Outcome-Based Education (OBE) Curriculum

for

B.Sc. in Footwear Engineering

Institute of Leather Engineering and Technology

University of Dhaka

Dhaka-1209, Bangladesh

Outcome-Based Curriculum
(Sustaining OBE Compliance)

Part A

1. Title of the Academic Program: B. Sc. in Footwear Engineering

2. Name of the University: University of Dhaka

3. Vision of the University: To emerge as an institute of eminence in the fields of engineering, technology, business and management in serving the industry and the nation by empowering students with a high degree of technical, managerial and practical competence.

4. Mission of the University

M1: To strengthen the theoretical, practical, and ethical dimensions of the learning process by fostering a culture of research and innovation among faculty members and students.

M2: To encourage long-term interaction between the academia and industry through the involvement of the industry in the design of the curriculum and its hands-on implementation.

M3: To strengthen and mold students in professional, ethical, social, and environmental dimensions by encouraging participation in co-curricular and extra-curricular activities.

5. Name of the Program Offering Entity: Institute of Leather Engineering and Technology

6. Vision of the Program Offering Entity

To enable a center of excellence by providing advance educational programs with innovative research, in the field of leather, footwear, leather products and allied sector to produce competent graduates.

7. Mission of the Program Offering Entity

- Provide a contemporary educational approach that integrates high-tech and modern methods, enhancing their learning experience through research conducted locally and internationally.
- Promote industry-academia collaboration for better understanding and skill development in undergraduate programs in the fields of leather, footwear, and leather products.
- Undertake actions to motivate students for life-long learning, student's personal development by fostering ethical and moral values.

8. Objectives of the Program Offering Entity

- To produce competent graduates in the field of leather, footwear, and leather products sector;
- To initiate, organize and undertake research in the fields of leather, footwear and leather products engineering;
- To provide industry-oriented training programs in various fields of leather, footwear and leather products engineering;
- To ensure quality control and laboratory facilities for testing raw materials, consumable and finished products;
- To provide facilities for environmental pollution control, chemical management and occupational health and safety compliances;
- To organize seminars, conferences, workshops, exhibitions and other events to disseminate knowledge about state-of-the-art technologies for the relevant fields;
- To establish bridge programs and research collaborations with various academic, research, and industrial organizations both at home and abroad.

9. Name of the Degree: B.Sc. in Footwear Engineering

10. Description of the Program

Institute is committed to providing students with the very best education and training opportunities to enable them to utilize their potential toward their ambitions through B.Sc. in Footwear Engineering. The program provides its undergraduate students with the opportunity to participate in industrial training, where they can relate theories, concepts, and techniques learned from the academic courses with real-life experiences. At the end of the final year, students are involved in project work, report writing, and oral presentation.

B.Sc. in Engineering is a total 160.0 credits program, comprising 93.5 credits of core coursework (including field tour, capstone project, internship, and comprehensive viva), 45.5 credits of general education coursework (basic science, mathematics, and humanities) and 21.0 credits of allied engineering courses. With a rationalized course curriculum and advanced tools and teaching methods, the graduates will attain competency at the global standard and they will perform a high level of professional activities.

11. Graduate Attributes: The process of achieving the mission and vision of the program is divided into equal contributions, stated from responses given by the key stakeholders like employers and alumni. Employers happen to motivate graduates and know the performance of their traits in some key areas of graduate attributes such as knowledge, problem analysis skills, work skills, communication skills, digital literacy, and interpersonal skills. Each of the key graduate attributes is further subdivided into subcategories (as shown in the list below) to provide an in-depth understanding of our graduate's status in that specific field.

Attribute-1: Knowledge profile
K1: A systematic, theory-based understanding of the natural sciences applicable to the discipline
K2: Conceptually based mathematics, numerical analysis, statistics and formal aspects of computer and information science to support analysis and modelling applicable to the discipline
K3: A systematic, theory-based formulation of engineering fundamentals required in the engineering discipline
K4: Engineering specialist knowledge that provides theoretical frameworks and bodies of knowledge for the accepted practice areas in the engineering discipline; much is at the forefront of the discipline
K5: Engineering knowledge that aids effective practice-area problem-solving.
K6: Knowledge of engineering practice (technology) in the practice areas in the engineering discipline
K7: Comprehension of the role of engineering in society and of the identified issues in engineering practice in the discipline: ethics and the engineer's professional responsibility to public safety; the impacts of engineering activity in economic, social, cultural, environmental and sustainability terms
K8: Engagement with selected knowledge in the research literature of the discipline
Attribute-2: Creative and critical thinking, and problem solving
Creative: Able to find new ways to address problems sustainably, answer questions or expressing meaning.
Critical thinking: Able to evaluate and draw conclusions from information, to find sustainable solutions to complex problems and make decisions

Innovation: Involve the creative use of engineering principles and research-based knowledge in novel ways
Attribute-3: Interpersonal skills and digital literacy
Communication: Graduates convey ideas and information effectively to a range of audiences for a variety of purposes and contribute in a positive and collaborative manner to achieving common goals.
Professionalism and leadership: Graduates engage in professional behavior and have the potential to be entrepreneurial and take leadership roles in their chosen occupations or careers and communities.
Collaboration: Able to work effectively with others and in teams, encouraging collaboration and contributing positively.
ICT proficient: Able to use the devices, applications, and software commonly used in the discipline and in general use. Staying up-to-date with the latest advancements and effectively utilizing widely used digital tools, programs, and apps within and beyond the industry are essential components for success in the digital age.
Information and data literacy: Demonstrates a comprehensive understanding of legal, ethical, and security requirements is essential for interpreting, critically analyzing, and accurately representing information in various contexts.
Attribute-4: Ethics and sustainability
Integrity: Acting ethically, honestly, and fairly in personal, academic, and workplace settings.
Appropriate conduct: Demonstrating appropriate and socially responsible behavior, including academic conduct.
Sustainability: Acquiring the knowledge and skills to promote societal and environmental sustainability.

12. Program Educational Objectives (PEOs)

PEO1: To produce footwear graduate engineers equipped with in-depth knowledge of science, engineering and technology and capable of critical analysis

PEO2: To foster graduates with professional and ethical attributes in the practice of engineering

PEO3: To nourish graduates who are engaged in the pursuit of knowledge through continuing education, research, and professional development activities

PEO4: To provide footwear graduates with language proficiency and digital literacy who contribute to the well-being of their organizations and communities

PEO5: To advance in career paths associated with the footwear engineering disciplines, including industrial engineering and environmental engineering and sciences-related opportunities

13. Program Learning Outcomes (PLO)

PLO1: Engineering Knowledge (Fundamental)

Able to apply the knowledge of mathematics, science, engineering fundamentals, and footwear engineering as specified in K1 to K4 to the solution of complex engineering problems.

PLO2: Problem Analysis (Thinking Skill)

Able to identify, formulate, research the literature and analyze complex engineering problems and reach substantiated conclusions using first principles of mathematics, the natural sciences and the footwear and allied engineering sciences (K1 to K4, K8).

PLO3: Design/development of solutions (Thinking Skill)

Able to design solutions for complex footwear-allied engineering problems and design system components or processes that meet the specified needs with appropriate consideration for public health and safety as well as cultural, societal, and environmental concerns (K5).

PLO4: Investigation (Thinking)

Able to conduct investigations of complex problems using research-based knowledge (K8), considering design of experiments, analysis and interpretation of data, and synthesis of information to provide valid conclusions.

PLO5: Modern tool usage (Fundamental)

Able to 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 (K6).

PLO6: The Engineer and Society (Social)

Able to apply reasoning informed by contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to professional engineering practice (K7).

PLO7: Environment and sustainability (Social)

Able to understand the impact of professional engineering solutions in societal and environmental contexts and demonstrate the knowledge of, and need for sustainable development (K7).

PLO8: Ethics (Personal)

Able to apply ethical principles and commit to professional ethics, responsibilities, and the norms of the engineering practice. (K7)

PLO9: Individual work and teamwork (Personal)

Able to function effectively as an individual and as a member or leader of diverse teams as well as in multidisciplinary settings.

PLO10: Communication (Social)

Able to communicate effectively about complex engineering activities with the engineering community and with society at large. Be able to comprehend and write effective reports, design documentation, make effective presentations and give and receive clear instructions.

PLO11: **Project management and finance (Personal)**

Able to demonstrate knowledge and understanding of engineering and management principles and apply these to one's own work as a member or a leader of a team to manage projects in multidisciplinary environments.

PLO12: Lifelong learning (Personal)

Able to recognize the need for and have the preparation and ability to engage in independent, life-long learning in the broadest context of technological change.

14. Mapping mission of the university with PEOs

	Mission 1	Mission 2	Mission 3
PEO1	✓	✓	
PEO2	✓	✓	✓
PEO3		✓	✓
PEO4		✓	✓
PEO5	✓	✓	✓

15. Mapping of PLOs with PEOs

PLOs	PEO1	PEO2	PEO3	PEO4	PEO5
PLO1	✓				
PLO2	✓		✓		✓
PLO3	✓		✓		✓
PLO4	✓		✓	✓	✓
PLO5	✓		✓		✓
PLO6		✓	✓	✓	✓
PLO7	✓		✓		✓
PLO8	✓	✓			✓
PLO9		✓	✓	✓	✓
PLO10	✓	✓	✓	✓	✓
PLO11	✓	✓		✓	✓
PLO12	✓	✓	✓	✓	✓

16. Mapping courses with the PLOs

Course	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12
0723-FE-1101	✓	✓	✓	✓	✓	✓	✓					
0541-Math-1103	✓	✓	✓	✓								
0533-Phy-1105	✓	✓	✓	✓	✓							✓
0531-Chem-1107	✓	✓	✓	✓								
0531-Chem-1109	✓	✓	✓				✓	✓				✓
0531-Chem-1110	✓	✓	✓	✓				✓	✓	✓		✓
0715-ME-1112	✓	✓	✓	✓					✓	✓		✓
0417-Hum-1114					✓	✓			✓	✓	✓	✓
0723-FE-1116	✓	✓			✓				✓	✓		✓
0723-FE-1201	✓	✓	✓	✓		✓	✓					
0723-FE-1202	✓	✓	✓	✓	✓		✓		✓			
0723-FE-1203	✓	✓	✓	✓	✓							
0723-FE-1204	✓		✓	✓	✓				✓			
0541-Math-1205	✓	✓		✓	✓							
0611-CSE-1207	✓	✓	✓	✓	✓	✓				✓		✓
0611-CSE-1208	✓	✓	✓	✓	✓	✓				✓	✓	✓
0531-Chem-1209	✓	✓	✓	✓	✓							✓
0531-Chem-1210	✓	✓	✓		✓			✓	✓	✓		✓

0723-FE-2101	✓	✓	✓	✓	✓		✓					
0723-FE-2102	✓	✓	✓	✓	✓		✓		✓			
0723-FE-2103	✓	✓	✓	✓	✓		✓					
0723-FE-2104	✓	✓	✓	✓					✓			
0723-FE-2105	✓	✓	✓	✓								
0723-FE-2106	✓	✓	✓	✓	✓				✓			
0713-EEE-2107	✓	✓				✓	✓					✓
0533-Phy-2108	✓	✓	✓		✓				✓	✓		✓
0541-Math-2109	✓	✓		✓								
0723-FE-2201	✓	✓	✓	✓	✓		✓					
0723-FE-2202	✓	✓	✓	✓	✓				✓			
0531-Chem-2203	✓	✓	✓	✓	✓	✓	✓					✓
0531-Chem-2204	✓	✓	✓		✓			✓	✓	✓		✓
0531-Chem-2205	✓	✓		✓	✓		✓					
0531-Chem-2206	✓	✓	✓		✓		✓	✓	✓	✓		✓
0715-ME-2207	✓	✓	✓	✓	✓							✓
0715-ME-2208	✓	✓	✓	✓	✓				✓			✓
0723-FE-2110	✓				✓				✓	✓		✓
0723-FE-3101	✓	✓	✓	✓	✓							

0723-FE-3102	✓	✓	✓	✓	✓				✓			
0531-Chem-3103	✓	✓	✓	✓	✓							
0531-Chem-3104	✓	✓	✓	✓	✓	✓	✓			✓		
0723-FE-3105	✓	✓	✓	✓	✓	✓	✓	✓				✓
0715-ME-3107	✓	✓	✓	✓	✓	✓	✓					
0417-Hum-3109	✓	✓		✓		✓		✓	✓	✓		✓
0541-Math-3111	✓	✓	✓	✓								✓
0723-FE-3112	✓	✓	✓	✓	✓				✓			
0723-FE-3201	✓	✓	✓	✓	✓		✓					
0723-FE-3202	✓	✓	✓	✓					✓			
0723-FE-3203	✓	✓	✓	✓								✓
0723-FE-3204	✓	✓	✓	✓	✓				✓			✓
0723-FE-3205	✓	✓	✓									
0723-FE-3206	✓	✓	✓		✓	✓					✓	✓
0723-FE-3207	✓	✓	✓	✓	✓							
0417-Hum-3208	✓	✓	✓	✓	✓				✓	✓	✓	✓
0723-FE-3209	✓	✓	✓	✓	✓							
0723-FE-3210	✓				✓				✓	✓		✓
0723-FE-4101	✓	✓	✓	✓								

0723-FE-4102	✓	✓	✓	✓	✓				✓			
0723-FE-4104	✓	✓	✓	✓	✓				✓			
0723-FE-4105	✓	✓	✓		✓	✓			✓			✓
0723-FE-4106	✓	✓		✓	✓				✓	✓		✓
0417-Hum-4107	✓	✓	✓	✓	✓						✓	
0723-FE-4109	✓	✓		✓	✓				✓			✓
0723-FE-4111	✓	✓	✓	✓								
0723-FE-4112	✓	✓	✓	✓	✓				✓			
0723-FE-4201	✓	✓	✓	✓	✓		✓					
0723-FE-4202	✓	✓	✓	✓	✓		✓		✓		✓	✓
0723-FE-4203	✓	✓	✓	✓	✓				✓			✓
0723-FE-4205	✓	✓	✓	✓	✓	✓	✓					
0723-FE-4206	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
0723-FE-4208	✓	✓	✓							✓		✓
0723-FE-4210	✓	✓	✓			✓				✓		✓
	70	67	60	56	52	16	20	08	32	19	07	34

Part B

17. Structure of the Curriculum

(a) Duration of the Program: Years: 4, Semesters: 8

(b) Admission Requirements:

DU-A unit entrance examination requirements

i. A candidate has to be a recently passed student in HSC in Science group or recognized equivalent examinations.
ii. Candidates must be obtained at least GPA of 3.50 (scale of 5.00) in both SSC and HSC/ equivalent examinations, and the total GPA should be 8.00 (including additional subjects).
iii. DU A (Science) -unit admission exam will be based on MCQ and written exam.
iv. Other criteria and selection of the candidates for admission shall be decided as per the University admission rules and regulations.

