. Role of syntan product chemistries in obtaining desired feel in leather. General manufacturing principles of acrylic, PU and other polymeric syntans.

**UNIT III**
**FATLIQUORS**
9

UNIT IV DYE AND PIGMENTS


UNIT V FINISHING CHEMICALS


COURSE OUTCOMES:

At the end of this course, the students are expected to,
CO1.Classify and explore leather auxiliaries and leather chemicals.
CO2.Acquire indepth knowledge on synthetic tanning agents.
CO3.Comprehend chemistry of oil and oil modification for the leather lubrication.
CO4.Explore the physical chemistry of colloids.
CO5.Analyse the chemistry of finishing chemicals.

TEXT BOOKS AND REFERENCES:


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COURSE OBJECTIVE: To provide orientation on the machineries used for leather and leather products manufacture.

UNIT I  MECHANICAL POWER TRANSMISSION AND FLUID POWER SYSTEMS  9
Machine elements bearing, shafts keys and coupling shaft. Introduction to mechanical power transmission system components - Belts, chains, Gears and Cams. Introduction to Fluid power – Advantages and Applications – Fluid power systems – Types of fluids - Properties of fluids. Pumps, compressor, control valves and actuator used in fluid power system.

UNIT II  PRINCIPLES AND OPERATION OF LEATHER PROCESSING MACHINERIES  9
Salient features, purpose and mechanism of working of the various machinery used in beam house, tanning and finishing yards - unhairing, fleshing, scudding, sammying, setting, shaving, staking, buffing, dedusting, glazing machines, finiflex, hydraulic press, curtain coating, roller coating, transfer coating, autospray, driers, measuring machine. latest trends and innovations in leather processing machinery, including the use of automation, robotics, and data analytics for improved efficiency and productivity.

UNIT III  PRINCIPLES AND OPERATION OF LEATHER PRODUCT MACHINERIES  9
Salient features and purpose and mechanism of working of the various machinery used in leather product manufacturing – Clicking, Splitting, Skiving, sewing machines – Flat bed, Post bed, Cylinder bed machines, strap cutting machine, lasting machines – Forepart lasting, Heel seat lasting, Side lasting, Post lasting machines, Heat setting, Ponding, Roughing, Heat activator, Sole pressing, Shoe polishing machine. prevailing technological developments and their impact on these machines and their operations.

UNIT IV  TRANSPORT SYSTEMS AND AUTOMATION IN LEATHER PRODUCT MANUFACTURING  9

UNIT V  LAYOUT AND MAINTENANCE  9
Lay out for a small/medium tannery and leather product unit. Arrangements of machines as per the sequence of operation for standard leather processing/ product making. Preventive maintenance and safety utilizing digital systems and real-time monitoring tools in the use of leather and leather product machineries.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
At the end of the course, the students will be in the position to,
CO1. Explain the knowledge of mechanical power transmission and fluid power systems.
CO2. Choose and construct the working principles of leather processing machineries.
CO3. Explain the working principles of leather product machineries.
CO4. Evaluate the transport systems and automation in leather product manufacture.
CO5. Elaborate the layout and maintenance of tannery and leather product unit
TEXT BOOKS AND REFERENCES:

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PTLT3411  PHYSICAL TESTING AND ANALYSIS LABORATORY  L T P C  0 0 3 1.5

COURSE OBJECTIVE: To provide practical knowledge on microscopical and microbiological testing of leathers and physical testing of leathers.

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

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

PHYSICAL TESTING LAB
Strength Properties
a) Tensile Strength and Elongation at break
b) Tongue tear strength
c) Stitch tear and slit tear strengths

**Fastness Properties**
- a) Rub fastness
- b) Light fastness

**TOTAL: 45 PERIODS**

**COURSE OUTCOMES:**
At the end of the course, the students would have practical experience and understanding in,
CO1. Summarize the various microscopical analysis/identification of leathers.
CO2. Analyze the various microbiological testing of raw skins/hides, pelts and leathers and various process liquors.
CO3. Demonstrate the various physical testing methods for assessing leathers

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**SEMESTER V**

**PTLT3501**

**THEORY OF LEATHER FINISHING**

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**COURSE OBJECTIVE:** To impart knowledge on materials and processes/operations involved in leather finishing.

**UNIT I SURFACE COATING**
Finishing vs DGFT norms; Updates in the export of finished leathers; Theory of surface coating; Characteristics of various components of coating system; Parameters of the process of coating and its influence on coating characteristics; Testing of coatings.

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

**UNIT III POLYMERIC MATERIALS AND THEIR DISPERSION FORMS**
General introduction to addition and condensation polymerization; various methods of polymerisations, resins binders - acrylics, vinyls and urethanes, protein binders, cellulose nitrate, cellulose acetate butyrate, - protein binders - lacquers - emulsion and emulsifiers - evaluation and control - solvents and thinners.

**UNIT IV PRINCIPLES OF FINISHING, FINISH FORMULATIONS AND THEIR APPLICATION**
Impregnation: Terminology, types of impregnating binders, characteristics, selection of systems for corrected and full grain impregnation, formulations, application methods and precautions

Finishing: Definition, aims, film formation mechanisms, properties of films such as glass transition temperature / minimum film forming temperature, transparency, gloss and resistance to heat, light and solvent. Binder to pigment ratio, plasticizer, wetting agents, role in dispersion and stability - requirements in multiple coat technique – such as clearing coat, sealer coat, base coat, top and feel coat. Single coat composition methods like spraying, curtain coating, roller coating etc. Compact finishing systems and their advantages. Cationic finishes and their relative merits. Foam finish; Eco-friendly finishing - Volatile Organic Compounds (VOC) reductions. Finish formulation for various types of leathers.

UNIT V  VARIOUS FINISHING METHODS AND TECHNIQUES  9
Role of equipment like HVLP spray, Roller coats, Continuous embossing machines, Finiflex, etc. Methods such as oil pull-up, waxy, burnishable, antique, grain suede, screen printing, roller printing, tie and dye finishing. Pearl finishing, easy-care and patent finishing, cationic finishing, foam finishing, transfer foil, lamination, transfer coating, texture modification/creation using perforation, scaling, engraving and foil transfer. Finishing of leather products and components. Maintenance of leather products and easy care steps.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
On the completion of the course students are expected to,
CO1. Demonstrate the role of various finishing agents and auxiliaries used in leather finishing.
CO2. Inspect the various strategies for finishing different types of leathers.
CO3. Categorize the various upgradation technologies for enhancing value to low grade substrates.
CO4. Perceive the application of different machineries used in leather finishing.
CO5. Discuss the principles of finishing mechanisms.

TEXT BOOKS AND REFERENCES:
3. Treatise on coating, Misers and Long Ed. Marcel Dekker, New York (5 Vol.).

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1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively.
COURSE OBJECTIVE: To impart knowledge on biotechnological applications in processing of skins into leather.

UNIT I PROTEINS, NUCLEIC ACID AND ENZYMEOLOGY 9

UNIT II GENETIC ENGINEERING (RECOMBINANT DNA TECHNOLOGY) 10

UNIT III ENZYMES FOR LEATHER PROCESSING 10
Cleaner Leather Processing: Use of enzyme options in beam house operations - Soaking, unhairing, bating, degreasing, offal treatment: Types of enzymes - proteases, lipases - properties, assay systems and production. Types of fermentation, Preparation of media, preparation of inoculum, separation and purification of products.

UNIT IV WASTE MANAGEMENT FOR LEATHER 8
General features of the organic and inorganic pollutants of tannery. Stabilization and disposal of organic and chemical wastes and their biological treatment. Possible energy generation from wastes.

UNIT V UTILISATION OF COLLAGENOUS TISSUES FOR BIOMEDICAL AND OTHER APPLICATIONS 8
Collagen and its application in food, cosmetic and medical fields.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
At the end of this course, the students are expected to,
CO1. Explore and understand the biotechnological concepts and its relevance for application in leather processing.
CO2. Acquire in depth knowledge in the principles of genetic engineering.
CO3. Analyse the different types of enzyme used for leather processing.
CO4. Articulate the waste management system for leather industries.
CO5. Acquire breadth of knowledge of collagen application.

TEXT BOOKS AND REFERENCES:
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PTLT3503 FINISHING TECHNIQUES

L T P C
3 0 0 3

COURSE OBJECTIVE: To impart knowledge on materials and processes/operations involved in leather finishing.

UNIT I INTRODUCTION
Preparing leather for finishing, grain clearing, wet pigmenting, buffing of grain surface, polishing, glazing, plating, printing and embossing, preparation of finishes.

UNIT II APPLICATION OF FINISHES
Pad coating, spray coating, Roller coating, design of Roller coater, curtain coating requirements, behaviour of curtain coating mixtures, drying conditions, fixation.

UNIT III FINISHING FOR DIFFERENT TYPES OF LEATHERS
Shoe upper leather, nappa leather, glaze kid leather, nubuck leather, suede leather, patent leather, corrected grain leather, pull-up leather, clothing leather.

UNIT IV NOVEL FINISHING TECHNIQUES
Role of newer equipments like auto spray, roller coats, continous embossing machines, finiflex etc., Methods such as oil-pull-up, Waxy burnishable, antique, grain sueded, screen printing, roller coating, pearl finishing easy care and patent finishing.