Footwear Engineering program requirements

i. A candidate must pass the DU-A (Science) unit entrance examination.
ii. A Candidate must be either in the merit or waiting list of the DU A-unit entrance examination announced by DU-A unit admission authority.
iii. A candidate has to select the Footwear Engineering program in his/her preference list and he/she has to be among the leading candidates preferring this discipline based on their merit position and seat capacity of the discipline in DU.

(c) Total credit requirement to complete the program: 160.0

(d) Total class weeks in a semester: 14 weeks

(e) Minimum CGPA requirements for graduation: 2.50

(f) Maximum academic years of completion: 6 academic years

(g) Category of Courses:

i. General Education Courses: Total 45.5 credits.

Theoretical Courses				
Course Code	**Course Title**	**Course Credit**	**Year**	**Semester**
0541-Math-1103	Algebra and Geometry	3.0	1st	I
0533-Phy-1105	Engineering Physics	3.0	1st	I
0531-Chem-1107	Inorganic Chemistry	3.0	1st	I
0531-Chem-1109	Physical Chemistry	3.0	1st	I
0541-Math-1205	Calculus	3.0	1st	II

0531-Chem-1209	Organic Chemistry	3.0	1st	II
0541-Math-2109	Differential Equation and Numerical Methods	3.0	2nd	I
0531-Chem-2205	Analytical Chemistry	3.0	2nd	II
0531-Chem-3103	Instrumental Analysis	3.0	3rd	I
0417-Hum-3109	Industrial Sociology	3.0	3rd	I
0541-Math-3111	Probability and Statistics	3.0	3rd	I
0417-Hum-4107	Cost and Management Accounting	3.0	4th	I
Lab Courses				
0531-Chem-1110	Inorganic and Physical Chemistry Lab	1.5	1st	I
0417-Hum-1114	Employability Skills-I	1.5	1st	I
0531-Chem-1210	Organic Chemistry Lab	1.5	1st	II
0533-Phy-2108	Physics and Electronics Lab	1.5	2nd	I
0531-Chem-2206	Analytical Chemistry Lab	1.5	2nd	II
0531-Chem-3104	Chemical Analysis of Leather and Leather Products Lab	1.5	3rd	I
0417-Hum-3208	Employability Skills-II	1.5	3rd	II

ii. Core Courses: In Footwear Engineering program, ILET, DU would like to divide the core courses further in to 2 sub categories under core course category i.e., Core Engineering Courses, Aligned Engineering Courses.

Core Engineering Courses: Total 82.0 credits

Theoretical Courses				
Course Code	**Course Title**	**Course Credit**	**Year**	**Semester**
0723-FE-1101	Fundamentals of Leather	3.0	1st	I
0723-FE-1201	Leather Processing-I	3.0	1st	II
0723-FE-1203	Fundamentals of Footwear	3.0	1st	II
0723-FE-2101	Leather Processing-II	3.0	2nd	I
0723-FE-2103	Footwear Design and Development	3.0	2nd	I

0723-FE-2105	Footwear Manufacturing-I	2.0	2nd	I
0723-FE-2201	Footwear Manufacturing- II	3.0	2nd	II
0723-FE-3101	Footwear Manufacturing-III	3.0	3rd	I
0723-FE-3105	Environmental Science and Engineering	2.0	3rd	I
0723-FE-3201	Non-Leather Materials for Footwear-I	2.0	3rd	II
0723-FE-3203	Testing of Footwear and Allied Materials	3.0	3rd	II
0723-FE-3205	Leather Products Manufacturing	3.0	3rd	II
0723-FE-3207	Supply Chain Management	3.0	3rd	II
0723-FE-3209	Footwear Merchandising	2.0	3rd	II
0723-FE-4101	Manufacturing of Specialty Footwear	3.0	4th	I
0723-FE-4105	Industrial Utility and Maintenance	3.0	4th	I
0723-FE-4109	Total Quality Management	3.0	4th	I
0723-FE-4111	Non-Leather Materials for Footwear-II	2.0	4th	I
0723-FE-4201	Wastewater and Solid Waste Management	3.0	4th	II
0723-FE-4203	Sports Footwear Manufacturing	3.0	4th	II
0723-FE-4205	Production Planning and Quality Control	3.0	4th	II
Lab Courses				
0723-FE-1202	Leather Processing -I Lab	1.5	1st	II
0723-FE-1204	Fundamentals of Footwear Lab	1.5	1st	II
0723-FE-2102	Leather Processing-II Lab	1.5	2nd	I
0723-FE-2104	Footwear Design and Development-I Lab	1.5	2nd	I
0723-FE-2106	Footwear Manufacturing-I Lab	1.5	2nd	I
0723-FE-2202	Footwear Manufacturing-II Lab	1.5	2nd	II
0723-FE-3102	Footwear Manufacturing-III Lab	1.5	3rd	I
0723-FE-3112	Footwear Design and Development-II Lab	1.5	3rd	I
0723-FE-3202	Footwear design and Development- III Lab	1.5	3rd	II
0723-FE-3204	Testing of Footwear and Allied Materials Lab	1.5	3rd	II
0723-FE-3206	Leather Products Manufacturing Lab	1.5	3rd	II

0723-FE-4102	Manufacturing of Specialty Footwear Lab	1.5	4th	I
0723-FE-4104	Computer Aided Design	1.5	4th	I
0723-FE-4106	Industrial Utility and Maintenance Lab	1.5	4th	I
0723-FE-4112	Non-Leather Materials for Footwear Lab	1.5	4th	I
0723-FE-4202	Waste Management Lab	1.5	4th	II

Allied Engineering Courses: Total 21.0 credits

Theoretical Courses				
Course Code	**Course Title**	**Course Credit**	**Year**	**Semester**
0611-CSE-1207	Fundamentals of Computer and Information Technology	3.0	1st	II
0713-EEE-2107	Fundamentals of Electrical and Electronics Engineering	3.0	2nd	I
0531-Chem-2203	Polymer Science and Engineering	3.0	2nd	II
0715-ME-2207	Fundamentals of Mechanical Engineering	3.0	2nd	II
0715-ME-3107	Materials Science and Engineering	3.0	3rd	I
Lab Courses				
0715-ME-102	Engineering Drawing	1.5	1st	I
0611-CSE-1208	Fundamentals of Computer and Information Technology Lab	1.5	1st	II
0531-Chem-2204	Polymer Science and Engineering Lab	1.5	2nd	II
0715-ME-2208	Mechanical Workshop Practice	1.5	2nd	II

iii. Elective Courses: In B. Sc. in Footwear Engineering program, all of the courses are compulsory courses. So, there is no elective/optional course in this program.

iv. Capstone Course/Internship/Field Tour/Project: Total 11.5 credits

Course Code	Course Title	Course Credit	Year	Semester
0723-FE-1116	Field Tour-I	1.0	1st	I
0723-FE-2210	Field Tour-II	1.0	2nd	II
0723-FE-3210	Field Tour-III	1.0	3rd	II
0723-FE-4206	Capstone Project	3.0	4th	II
0723-FE-4208	Comprehensive Viva	2.5	4th	II
0723-FE-4210	Internship	3.0	4th	II

18. Semester wise distribution of courses

Year-1st, Semester-I			
Course Code	**Course Title**	**Credit**	
		Theoretical	**Lab**
0723-FE-1101	Fundamentals of Leather	3.0	
0541-Math-1103	Algebra and Geometry	3.0	
0533-Phy-1105	Engineering Physics	3.0	
0531-Chem-1107	Inorganic Chemistry	3.0	
0531-Chem-1109	Physical Chemistry	3.0	
0531-Chem-1110	Inorganic and Physical Chemistry Lab		1.5
0715-ME-1112	Engineering Drawing		1.5
0417-Hum-1114	Employability Skills-I		1.5
0723-FE-1116	Field Tour-I		1.0
	Total	**15.0**	**5.5**
	Semester Total	**20.5**	

Year-1st, Semester-II			
Course Code	**Course Title**	**Credit**	
		Theoretical	**Lab**
0723-FE-1201	Leather Processing-I	3.0	
0723-FE-1202	Leather Processing -I Lab		1.5
0723-FE-1203	Fundamentals of Footwear	3.0	
0723-FE-1204	Fundamentals of Footwear Lab		1.5
0541-Math-1205	Calculus	3.0	
0611-CSE-1207	Fundamentals of Computer and Information Technology	3.0	
0611-CSE-1208	Fundamentals of Computer and Information Technology Lab		1.5
0531-Chem-1209	Organic Chemistry	3.0	
0531-Chem-1210	Organic Chemistry Lab		1.5
	Total	**15.0**	**6.0**
	Semester Total	**21.0**	

Year-2nd, Semester-I			
Course Code	**Course Title**	**Credit**	
		Theoretical	**Lab**
0723-FE-2101	Leather Processing-II	3.0	
0723-FE-2102	Leather Processing-II Lab		1.5
0723-FE-2103	Footwear Design and Development	3.0	
0723-FE-2104	Footwear Design and Development-I Lab		1.5
0723-FE-2105	Footwear Manufacturing-I	2.0	
0723-FE-2106	Footwear Manufacturing-I Lab		1.5
0713-EEE-2107	Fundamentals of Electrical and Electronics Engineering	3.0	
0533-Phy-2108	Physics and Electronics Lab		1.5
0541-Math-2109	Differential Equation and Numerical Methods	3.0	
	Total	**14.0**	**6.0**
	Semester Total	**20.0**	

Year-2nd, Semester-II			
Course Code	**Course Title**	**Credit**	
		Theoretical	**Lab**
0723-FE-2201	Footwear Manufacturing-II	3.0	
0723-FE-2202	Footwear Manufacturing-II Lab		1.5
0531-Chem-2203	Polymer Science and Engineering	3.0	
0531-Chem-2204	Polymer Science and Engineering Lab		1.5
0531-Chem-2205	Analytical Chemistry	3.0	
0531-Chem-2206	Analytical Chemistry Lab		1.5
0715-ME-2207	Fundamentals of Mechanical Engineering	3.0	
0715-ME-2208	Mechanical Workshop Practice		1.5
0723-FE-2210	Field Tour-II		1.0
	Total	**12.0**	**7.0**
	Semester Total	**19.0**	

Year-3rd, Semester-I			
Course Code	**Course Title**	**Credit**	
		Theoretical	Lab
0723-FE-3101	Footwear Manufacturing-III	3.0	
0723-FE-3102	Footwear Manufacturing-III Lab		1.5
0531-Chem-3103	Instrumental Analysis	3.0	
0531-Chem-3104	Chemical Analysis of Leather and Leather Products Lab		1.5
0723-FE-3105	Environmental Science and Engineering	2.0	
0715-ME-3107	Materials Science and Engineering	3.0	
0417-Hum-3109	Industrial Sociology	2.0	
0541-Math-3111	Probability and Statistics	3.0	
0723-FE-3112	Footwear Design and Pattern Making-II Lab		1.5
	Total	16.0	4.5
	Semester Total	**20.5**	

Year-3rd, Semester-II			
Course Code	**Course Title**	**Credit**	
		Theoretical	**Lab**
0723-FE-3201	Non-Leather Materials for Footwear-I	2.0	
0723-FE-3202	Footwear Design and Pattern Making- III Lab		1.5
0723-FE-3203	Testing of Footwear and Allied Materials	3.0	
0723-FE-3204	Testing of Footwear and Allied Materials Lab		1.5
0723-FE-3205	Leather Products Manufacturing	3.0	
0723-FE-3206	Leather Products Manufacturing Lab		1.5
0723-FE-3207	Supply Chain Management	3.0	
0417-Hum-3208	Employability Skills-II		1.5
0723-FE-3209	Footwear Merchandising	2.0	
0723-FE-3210	Field Tour-III		1.0
	Total	**13.0**	**7.0**
	Semester Total	**20.0**	

Year-4th, Semester-I			
Course Code	**Course Title**	**Credit**	
		Theoretical	**Lab**
0723-FE-4101	Manufacturing of Specialty Footwear	3.0	
0723-FE-4102	Manufacturing of Specialty Footwear Lab		1.5
0723-FE-4104	Computer Aided Design		1.5
0723-FE-4105	Industrial Utility and Maintenance	3.0	
0723-FE-4106	Industrial Utility and Maintenance Lab		1.5
0417-Hum-4107	Cost and Management Accounting	3.0	
0723-FE-4109	Total Quality Management	3.0	
0723-FE-4111	Non-Leather Materials for Footwear-II	2.0	
0723-FE-4112	Non-Leather Materials for Footwear Lab		1.5
	Total	**14.0**	**6.0**
	Semester Total	**20.0**	

Year-4th, Semester-II			
Course Code	**Course Title**	**Credit**	
		Theoretical	**Lab**
0723-FE-4201	Wastewater and Solid Waste Management	3.0	
0723-FE-4202	Waste Management Lab		1.5
0723-FE-4203	Sports Footwear Manufacturing	3.0	
0723-FE-4205	Production Planning and Quality Control	3.0	
0723-FE-4206	Capstone Project		3.0
0723-FE-4208	Comprehensive Viva		2.5
0723-FE-4210	Internship		3.0
	Total	**9.0**	**10.0**
	Semester Total	**19.0**	

Total Credits: 160.0

Part C

19. Description of all courses of the program

Course Code: 0723-FE-1101 Course Title: Fundamentals of Leather Credits: 3

Rationale of the Course: This course aims to provide students with an in-depth understanding of the fundamental concepts of leather technology. The course covers topics such as the structure and composition of hides and skins, preservation and curing of hides and skins, molecular structure and properties of collagen, leather biotechnology, and natural and synthetic polymers.

Course Content

Introduction: Hides and skins- Historical background, different parts, types, sources, world supply, national supply, and regional status.

Slaughtering: Slaughtering and flaying of animals; tools, equipment, and techniques of slaughtering and flaying, hides and skins of slaughtered and fallen animals; cares to be taken during flaying.

Preservation/curing of hides and skins: Handling and storage, collection practice in Bangladesh, degradation, degradation factors, importance and principles of preservation, methods of preservation/curing, advantages and disadvantages of different types of curing, factors affecting preservation/curing process, preservation defects.

Hides/Skins structure and its components: Structural difference between hides and skins of different origins, chemical composition of hides and skins; structure of fibrous and globular proteins, importance of histology in leather production; tissues- epithelial tissues, connective tissues, and cells; histological structure of hide and skin and appearances of cross-sections under a microscope.

Molecular structure and properties of collagen: Formation of the collagen fiber structure, hierarchy of collagen structure, arrangement of amino acid, peptide chain, collagen genes, and RNA, amino acid composition and primary structure, helix stabilization, Diameter, strength, three-dimensional weaves of collagen in leather, interweave, bonding, tensile strength, and flexibility. Properties of crosslinks.

Leather Biotechnology: Bacteria and its classifications: morphological, mode of nutrition, temperature, and pH; structure, nutritional requirements, bacterial culture media. General principles of microbial control. Introduction to fermentation, basic concepts of enzymes–characteristics, classification, catalytic properties, lowering of activation energy, concept of specificity of enzyme, Michaelis–Menten equation, Km and Vmax determination and their significance, different methods for enzyme assay, application of enzymes in curing, soaking, dehairing, bating, degreasing, tanning.

Natural and man-made polymer: Natural- vegetable (cellulose), cotton, jute, etc., animal (protein)- leather, wool, virgin wool, silk, hair, etc., mineral- asbestos, Man-made- cellulosic, viscose, acetate, rubber, synthetic polymers, etc.

Course Objectives

a. To introduce students to the historical background, different types, sources, and world supply of hides and skins.
b. To familiarize students with animal slaughtering and flaying techniques and the importance of care during flaying.
c. To equip students with the principles and methods of preservation and curing of hides and skins.
d. To provide students with an understanding of the structure and composition of hides and skins and their components.
e. To enable students to comprehend collagen's molecular structure and properties and its applications in leather technology.

Course Learning Outcomes (CLOs): Upon successful completion of this course, students will be able to-

	Course Learning Outcomes (CLOs)	**Learning Level**
CLO1	State different parts, types, sources, and world supplies of hides and skins.	C1, A1
CLO2	Explain the modern slaughtering and flaying techniques for animals.	C2, A3
CLO3	Compare and analyze diverse, modern, and environment-friendly curing methods.	C3, C4
CLO4	Illustrate and analyze the histological structure of hides and skins, including their importance in leather production.	C4, A4
CLO5	Correlate the role of biotechnology and various natural and man-made polymers used in leather, leather products, and the footwear industries.	C4, A4

Mapping of Course Learning Outcomes (CLOs) with Programs Learning Outcomes (PLOs)

CLOs	**PLO1**	**PLO2**	**PLO3**	**PLO4**	**PLO5**	**PLO6**	**PLO7**	**PLO8**	**PLO9**	**PLO10**	**PLO11**	**PLO12**
CLO1	3	3	-	3	-	-	-	-	-	-	-	-
CLO2	3	2	2	-	3	1	-	-	-	-	-	-
CLO3	3	-	3	-	3	-	2	-	-	-	-	-
CLO4	3	3	-	3	2	-	-	-	-	-	-	-
CLO5	3	3	3	2	3	-	3	-	-	-	-	-

Rank: 3-High match, 2-Medium match, 1-Low match

Mapping of Course Learning Outcomes (CLOs) with the Teaching-Learning and Assessment Strategy

CLOs	**Teaching-Learning Strategy**	**Assessment Strategy**
CLO1	Lecture, Whiteboard illustration, Group discussion	In-course assessment, Final examination, Assignment
CLO2	Lecture, Multimedia presentation	Group Presentation, In-course Exam; Final Exam
CLO3	Lecture, Video presentation, Group discussion, Multimedia presentation, Audiovisual, Assignment	In-course Assessment, Oral presentation, Final examination, Assignment, Case study and quiz.
CLO4	Audio-visual presentation, Group discussion, Pictorial	In-course assessment, Final examination
CLO5	Lecture and Multimedia presentation	In-course Assessment and Final examination

Learning Materials

i. **Recommended Readings**
   a) Anthony D. Covington- Tanning Chemistry: The Science of Leather
   b) Dutta S.S.-An introduction to the principles of leather manufacture.
   c) Wiseman A.-Topics in Enzyme and Fermentation Biotechnology' (Vol.2)

ii. **Supplementary Readings**
   a) Procter H.R.-The Principle of Leather Manufacture.
   b) Sarkar K.T.-Theory and Practice of Leather Manufacture.

iii. **Others:** Handout/lecture material provided by the course teacher.

Course Code: 0541-Math-1103 Course Title: Algebra and Geometry Credits: 3

Rationale of the Course: This course covers formulas, algebraic expressions, first-degree equations, inequalities, the rectangular coordinate system, the area, perimeter, and volume of geometric shapes, as well as the properties of triangles and circles which are essential for engineers as a fundamental course.

Course Content:

Inequalities, Vector Algebra and Vector Calculus: Review of geometric vectors in R^2 and R^3 space, scalar and vector products, solutions of vector equations, applications of vectors in geometry, vectors in R^n and C^n, inner product, norm and distance in R^n and C^n.

Matrices and Determinants: Notion of matrix, types of matrices, matrix operations, laws of matrix algebra, determinant function, properties of determinants, minors, cofactors, expansion and evaluation of determinants, elementary row and column operations and row-reduced echelon matrices, invertible matrices.

System of Linear Equations: Linear equations, system of linear equations (homogeneous and non-homogeneous) and their solutions, Application of Matrices and determinants for solving system of linear equations, applications of the Algebra in science, engineering and business.

Two-dimensional Geometry: Change of axes, pair of straight lines, general equation of second degree, circle and system of circle, parabola and hyperbola.

Three-dimensional Geometry: Rectangular co-ordinates, direction ratios and cosines of a line, equations of a line and a plane, intersecting planes, symmetric form of a straight line, angle between lines and planes, coplanar lines, skew lines, shortest distance, equations of a sphere.

Course Objectives:

a. To know about inequalities, vector algebra, and vector calculus.
b. To know about matrices and determinants.
c. To know about applications of algebra in science, engineering, and business.
d. To know about two- and three-dimensional geometry.

Course Learning Outcomes (CLOs): Upon completion of the course, the students will be able to -

	Course Learning Outcomes (CLOs)	Learning Level
CLO1	Describe the basic ideas of inequalities, vector algebra, and vector calculus.	C1, A1
CLO2	Understand the properties of matrices and determinants; and solve systems of linear equations.	C2, A2
CLO3	Relate applications of algebra in science, engineering, and business.	C3, A3
CLO4	Sketch graphs of and discuss relevant features of lines, circles, and other conic sections.	C3, A3
CLO5	Find equations of lines and planes in space and identify and describe quadratic surfaces.	C4, A4

Mapping of CLOs with PLOs

CLOs	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12
CLO1	3	2	-	1	-	-	-	-	-	-	-	-
CLO2	3	3	-	1	-	-	-	-	-	-	-	-
CLO3	3	3	1	1	-	-	-	-	-	-	-	-
CLO4	3	3	-	1	-	-	-	-	-	-	-	-
CLO5	3	3	-	1	-	-	-	-	-	-	-	-

Rank: 3-High match, 2-Medium match, 1-Low match.

Mapping of Course Learning Outcomes (CLOs) with the Teaching-Learning and Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture, group discussion, and problem-based exercises	Assignment, In-course Exam, and Final Exam
CLO2	Lecture, group discussion, and problem-based exercises	Assignment, In-course Exam, and Final Exam
CLO3	Lecture, group discussion, and problem-based learning	Assignment, In-course Exam, and Final Exam
CLO4	Lecture, group discussion, and problem-based exercises	Assignment, In-course Exam, and Final Exam
CLO5	Lecture, group discussion, and problem-based exercises	Group Presentation, Assignment, In-course Exam, and Final Exam

Learning Materials

i. Recommended Readings

a) H. Anton, and C.Rorres, Linear Algebra with Applications
b) S. Lipshutz, Linear Algebra, Schaum's Outline Series.
c) Brestscher, Linear Algebra with Applications.

ii. Supplementary Readings

a) Khosh Mohammad, Analytic Geometry and Vector Analysis.
b) G. Strang, Linear Algebra with Applications.

iii. Others: Handout/lecture material provided by the course teacher.

Course Code: 0533-Phy-1105 Course Title: Engineering Physics Credits: 3.0

Rationale of the Course: Engineering physics will provide a more thorough ground in applied physics for a selected specialty such as wave and oscillations, forces and motion, heat, elasticity, properties of matter, electricity and magnetism, nuclear physics, modern physics, and optics. The course will also bridge the gap between theoretical science and practical engineering.

Course Content

Elasticity: Rigid body, perfectly elastic body, plastic body, stress and strain, stress-strain curve for ductile and brittle material, Hooke's law and different elastic constants-moduli of elasticity, poison's ratio, determination of elastic constants, factors affecting elasticity.

Optics: Theories of light, electromagnetic spectrum, optical instruments, compound microscope, polarizing microscope, camera and photographic techniques, spectrophotometer, interference of light, Young's experiment, Fresnel's bi-prism, Newton's rings, diffraction of light, Fresnel and Fraunhofer diffraction, diffraction gratings, resolving power of a grating, polarized and unpolarized light, polarization by reflection and refraction, Brewster's and Malu's law, double refraction, polarization by scattering, optical activity.

Heat: Humidity, vapor pressure, temperature-related humidity, transmission of heat, thermal conductivity of solids and liquids, coefficient of thermal conductivity, good and bad conductor of heat, heat flow through compound walls.

Electricity and magnetism: Electric charge, Coulomb's law, electric field, electric dipole, electric flux and Gauss's law, applications of Gauss's law, electric potential, equipotential surface, capacitor capacitance and dielectrics, combination of capacitors in series and parallel, dielectrics and Gausses law, energy storage in an electric field, electric current and current density, resistance, resistivity and conductivity, continuity equation, Ohm's law, combination of resistances, Kirchhoff's laws, Wheatstone bridge, Lorentz force, Ampere's circuital law with applications, solenoid, toroid, electromagnetic induction-Faraday's laws, Lenz's law, self and mutual induction, inductor and inductance, energy stored in magnetic field.

Nuclear physics and modern physics: Properties of atomic nucleus, mass defect, binding energy, nuclear stability, natural and artificial radioactivity, laws of radioactive disintegration, half-life and mean life, radio-toxicity, radioactive waste management. X-ray and their applications, wave-particle duality, de-Broglie hypothesis, photoelectric effect, Compton effect.

Course Objectives: The aims of this course are:

a. To provide fundamental knowledge and illustrate to the students on different topics of Physics.
b. To impart knowledge in basic concepts of physics relevant to engineering applications.
c. To relate the physical phenomena with proficiency in problem-solving, critical thinking, and analysis.

Course Learning Outcomes (CLOs): By the end of the course students will be able to -

	Course Learning Outcomes (CLOs)	**Learning Level**
CLO1	State various physical laws and fundamental concepts of physics.	C1, A1
CLO2	Explain the factors and related theories of elasticity, optics, heat, electricity and magnetism, nuclear physics, and modern physics.	C2, A2
CLO3	Analyze and apply a conceptual and quantitative understanding of properties of elasticity, optics, heat, electricity, and nuclear physics.	C3, C4, A3
CLO4	Relate and evaluate application-driven ideas that can be applied in solving engineering problems of the footwear industry.	C5, A4

Mapping of CLO with PLO

CLOs	**PLO1**	**PLO2**	**PLO3**	**PLO4**	**PLO5**	**PLO6**	**PLO7**	**PLO8**	**PLO9**	**PLO10**	**PLO11**	**PLO12**
CLO1	3	2	-	-	-	-	-	-	-	-	-	-
CLO2	3	2	2	2	-	-	-	-	-	-	-	-
CLO3	3	3	3	3	2	-	-	-	-	-	-	-
CLO4	3	2	2	1	2	-	-	-	-	-	-	2

Rank: 3-High match, 2-Medium match, 1-Low match.