UNIT V CLEANER FINISHING TECHNIQUES
Role of finishing equipment such as HVLP spray, foam finishing, etc. in cleaner perspective. Aqueous finishing concepts and formulation; Other novel finishing techniques to reduce VOC. Cleaner finishing of splits for shoe suede, garment suede, grain finished effect and specialty finishes - processing technologies and finishing techniques especially suited for the purpose. Upgradation of lower ends for better utilization.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
On the completion of the course students are expected to,
CO1. Outline the various finishing agents and auxiliaries used in leather finishing.
CO2. Summarize the various application methods of finishing
CO3. Categorize the different types of finished leathers
CO4. Evaluate and assess the various novel finishing techniques
CO5. Discuss and improve the new cleaner finishing techniques

TEXT BOOKS AND REFERENCES:
2. Patterson, P., Pigments - An Introduction to Theory of Physical Chemistry, Elsevier
   Northampton NN3 1JD, Reprinted 1995.

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PTLT3511 FINISHING PRACTICE LABORATORY L T P C
0 0 4 2

COURSE OBJECTIVE: To provide practical training in various methods of finishing of leathers.

Practical training/demonstration to students in the following areas:
- Modern methods of finishing
- Use of cross linkers, Feel modifiers
- Water repellent finish formulations
- Finishing using Roller coaters, Transfer coating m/c
- Cationic and foam finishing technologies
- Patent finishing using Roller Coaters
- Trouble shooting in finishing
- Finishing of various types of leathers – chrome-free, exotic, upholstery and water-repellent leathers
- Finishing of split leathers
- Finishing of leather components and leather products

TOTAL: 60 PERIODS

COURSE OUTCOMES:
At the end of this course, the students are expected to,
CO1. Illustrate the practical experience in finishing of various types of leathers.
CO2. Analyse the recent technology involved in leather finishing.
CO3. Compile the use of various machinery operation involving in leather finishing.
SEMESTER VI

PTLT3601  INDUSTRIAL ENGINEERING  L T P C  3 0 0 3

COURSE OBJECTIVE: To design and develop Industrial engineering manufacturing operations.

UNIT I  PRODUCT DESIGN AND DEVELOPMENT  9
Principles of product design, tolerance design; Quality and cost considerations; Product life cycle; Standardization, simplification, diversification; Value engineering and analysis; Concurrent engineering; Design for “X”.

UNIT II  WORK SYSTEM DESIGN  9
Taylor’s scientific management, Gilbreths’s contributions; Productivity – concepts and measurements; Method study, Micro-motion study, Principles of motion economy; Work measurement – time study, Work sampling, Standard data, PMTS; Ergonomics; Job evaluation and merit rating.

UNIT III  FACILITY DESIGN  9
Facility location factors and evaluation of alternate locations; Types of plant layout and their evaluation; Computer aided layout design techniques; Assembly line balancing; Materials handling systems.

UNIT IV  OPERATION RESEARCH  9
Linear programming – problem formulation, simplex method, duality and sensitivity analysis; Transportation and assignment models; Integer programming; Constrained and unconstrained nonlinear optimization; Markovian queuing models; Simulation – manufacturing applications.

UNIT V  PRODUCTION CONTROL  9
Forecasting techniques – causal and time series models, moving average, exponential smoothing, trend and seasonality; Aggregate production planning; Master production scheduling; MRP, MRP-II and ERP; Routing, scheduling and priority dispatching; Push and pull production systems, concepts of Lean and JIT manufacturing systems; Logistics, distribution, and supply chain management; Inventory – functions, costs, classifications, deterministic inventory models, quantity discount; Perpetual and periodic inventory control systems.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
At the end of this course, the students are expected to,
CO1. Compare and contrast the principles and costing of product design.
CO2. Classify and analyse the work system design and ergonomics.
CO3. Design and develop layout design techniques and material handling.
CO4. Explain operational research and simulation applications.
CO5. Develop forecasting techniques and classification of inventory models.

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PTLT3602 SUPPLY CHAIN MANAGEMENT L T P C
3 0 0 3

COURSE OBJECTIVE: Understand the scope and practice of business logistics and supply chain in service oriented firms.

UNIT I INTRODUCTION 9

UNIT II MANAGING FLOWS 9

UNIT III INVENTORY 9
UNIT IV  TRANSPORTATION


UNIT V  ORGANISATION AND CONTROL


TOTAL: 45 PERIODS

COURSE OUTCOMES:
At the end of this course, the students are expected to,
CO1. Acquire basic knowledge on logistics and supply chain management.
CO2. Explore the tools and practices for managing an organisation.
CO3. Analyse the importance and management of the inventory.
CO4. Elucidate the importance of transportation and strategies.
CO5. Elucidate on the organization structure and responsibilities for the supply chain management.

TEXT BOOKS AND REFERENCES:

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**PTLT3603  FOOTWEAR TECHNOLOGY  L T P C**

**3 0 0 3**

**COURSE OBJECTIVE:** To impart knowledge on the manufacture, evaluation and application of materials and components used in footwear manufacture.

**UNIT I  DESIGN AND PATTERN DEVELOPMENT**

9

Introduction to human foot and Footwear and its importance - Different types of Footwear based on Styles and Designs – Introduction to Last and its importance – Difference between Human foot and Last – Terminologies on the Last and its parts – Preparation of mean forme by using last – Preparation of of upper and lining standards.

**UNIT II  FOOTWEAR MATERIALS AND COMPONENTS**

9

Importance and vital role of leather in footwear and various types lathers used in footwear – Role of non-leather materials in footwear – Various components used in footwear and its specifications - Types Natural and Synthetic outsole materials – Threads and its quality parameters – Shank and its importance in footwear – Classification of Adhesives and its advantages and disadvantages – Adhesive properties and its quality parameters – Importance of inter-lining materials - Toe puff and counter stiffener - Types of Fasteners and grinderies.

**UNIT III  CUTTING, PRE-CLOSING AND CLOSING**

9

Types of upper and lining leathers based on finish and animal origin; Different types of Natural and Synthetic soling materials – Adhesives used in upper and full shoe manufacturing process; threads, shank, insole boards, reinforcement materials, types of fasteners and grinderies.

**UNIT IV  PRELASTING AND LASTING**

9

Principles and methods of Pre-lasting operations: Counter moulding, insole attaching and toe mulling – Lasting operations: Machine lasting (Toe, side & seat lasting) Sole preparation (Halogenation or roughening), sole cementing, Heat activation, Sole attaching process - Health and Safety control measures follows in shoe manufacturing line – Various Shoe dressing techniques – Quality checking parameters for finished shoe.

**UNIT V  DIFFERENT METHODS OF SHOE CONSTRUCTION**

9

Introduction to cemented construction, its advantages and disadvantages – Introduction to Machine sewn or McKay construction, its advantages and disadvantages – Introduction to Californian construction, its advantages and disadvantages – DVP & DIP constructions, its advantages and disadvantages.

**TOTAL: 45 PERIODS**

**COURSE OUTCOMES:**

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

CO1. Explain the basic of footwear design and the process of pattern development.
CO2. Identify various materials and components used in footwear fabrication process.
CO3. Develop skills on cutting process of various footwear materials
CO4. Outline the sequence of preclosing, closing and prelasting operations of basic footwear models.
CO5. Elaborate various footwear constructions.

**TEXT BOOKS AND REFERENCES:**

2. “Shoes and Leather News”, Published by bureau of foreign and domestic commerce, Dept of commerce, US, 1940.
3. B. Venkatappaiah, (1997), “Introduction to modern footwear technology” Chennai. -
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1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively.

PTLT3604 SAFETY IN LEATHER INDUSTRIES

COURSE OBJECTIVE: To impart knowledge on Occupational Safety and Hazard aspects in leather manufacture.

UNIT I SAFETY PHILOSOPHY, HAZARD IDENTIFICATION AND ASSESSMENT
Legal framework of safety and health in India International conventions and trends; Responsibilities and enforcement mechanism. Need for safety and health (cost/benefit rational; safety, environment and productivity triangle); Role of industrial hygiene, Hazard classification (hazard categories and groups), Hazard identification and assessment (tools and methods).

UNIT II SAFETY IN USE OF HAZARDOUS SUBSTANCES AT WORK
Chemical and biological hazards in the work place in the leather industry; Health effects of chemical and biological exposure Hazard information systems on hazardous substances (material safety data sheets, labelling), workplace exposure monitoring and evaluation, hazard prevention and control measures (storage, handling and disposal) in the leather industry.

UNIT III PRODUCTIVE MACHINE SAFETY IN THE LEATHER INDUSTRY, WORK ECOLOGY AND ERGONOMICS
Safety hazards of machinery, machine tools and electrical installations; Hazard prevention and safeguarding of machinery (guards, machine controls, ergonomics); Role of preventive maintenance; Safe workstation design and layout, Manual handling of material; Lighting (standards, use of natural and artificial illumination); Climate control (standards, temperature/humidity, improving general ventilation); Noise management (standards, prevention and protection); Safety of factory premises and installations (railings, flooring, safe structures); Welfare measures; Personal protection and hygiene (selection, use, maintenance).

UNIT IV EMERGENCY PREVENTION AND PREPAREDNESS
Planning for emergencies; Control of fire and explosion; Dealing with medical emergencies.

UNIT V SAFETY AND HEALTH MANAGEMENT AND PROMOTION 8
Promoting safety and health practices at the workplace (training, safety and warning signs); Role and responsibilities of managers, supervisors and workers.