Mapping of Course Learning Outcomes (CLOs) with the Teaching-Learning and Assessment Strategy

CLOs	**Teaching-Learning Strategy**	**Assessment Strategy**
CLO1	Lecture whiteboard lustration, slide presentation, problem practices, interactive discussion	In-course Exam; Final Exam
CLO2	Interactive audiovisual lecture, whiteboard lustration, slide presentation, problem practices	In-course Exam; Final Exam
CLO3	Lecture, whiteboard illustration, problem-based excesses	Quiz, Assignment, and Final Exam
CLO4	Lecture, slide presentation, group discussion, whiteboard illustration, and problem-based exercises	Assignment, In-course Exam, and Final Exam

Learning Materials

i. Recommended Readings

a) Resnick/Halliday/Krane-Physics, Vol I and II.
b) David Halliday/Robert Resnick/Jearl Walker-Fundamentals of Physics.
c) Dr. Gias Uddin Ahmad: Physics for Engineers Part-1 and 2

ii. Supplementary Readings

a) Arther Beiser-Concepts of Modern Physics.
b) Francis A. Jenkins and Harvey E. White: Fundamentals of Optics

iii. Others: Handout/lecture material provided by the course teacher.

Course Code: 0531-Chem-1107 Course Title: Inorganic Chemistry Credits: 3.0

Rationale of the Course: The course is designed to provide applied knowledge on inorganic chemistry related to leather, footwear, and allied engineering education. The different concepts from this course will help students understand the mechanism involved in different leather processing and footwear manufacturing.

Course Contents

Concepts in chemical bond: A review of ionic, covalent and co-ordinate bond**,** covalent character in ionic compounds: Polarization, Fajan's rules; VSEPR theory, valence bond theory: General description, hybridization, multiple bonding; molecular orbital theory: MO diagram of molecules, bond order; ionic character covalent compound, hydrogen bond and other intermolecular forces, metallic bond.

Acids and bases: Arrhenius concept, Bronsted-Lowry concept, Lewis concept, solvent system concept, hard and soft acid-base, acid-base strengths, acid strength of BX_3, oxoacids, haloacids, self-ionization of water, pH, buffer solutions and mechanism, importance of pH in tanning processes, acid base titrations, equivalent point and end point, selection of indicator in acid-base titration, common ion effect, common ion effect in group separation table.

Redox reactions: Oxidation-reduction reactions, oxidation number, balancing oxidation-reduction equations by half-reaction method, strengths of oxidizing and reducing agents, disproportion reaction, auto-oxidation, induced oxidation, redox titration, redox indicator, iodometry and iodimetry, Back titration and its application, applications of redox titration.

Transitional and inner-transitional metals: d-block and 1^{st} transitional elements, characteristics of transitional elements, shape and orientation of d-orbitals, structure and property relations in 'd' block elements; 4f-bolck element: Lanthanides, general characteristics, application of transition metal compounds in leather tanning.

Theories of co-ordination chemistry: double salt and complex compounds, ligand and its types, coordination number, Werner's coordination theory, chelate complexes, nomenclature, Sidgwick theory; Valence Bond Theory (VBT) of structure of inorganic complex with simple examples, Crystal Field Theory, application of crystal field theory color of transition metal complexes.

Inorganic compounds used for tanning: Chromium salts, their behavior in solution, variable oxidation state of chromium, color of chromium compounds, structure and bonding of chromium in leather.

Course Objectives: This course will guide the students to learn about-

a. the basic concepts involved in inorganic chemistry that will prepare the students for advanced coursework in chemistry as well as leather and footwear engineering.
b. different types of bonds and interactions related to leather, polymeric and other footwear materials.
c. in-depth knowledge of chemical science directed towards materials, energy technology, and leather tanning, and footwear manufacturing.

Course Learning Outcomes (CLOs): Upon completing this course students will be able to

	Course Learning Outcomes (CLOs)	**Learning Level**
CLO1	Define chemical bonding, and molecular geometry based on established theories, and develop critical thinking skills in different intermolecular forces.	C1, A1
CLO2	Apply the fundamentals principle of chemical bonding and transitional metal chemistry in different steps of leather processing.	C3, A2
CLO3	Illustrate and analyze the chemistry theories to explain the interactions between acids and bases and the fundamental ideas of buffer solutions.	C2, C4, A3
CLO4	Describe the concept of redox reactions and the various redox titration techniques, and apply them in real-life applications purpose.	C2, C3, A2
CLO5	Analyze the theories of coordination chemistry along with aqueous chemistry of chromium and apply them in tanning process.	C4, A3

Mapping of CLO with PLO

CLOs	**PLO1**	**PLO2**	**PLO3**	**PLO4**	**PLO5**	**PLO6**	**PLO7**	**PLO8**	**PLO9**	**PLO10**	**PLO11**	**PLO12**
CLO1	3	2	2	2	-	-	-	-	-	-	-	-
CLO2	2	2	2	-	-	-	-	-	-	-	-	-
CLO3	3	2	1	-	-	-	-	-	-	-	-	-
CLO4	3	2	1	-	-	-	-	-	-	-	-	-
CLO5	3	2	2	-	-	-	-	-	-	-	-	-

Rank: 3-High match, 2-Medium match, 1-Low match.

Mapping of Course Learning Outcomes (CLOs) with the Teaching-Learning and Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Interactive audiovisual lecture, whiteboard lustration, slide presentation, problem practices	In-course Exam; Final Exam
CLO2	Interactive audiovisual lecture, whiteboard lustration, slide presentation, problem practices	In-course Exam; Final Exam
CLO3	Lecture, whiteboard illustration, problem-based excesses	Quiz, Assignment, and Final Exam
CLO4	Lecture, slide presentation, group discussion, whiteboard illustration, and problem-based exercises	Quiz, In-course Exam, and Final Exam
CLO5	Lecture, whiteboard illustration, group discussion, and problem-based exercises	In-course Exam, Assignment, Final Exam

Learning materials

i. Recommended readings

a) G. F. Lipotrot- Modern Inorganic Chemistry.
b) F. Albert Cotton, Geoffrey Wilkinson, Paul L. Gaus- Basic Inorganic Chemistry
c) Darren Ebbing and Steven D . Gammon - General Chemistry, 10th edition

ii. Supplementary Readings

a) R. D. Madan- Modern Inorganic Chemistry.
b) K. N. Upadhyaya- A Text Book of Inorganic Chemistry.

iii. Others: Lecture/hand notes provided by the course teachers.

Course Code: 0531-Chem-1109 Course Title: Physical Chemistry Credits: 3.0

Rationale of the Course: The course is designed to give the students an understanding of different topics on physical chemistry like introductory concepts on surface chemistry, reaction kinetics, thermodynamics, photochemistry, colloidal science, colligative properties as well as corrosion and reaction. After completion of the course, students will be able to gather theoretical knowledge of physical chemistry and apply it in related engineering fields.

Course Contents

Surface chemistry: Residual force of surface, adsorption and absorption, nature and characteristics of adsorption, types of adsorption, types of adsorption isotherms, theoretical study of adsorption of gas by solid: Freundlich, Langmuir, and BET isotherms, adsorption of solid from solution, applications adsorption.

Colloidal solution: True solution, suspension, types of colloids, general methods of preparation and purification, general properties of sols, the origin of charge, protective action; emulsion, types

and preparation of emulsion, emulsifier, stability of emulsions, application of colloids in tanning processes.

Photochemistry: Laws of photochemistry - Grotthuss-Draper law, Stark-Einstein law and Beer-Lambert law (derivation and problems), quantum yield, significance of quantum yield, photophysical processes: Jablonski diagram, chemiluminescence, fluorescence, phosphorescence, photosensitization and photoquenching, applications of photochemistry.

Chemical kinetics: Rate of reaction, order, and molecularity, elementary and overall reaction integral rate equation for 1^{st}, 2^{nd}, and 3^{rd} order kinetics, half-life, order determination methods, temperature dependence of reaction rate, simple theories of reaction rate, energy of activation, collision theory of reaction rates.

Properties of dilute solution: Review of different types of solution, colligative properties, lowering of vapor pressure, elevation of boiling point, depression of freezing point, osmotic pressure and osmosis, deduction of their formula, molecular weight from Raoult's Law, their experimental determination, application of colligative properties, applications of colligative properties.

Corrosion and reactions: Introduction, different types of corrosion, influence of different factors on corrosion, thermodynamics of corrosion, mechanisms of corrosion, different corrosion prevention methods

Thermodynamics: Work, heat, energy, internal energy and enthalpy, thermodynamics systems, 1^{st} law of thermodynamics, reversible and irreversible processes, isothermal and adiabatic expansion of ideal gas, 2^{nd} law of thermodynamics, spontaneous process, entropy, Carnot's cycle, efficiency of a machine.

Course Objectives:

a. To expose and explain different laws of physical chemistry.
b. To provide lessons on analysis and derivation of different standard equations using various parameters and variables.
c. To improve the ability of the students to interpret the tabulated experimental data for different physical processes.
d. To promote knowledge of the basic concepts of physical chemistry to enter into the field of engineering education.

Course Learning Outcomes (CLOs): At the completion of this course students will be able to -

	Course Learning Outcomes (CLOs)	**Learning Level**
CLO1	Narrate the physical law and principles of surface chemistry and apply them in environmental remediation methods.	C1, C3, A3
CLO2	Explain colloids and emulsion, their classification, preparative methods, and properties of sol, and illustrate the real-life applications.	C2, C4, A3

CLO3	Illustrate different principles of photochemistry, and concepts of photochemical and photophysical processes, and compare them with thermal reactions.	C3, A3
CLO4	Compare the kinetics of zero, 1st, 2nd, and 3rd order reactions and narrate the different reaction order determination techniques and the theories of reaction rate.	C2, C4, A3
CLO5	Explain four colligative properties, and concepts of thermodynamics and apply them in real-life practices.	C3, A3
CLO6	Explain the concept of corrosion of materials in different environmental conditions and design the methods for the prevention of corrosion.	C2, C5, A4

Mapping of CLO with PLO

CLOs	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12
CLO1	3	2	1	-	-	-	-	-	-	-	-	1
CLO2	3	2	2	-	-	-	-	-	-	-	-	1
CLO3	3	3	2	-	-	-	2	-	-	-	-	-
CLO4	2	2	-	-	-	-	-	-	-	-	-	-
CLO5	3	2	-	-	-	-	2	-	-	-	-	1
CLO6	3	2	-	-	-	-	2	1	-	-	-	-

Rank: 3-High match, 2-Medium match, 1-Low match.

Mapping of Course Learning Outcomes (CLOs) with the Teaching-Learning and Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Interactive audiovisual lecture, whiteboard illustration, problem-solving practices	In-course Exam; Final Exam
CLO2	Interactive audiovisual lecture, whiteboard illustration, problem-solving practices	In-course Exam; Final Exam
CLO3	Lecture, whiteboard illustration, slide presentation, problem-based excesses	Quiz, Assignment, and Final Exam
CLO4	Lecture, slide presentation, group discussion, whiteboard illustration, and problem-based exercises	In-course Exam, and Final Exam
CLO5	Lecture, whiteboard illustration, group discussion, and problem-based exercises	In-course Exam, Assignment, Final Exam
CLO6	Lecture, whiteboard illustration, and problem-based exercises	Assignment, Final Exam

Learning Materials

i. **Recommended Readings**
   a) S. Glasstone-Text Book of Physical Chemistry.
   b) Moron and Lando- Fundamentals of Physical Chemistry.

ii. **Supplementary Readings**
   a) Bahl And Tuli- Essentials Physical Chemistry.
   b) S.S. Dara- Engineering Chemistry, 1st Edition.

iii. **Others**: Handout/lecture material provided by the course teacher

Course Code: 0531-Chem-1110 Course Title: Inorganic and Physical Chemistry Lab Credits: 1.5

Rationale of the course: The course is designed to provide knowledge related to safety during working in the Chemistry laboratory, and the development of skills for the use of lab apparatus and equipment using mainly quantitative and qualitative analysis.

Course Contents

1. Uses of some common apparatus and reagents: Preparation of the substance for analysis and weighing the sample, Preparation of the standard solution of primary standard substances like oxalic acid, succinic acid, sodium carbonate, potassium dichromate.

2. Titration: Acid- base titration: standardization of secondary standard substances like sodium hydroxide, hydrochloric acid, sulphuric acid; redox titration: standardization of secondary standard substances like potassium permanganate, sodium thiosulphate; estimation of Fe and Cu from supplied sample solution.

3. Systematic qualitative analysis of inorganic salts: Physical appearance, preliminary dry test, wet test for acid radicals, flame test, group separation table.

Course Objectives: The course learning objectives of this course are to

a. familiarize a student with the basic techniques of chemistry laboratory such as weighing, measuring, and transferring liquids, heating, and filtering.
b. impart knowledge on the identification of different cations and anions by systematic semi micro qualitative analysis.
c. prepare different standard solutions and perform quantitative analysis.

Course Learning Outcomes (CLOs): At the end of the course, students will be able to -

CLOs	Course Learning Outcomes (CLOs)	Learning Level
CLO1	Explain the principles behind the experiment performed in the laboratory.	C2, P2
CLO2	Perform the hands-on experimental work on volumetric analysis using the equipment/set-up in the laboratory to achieve the respective objectives of the experiments individually or in a group.	C3, P3
CLO3	Inspect the salts and analysis them to determine the cations and anions present in the sample salts through systematic quantitative analysis.	C4, P3
CLO4	Write laboratory reports that compare and contrast theoretical predictions and experimental measurements as well as observations and draw conclusions and inferences from agreements and/or disagreements observed.	C3, P3

Mapping of CLO with PLO

CLOs	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12
CLO1	3	2	-	-	-	-	-	-	-	-	-	-
CLO2	3	2	1	-	-	-	-	-	2	-	-	-
CLO3	3	2	2	2	-	-	-	-	-	-	-	-
CLO4	3	2	-	-	-	-	-	2	-	2	-	2

Rank: 3-High match, 2-Medium match, 1-Low match.

Mapping of Course Learning Outcomes (CLOs) with the Teaching-Learning, and Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Interactive Lectures, Group Discussions, Demonstration, Hands-on practice, and Group work	Quiz, Viva Voce, Report evaluation, Final Exam
CLO2	Lecture, Demonstration, Hands-on practice, and Group work	Presentation, Report evaluation, Final Exam
CLO3	Lecture, Demonstration, Hands-on practice, and Group work	Quiz, Viva Voce, Report evaluation, Final Exam
CLO4	Lecture, Demonstration, Hands-on practice, and Group work	Report evaluation, Final Exam

Learning materials

i. Recommended readings

a) Vogel A. I. - Qualitative Chemical Analysis
b) Vogel A. I. - Text Book of Quantitative Chemical Analysis

ii. Supplementary Readings

a) P. K. Sarker - Analytical Chemistry for Leather Manufacture.
b) Fifield and Haines-Environmental Analytical Chemistry.

iii. Others: Lecture notes and Lab procedure provided by the course teachers.

Course Code: 0715-ME-1112 Course Title: Engineering Drawing Credits: 1.5

Rationale of the Course: This course is assigned for first-year students to know and practice the types of drawing instruments, types of projection, projection of points, straight lines, and solids; development of surface, etc. At the end of the course, the students will be able to develop skills in basic engineering drawings related to footwear and allied engineering.

Course Content

Drawing equipment and the uses of instruments; basic drafting techniques, planning of drawing sheet; dimensioning, types of lines, lettering, numbering.

Geometrical construction, theory of projection, orthographic projection, first and third angle projection, multi-view projection problems, oblique and isometric drawings, perspective views, sectional views, auxiliary views, assembly drawings, and basic concepts of working drawing.

Course Objectives: This course is designed to provide adequate knowledge on-

a. different types of drawing tools, and equipment.
b. letters and numbers in drawing sheets.
c. different types of projections related to points, straight lines, and solids.
d. the development of different types of views and surfaces.

Course Learning Outcomes (CLOs): Upon successful completion of this course, students will be able to

	Course Learning Outcomes (CLOs)	**Learning Level**
CLO1	Define and identify different types of lines, shapes, and views.	C1, A1, P1
CLO2	Explain and illustrate different theories or concepts of Engineering Drawing.	C2, A2, P2
CLO3	Apply various geometrical construction rules and techniques for drawing different projections of 3D objects.	C3, A3, P3
CLO4	Solve the drawing-related problems of different projections, views, and angles.	C4, A4, P3

Mapping of CLOs with PLOs

CLOs	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12
CLO1	3	1	-		-							
CLO2	3	1	-	-	-	-	-	-	-	-		
CLO3	3	3	2	2	-	-	-	-	2	1	-	-
CLO4	3	3	2	2	-	-	-	-	-	-	-	1

Rank: 3-High match, 2-Medium match, 1-Low match.

Mapping of Course Learning Outcomes (CLOs) with the Teaching-Learning, and Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Interactive Lectures, Group Discussions, Demonstration, Hands-on practice, and Group work	Quiz, Viva Voce, Report evaluation, Final Exam
CLO2	Lecture, Demonstration, Hands-on practice, and Group work	Presentation, Report evaluation, Final Exam
CLO3	Lecture, Demonstration, Hands-on practice, and Group work	Quiz, Viva Voce, Report evaluation, Final Exam
CLO4	Lecture, Demonstration, Hands-on practice, and Group work	Report evaluation, Final Exam

Learning Materials

i. Recommended Readings

a) Chandra Mandal, Dr. Amalesh and Islam, Dr. Md. Kamrul.,- "Mechanical Engineering for Engineers".

b) Geisecke E., Federick; Mitchel E., Alva; Spencer C., Henry; Hill L., Ivan; Dygdon Thomas., John; Novak E., James; Loving O. R.; Lockhart E., Shawna-"Technical Drawing with Engineering Graphics".

ii. Supplementary Readings

a) Simmons H., Colin; Dennis E., Maguire and Phelps., Neil- "Mechanical Engineering Drawing"

b) Warren J. Luzaddder and Jon M. Duff.-"Fundamental of Engineering Drawing"

iii. Others: Handout/Lecture notes provided by course teacher.

Course Code: 0417-Hum-1114 Course Title: Employability Skills-I Credits: 1.5

Rationale of the Course: This course is designed to enable students in employability-related communication to enhance their performance in different types of communicative English. After completing the course, students will be competent in speaking, listening, writing, reading, and developing communicative skills in technical and business English.

Course Content

Language: Function, Difference between written and spoken language, Planning format, paragraph heading, Listening, understanding and speaking skills, effective communication, techniques of description, uses of visual aids, reading skills.

Different types of Communication: Intrapersonal, interpersonal, small group, organizational, intercultural, and mass communications; significance of communication in corporate and multinational business organizations; communication network- Vertical communications downward communication and upward communication, horizontal communication, systems of communication: Stimulus to communication, communication components.

Business letters: Drafting letters, applications, letters of complaint, letters to the press, apology and explanation, request letters, functions of a first, middle and last paragraph(s), characteristics and drafting process of positive letters, negative letters, persuasive letters, routine letters and memos.

Report Writing: Types of report, characteristics, and importance of different types-Purpose-Scope-different styles of writing reports. The process of preparing informal and formal reports, drafting reports, progress reports, technical reports, and industrial reports.

Proposals: For new equipment, increasing production, description of visits, experiments, etc.

Explaining: Process explaining, complaining, and reporting damage.

Course Objectives

a. To assist students in becoming well-versed, responsible, and creative communicators through individual skill assessments by exploring their values and career choices.
b. To encourage students about realistic employment choices and to identify the steps necessary to achieve their goals.
c. To develop students' communication skills in the structure, elucidation, and delivery of messages in diverse professional, cultural, and global communities.

Course Learning Outcomes (CLOs): The course is designed to achieve the following learning outcomes

	Course Learning Outcomes (CLOs)	**Learning Level**
CLO1	Demonstrate the basic domains of English language, business letters, reports, and proposal writing.	C2, A2, P2
CLO2	Manipulate and apply the language skills, tools, and techniques to develop technical and professional letters, reports, and proposals.	C3, A2, P3
CLO3	Relate and apply the acquired skills on Communicative English to explore future career.	C4, A3, P3

Mapping of CLOs with PLOs

CLOs	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12
CLO1	-	-	-	-	-	2	-	-	3	3	3	2
CLO2	-	-	-	-	2	3	-	-	2	3	2	3
CLO3	-	-	-	-	-	2	-	-	2	3	3	3

Rank: 3-High match, 2-Medium match, 1-Low match

Mapping of Course-Learning Outcomes (CLOs) with the Teaching-Learning and Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture, Multimedia presentation, group discussion	Lab Performance Report, Continuous Assessment; Final Examination
CLO2	Lecture, Video presentation, Problem-based Learning	Lab Performance Report, Assignment, Continuous Assessment; Final Examination
CLO3	Lecture, multimedia presentation, literature review, group discussion, analysis, and comparison through various circumstances	Lab Performance Report, Continuous Assessment; Final Examination

Learning Materials

i. Recommended Readings

a) Mishra. B, Sharma. S (2011) Communication Skills for Engineers and Scientists. PHI Learning Pvt. Ltd. ISBN: 8120337190.
b) Chaturvedi P. D, Chaturvedi M. (2011) Business Communication: Concepts, Cases and Applications. Pearson Education India. ISBN: 8131718727.
c) Greenbaum. Sidney. College Grammar of English. Longman Publishers. ISBN: 9780582285972.

ii. Supplementary readings:

a) Frances Trought (2017) Employability Skills: How to stand out from the crowd in the graduate job market ISBN: 978-1-292-15890-7 (print)

iii. Others: Handout/lecture material provided by the course teacher

Course Code: 0723-FE-1116 Course Title: Field Tour-I Credit: 1.0

Rationale of the Course: Industrial visits serve as an excellent platform to learn for students pursuing B.Sc. in Footwear Engineering degree and they help in bridging the gap between classroom learning and the actual work conditions. The Field Tour-I course is designed to help inculcate a practical workplace environment to the students and to render a holistic engineering education to them.

Course Content

In 1st Year 1st Semester, students will visit a reputed leather industry.

Discussions with the company supervisor about any project or assignment/task.

Understanding the systems in the workplace – Processes, Organization, Administration.

Recording all the work done or knowledge gained.

Maintaining a logbook and giving feedback to the guide teacher.

Course Objectives

a. To provide exposure to the students to leather engineering practices in the tannery.
b. To instill communication skills in engineering which include interaction with the working environment and technical writing.

Course Learning Outcomes (CLOs): At the completion of this course students will be able to -

	Course Learning Outcomes (CLOs)	**Learning Level**
CLO1	Identify and recognize the machines and equipment of leather industry.	C2, A2, P1
CLO2	Describe and analyze the process flowchart, faults, remedies and recent development in leather processing.	C2, C4, A3, P3
CLO3	Write technical reports and deliver oral presentations related to the industrial visit/work completed.	C3, A2, P2

Mapping CLOs with PLOs

	PLO1	**PLO2**	**PLO3**	**PLO4**	**PLO5**	**PLO6**	**PLO7**	**PLO8**	**PLO9**	**PLO10**	**PLO11**	**PLO12**
CLO1	3	-	-	-	2	-	-	-	2	-	-	2
CLO2	2	2	-	-	2	-	-	-	2	-	-	-
CLO3	2	-	-	-	-	-	-	-	2	3	-	2

Rank: 3-High match, 2-Medium match, 1-Low match.

Mapping of Course-Learning Outcomes (CLOs) with the Teaching-Learning and Assessment Strategy

CLOs	**Teaching-Learning Strategy**	**Assessment Strategy**
CLO1	Interactive Lecture, Display and demonstration, Presentation and viva	Participation, Performance Assessment, Presentation, Report Evaluation
CLO2	Interactive Lecture, Display and demonstration, Presentation and viva	Participation, Performance Assessment, Presentation, Report Evaluation
CLO3	Discussion, Self-study, Motivational discussion, Presentation and viva	Participation, Performance Assessment, Presentation, Report Evaluation

Learning Materials

i. Recommended Readings

a) Writing the Winning Thesis or Dissertation: A Step-by-Step Guide - By Allan A. Glatthorn, Randy L. Joyner.
b) Relevant books, scientific journals, handbooks, patents and manuals.

Course Code: 0723-FE-1201 Course Title: Leather Processing-I Credits: 3.0

Rationale of the Course: This course explores the essential pre-tanning processes in leather manufacturing including sorting, grading, beam house operations, soaking, unhairing, liming, deliming, bating, pickling, and degreasing. Students will develop the knowledge and skills needed to analyze, evaluate, and apply these processes for the production of high-quality leather products.

Course Content

Sorting and gradation of raw hides and skins: Principles; objectives, methods, and importance in leather processing.

Beam house operation/ pre-tanning Processes: Introduction and role of beam house operations in leather making.

Soaking: Objectives and mechanism, soaking of different hides and skins, enzymatic soaking, influencing factors, role of hyaluronic acid, aids and controls, eco-friendly process technologies in soaking, defects and their remedies, green fleshing.

Unhairing and liming: Objectives, types, advantages and disadvantages, immunization of keratin, swelling of collagen based on Dornan's theory, mechanism of unhairing, sulphide free unhairing system, enzymatic unhairing, control of enzymatic unhairing and advantages and, scope of hair utilization or disposal, prevention of H_2S emission from lime effluent.

Fleshing: Objectives, types, advantages and disadvantages.

Deliming and bating: Objectives, selection of deliming agents, completion test of deliming, mechanism of bating, effect of bating on leather quality, acid and alkali bating: advantages and disadvantages, bating completion test, pollutants emission, cleaner technology options.

Pickling: Acid binding capacity of collagen, organic acids and salts in pickling, importance and controls, de-pickling.

Degreasing: Objectives and importance, different systems and methods of degreasing.

Course Objectives

a. To provide students with a comprehensive understanding of sorting, grading, and beam house operations in the leather-making process.
b. To enable students to comprehend the processes of soaking, unhairing, liming, and fleshing.
c. To familiarize students with the objectives, types, advantages, and disadvantages of deliming, bating, pickling, and degreasing in leather manufacturing.