COURSE OUTCOMES:
At the end of the course, the students will be in the position to,
CO1. Acquire knowledge on legal framework of safety and health, hazard identification and assessment methods
CO2. Analyse and understand Chemical and biological hazards in the work place.
CO3. Acquire knowledge on machinery safety, work ecology and ergonomics in the leather industry.
CO4. Comprehensive knowledge on emergency prevention and preparedness.
CO5. Acquire knowledge on safety and health management.

TEXT BOOKS AND REFERENCES:

COURSE ARTICULATION MATRIX:

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SEMESTER VII
PTLT3701 LEATHER GOODS AND GARMENTS TECHNOLOGY 3 0 0 3

COURSE OBJECTIVE: To impart knowledge on making leather goods and garments.

UNIT I OVERVIEW 9
Classification of Leather Goods and Garments; Selection of Materials, grading and assorting of leathers for leather goods and garments; Property requirements for leather and other materials; Accessories for Leather goods and garments - Various types of fasteners, fittings and other accessories. Alternative materials and their adaptability for goods and garments. Operational sequences in leather goods and garments production.
UNIT II OPERATIONS 10

Production planning: Nomenclature used for component identification in various leather garments skirts, jackets, trousers etc and various leather goods – Wallet, hand bags, Executive bags etc. Process scheduling and line balancing.


Assembling: Pre assembly and assembly operations – skiving, splitting, folding, sewing etc. Various types of assembly techniques for leather goods and garments.

Quality: Quality control measures in leather products manufacture.

UNIT III MACHINERY 9

Machinery needs for leather goods and garments manufacture. Various types of sewing machines – flat bed, cylinder bed, post bed and other special sewing machines – different feed mechanisms. Clicking, splitting, skiving, folding, embossing, creasing machines – their working principles operation and maintenance.

UNIT IV DESIGN AND DEVELOPMENT 9

Pattern design and development – measurement/ sizing for various types of garments, pattern design of leather goods and garments, pattern grading for leather garments. CAD applications for leather goods and garments. Fashion and material trends.

UNIT V ORGANISATION AND MANAGEMENT 8

Project Feasibility reports, plant lay out, costing and pricing for leather goods and garments. Analysis of International market trends for goods and garments – EU, USA and other markets. Social auditing of leather goods and garment units - occupational Health and Safety, ISO 9000 and 14000.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On the completion of the course students are expected to,

1. CO1. Explain the various materials and components for the manufacture of leather goods and garments. CO2. Develop and construct the various operations involved in making of leather good and garments.
2. CO3. Analyze and examine the working principle, operation and maintenance of different machineries used for making leather goods and garments.
3. CO4. Evaluate the various design and development of leather goods and garments.
4. CO5. Imagine and formulate the Organisation and management of leather goods and garments manufacturing unit.

TEXT BOOKS AND REFERENCES:

6. A course manual on leather garment pattern designing.
COURSE ARTICULATION MATRIX:

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PTLT3702 ECO-LABELLING FOR LEATHER SECTOR

L T P C 3 0 0 3

OBJECTIVE: To understand the importance of eco-labelling and practice on implementation of the eco-labelling standards in leather sector.

UNIT I INTRODUCTION TO ECO-LABELLING 8

UNIT II TYPES OF ECO-LABELLING 8
Type I – The ‘classic’ ecolabel, gold standard of eco-labelling; Type II – Self-declaration claims; Type III – Environmental declarations (report cards/information labels).

UNIT III GLOBAL STANDARDS AND FRAMEWORK FOR ECOLABELLING 11
Principles and procedures for developing Type I environmental labelling programmes; Selection of product categories, product environmental criteria and product function characteristics, and for assessing and demonstrating compliance. ISO 1450:2020 Environmental management — Vocabulary; ISO 14020:2022 Environmental statements and programmes for products — Principles and general requirements; ISO 14021:2016 Environmental labels and declarations — Self-declared environmental claims (Type II environmental labelling); ISO 14024:2018 Environmental labels and declarations — Type I environmental labelling — Principles and procedures; ISO 14025:2006 Environmental labels and declarations — Type III environmental declarations — Principles and procedures; ISO 14040:2006 Environmental management — Life cycle assessment — Principles and framework; ISO 14044:2006 Environmental management — Life cycle assessment — Requirements and guidelines

UNIT IV LEATHER SECTOR ECO-LABELLING 8
Impediment in the eco-labelling of leather sector. Technologies for leather sector to achieve environment friendly approaches.

UNIT V CASE STUDY 10

TOTAL: 45 PERIODS
COURSE OUTCOMES:
At the end of the course, the students are expected to,
CO1. Analyse eco-labelling significance in the leather sector.
CO2. Classify the types of eco-labelling.
CO4. Elucidate the requirement for the qualification of leather sector to eco-labelling.
CO5. Explore the implementation of the eco-labelling for leather sector.

TEXT BOOKS AND REFERENCES:
1. Ecolabelling and international trade, Simonetta Zarrilli, Veena Jha, Rene Vossenaar.
2. Green Marketing as a Positive Driver Toward Business Sustainability, Anitha Acharya.

COURSE ARTICULATION MATRIX:

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PTLT3703 REDUCE, REUSE AND RECYCLE L T P C 3 0 0 3

COURSE OBJECTIVE: To impart knowledge on reduce, reuse and recycle concepts in leather and leather products manufacture

UNIT I INTRODUCTION 10

UNIT II WASTE TO ENERGY 8
Introduction to waste production in different sectors such as slaughterhouse, tannery, goods and garments manufacture and footwear. Waste-to-Energy – combustion, gasification, pyrolysis, biomethanation, bio-refineries. Landfill gas generation, collection conversion to fuels for useful energy applications-engine, compressors, burners, lamps etc.
UNIT III WASTE RECYCLING
Waste recycling to recover resources – Slaughter house, tannery, goods and garment and footwear industry

UNIT IV WASTE UTILIZATION
Technologies for Waste Utilization and cleaner production processes in Leather manufacture (Beam house, Tanning, Post tanning and Finishing)

UNIT V CASE STUDIES
Case studies & implementation of waste utilization in different product sectors: Manufacturing process, pollution sources, waste characterization, waste reduction/reuse/recovery and final treatment methods for – Tanning industry; Garment; Goods; Footwear; ETPs

TOTAL: 45 PERIODS

COURSE OUTCOMES:
At the end of the course, the students are expected to,
CO1. Explain waste as a resource aspect.
CO2. Identify and analyse different waste generation methods in different product sectors.
CO3. Perceive knowledge on waste recycling and develop new products.
CO4. Justify the different methods of waste utilization and cleaner leather processing techniques.
CO5. Elaborate the effect of implementation of RRR in the industry.

TEXT BOOKS AND REFERENCES:

COURSE ARTICULATION MATRIX:

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1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively.
COURSE OBJECTIVES:
- Teach the need for quality, its evolution, basic concepts, contribution of quality gurus, TQM framework, Barriers and Benefits of TQM.
- Explain the TQM Principles for application.
- Define the basics of Six Sigma and apply Traditional tools, New tools, Benchmarking and FMEA.
- Describe Taguchi’s Quality Loss Function, Performance Measures and apply Techniques like QFD, TPM, COQ and BPR.
- Illustrate and apply QMS and EMS in any organization.

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

UNIT II  TQM PRINCIPLES

UNIT III  TQM TOOLS & TECHNIQUES I

UNIT IV  TQM TOOLS & TECHNIQUES II
Quality circles – Quality Function Deployment (QFD) - Taguchi quality loss function – TPM – Concepts, improvement needs – Performance measures- Cost of Quality - BPR.

UNIT V  QUALITY MANAGEMENT SYSTEM

COURSE OUTCOMES:
At the end of this course, the students are expected to,
CO1. Explain the TQM concepts in a selected enterprise.
CO2. Summarize the TQM principles in a selected enterprise.
CO3. Apply the six sigma, traditional tools, new tools, benchmarking and FMEA as TQM tools in leather manufacturing.
CO4. Analyze Taguchi’s Quality Loss Function and Performance Measures on leather manufacturing sector and apply QFD, TPM, COQ and BPR.
CO5. Adapt QMS and EMS in leather based organization.

TOTAL: 45 PERIODS
TEXT BOOKS AND REFERENCES:

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SEMINAR VIII

PTLT3801
QUALITY ASSURANCE FOR LEATHER
L T P C
3003

COURSE OBJECTIVE: To train the students to understand and implement quality assurance system in the leather manufacturing unit.

UNIT I INTRODUCTION TO QUALITY ASSURANCE
Definition of quality, fundamentals of statistics and probability, confidence intervals, testing significance, statistical process control techniques, analysis, defect diagnosis and prevention. Quality assurance- Definition, Importance of quality assurance, Quality Assurance vs. Quality Control, Pros and cons of QA, History of ISO and QA, QA standards.

UNIT II RAW MATERIAL QUALITY
Importance of raw material quality assessment in leather processing, Pre-tanning raw material assessment, tanning raw material assessment, post tanning raw material assessment, finishing raw material assessment.

UNIT III PROCESS CONTROL IN LEATHER PROCESSING
Process flow charts; In-process control check; Responsibilities; Calibration, validation and qualification of the pre-tanning, tanning, post tanning and finishing processes.

UNIT IV INTERMITTENT QUALITY CONTROL
Calibration, validation and qualification of the pelt/leather at intermittent stages – Limed pelt, pickled pelt, tanned leather, crust leather, finished leather.
UNIT V CASE STUDY
Implementation of the quality assurance system in the leather manufacturing unit.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
At the end of the course, the students are expected to,
CO1. Comprehend the importance of quality assurance in the leather sector.
CO2. Explore and understand the importance of the quality of raw materials for leather processing.
CO3. Acquire knowledge of the in process control of leather manufacturing.
CO4. Elucidate the qualification of the interment products.
CO5. Explore and analyse the implementation of the quality assurance for leather manufacturing.

TEXT BOOKS AND REFERENCES:

COURSE ARTICULATION MATRIX:

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PTGE3851 HUMAN VALUES AND ETHICS

COURSE DESCRIPTION
This course aims to provide a broad understanding about the modern values and ethical principles that have evolved and are enshrined in the Constitution of India with regard to the democratic, secular and scientific aspects. The course is designed for undergraduate students so that they could study, understand and apply these values in their day to day life.
COURSE OBJECTIVES:

- To create awareness about values and ethics enshrined in the Constitution of India
- To sensitize students about the democratic values to be upheld in the modern society.
- To inculcate respect for all people irrespective of their religion or other affiliations.
- To instill the scientific temper in the students’ minds and develop their critical thinking.
- To promote sense of responsibility and understanding of the duties of citizen.

UNIT I DEMOCRATIC VALUES


Reading Text: Excerpts from John Stuart Mills’ On Liberty

UNIT II SECULAR VALUES

Understanding Secular values – Interpretation of secularism in Indian context - Disassociation of state from religion – Acceptance of all faiths – Encouraging non-discriminatory practices.

Reading Text: Excerpt from Secularism in India: Concept and Practice by Ram Puniyani

UNIT III SCIENTIFIC VALUES


Reading Text: Excerpt from The Scientific Temper by Antony Michaelis

UNIT IV SOCIAL ETHICS

Application of ethical reasoning to social problems – Gender bias and issues – Gender violence – Social discrimination – Constitutional protection and policies – Inclusive practices.

Reading Text: Excerpt from 21 Lessons for the 21st Century by Yuval Noah Harari

UNIT V SCIENTIFIC ETHICS

Transparency and Fairness in scientific pursuits – Scientific inventions for the betterment of society - Unfair application of scientific inventions – Role and Responsibility of Scientist in the modern society.


TOTAL: 30 PERIODS

REFERENCES:

5. Research Methodology for Natural Sciences by Soumitro Banerjee, IISc Press, January 2022

COURSE OUTCOMES

Students will be able to
CO1: Identify the importance of democratic, secular and scientific values in harmonious functioning of social life.
CO2: Practice democratic and scientific values in both their personal and professional life.
CO3: Find rational solutions to social problems.
CO4: Behave in an ethical manner in society.
CO5: Practice critical thinking and the pursuit of truth.

COURSE OBJECTIVE: To make use of the knowledge gained by the student at various stages of the degree programme. This helps to judge the level of proficiency, originality and capacity for application of the knowledge attained by the student at the end of the programme. Each student is required to submit a report on the project undertaken by and assigned to him by the Department. The report should be based on the information available in the literature, plan of work, experimental details, data determined in the laboratory/industry, results, discussion of the data presented, conclusion and future work. Proper bibliographic details are necessary in the report.

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

TOTAL: 90 PERIODS

COURSE OUTCOMES:
At the end of this course, the students are expected to,
CO1. Identify a problem and define project objectives.
CO2. Plan and execute the project work.
CO3. Compare data and compile results.
CO4. Analyse and discuss the results.
CO5. Develop the skill to present and communicate the findings effectively.

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PROFESSIONAL ELECTIVES
PTLT3001   COMPUTER APPLICATIONS FOR APPAREL AND GOODS   L T P C
                      3 0 0 3

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

UNIT I  COMPUTER APPLICATION IN DESIGNING  7

UNIT II  HARDWARES IN COMPUTER APPLICATION  11
Introduction, Principles, Capabilities and operation of graphical workstations, central processing units, graphic terminals, input/output devices, interface and storage devices, net-working concepts of LAN and WAN. Digitization: 2D & 3D Coordinate extracting, principles of digital and analog conversion, digital input/output processing systems. CNC devices for computer aided cutting including laser and water jet, computer aided manufacturing.

UNIT III  PATTERN ENGINEERING USING CAD  9
Computerized techniques for pattern generation, grading and assessment of apparel and goods patterns, consumption calculations, pattern nesting and costing, stitching etc. through computerized techniques. Data Conversion techniques, DXF.

UNIT IV  PROTOTYPE MODELLING  9
Sketching, Manual Designing, Demonstrating – Aesthetic Appearance, Functionality; Digitization; Accessories; Detailing; Prototyping; Compiling Specifications; Sampling; Testing; Final Product.

UNIT V  RAPID PROTOTYPING AND PRODUCTION TECHNIQUES  9

TOTAL: 45 PERIODS

COURSE OUTCOMES:
On completion of the course students are expected to,
CO1. Explain the concepts of computer applications in leather goods and garments manufacturing.
CO2. Identify different hardware used for the computational leather goods manufacturing.
CO3. Apply CAD pattern engineering for the leather goods manufacturing.
CO4. Justify the computer application in prototype modelling.
CO5. Examine advanced computational techniques in CAD, rapid prototyping, simulation, 3D printing and robotics.

REFERENCES:
5. Desai and Abel, “Introduction to FEM”.
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### PTTL3002 AUTOMATION IN GARMENTS AND GOODS MANUFACTURE

#### COURSE OBJECTIVE:
The objective of this course is to present the students on basic concepts in industrial automation.

#### UNIT I FUNDAMENTAL CONCEPTS OF INDUSTRIAL AUTOMATION
Fundamental concepts in manufacturing and automation, definition of automation, reasons for automating. Types of production and types of automation, automation strategies, levels of automation.

#### UNIT II MANUFACTURING OPERATIONS
Automation in production systems, principles and strategies, Product/Production Relationships, Production concepts and Mathematical models, Manufacturing Economies.

#### UNIT III NUMERICAL CONTROL AND ROBOTICS

#### UNIT IV AUTOMATION FOR APPAREL AND GOODS INDUSTRY

#### UNIT V PREVENTIVE MAINTENANCE AND SAFETY USING SOFTWARES

#### TOTAL: 45 PERIODS

### COURSE OUTCOMES:
At the end of this course, the students are expected to,

- CO1. Summarize the requirements of automation in manufacturing systems.
- CO2. Identify the techniques of machinery automation and shop floor automation.
- CO3. Apply basic numeric control used for automation process.
- CO4. Design the process of automation in apparel and goods manufacturing process.
- CO5. Interpret required preventive maintenance and safety in the apparel and goods industry.
TEXT BOOKS AND REFERENCES:

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PTLT3003 PRODUCT MERCHANDISING IN GARMENTS AND GOODS INDUSTRY 3 0 0 3

COURSE OBJECTIVE: To impart knowledge on leather products merchandising that relates to the domestic and global leather and leather product merchandising.

UNIT I BASICS OF APPAREL MERCHANDISING
Introduction, Functions and role of Merchandiser, Merchandising Process, Meaning and Need for quality control in Merchandising process.

UNIT II PURCHASING PRINCIPLES AND MANAGEMENT
Purchasing scope and development - Strategic aspects of purchasing - Key purchasing -variables consideration - Purchasing negotiations and competitive – Bidding - Outsourcing -purchasing operation - Buying capital goods and services - Purchasing for resale - Purchasing systems and technology - Evaluation of purchasing performance - Purchasing ethics and legal issues.

UNIT III PRINCIPLES AND PRACTICE OF MERCHANDISING
Merchandising concepts, technology, systems, planning - Merchandise pricing and budgeting, sample handling - Managing merchandise assortments - Developing and - presenting product lines - Introduction to shipping operation.

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

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

TOTAL: 45 PERIODS

COURSE OUTCOMES:
At the end of this course, the students will be in the position to understand,
CO1. Explain the basic principles of merchandising.
CO2. Apply the purchasing principles and management for product merchandising.
CO3. Illustrate the fundamentals of procurement and merchandising.
CO4. Justify basic knowledge of retail sector.
CO5. Discuss the global marketing and global sourcing

TEXT BOOKS AND REFERENCES:

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PTLT3004 GARMENTS AND GOODS MARKET TRENDS AND FASHION FORECASTING L T P C 3 0 0 3

COURSE OBJECTIVE: The objective of this course is present the students on the fashion trends and their consideration in product development.
UNIT I  INTERNATIONAL TRENDS OF GOODS AND GARMENTS MARKET  6

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 leather and non-leather Goods and Garments; Market Strategy - Prototype Development - Field test and evaluation - Standard preparation - Second prototype - Final run; Costing.

UNIT IV  PRESENTATION TECHNIQUES  8
Organisation 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 apparel and goods production and marketing.

COURSE OUTCOMES:
At the end of this course, the students are expected to,
CO1. Summarize on market strategy for developing a new product.
CO2. Identify the factors contributing to the fashion trends in leather goods industry.
CO3. Classify different methods on design and new product development.
CO4. Develop the art portfolios and explain the different presentation techniques.
CO5. Plan the fashion trend and forecasting analysis.

TEXT BOOKS AND REFERENCES:
1. Apparel Product Design and Merchandising Strategies by Cynthia L. Regan. Publisher: Prentice Hall

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1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively.
COURSE OBJECTIVE: The objective of this course is present students on the quality control and management aspects associated with manufacturing apparel and goods.