Course Learning Outcomes (CLOs): Upon completion of the course, the students will be able to:

	Course Learning Outcomes (CLOs)	**Learning Level**
CLO1	Recall and explain the principles of sorting, and grading of raw hides and skins, and leather processing.	C1, C2, A1, A2
CLO2	Describe the role and importance of beam house operations in leather making.	C2, A2
CLO3	Analyze the mechanism, environmental impact, and factors influencing the beam house operations.	C3, A3
CLO4	Compare and analyze different techniques of different pre-tanning operations.	C3, C4, A4
CLO5	Evaluate the suitability of pre-tanning operations based on specific leather manufacturing requirements.	C5, A4

Mapping of CLO with PLO

CLOs	**PLO 1**	**PLO2**	**PLO3**	**PLO4**	**PLO5**	**PLO6**	**PLO7**	**PLO8**	**PLO9**	**PLO10**	**PLO11**	**PLO12**
CLO1	3	-	-	-	-	-	-	-	-	-	-	-
CLO2	3	2	-	-	-	-	-	-	-	-	-	-
CLO3	3	3	2	2	-	2	2	-	-	-	-	-
CLO4	3	3	2	2	-	-	3	-	-	-	-	-
CLO5	3	3	2	2	-	2	3	-	-	-	-	-

Rank: 3-High match, 2-Medium match, 1-Low match

Mapping of Course Learning Outcomes (CLOs) with the Teaching-Learning and Assessment Strategy

CLOs	**Teaching-Learning Strategy**	**Assessment Strategy**
CLO1	Lecture, Multimedia presentation, demonstration and problem-based exercises	Group Presentation, In-course Exam; Final Exam
CLO2	Lecture, group discussion and problem-based exercises	Group Presentation, In-course Exam; Final Exam

CLO3	Lecture, guided reading and problem-based learning (PBL): Identifying the problem to be solved	Assignment, Group Presentation, In-course Exam, and Final Exam
CLO4	Lecture, multimedia presentation, group discussion, literature review, demonstration, and problem-based exercises	Group Presentation, In-course Exam, and Final Exam
CLO5	Lecture, group discussion, literature review, and problem-based exercises	Group Presentation, Assignment, In-course Exam, and Final Exam

Learning Materials

i. Recommended Readings

a) Theory and Practice of Leather Manufacture–K. T. Sarkar, Macmillan India Press, Madras
b) Tanning Chemistry: The Science of Leather-Anthony D Covington
c) Possible Defects in Leather Production-Gerhard John.

ii. Supplementary Readings

a) Introduction to the Principles of Leather Manufacture- S. S. Dutta, 4th Edition.
b) Leather Technician`s Handbook–J. H. Sharphouse, Vernon Lock Ltd., 125 High Holborn, London W-C1

iii.Others: Handout/lecture material provided by the course teacher

Course Code: 0723-FE-1202 Course Title: Leather Processing-I Lab Credits: 1.5

Rationale of the Course: Leather Processing-I Lab is a practical course that is designed to develop graduate's essential knowledge of leather manufacturing. The main aim of this course is to introduce the students to skills necessary for manufacturing of wet-blue leather. The course will deal with the different stages of pre-tanning process, the importance of pre-tanning, and its methods resulting in enhancing interest in the chemistry and mechanism of leather.

Course Content

1. Identification of raw hides and skins/ wet blue/ crust leather/finished leather.
2. Curing of freshly flayed cow hides and goat skins with sodium chloride (common salt) and its effect on moisture content at different time intervals.
3. Determination of rate of moisture uptake and degree of swelling of cow hides and goat skins during soaking.
4. Painting method of unhairing for wet salted goat skins/sheep skins.
5. Liming with slaked lime and/or sodium sulfide.
6. Comparative effects of deliming with boric acid, lactic acid, ammonium chloride, and ammonium sulfate.

7. Bating with acidic/alkaline bate powder of wet salted goat skins/sheep skins/cowhides.
8. Effect of sodium chloride on pickling of wet salted goat skins/sheep skins/cowhides.
9. Manufacturing of chrome-tanned wet blue leather from wet salted hides and skins.

Course Objectives:

a. To introduce students to quantitative and qualitative control parameters in pre-tanning operations.
b. To enhance the student's ability to analyze and alleviate the issues during leather manufacturing.
c. To guide students in assessing different completion parameters of different stages of the pre-tanning operations.
d. To develop students' skills on the manufacturing of wet blue leather.

Course Learning Outcomes (CLOs): Upon completion of the course, the students will be able to

	Course Learning Outcomes (CLOs)	**Learning Level**
CLO1	Identify and classify different types of leather, according to origin, grain patterns, and texture.	C2, A2, P2
CLO2	Apply and analyze the process of curing and pre-tanning operations of hides and skins.	C3, C4, A2, P3
CLO3	Compare and evaluate the effectiveness of different techniques of beam house operations.	C4, C5, A3, P4
CLO4	Demonstrate practical proficiency in the manufacturing of wet-blue leather as an individual and/or teamwork.	C5, A3, P4

Mapping of CLO with PLO

CLOs	**PLO1**	**PLO2**	**PLO3**	**PLO4**	**PLO5**	**PLO6**	**PLO7**	**PLO8**	**PLO9**	**PLO10**	**PLO11**	**PLO12**
CLO1	3	2	2	2	1	-	1	-	-	-	-	-
CLO2	3	3	2	3	2	-	2	-	-	-	-	-
CLO3	3	3	2	3	2	-	3	-	-	-	-	-
CLO4	3	3	2	3	2	-	3	-	3	-	-	-

Rank: 3-High match, 2-Medium match, 1-Low match

Mapping of Course Learning Outcomes (CLOs) with the Teaching-Learning and Assessment Strategy

CLOs	**Teaching-Learning Strategy**	**Assessment Strategy**
CLO1	Lecture, Demonstration, Hands-on practice, and Group work	Lab Performance, Continuous assessment: Viva, Report, Final Exam
CLO2	Lecture, Demonstration, Hands-on practice, Group discussion, and Group work	Lab Performance, Continuous assessment: Viva, Report, Final Exam

CLO3	Lecture, Demonstration, Hands-on practice, and Group work	Lab Performance, Continuous assessment: Viva, Report, Final Exam
CLO4	Lecture, Demonstration, Hands-on practice, and Group discussion	Lab Performance, Continuous assessment: Viva, Report, Final Exam

Learning Materials

i. Recommended Readings

a) Leather Technician`s Handbook–J. H. Sharphouse, Vernon Lock Ltd., 125 High Holborn, London W-C1
b) Theory and Practice of Leather Manufacture- K.T. Sarkar.
c) Possible Defects in Leather Production-Gerhard John.

ii. Supplementary Readings

a) Introduction to the Principles of Leather Manufacture- S. S. Dutta, 4th Edn. I. L. T. A., Calcutta.
b) Tanning Chemistry, The Science of Leather-Anthony D Covington.

iii. Others: Handout/lecture material provided by the course teacher

Course Code: 0723-FE-1203 Course Title: Fundamentals of Footwear Credits: 3.0

Rationale of the Course: This is one of the fundamental courses in Footwear Engineering. This course will provide the students with the basic concepts of foot, last, footwear, shoe sizing and fitting system, and materials, components, and accessories used in footwear.

Course content

Basic concepts of footwear: Introduction, history, types, and features of oxford, derby, court, moccasin, sandal, casual, boot, sports, mule, clogs, occupational and safety footwear, and bespoke footwear.

Parts of footwear: Vamp, quarter, toe cap, apron, tongue, counter, backstraps, fastenings, toe puff, stiffener, eyelets, trims/ornaments and parts of lining, insole, insock, welt, rand, bottom filler, midsole, runner, sole, heel, shank piece, and straps for the basic styles of footwear.

Foot: Function and types, foot anatomy, development of human foot from infants to adults, different foot problems, foot measurement importance, and process, measurement for bespoke footwear, the device to measure various anatomical parameters of the foot, Brannock device for foot measurement, foot scanner.

Last: Definition, functions, parts, materials, dimension/measurement, classification of last, differences between last and feet, characteristic features of different basic style shoe lasts, manufacturing, customization, and defects of last, last storage, and afterlife of last.

Shoe size and fitting: Definition and classification of shoe size and fitting, different shoe sizing systems (UK, Paris point, American, centimeter, and mondo) and their comparison, shoe size

conversion techniques, inconsistency of shoe sizing, the importance of fitting, principles of good fit, fitting process, fitting problems, multi-fitting, fitting of infants, children's and adults' footwear, benefits of high standards of fit.

Footwear materials, components and accessories: Upper and lining material, toe puff and stiffener, welt, insole, soling material, heel, shank, adhesive, primer, footwear accessories, types and functions of accessories, decorative trims and their advantages, function, and attachment process (stapling, prongs/lugs, and two-part fittings) for decorative trims, zippers, buckle, touch-and-close fastener, faults and remedies of attachment processes.

Course Objectives: The objectives of this course are as follows:

a. To provide students with fundamental knowledge about foot, last, and footwear.
b. To introduce students to different shoe sizing and fitting systems.
c. To familiarize the students with different materials, components, and accessories used in footwear manufacturing.

Course Learning Outcomes (CLOs): Upon completion of the course, the students will be able to:

	Course Learning Outcomes (CLOs)	**Learning Level**
CLO1	Outline the basic knowledge of footwear, foot, last, shoe sizing and fitting, components, and materials used in footwear manufacturing.	C1, A1
CLO2	Explain the functions, anatomy, problems, measurement, sizing, and fitting of foot, footwear, and lasts.	C2, A2
CLO3	Apply different measurement processes, and shoe sizing systems including a variety of materials and accessories during footwear manufacturing.	C3, A3
CLO4	Relate different foot problems with the foot measurement process, last customization, fitting principles, and appropriate materials and components for manufacturing.	C4, A4

Mapping of CLO with PLO

CLOs	**PLO1**	**PLO2**	**PLO3**	**PLO4**	**PLO5**	**PLO6**	**PLO7**	**PLO8**	**PLO9**	**PLO10**	**PLO11**	**PLO12**
CLO1	3	1	-	-	-	-	-	-	-	-	-	-
CLO2	3	2	-	-	-	-	-	-	-	-	-	-
CLO3	3	3	3	-	2	-	-	-	-	-	-	-
CLO4	3	3	3	3	2	-	-	-	-	-	-	-

Rank: 3-High match, 2-Medium match, 1-Low match

Mapping of Course Learning Outcomes (CLOs) with the Teaching-Learning and Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture, multimedia presentation, whiteboard illustration, interactive discussion, group discussion	Assignment, In-course Exam; Final Exam
CLO2	Lecture, multimedia presentation, video presentation, whiteboard illustration	Assignment, In-course Exam; Final Exam
CLO3	Lecture, multimedia presentation, group discussion, interactive discussion, problem-based exercise	Group presentation, In-course Exam; Final Exam
CLO4	Lecture, multimedia presentation, interactive discussion, whiteboard illustration, case study	Assignment, Group presentation, In-course Exam; Final Exam

Learning Materials

i. **Recommended Readings**
   a) Venkatappaiah B.- Introduction to The Modern Footwear Technology.
   b) Miller R. G. (Editor)- Manual of Shoe Making.
   c) Thornton J. H.- Text Book of Footwear Manufacture.

ii. **Supplementary Readings**
   a) Ruth Thomson – Making Shoes.
   b) Swayam Siddha – Product Knowledge.

iii. **Others:** Handout/lecture material provided by the course teacher.

Course Code: 0723-FE-1204 Course Title: Fundamentals of Footwear Lab Credits: 1.5

Rationale of the Course: This practical course is based on fundamental knowledge of footwear. The course will provide knowledge of human foot anatomy and footwear. Students will get an overview of the shoe last, different types of materials used in footwear manufacturing. At the end of the course, students will be able to learn about cutting, closing, and stitching operations in detail.

Course Content

1. **Identification of foot bones:** Identification of foot bones from skeleton and model.
2. **Identification of footwear parts:** Identification of footwear upper and bottom parts- upper, toe cap, vamp, quarter, counter, lining, toe puff, stiffener, heel grip, thread, eyelet, insock, insole, mid-sole, sole, shank, bottom filler, heel, heel block, etc.
3. **Identification of footwear:** Identification of different types of footwear, such as oxford, derby, moccasin, sandal, boot, sports, safety footwear, etc.
4. **Identification of last:** Identification of different types of last and specification.

5. **Identification of footwear materials:** Identification of footwear materials-upper leather, synthetic, fabrics, lining leather, insole material, different soling materials-leather, PVC, PU, vulcanized rubber, TPR, EVA, resin rubber, etc.
6. **Cutting practice:** Identification of different parts of clicking machine and setting up of different types of clicking machines, identification of different types of clicking knives and clicking machines, cutting practice with paper, synthetic, and leather materials.
7. **Practice for preparatory operations of closing:** Exercise of skiving, stitch marking, edge folding, ID marking, splitting, pre-forming, etc. for closing operation.
8. **Practice for stitching:** Hand stitching practice for lock stitching, chain stitching, zig-zag stitching; Machine stitching practice-Identification of various sewing machines and their parts and functions, identification of sewing needle, sewing exercise with paper without thread, practice threading systems for different types of sewing machines, sewing exercises with synthetic material and thread, sewing exercises with leather and thread, and identification of different types of seams; Practice for construction of different types of seams-Lapped seam, closed seam, open seam, butted seam, moccasin seam, etc.

Course Objectives: Specific objectives of this course are as follows:

a. To enhance knowledge about the human foot, shoe last, and different types of footwear and parts of footwear.
b. To provide in-depth cutting, closing, and stitching knowledge.
c. To provide essential knowledge related to the footwear manufacturing process.

Course Learning Outcomes (CLOs): Upon completion of the course, the students will be able to:

	Course Learning Outcomes (CLOs)	**Learning Level**
CLO1	Recall different types of footwear, footwear upper and bottom parts, and foot bones.	C1, A1, P1
CLO2	Explain different types of last required for manufacturing different types of footwear.	C2, A2, P2
CLO3	Classify different types of upper, lining, and soling material and assess their quality.	C3, C4, A4, P4
CLO4	Perform cutting, closing, and stitching practices.	C4, A3, P3

Mapping of CLO with PLO

CLOs	**PLO1**	**PLO2**	**PLO3**	**PLO4**	**PLO5**	**PLO6**	**PLO7**	**PLO8**	**PLO9**	**PLO10**	**PLO 11**	**PLO12**
CLO1	3	-	-	-	-	-	-	-	3	-	-	-
CLO2	3	-	-	-	2	-	-	-	3	-	-	-
CLO3	3	-	-	3	3	-	-	-	3	-	-	-
CLO4	3	-	2	-	3	-	-	-	3	-	-	-

Rank: 3-High match, 2-Medium match, 1-Low match

Mapping of Course Learning Outcomes (CLOs) with the Teaching-Learning and Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Interactive discussion, Demonstration, and Hands-on practice	Lab Performance, Final Exam
CLO2	Interactive discussion, Demonstration, and Hands-on practice	Lab Performance, Continuous assessment: Viva, Report, Final Exam
CLO3	Interactive discussion, Demonstration, and Hands-on practice	Lab Performance, Continuous assessment: Viva, Report, Final Exam
CLO4	Lecture, Demonstration, Hands-on practice, Video presentation, and Problem-based group discussion	Lab Performance, Continuous assessment: Viva, Report, Final Exam

Learning Materials

i. Recommended Readings

a) Footwear Design-Aki Choklat
b) The Science of Footwear-Ravindra S. Goonetilleke
c) Manual of Shoe Making- R. G. Miller

ii. Supplementary Readings

a) Handbook of footwear design and manufacture-A. Luximon
b) Text Book of Footwear Manufacture-J. H. Thornton

iii. Others: Handout/lecture material provided by the course teacher.