UNIT I  MODELING AND STATISTICAL INFERENCES

UNIT II  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 III  TESTING STANDARDIZATION
Significance of Testing for assessment of Apparel and Goods Performance; List of testing and their methodology.

UNIT IV  QUALITY TESTING IMPROVEMENT
Concepts of TQM, TQC, KANBAN, Zero defects, JIT – continuous improvement – HRD in quality management – quality grades, Dr. Deming’s 14 points management concept, TQA.

UNIT V  QUALITY ASSURANCE SYSTEM
Introduction to ISO – 9000 and 14000 and related international /national standards, case study.

COURSE OUTCOMES:
At the end of this course, the students are expected to,
CO1. Outline various statistical methods for leather goods sector.
CO2. Apply the concept of quality.
CO3. Analyze various Testing standards.
CO4. Improve the quality management system.
CO5. Apply ISO-9000 and 14000 for leather product industry.

TEXT BOOKS AND REFERENCES:

COURSE ARTICULATION MATRIX:

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TOTAL: 45 PERIODS
1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively.

PTLT3006 MACHINERIES FOR APPARELS AND GOODS MANUFACTURE  L T P C  3 0 0 3

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

UNIT I MACHINERIES FOR APPARELS MANUFACTURING  9

UNIT II MACHINERIES FOR GOODS MANUFACTURING  9

UNIT III ADVANCEMENT IN MACHINERIES  10

UNIT IV MODULAR MANUFACTURING AND PLANT LAYOUT  11
Productivity improvements: scheduling, simulation, Toyota and lean manufacturing system. Factor affecting plant location and construction of factory building for balancing the production line in apparel and goods industry.

UNIT V PREVENTIVE MAINTENANCE AND SAFETY  6
Preventive maintenance and safety in the use of apparel and goods machinery.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
At the end of this course, the students will be able to understand the working principles of machineries used in apparel and goods manufacture and their use and maintenance. The students also understand the following,
CO1. Explain various machineries used in apparel and goods manufacture.
CO2. Identify the features and purpose of the various machinery used.
CO3. Interpret the preventive maintenance and safety in the use of apparel and goods machinery.
CO4. Examine the malfunction of various product machineries.
CO5. Design of optimal machinery layout in apparel and goods unit.

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

COURSE ARTICULATION MATRIX:

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PTLT3007          COMPUTER APPLICATIONS FOR FOOTWEAR   L T P C  
                                                                 3 0 0 3

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

UNIT I   INTRODUCTION FOR CAD IN FOOTWEAR MANUFACTURE   9
Starting AutoCAD – AutoCAD screen components – Starting a drawing: Open drawings, create drawings (Start from scratch, use a template & Use a wizard) – Invoking commands in AutoCAD – Drawing lines in AutoCAD – Co-ordinate systems: Absolute co-ordinate system, Relative co-ordinate system – Direct distance method – Saving a drawing: Save & Save As – Closing a drawing – Quitting AutoCAD.

UNIT II   CAD FOR PATTERN MAKING   8
Introduction to different types tool bar in footwear cad, draw tools, designing tools, pattern tools, grading tools, editing tools and making marking and other output related tools, ideas about geometric primitives. Create pattern, general elements, attach and detach GP, exchange boundary, exchange axis, pattern properties, attach element detach element and pattern editing.

UNIT III LAST MODELLING   10
Digitization with 3D Scanner; manipulation and optimization of digitized last; use of macros; last comparison; grading wizard; flattening; 3D visualization of last and styles; concept of e-last; introduction to sole and sole mould design.

UNIT IV   ADVANCED COMPUTATIONAL TECHNIQUES   8
Principles and practice of foot scanner; conversion of foot dimensions to last model; creation of still files for last manufacture; simulation – concepts and applications; robotics: concepts and applications in footwear manufacture; 3D Printing: concepts and applications in footwear manufacture.
UNIT V  COMPUTER AIDED MEASUREMENT AND CONTROL SYSTEMS  10
Role of computers in measurement and control, Elements of computer aided measurement and control, man-machine interface, computer aided process control hardware, process related interfaces, Communication and networking, Industrial communication systems, Data transfer techniques, Computer aided process control software, Computer based data acquisition system, Internet of things (IoT) for plant automation.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
On completion of the course students are expected to,
CO1. Explain the concepts of computer applications in footwear sector.
CO2. Apply CAD for pattern engineering for footwear pattern making.
CO3. Analyze the computer application in sole modelling for footwear.
CO4. Examine the advanced computational techniques in footwear application.
CO5. Recommend the application of computer in measurement and control systems.

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

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PTLT3008  AUTOMATION IN FOOTWEAR MANUFACTURE  L T P C  3 0 0 3

COURSE OBJECTIVE: The objective of this course is to present the students on basic concepts in industrial automation.
UNIT I  INTRODUCTION TO AUTOMATION  9

UNIT II  INTRODUCTION TO MACHINE LEARNING  9
Philosophy of learning in computers, Overview of different forms of learning, Classifications vs. Regression, Evaluation metrics and loss functions in Classification, Evaluation metrics and loss functions in Regression, Applications of AI in Robotics.

UNIT III  AUTOMATION COMPONENTS  9
Sensors for temperature, pressure, force, displacement, speed, flow, level, humidity and pH measurement. Actuators, process control valves, power electronics devices DIAC, TRIAC, power MOSFET and IGBT. Introduction of DC and AC servo drives for motion control.

UNIT IV  TOTALLY INTEGRATED AUTOMATION  9
Need, components of TIA systems, advantages, Programmable Automation Controllers (PAC), Vertical Integration structure.

UNIT V  AUTOMATION FOR FOOTWEAR INDUSTRY  9

TOTAL: 45 PERIODS

COURSE OUTCOMES:
At the end of this course, the students are expected to,
CO1. Explain the basics of automation in manufacturing systems.
CO2. Summarize the basic knowledge on machine learning.
CO3. Apply the techniques of machinery automation and shop floor automation in footwear manufacturing.
CO4. Analyze the totally integrated automation system in the manufacturing unit.
CO5. Design the process of automation in footwear manufacturing process.

TEXT BOOKS AND REFERENCES:

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1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively.
COURSE OBJECTIVE: To impart knowledge on leather products merchandising that relates to the domestic and global leather and leather product merchandising.

UNIT I INTRODUCTION TO MERCHANDISING 9

UNIT II PRINCIPLES OF MARKETING MANAGEMENT 9

UNIT III MARKETING MANAGEMENT 9
Functions of a Merchandiser - Types of Samples - Sample Quality and Sample Order - Expediting Procedures - Record Maintenance - Approval, Types of Approvals - Check Points for a Proper Approval - Approving Sewing Operations & Various Processes.

UNIT IV PRACTICE OF MERCHANDISING 9
Time Management - Production Scheduling - Route Card Format - Accessories Follow-Up - Various Processes Follow-Up & Practical Check Points. Pattern Approval - Size Set Approval Procedures - Pre - (Pilot Run Inspection) - Order Execution Procedures.

UNIT V RETAIL MERCHANDISING 9
Fashion Merchandising vs. Retail Merchandising, Job Objectives of Retail Merchandising, Definition of Promotional Merchandising, Visual Merchandising Techniques, Sales Focused Merchandising, Outlet Vs. Retail, SWOT Analysis for Retail. The Advantages of Retail Outlets.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
At the end of this course, the students will be in the position to,
CO1. Explain the basic principles of merchandising.
CO2. Apply the principles of marketing management.
CO3. Summarize the importance of marketing management.
CO4. Design the fundamentals of structure of procurement and merchandising.
CO5. Outline the basic of retail sector.

TEXT BOOKS AND REFERENCES:
4. John D. Daniels Lee H Radebaugh, International Business: Environments and

COURSE ARTICULATION MATRIX:

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PTLT3010 FOOTWEAR MARKET TRENDS AND FASHION FORECASTING L T P C
3 0 0 3

COURSE OBJECTIVE: The objective of this course is present the students on the footwear fashion trends and their consideration in product development.

UNIT I INTERNATIONAL TRENDS OF FOOTWEAR MARKET
Historical evaluation of footwear styling. Seasonal influences on fashion, cultural and geographical instances on footwear fashion. Market research and track record.

UNIT II TREND FORECASTING
Trend forecasting: Importance of forecasting, Elements of forecasting, Principles of forecasting, Theories explaining forecasting, Steps in forecasting, Major areas of forecasting, Advantages and limitations in forecasting.

UNIT III FASHION FORECASTING

UNIT IV FASHION FORECASTING PROCESS

UNIT V COLOUR FORECASTING

TOTAL: 45 PERIODS

COURSE OUTCOMES:
At the end of this course, the students are expected to,
CO1. Explain the market strategy for developing a new product.
CO2. Identify the factors contributing to market trends in footwear industry.
CO3. Classify the different methods on design and new product development.
CO4. Analyze the fashion forecasting of the footwear.
CO5. Perceive the colour forecasting techniques.

TEXT BOOKS AND REFERENCES:
3. “Shoes and Leather News”, Published by bureau of foreign and domestic commerce, Dept of commerce, US, 1940.

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PTLT3011 PRINCIPLES OF TESTING FOR FOOTWEAR AND COMPONENTS

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

UNIT I INTRODUCTION TO LEATHER AND NON-LEATHER FOOTWEAR AND COMPONENTS AND STANDARDS IN TESTING 9
Types of footwear - Boots, Pumps shoes, Slippers, Trainers, Sports footwear, Sandals, Casuals.
Types of Footwear components - Whole shoe, Upper – Vamp, Quarter – Tongue, Toe Puff, Lining – Vamp lining, Quarter lining, Counter stiffeners, Heels and heel grips, shanks, Insole, Insock, Top-piece attachments, Elastics and Velcros, Adhesives, Laces, Metallic components - Buckles, Eyelets, Fasteners, Outsoles.
Indian and International Footwear testing standards and specifications and implementations.

UNIT II PHYSICAL TESTING OF FOOTWEAR COMPONENTS – LEATHER AND NON-LEATHER 9
Components and materials specific mechanical tests - Quantitative and Qualitative assessment – Tensile strength, Flex resistance, Upper-outsole bond, Attachment strength, Lastometer, Burst strength, Seam and Stitch tear strength, Sole Slip,
Flexing, Density and Abrasion resistance, Hardness, Color fastness properties, Tests for Zips, Touch and close fasteners, Eyelets and other metallic and non-metallic components testing, Waterproofness and Comfort properties, Safety footwear types and their test methods

UNIT III CHEMICAL TESTING OF FOOTWEAR COMPONENTS - LEATHER
Restricted substance list (RSL) - Aromatic amines released from Azo dyes - Chromium (VI) estimation - Polychlorophenols estimation - Formaldehyde estimation- Dimethyl fumarate (DMFu) estimation - Organotin estimation - Phthalate (If Coated leather) estimation - pH value.

UNIT IV CHEMICAL TESTING OF FOOTWEAR COMPONENTS - TEXTILE
Aromatic amines released from Azo dyes- Allergenic and carcinogenic disperse dyes Determination-Formaldehyde estimation- Dimethyl fumarate (DMFu) Estimation- Organotin Estimation-Pthalate estimation- pH value.

UNIT V CHEMICAL TESTING OF FOOTWEAR COMPONENTS - POLYMERIC MATERIAL AND METAL COMPONENT
Polymeric material: Dimethyl fumarate (DMFu) Estimation-Organotin estimation - Phthalate estimation. Metal component: Nickel, on skin contact.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
At the end of this course, the students are expected to,
CO1. Explain basic on leather and non-leather footwear and footwear components.
CO2. Identify the physical testing standards for the leather and non-leather footwear components.
CO3. Analyze the various chemical testing standards of leather footwear components.
CO4. Appraise various chemical testing standards of textile footwear components.
CO5. Aware of various chemical testing standards of the polymeric and metal based footwear components.

TEXT BOOKS AND REFERENCES:
3. Personal Protective Equipment, IS 15298 (PART1).
4. IS 15844: SPORTS FOOTWEAR – SPECIFICATION.

COURSE ARTICULATION MATRIX:

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1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively.
COURSE OBJECTIVE: To impart theory and practical knowledge on the working principles, use and maintenance of machineries used in Footwear manufacture.

UNIT I  MACHINERIES FOR PRECLOSING  10

UNIT II  MACHINERIES FOR CLOSING  10
Needle: Parts of Needle and their role; Needle Finishes; Needle systems; Needle Size; Classification of Needle on the basis of Needle Point; Cutting Point [P, S, LR, PLR, PCR, D, D1, VR]; Number of Needles; Direction of Needle-bar movements; Material transportation Systems in Stitching machines (Drop Feed, Compound Feed, Unison Feed, Step Feed); Stitching machine Construction; Parts of Stitching Machine and their functions; Types of stitching Machines: - Flat Bed, Post Bed, Cylinder Bed, Variable Stitch, Length Flat Machine, Under Edge Trimmer, Twin Needle flat machine, Zig-Zag Machine; Computerized Stitching Machine. Introduction and Operation.

UNIT III  MACHINERIES FOR LASTING  8
Counter Moulding, Insole attaching, Toe puff activator, mulling chamber, thermo-cementing, preforming, Toe lasting, side lasting, seat lasting.

UNIT IV  MACHINERIES FOR SOLE ATTACHMENT  8
Heel crowing, heat setter, Hot air blower, roughing machine, Heat Reactivator, Sole Pressing machine, Delasting machine, Polishing machine.

UNIT V  MODULAR MANUFACTURING AND PLANT LAYOUT  9
Plant layout for productivity improvements – Scheduling and simulation. Factor affecting plant location and construction of factory building for balancing the production line footwear manufacture.

TOTAL: 45 PERIODS

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

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

CO1. Explain the general principles involved in various preclosing machineries used in footwear manufacture.
CO2. Identify the features and purpose of the various closing machineries.
CO4. Identify the features of the sole attachment machineries.
CO5. Design of optimal machinery layout in footwear unit.

TEXT BOOKS AND REFERENCES:
2. Blakeman, J., “An Introduction to applied Science for Boot and Shoe Manufacture”,

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PTLT3013 CHEMISTRY OF COLLAGEN L T P C 3 0 0 3

COURSE OBJECTIVE: To impart knowledge on the advanced physical and chemical concepts of native collagen and collagen processed into leather.

UNIT I HISTOLOGY OF SKIN
Histology and fibre packing in Skins. Techniques for study of macro-ultra and microstructural details of skins. Primary, secondary, tertiary and quaternary structure of collagen.

UNIT II MOLECULAR ARCHITECTURE OF COLLAGEN
Molecular architecture of collagen. Inter and intra-change forces in the stabilisation and aggregation of collagen molecules. Three dimensional network of collagen fibres in skins and leather matrix.

UNIT III PHYSICO-CHEMICAL PROPERTIES OF COLLAGEN
Hydration, fibre swelling and phase transitions in collagen fibres and their role in dimensional stability of skin and leather matrix.

UNIT IV THERMO-MECHANICAL PROPERTIES OF COLLAGEN
Molecular mechanisms in relaxation and folding with special reference to native collagen and tanned collagen. Helix to coil transition and effects of thermo-mechanical stress on connective tissue fibres.

UNIT V CROSSLINKING MECHANISM
Shrinkage and cross linking phenomena in native, chrome tanned and vegetable tanned collagen. Influence of electromagnetic and high energy radiation on native collagen.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
At the end of this course, the students are expected to,
CO1. Acquire comprehensive knowledge on the chemistry and physics of skin.
CO2. Analyse and understand the molecular of Collagen
CO3. Acquire in depth knowledge on physical and chemical properties of Collagen
CO4. Acquire in depth knowledge on thermo-mechanical properties of collagen.
CO5. Comprehend the electromagnetic and high energy radiation on collagen.
TEXT BOOKS AND REFERENCES:

COURSE ARTICULATION MATRIX:

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PTLT3014  BIOPHYSICS OF COLLAGEN  L T P C  3 0 0 3

COURSE OBJECTIVES:
- To understand hydration of skin protein and its functional sites
- To understand diffusion and transport phenomena in collagenous matrices
- To understand molecular level changes and dimensional changes during various unit processes in leather making
- To relate surface science to leather making.

UNIT I  REACTIVITY OF COLLAGEN  8
Macro and microporosity of skin and influence of hydration and water structure on the pore size pattern in skin. Functional sites in protein for interactions with vegetable and pretanning materials, Electrophilic and nucleophilic reactions at protein sites.

UNIT II  DIFFUSION AND TRANSPORT PHENOMENA  9

UNIT III  MOLECULAR BEHAVIOUR OF COLLAGEN  10
Molecular level changes in collagen at various process conditions (viz., soaking, liming/dehairing, deliming/bating, pickling, tanning, dyeing and fatliquoring).

UNIT IV  MACRO AND MICRO STRUCTURAL BEHAVIOUR OF COLLAGEN  9
Dimensional changes and ultra and micro structural variations of skins during soaking, liming, deliming/bating, pickling, tanning, retanning, fatliquoring and drying as well as finishing with resin and casein.
UNIT V  SURFACE SCIENCE FOR LEATHER

Surface science application to leather. Surface charge and energy of full chrome and chrome retanned leather. Emulsions in leather processing and the surface charge and potential of leather finish films, adhesion, mechanisms, influence of opacity, refractive index and scattering coefficient of pigments and pigment formulations and factors controlling the stability of leather finish films.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
At the end of this course, the students are expected to,
CO1. Analyse and explore the reactivity of collagen.
CO2. Explore the diffusion and transport phenomena.
CO3. Acquire indepth knowledge on molecular behaviour of collagen.
CO4. Acquire wide knowledge on macro and micro structural behaviour of collagen
CO5. Comprehend the importance of surface science for leather.

TEXT BOOKS AND REFERENCES:

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PTLT3015  BIOPROCESS TECHNOLOGIES  L T P C

COURSE OBJECTIVES:
The course aims to,
- Develop an understanding of the concepts in different fermentation and sterilisation process.
- Study the kinetics involved in growth and sterilisation of micro-organisms.

UNIT I  OVERVIEW OF FERMENTATION PROCESSES
Overview of fermentation industry, general requirements of fermentation processes, basic configuration of fermenter and ancillaries, main parameters to be monitored and controlled in fermentation processes.
UNIT II  RAW MATERIALS AND MEDIA DESIGN FOR FERMENTATION PROCESS
Criteria for good medium, medium requirements for fermentation processes, carbon, nitrogen, minerals, vitamins and other complex nutrients, oxygen requirements, medium formulation of optimal growth and product formation, examples of simple and complex media, design of various commercial media for industrial fermentations – medium optimization methods.