Course Code: 0541-Math-1205 Course Title: Calculus Credits: 3.0

Rationale of the Course: This course will help students develop a deeper grasp of functions, differentiation, and integration. Calculus concepts explored include limits and continuity, derivatives, definite integrals, exponential and logarithmic functions, trigonometric functions, and techniques of integration. Examining how calculus is used in the actual world is a major focus of this course.

Course Content:

Differential calculus: Functions of real variable and their graphs, limits of functions, continuity and derivative, higher derivatives, Leibnitz theorem, Role's theorem, mean value theorem, Taylor's theorem, Taylor's and Maclaurin's series, Maximum and minimum values of functions and applied maximum and minimum problems in science, and engineering, functions of two and three variables.

Integral calculus: Antiderivatives and indefinite integrals, Techniques of integration, Definite integration using antiderivatives, Definite integration using Riemann sums, Applications of the definite integral in geometry, science, and engineering.

Fundamental theorems of calculus: Basic properties of integration, Integration by reduction, Application of integration: Plane areas, Solids of revolution, Volumes by cylindrical shells, Volumes by cross-sections, Arc length and surface of revolution, Improper integrals: Gamma and beta functions.

Vector calculus: vector function of scalar variables, differentiation of vector functions and applications.

Course Objectives:

a. To provide a firm foundation in the concepts and techniques of the calculus, including basic functions and graphs and their properties, curve sketching, limits, continuity, differentiation, relative extrema and applications.
b. To introduce the students with integral calculus, the techniques of integration and some of the applications of integration to physical problems.
c. To provide knowledge on the applications of calculus in commerce and economics.

Course Learning Outcomes (CLOs): Upon completion of the course, the students will be able to -

	Course Learning Outcomes (CLOs)	**Learning Level**
CLO1	Identify a function from an algebraic, numerical, graphical, and verbal perspective and extract information relevant to the phenomenon modeled by the function.	C1, A1
CLO2	Describe the concept of limit and continuity of a function at a point graphically and algebraically using appropriate techniques.	C2, A1
CLO3	Calculate the area between curves, volumes of solids of revolution, surface area, arc length using integration.	C3, A2
CLO4	Interpret the derivative of a function at a point as the instantaneous rate of change and as the slope of the tangent line, the consequences of Rolle's theorem, and the mean value theorem.	C4, A3
CLO5	Evaluate integrals using different techniques of integration.	C5, A4

Mapping of CLOs with PLOs

CLOs	**PLO1**	**PLO2**	**PLO3**	**PLO4**	**PLO5**	**PLO6**	**PLO7**	**PLO8**	**PLO9**	**PLO10**	**PLO11**	**PLO12**
CLO1	3	3	-	1	-	-	-	-	-	-	-	-
CLO2	3	3	-	1	-	-	-	-	-	-	-	-
CLO3	3	3	-	2	-	-	-	-	-	-	-	-
CLO4	3	3	-	2	1	-	-	-	-	-	-	-
CLO5	3	2	-	2	-	-	-	-	-	-	-	-

Rank: 3-High match, 2-Medium match, 1-Low match.

Mapping of Course Learning Outcomes (CLOs) with the Teaching-Learning & Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture and literature review	Assignment, In-course Exam, and Final Exam
CLO2	Lecture, group discussion, and problem-based exercises	Assignment, In-course Exam, and Final Exam
CLO3	Lecture, guided reading, and problem-based learning	Assignment, In-course Exam, and Final Exam
CLO4	Lecture, group discussion, and problem-based exercises	Assignment, In-course Exam, and Final Exam
CLO5	Lecture, group discussion, and problem-based exercises	Group Presentation, Assignment, In-course Exam, and Final Exam

Learning Materials

i. Recommended Readings

a) H. Anton, I. C. Bivens, S. Davis, Calculus.
b) E.W. Swokowski, Calculus.
c) James Stewart, Calculus: Early Transcendentals.

ii. Supplementary Readings

a) Deborah Hughes-Hallett, Applied Calculus.
b) Stefan Waner and Steven Costenoble, Applied Calculus.

iii. Others: Handout/lecture material provided by the course teacher.

Course Code: 0611-CSE-1207 Course Title: Fundamentals of Computer and Information Technology Credits: 3.0

Rationale of the Course: This course is intended to introduce the fundamentals of computing devices and reinforce computer vocabulary, particularly with respect to personal use of computer hardware and software, the internet, networking, and mobile computing. It focuses on such computer literacy that prepares students for lifelong learning of computer concepts and skills.

Course Content:

Computer Basics: Generations of computer, block diagram of a computer, functions of the different units: input unit, output unit, memory unit, CPU (ALU+CU), input and output devices, computer memories: primary memory, secondary memory.

Computer Hardware and Software: Computer hardware, computer software, types, computer languages: machine language, assembly language, high-level language, program language translators: assembler, compiler, interpreter, computer virus: types of virus.

Operating System: Some popular operating Systems - UNIX - MS-DOS - Windows XP - Windows Vista – Linux, process management - multi-programming - multi-Tasking - multi-threading - multi-processing - time sharing - memory management - file management.

Digital Logic Design: Boolean algebra - logic gates - AND, OR, NOT, NAND, NOR gate - logic circuits - converting expression to logic circuit - universal NAND gate - universal NOR gate - Exclusive OR and equivalence function - design of combinational circuit - design of half- adder - design of full- Adder

Computer Networks: Resource share: hardware, software, information, network types: private, public, peer-to-peer, client-server, PAN, LAN, MAN, WAN, Network-relate devices: modem, NIC, hub, switch, router, gate-away, bridge, repeater, network topology: star, mesh, ring, bus, tree, hybrid, cloud computing

Communication systems: Analog signal, digital signal, data communication system, data transmission speed, data transmission method, bit synchronization, data transmission skills, data transmission mode, wired communication media: co-axial cable, twisted pair cable, optical fiber cable, wireless communication media: Wifi, bluetooth, hotspot, etc, mobile communication: 1G, 2G, 3G, 4G, TDMA, FDMA, CDMA, GSM, Telephone Number Systems in Bangladesh.

Internet: How internet works, internet server, ARPANET, types of internet, OSI Model, TCP/IP model, IP addressing, VPN.

Course Objectives:

a. To provide students the fundamental vocabulary of key terms related to computer hardware and software.
b. To develop knowledge on computer operating systems and language.
c. To introduce students with data management, and communication systems.

Course Learning Outcomes (CLOs): Upon completion of the course, the students will be able to -

	Course Learning Outcomes (CLOs)	**Learning Level**
CLO1	Describe the computer and information technologies, their internal mechanisms, and classifications.	C1, A1
CLO2	Explain the basics of the internet, mobile and wireless communications.	C2, A2
CLO3	Apply the fundamental of computer programming as well as the software development process and networking.	C3, A2
CLO4	Analyze and evaluate the information system briefly with real-life examples.	C5, A3

Mapping of CLOs with PLOs

CLOs	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12
CLO1	3	2	1	1	2	-	-	-	-	2	-	-
CLO2	3	2	2	1	2	1	-	-	-	2	-	-
CLO3	3	2	2	2	3	-	-	-	-	3	-	-
CLO4	3	2	1	3	3	1	-	-	-	3	-	3

Rank: 3-High match, 2-Medium match, 1-Low match.

Mapping of Course Learning Outcomes (CLOs) with the Teaching-Learning and Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture, multimedia presentation, group discussion,	Assignment, In-course Exam, and Final Exam
CLO2	Lecture, multimedia presentation, group discussion	Assignment, In-course Exam, and Final Exam
CLO3	Lecture, multimedia presentation, group discussion	Assignment, In-course Exam, and Final Exam
CLO4	Lecture, multimedia presentation, group discussion	Group Presentation, In-course Exam, and Final Exam

Learning Materials

i. Recommended Readings

a) H. Anton S. Frence- Computer Science.
b) Warford- Computer Science.
c) Peter Norton – An Introduction to Computer Science.

ii. Supplementary Readings

a) James Martin - Information Engineering: Introduction.
b) Kenneth C. Laudon and Jane P. Laudon- Management Information Systems:

iii. Others: Handout/lecture material provided by the course teacher.

Course Code: 0611-CSE-1208 Course Title: Fundamentals of Computer and Information Technology Lab Credits: 1.5

Rationale of the Course: A hands-on introduction to personal computers and application software. Students will learn basic computer terminology, the role of computers in society, and the use of word processing, spreadsheet, presentation, database, and Internet software.

Course Content:

Operating Computer using GUI Based Operating System: What is an Operating System; Basics of Popular Operating Systems; The User Interface, Using Mouse; Using right Button of the Mouse and Moving Icons on the screen, Use of Common Icons, Status Bar, Using Menu and Menu-selection, Running an Application, Viewing of File, Folders and Directories, Creating and Renaming of files and folders, Opening and closing of different Windows; Using help; Creating Short cuts, Basics of O.S Setup; Common utilities.

Understanding Word Processing: Word Processing Basics; Opening and Closing of documents; Text creation and Manipulation; Formatting of text; Table handling; Spell check, language setting and thesaurus; Printing of word document, Latex.

Making Small Presentation: Basics of presentation software; Creating Presentation; Preparation and Presentation of Slides; Slide Show; Taking printouts of presentation / handouts.Using Spread Sheet: Basics of Spreadsheet; Manipulation of cells; Formulas and Functions; Editing of Spread Sheet, printing of Spread Sheet.

Web meeting: GoToMeeting, Cisco WebEx, TeamViewer, Skype, Join.me, Zoom, Google Meet, Microsoft Teams, Dialpad Meetings, Apache OpenMeeting

Database Management System: My SQL language, program language.

Course Objectives:

a. To provide lessons on basic information systems using MS Office products.
b. To introduce different techniques and tools for programming, presentations, and effective communication.
c. To develop skills in data processing, web meeting, and data management.
d. To acquaint students with basic functional maintenance of computer.

Course Learning Outcomes (CLOs): Upon completion of the course, the students will be able to -

	Course Learning Outcomes (CLOs)	**Learning Level**
CLO1	Learn and apply the basic MS Office tools to prepare word files, and spreadsheets with figures, columns, and tables.	C1, C3, A2, P1
CLO2	Illustrate how to use a popular spreadsheet to maintain a minor bookkeeping, statistical and graphical analysis of data.	C2, A2, P2
CLO3	Prepare academic and professional PowerPoint presentation using MS Office products and Illustrator.	C4, A3, P3
CLO4	Execute the basics of computer programming.	C5, A4, P4

Mapping of CLOs with PLOs

CLOs	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12
CLO1	3	2	1	1	2	-	-	-	-	-	-	3
CLO2	3	2	-	1	3	1	-	-	-	2	-	2
CLO3	3	2	-	2	2	-	-	-	-	2	1	3
CLO4	3	2	1	2	3	-	-	-	-	-	2	1

Rank: 3-High match, 2-Medium match, 1-Low match.

Mapping of Course Learning Outcomes (CLOs) with the Teaching-Learning and Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture, multimedia presentation, group discussion	Lab Performance, Continuous assessment: Viva, Report, Final Exam
CLO2	Lecture, multimedia presentation, group discussion	Group Presentation, Lab Performance, Viva, Report, Final Exam
CLO3	Lecture, multimedia presentation, group discussion	Lab Performance, Viva, Report, Final Exam
CLO4	Lecture, multimedia presentation, group discussion	Lab Performance, Viva, Report, Final Exam

Learning Materials

i. Recommended Readings

a) Clive Finkelstein – An Introduction to Information Engineering.

ii. Supplementary Readings

a. James A. O'Brien George M. Marakas - Introduction to Information System.

iii. Others: Handout/lecture material provided by the course teacher.

Course Code: 531-Chem-1209 Course Title: Organic Chemistry Credits: 3.0

Rationale of the Course: The course is designed to provide fundamental knowledge related to basic organic chemistry. The students will learn about different organic functional groups, their synthesis, reaction mechanisms as well as structural orientations. This course also provides basic knowledge about fat, oil, wax, pigment, paints, varnish, and lacquers.

Course Contents

Introduction: A review of different organic functional groups, factors affecting melting and boiling point of organic compounds, hybridization of simple organic compounds, isomerism: geometrical and optical isomerism.

Concept of organic reaction: Electronic displacements: Inductive, electromeric, resonance and mesomeric effects, hyperconjugation and their applications; carbocations, carboanions, free radicals, nucleophiles, electrophiles, organic acids and bases and their relative strength.

Aromatic compounds: Aromaticity: Hückel's rule, aromaticity of common heterocyclic compound, electrophilic and nucleophilic aromatic substitution reactions, orientation of substitution reaction of benzene derivatives, aromatic amines, types of amines, diazonium salt, azo compounds, coupling reaction.
Carboxylic acids: Structure, preparation, properties, and use of carboxylic acids; Functional derivatives of carboxylic acid: Structure, preparation, properties, relative reactivity of acid halides, acid anhydrides, esters, and amides.