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

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

UNIT V  KINETICS OF MICROBIAL GROWTH AND PRODUCT FORMATION

COURSE OUTCOMES:
On the completion of the course students are expected to
CO1. Explore the fundamental configuration of fermenter.
CO2. Develop knowledge on the design and optimization of fermentation process.
CO3. Elucidate various sterilization techniques for the fermentation processes.
CO4. Comprehend the metabolic stoichiometry and energetics of the microbial cell.
CO5. Acquire knowledge on kinetics of the microbial growth and product formation.

TEXT BOOKS AND REFERENCES:
6. Harvey W. Blanch, Douglas S. Clark, Biochemical Engineering, Marcel Dekker, Inc.

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

PTLT3016 | COMPOSITE MATERIALS | L T P C
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COURSE OBJECTIVE: The Objective of this course is to provide knowledge to the students on various materials other than leather which have the same properties as leather.

UNIT I POLYMER BASED MATERIALS

UNIT II NATURAL FIBERS BASED MATERIALS

UNIT III BIO BASED MATERIALS

UNIT IV FRUIT / VEGETABLE BASED MATERIALS

UNIT V RECYCLED MATERIALS

TOTAL: 45 PERIODS

COURSE OUTCOMES:
At the end of this course, the students are expected to,
CO1. Explore various polymers used in developing like leather materials.
CO2. Comprehend the various natural fibers in making sheets.
CO3. Analyse the different biological origin materials.
CO4. Acquire in depth knowledge on various fruit and vegetable sources used to prepare leather like materials.
CO5. Develop various methods for recovering and recycling leather waste materials.

TEXT BOOKS AND REFERENCES:
3. Faux Real: Genuine Leather and 200 Years of Inspired Fakes. United States:
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PTLT3017 INTRODUCTION TO ETP AND CETP DESIGN

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

UNIT I INTRODUCTION
Details of leather processing with water and chemical input, water requirement based on type of process and wastewater generation, need for wastewater treatment, nature of pollutants, characteristics of pollutants, environmental significance of pollutants, standards for discharge of treated effluents, concept of individual Effluent Treatment Plants (ETPs) and Common Effluent Treatment Plants (CETPs), planning for segregation and collection of liquid and solid waste.

UNIT II PHYSICO-CHEMICAL TREATMENT OF WASTEWATER
Concept of unit operations and processes, Physical treatment with principle of the process and design criteria- basis for selection of treatment units- screening – flotation, mixing, equalization –sedimentation – filtration – evaporation– incineration, adsorption, membrane separation, stripping and crystallization– recent advances, Preparation of process flow diagram
Chemical treatment with principle of the process and design criteria- basis for selection of treatment units- Coagulation - flocculation–Precipitation –Disinfection, advanced oxidation process –Preparation of process flow diagram

UNIT III BIOLOGICAL WASTEWATER TREATMENT
Principles of Biological treatment with process and design criteria – Role of microorganisms in wastewater treatment, Introduction to microbial metabolism – Bacterial growth, Assessment of biodegradability of waste, classification of biological treatment processes, Suspended and attached growth systems, Activated Sludge Process, Membrane Bioreactors, Upflow Anaerobic sludge Blanket (UASB) Reactor,
Waste Stabilization Ponds, basis for selection of treatment units- Preparation of process flow diagram

UNIT IV  TERTIARY TREATMENT AND SOLID WASTE MANAGEMENT  9
Principles of Tertiary treatment with process and design criteria – Need and objectives of Tertiary Treatment, removal of residual organics, removal of Colour, polishing treatment, basis for selection of treatment units, sources of solids and solid waste generation, methods of solid waste disposal and treatment, criteria for design of Tertiary Treatment units and solid waste management facilities

UNIT V  DESIGN OF ETPS/ CETPS  9
Design concepts for ETPs/ CETPs, freezing of treatment process, arriving the sizes of treatment units, Selection and arriving the capacity of Electro Mechanical items, arriving energy requirement, layout Design, preparation of layout, preparation of Hydraulic Flow Diagram, Preparation of P & I diagram, construction requirements for Civil, mechanical, electrical and instrumentation items, Pre-commissioning activities, O & M of CETPs/ ETPs.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
At the end of this course, the students are expected to,
CO1. Explain the significance of various pollutants present in water, wastewater and develop the kinetics for reactor design.
CO2. Relevant physico-chemical systems for effective water and wastewater treatment.
CO3. Biological Wastewater Treatment.
CO4. Evaluate the various Tertiary Treatment and Solid Waste Management.
CO5. Design of ETP/CETPs.

TEXT BOOKS AND REFERENCES:

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PTLT3018

VALUE ADDITION TO WASTE

COURSE OBJECTIVE: To gain knowledge on the value addition to the by-products produced by the leather sector as a waste to wealth concept.

UNIT 1 INTRODUCTION TO TANNERY WASTE
Definition of pollution, Classification of pollutants from leather sector Solid- Liquid- Gaseous

UNIT II TANNERY BYPRODUCTS CHARACTERISTICS
Classification of solid wastes from tannery; composition and characteristics – raw trimmings, fleshings, hair wastes, shavings, wetblue/crust/finished leather trimmings, buffing waste.

UNIT III SOLID WASTE DISPOSAL

UNIT IV UTILIZATION OF UNTANNED SOLID WASTE
Technologies for utilization of raw trimmings – High end collagen products, glue, gelatin; Fleshing waste – Glue, energy recovery; Hair waste – Composite, keratin hydrolysate.

UNIT V UTILIZATION OF TANNED SOLID WASTE
Chrome and vegetable tanned shavings – leather board, protein fillers; utilization of crust/finished leather trimmings.

TOTAL: 45 PERIODS

OUTCOME:
On Completion of the course, the student is expected to be able to,
CO1. Acquire the knowledge of the waste produced in leather sector.
CO2. Explore the characteristics of tannery by-products.
CO3. Elucidate the solid waste disposal methods practiced in industries
CO4. Acquire knowledge on the untanned waste utilization.
CO5. Elucidate the tanned waste utilization methods.

REFERENCES:

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1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively.
COURSE OBJECTIVE: To train the students to understand and implement quality assurance system in the leather product manufacturing unit.

UNIT I  QUALITY ASSURANCE AND ITS METHODS  8
Quality assurance, Importance of quality assurance for product manufacturing; Quality assurance Methods - Failure testing, Statistical process control, Total quality management.

UNIT II  TOOLS FOR QUALITY ASSURANCE  9
Seven basic tools of quality - Stratification, histogram, check sheet, cause and effect diagram, pareto chart, scatter diagram, control chart; Quality assurance in software.

UNIT III  PROCESS CONTROL IN LEATHER PRODUCT MANUFACTURING  9
Process flow charts; In-process control check; Responsibilities; Calibration, validation and qualification of the manufacturing processes; Calibration, validation and qualification of the leather products at intermittent stages.

UNIT IV  QUALITY CONTROL  9
Quality control theory; Quality assurance and quality control; Importance of quality control; Responsibilities; Quality control of the final product Calibration, validation and qualification involved in quality control of the final product.

UNIT V  CASE STUDY  10
Implementation of the quality assurance system in the leather product manufacturing unit.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
At the end of the course, the students are expected to,
CO1. Explore the importance of quality assurance and the methods of quality assurance.
CO2. Classify the tools of the quality assurance.
CO3. Acquire knowledge of the in process control of leather product manufacturing.
CO4. Elucidate the qualification of the final products.
CO5. Explore the implementation of the quality assurance for leather product manufacturing.

TEXT BOOKS AND REFERENCES:
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PTLT3020 HUMAN RESOURCE MANAGEMENT L T P C 3 0 0 3

COURSE OBJECTIVE: To impart human resource management skills to the students.

UNIT I MANAGEMENT AND GENERAL EMPLOYMENT PRACTICES 9
HRM and HRD – Concept and Need; Motivation, Leadership, Employee involvement vs engagement, Employee empowerment; Performance management, Performance and potential appraisals; HR Accounting and HR Audit; Workplace ethics and behaviour, Healthy work-life balance and stress management; International HRM and cross-cultural diversity management.

UNIT II STRUCTURE, STAFFING, CULTURE AND CLIMATE 9
Organizational design, Human Resource Planning; Job design, Job Analysis - Job description and job specification; Equal Employment Opportunity; Recruitment, Selection, Placement, Induction and Socialization; Organizational culture – Creating and sustaining culture, Concept and determinants of Organizational climate; Employee retention; Organizational exit.

UNIT III HUMAN RESOURCE DEVELOPMENT 9

UNIT IV EMPLOYEE COMPENSATION 9
Job evaluation, Pay Structures, Competency based and Performance based pay systems, Benefit programs, Pay delivery administration.

UNIT V HEALTH, SAFETY, SECURITY AND LABOUR RELATIONS 9
Introduction to occupational Safety-Employee assistance programs, safety management and approaches, theft, fraud, investigations, corrections; Labour laws in India, unfair labour practices, collective bargaining.
COURSE OUTCOMES:
On the completion of course students are expected to
CO1. Acquire knowledge on human resource management and development of general employment practices.
CO2. Design organizational structure, staffing, culture and climate.
CO3. Acquire in-depth knowledge on HRD role clusters, developmental interventions from HRD perspective and contemporary issues.
CO4. Elucidate employee compensation and compensation administration.
CO5. Analyse occupational health, safety, security, labour laws and labour relations.

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PTLT3021 ENTREPRENEURSHIP DEVELOPMENT L T P C 3 0 0 3

COURSE OBJECTIVE: This course aims to provide necessary knowledge and attitude to understand and appreciate the process of starting and developing a new venture.

UNIT I QUALITY OF ENTREPRENEURS
Entrepreneurs – Mindset, character, motivation. Types of entrepreneurs. Competencies - creativity, innovation, risk taking, resilience, leadership, communication, negotiation and networking; Design thinking for entrepreneurs. Myths about entrepreneurs; benefits and drawbacks of entrepreneurship. Managerial concerns specific to growing ventures; Reasons for a venture failure. Successful first-generation entrepreneurs in leather sector – case study.

UNIT II PLANNING AND DEVELOPMENT
UNIT III  FINANCIAL MANAGEMENT  10

UNIT IV  ORGANIZATIONAL MANAGEMENT  9
Building Team – creating growth oriented organizational culture. Employee motivation, retention strategies. Organizational structure with clear roles, responsibilities, authorities and accountabilities. Attracting talent with ESOP and other incentives and benefits. Training and development to enhance the quality of operators, supervisors and managers of the tannery.

UNIT V  BUSINESS DEVELOPMENT STRATEGIES  10

COURSE OUTCOMES:
At the end of this course, the students are expected to,

CO1. Acquire conceptual and theoretical knowledge about entrepreneurs and entrepreneurship
CO2. Design and development of Business Plan.
CO3. Acquire basic knowledge in financial management.
CO4. Explore the various organizational management aspects to attract, retain and develop talented workforce.
CO5. Acquire knowledge on business development strategies.

TOTAL: 45 PERIODS

TEXT BOOKS AND REFERENCES:
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PTLT3022 ORGANIZATION AND MANAGEMENT OF LEATHER MANUFACTURE L T P C

COURSE OBJECTIVE: To provide skills and knowledge on organization and management for leather sector.

UNIT I RAW MATERIAL RESOURCE MANAGEMENT 10

UNIT II INDUSTRY MANAGEMENT 10

UNIT III DOMESTIC TRADE MANAGEMENT 8

UNIT IV INTERNATIONAL TRADE MANAGEMENT 7
UNIT V DEVELOPMENT STRATEGY

TOTAL: 45 PERIODS

COURSE OUTCOMES:
At the end of this course, the students are expected to,
CO1. Elucidate raw material resource management.
CO2. Explore about leather industry in India and world.
CO3. Analyse and understand the domestic trade management in leather.
CO4. Analyse and understand the international trade management in leather.
CO5. Explore industry, trade management and development strategy in leather.

TEXT BOOKS AND REFERENCES:
6. Bulletins of India’s Foreign Trade in Leather and Leather Products, CLRI.

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PTLT3023 LEATHER AND LEATHER PRODUCTS COSTING L T P C 3 0 0 3

COURSE OBJECTIVE: To impart knowledge on leather and leather products costing

UNIT I COSTING METHODS 10
Cost accounting, elements of cost, classification of cost elements – examples from leather industry, methods of costing.

UNIT II COST ANALYSIS 8
Cost profit volume analysis, breakeven analysis; standard costing, analysis of variance.

UNIT III LEATHER AND LEATHER PRODUCT COSTING 9
Costing of leather and leather products – material, labour, power and overhead expenses.

UNIT IV RISK ANALYSIS OF FOREIGN EXCHANGE 10
Foreign exchange mechanisms, exchange rates; foreign exchange exposure management – risks, strategies to reduce risk.

UNIT V BUDGET MANAGEMENT 8
Budget, types of budgets, budgeting and control in tanneries and leather products industry. TOTAL: 45 PERIODS

COURSE OUTCOMES:
At the end of this course, the students are expected to,
CO1. Acquire basic knowledge on costing.
CO2. Elucidate costing analysis.
CO3. Acquire indepth knowledge on costing of leather and leather products.
CO4. Explore the risk analysis of foreign exchange.
CO5. Elucidate budget management and types.

TEXT BOOKS AND REFERENCES:

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

- To understand the changing business environment
- To identify the indicators of management thoughts and practices
- To understand fundamental premise underlying market driven strategies

UNIT I  INTRODUCTION  9

UNIT II  MARKETING STRATEGY  9

UNIT III  MARKETING MIX DECISIONS  9

UNIT IV  BUYER BEHAVIOUR  9

UNIT V  MARKETING RESEARCH & TRENDS IN MARKETING  9

COURSE OUTCOMES:
At the end of this course, the students are expected to,
CO1. Acquire basic knowledge on the marketing management.
CO2. Explore and analyse different marketing strategies.
CO3. Comprehend decision making skills for a business.
CO4. Articulate the buyers behaviour.
CO5. Elucidate the marketing research methods and trends.

TEXT BOOKS AND REFERENCES:
COURSE ARTICULATION MATRIX:

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PTLT3025 FOREIGN TRADE L T P C

3 0 0 3

COURSE OBJECTIVE: To impart knowledge on international marketing and foreign trade aspects of leather industry.

UNIT I INTRODUCTION
Basics of International trade - India's trade policy, International trade and Monetary Systems- Marketing Services in International Trade Pricing and trade cycles- Precautionary measures to prevent fraud in International trade - International Trade Multimodal Transport Operations- Consumer Behavior and Role of international Marketing- Indian Market Analysis.

UNIT II MANAGEMENT OF IMPORT AND EXPORT

UNIT III DOMESTIC AND IMPORTTRADE MANAGEMENT
Marketing concepts and Import-Forms of organization in Import and domestic Trade-Products, Sales forecasting and sales Management-pricing, Promotion, Branding and Advertising. Retail Management - Introduction to Logistics - Parameters of Supply Chain Management - Management of logistics and Supply Chain - Consumer Supply Chain Relationship.

UNIT IV IMPORT POLICY
The Customs Tariff Act-Exemptions in Import-by UN and its agencies and their Officials-Import by UN or international organizations for execution of projects in India-Imports by Government Diplomats, Trade representatives etc.-Customs Tariff.
UNIT V MARKETING STRATEGY  
TOTAL: 45 PERIODS

COURSE OUTCOMES:
At the end of this course, the students are expected to,
CO1. Acquire basic knowledge on international trade.
CO2. Elucidate import export management.
CO3. Elucidate domestic and import trade management.
CO4. Analyse import policy
CO5. Explore marketing strategies.

TEXT BOOKS AND REFERENCES:
1. Wagdre, H. International Marketing Management, Adhyayan Publisher, 2007

COURSE ARTICULATION MATRIX:

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PTLT3026 ENTERPRISE RESOURCE PLANNING L T P C 3 0 0 3

COURSE OBJECTIVE: The objective of this course is to teach the principles of ERP technologies involved in enterprise resource and various case studies in the pre and post implementation of ERP’s that will enable the students to perform as an efficient entrepreneur.

UNIT I INTRODUCTION
What is ERP? - Need of ERP - Advantages of ERP - Growth of ERP.

UNIT II ERP AND RELATED TECHNOLOGIES
Business process Reengineering (BPR) - Management Information System (MIS) - Decision Support Systems (DSS) - Executive Support Systems (ESS) - Data Warehousing, Data Mining - Online Analytical Processing (OLTP) - Supply Chain Management (SCM) - Customer Relationship Management (CRM).

UNIT III ERP MODULES AND VENDORS 10

UNIT IV  ERP IMPLEMENTATION LIFE CYCLES  10
Evaluation and selection of ERP package - Project planning - Implementation team training and testing - End user training and Going Live - Post Evaluation and Maintenance.

UNIT V  ERP CASE STUDIES  8
Post implementation review of ERP Packages in Manufacturing, Services, and other Organizations.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
At the end of this course, the students are expected to,
CO1. Acquire basic knowledge on ERP.
CO2. Explore and analyse various ERP technologies.
CO3. Articulate ERP modules.
CO4. Develop ERP implementation lifecycles.
CO5. Explore the inferences of POST implementation ERP.

TEXT BOOKS AND REFERENCES:

COURSE ARTICULATION MATRIX:

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PTLT3027  OPERATIONAL RESEARCH  L T P C  3 0 0 3

COURSE OBJECTIVE: To understand and gain knowledge on several mathematical and software tools helpful for operational research.

UNIT I  MATHEMATICAL PROGRAMMING  12
UNIT II  DYNAMIC PROGRAMMING  10
Elements of DP models, Bellman’s optimality criteria, Recursion formula, Solution
of multistage decision problem by DP method. Application is Heat Exchange Extraction
systems.

UNIT III  PERT, CPM and GERT  9
Network representation of projects, Critical path calculation, construction of the
time-chart and resource leveling, Probability and cost consideration in project scheduling,

UNIT IV  ELEMENTS OF QUEUING THEORY  7
Basic elements of the Queuing model, M/M/1 and M/M/C Queues.

UNIT V  ELEMENTS OF RELIABILITY THEORY  7
General failure distribution, for components, Exponential failure distributions, General model,
Maintained and Non-maintained systems, Safety Analysis.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
At the end of this course, the students are expected to,
CO1. Acquire basic knowledge on the mathematical programming.
CO2. Acquire basic knowledge on the dynamic programming.
CO3. Analyze the methods for the calculation involved in business.
CO4. Elucidate the elements of queuing theory.
CO5. Comprehend reliability theory.

TEXT BOOKS AND REFERENCES:
   Hill, 2005.
   New Delhi, 2006.

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