Amino acids and protein: Introduction, synthesis and reaction of amino acids, physical and chemical properties of amino acids, peptide bond, structure of proteins: primary, secondary, tertiary, and quaternary, denaturation.
Fats, oils, and waxes: Introduction to fat, oil and wax, fatty acids, physical and chemical properties, analysis of fat and oil: Free acid and alkali value, acid value, iodine value, saponification value, and unsaponifiable matter, Acetyl value, Reichert meissl and Polenske value.

Paint, varnish, and lacquers: Pigment, classification of pigment, paints, constituents of paints, varnish, characteristics, constituents, types of varnish, comparison between varnish and lacquers.

Course Objectives:

a. provide the fundamental principles of organic chemistry, synthesis, and reactivity of important functional groups.
b. impart knowledge on functional group transformations, simple reaction mechanisms, and the synthesis of organic molecules by multi-step synthesis strategies.
c. deliver conceptual knowledge about fat, oil, wax, pigment, paints, varnish, and lacquers.

Course Learning Outcomes (CLOs): Upon completing this course students will be able to:

	Course Learning Outcomes (CLOs)	**Learning Level**
CLO1	Describe the fundamental principles of organic chemistry that include chemical bonding, hybridization, physicochemical properties, and isomerism.	C1, A1
CLO2	Explain the concepts of aromaticity and the reaction orientation of benzene derivatives with mechanisms.	C2, A2
CLO3	Illustrate the preparative methods, properties, reactions, and uses of carboxylic acid and its functional derivatives as well as aromatic amines and diazonium salt.	C3, A3
CLO4	Compare the structural properties of amino acids and the formation of protein.	C4, A3
CLO5	Analyze and interpret the physicochemical properties of lipids, and surface-coating materials.	C4, C5, A3

Mapping of CLO with PLO

CLOs	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12
CLO1	3	2	-	-	-	-	-	-	-	-	-	-
CLO2	3	2	-	-	-	-	-	-	-	-	-	-
CLO3	2	2	1	-	-	-	-	-	-	-	-	-
CLO4	3	3	2	2	-	-	-	-	-	-	-	-
CLO5	3	2	2	2	2	-	-	-	-	-	-	2

Rank: 3-High match, 2-Medium match, 1-Low match.

Mapping of Course Learning Outcomes (CLOs) with the Teaching-Learning and Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Interactive audiovisual lectures, group discussions, problem-solving practices	In-course Exam; Final Exam
CLO2	Lecture, whiteboard illustration, slide presentation, problem-based excesses	Quiz, Final Exam
CLO3	Lecture, slide presentation, group discussion, whiteboard illustration, and problem-based exercises	In-course Exam, Final Exam
CLO4	Lecture, multimedia presentation	In-course Exam, Final Exam
CLO5	Lecture with whiteboard illustration, multimedia presentation, audio-visual	Assignment, In-course Exam, Final Exam

Learning materials

i. Recommended readings

a) Morrison and Boyd- Organic Chemistry.
b) I. L. Finar- Organic Chemistry, Volume - 1
c) O.G. Palanna- Engineering Chemistry

ii. Supplementary Readings

c) Raghupati Mukhopadhyay- Engineering Chemistry.
d) B. S. Bahl and Arun Bahl- Organic Chemistry.

iii. Others: Lecture/hand notes provided by the course teachers.

Course Code: 0531-Chem-1210 Course Title: Organic Chemistry Lab Credits: 1.5

Rationale of the Course: The course is designed to provide practical knowledge related to safety during working in an organic chemistry laboratory, and the development of skills for the use of lab apparatus and equipment using mainly qualitative and quantitative analysis of organic compounds and leather chemicals.

Course Content

1. Identification of organic compounds: Physical appearance, elemental analysis (detection of N, S, and halogens in organic compounds), solubility test, functional group analysis: carboxylic acids, carbonyls, alcohols, phenols, esters, amines, amides, and substituted amides, nitro compounds, unsaturated compounds, halogenated compounds, thiol compounds, determination of physical properties of organic compounds, literature survey, the naming of the identified compounds.

2. Test for protein and amino acids.

Course Objectives:

a. To conduct experiments on the identification of organic compounds through systematic analysis.
b. To provide the facility to carry out experiments related to the chemical analysis of leather samples.
c. To improve students' capability for both individual and teamwork.

Course Learning Outcomes (CLOs): After completing this course, students will be able to -

	Course Learning Outcomes (CLOs)	**Learning Level**
CLO1	Demonstrate elemental analysis of organic compounds and leather samples.	C2, A2
CLO2	Manipulate the laboratory experiments on functional group analysis of organic compounds and leather samples.	C2, P2
CLO3	Determine melting and boiling point of organic compounds as well as conduct the systematic analysis of organic compounds.	C3, A2
CLO4	Perform and analyze laboratory experiments on quantitative analysis of amino acids, and proteins through specific tests as individual and/or teamwork.	C3, C4, P3, A3
CLO5	Prepare laboratory reports based on experimental data without resorting to plagiarism.	C5, A4

Mapping of CLOs with PLOs

CLOs	**PLO1**	**PLO2**	**PLO3**	**PLO4**	**PLO5**	**PLO6**	**PLO7**	**PLO8**	**PLO9**	**PLO10**	**PLO11**	**PLO12**
CLO1	3	2	-	-	-	-	-	-	1	-	-	-
CLO2	3	2	-	-	-	-	-	-	2	-	-	-
CLO3	3	2	-	-	2	-	-	-	2	-	-	-
CLO4	2	2	2	-	-	-	-	-	3	-	-	-
CLO5	2	2	-	-	-	-	-	2	3	2	-	2

Rank: 3-High match, 2-Medium match, 1-Low match.

Mapping of Course Learning Outcomes (CLOs) with the Teaching-Learning and Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Interactive Lectures, Group Discussions, Demonstrations, and Group work	Quiz, Viva Voce, Report evaluation, Final Exam
CLO2	Lecture, Demonstration, and Group work	Quiz, Report evaluation, Final Exam
CLO3	Lecture, Demonstration, Hands-on practice, and Group work	Quiz, Viva Voce, Report evaluation, Final Exam
CLO4	Lecture, Demonstration, Hands-on practice, and Group work	Quiz, Report evaluation, Viva voce
CLO5	Interactive Lectures, Demonstration	Report Evaluation, Viva voce

Learning Materials

i. Recommended Readings

a) Oliver Kamm- Qualitative organic analysis; an elementary course in the identification of organic compounds
b) Ralph L. Shriner- The Systematic Identification of Organic Compounds

ii. Supplementary Readings

a) Vogel A. I. - Text Book of Quantitative Chemical Analysis
b) P. K. Sarker - Analytical Chemistry for Leather Manufacture.

iii. Others: Lecture notes and Laboratory procedure provide by the course teachers.

Course Code: 0723-FE-2101 Course Title: Leather Processing-II Credits: 3

Rationale of the Course: This course provides an introduction to the tanning and post-tanning processes in leather manufacturing. By the end of the course, students will gain knowledge of the theory behind tanning processes and their practical applications in the leather manufacturing industry.

Course contents

Tanning: Basic concept, theoretical background, tanning behavior of group elements, tanning potentials of various metal, non-metals, natural and synthetic materials, tanning characteristics, hydrothermal stability and shrinkage temperatures of various tanning materials, Aluminium, Titanium tanning and iron tanning, aldehyde tanning, Zirconium tanning.

Chrome tanning: Chromium complexes and their structures, study on the phenomena of hydrolysis, olation, oxolation, polymerisation of chrome complexes, masking, principle of masking, effect of masking on chrome tannage, method of chrome tannage, preparation of chrome liquors and powders, sammying, splitting, and shaving.

Neutralization: Wetback, objectives and principles of neutralization for chrome tanned leather, vegetable tanned leather, influencing factors of neutralization, selection of proper neutralizing agents, controls of neutralization, test for neutralization, neutralization and its impact on subsequent leather processing.

Vegetable tanning: Tannin, non–tannin materials, classification of vegetable tannins, chemistry of vegetable tanning materials, theory of vegetable tanning, physicochemical properties of vegetable tannin, vegetable tanning materials and their properties, leaching of vegetable tanning and general methods of tannin extract preparation, mechanism of vegetable tanning, principle of vegetable tanning, sources, supply of vegetable tanning materials, different syntans, classification of syntans, semi chrome leather.

Dyeing and fat-liquoring: Leather dyes and their applications, factors affecting dyeing process, dyeing methods, dyeing defects. Fat liquoring: objectives, modern model of fat liquoring mechanism, classification of fat liquor, function of anionic, cationic and amphoteric fat liquors, setting, and drying.

Finishing: Definition, classification of finishes, structure of finishes, materials for leather finishing, theory of film formation, preparation of leather for finishing: buffing, snuffing, de-dusting, conditioning, polishing, ground coating, season coatings, intermediate coatings, top coating, ironing, glazing, plating, shoe upper leather, lining leather, nubuck, corrected grain leather.

Course Objectives:

a. To introduce the fundamental concept of tanning, characteristics of various tanning materials, and different leather processing techniques.
b. To provide comprehensive knowledge on tanning, post-tanning, and finishing operations.
c. To improve knowledge on developing different types of shoe upper and lining leather.

Course Learning Outcomes (CLOs): Upon successful completion of this course, students will be able to -

	Course Learning Outcomes (CLOs)	**Learning Level**
CLO1	Describe the basic concept of the tanning and post-tanning operations of leather manufacturing.	C1, A1
CLO2	Explain various characteristics of tanning and post-tanning materials.	C2, A2
CLO3	Analyze the selection criteria of different chemicals for leather manufacturing.	C4, A3
CLO4	Evaluate and rectify various defects of wet-blue, crust, and finished leather.	C5, A4
CLO5	Develop recipes for specific types of shoe-upper leather from different origins.	C5, A4

Mapping of CLOs with PLOs

CLOs	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12
CLO1	3	2	-	-	-	-	-	-	-	-	-	-
CLO2	3	3	-	-	-	-	-	-	-	-	-	-
CLO3	3	3	2	3	-	-	2	-	-	-	-	-
CLO4	3	3	3	2	2	-	3	-	-	-	-	-
CLO5	3	3	2	3	2	-	3	-	-	-	-	-

Rank: 3-High match, 2-Medium match, 1-Low match.

Mapping of Course Learning Outcomes (CLOs) with the Teaching-Learning and Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture, White board illustration, Group discussion, Pictorial	In-course assessment, Final examination, Assignment
CLO2	Lecture, Multimedia presentation	Group Presentation, In-course Exam; Final Exam
CLO3	Lecture, Video presentation, Group discussion, Multimedia presentation, Audiovisual, Assignment	In-course Assessment, Oral presentation, Final examination, Assignment, Case study, and quiz.
CLO4	Audio-visual presentation	Final examination
CLO5	Lecture and Multimedia presentation	In-course Assessment and Final examination

Learning Materials:

i. Recommended Readings

a) Anthony D. Covington- Tanning Chemistry: The Science of Leather.
b) Heidenmann Eckhart - Fundamentals of Leather Manufacture.
c) Procter H.R.-The Principle of Leather Manufacture.

ii. Supplementary Readings

a) Sarphouse J.H.-Leather Technicians Handbook.
b) Gerhard John--- Possible Defects in Leather Production.

iii. Others: Handout/lecture materials or notes on provided by the course teacher.

Course Code: 0723-FE-2102 Course Title: Leather Processing-II Lab Credits: 1.5

Rationale of the Course: The course is designed to enhance the skills of students in the field of leather manufacturing. This course aims to equip students effectively applying practical methodologies, tools, and techniques in developing different types of shoe upper leather.

Course Contents:

1. Manufacturing of full chrome shoe upper dyed crust leather.
2. Manufacturing of full vegetable-tanned natural crust leather
3. Manufacturing of chrome-free combination tanned leather
4. Manufacturing of shoe lining leather.
5. Manufacturing of aniline-finished shoe upper leather
6. Manufacturing of corrected grain shoe upper leather.

Course Objectives: The objectives of the course are

a. To impart skills on the application of different chemicals in leather processing.
b. To enhance the student's ability for developing specific types of shoe upper and lining leather.
c. To improve skills on different finishing techniques in shoe upper leather preparation.

Course Learning Outcomes (CLOs): Upon successful completion of this course, students will be able to –

	Course Learning Outcomes (CLOs)	**Learning Level**
CLO1	Select raw materials, processes, chemicals, tools, and machinery for crust and finished leather manufacture.	C2, A1, P1
CLO2	Apply appropriate recipes for the manufacturing of crust and finished leather.	C3, A2, P2
CLO3	Perform quality and process control for crust and finishing operations.	C3, A2, P3
CLO4	Optimize the recipes for different types of crust and finished shoe upper and lining leather.	C4, A3, P4

Mapping of CLOs with PLOs

CLOs	**PLO1**	**PLO2**	**PLO3**	**PLO4**	**PLO5**	**PLO6**	**PLO7**	**PLO 8**	**PLO9**	**PLO10**	**PLO11**	**PLO12**
CLO1	3	3	1	3	-	-	1	-	2	-	-	-
CLO2	3	3	2	2	2	-	2	-	2	-	-	-
CLO3	3	3	2	3	3	-	2	-	3	-	-	-
CLO4	3	3	3	3	3	-	3	-	3	-	-	-

Rank: 3-High match, 2-Medium match, 1-Low match.

Mapping of Course Learning Outcomes (CLOs) with the Teaching-Learning and Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Audiovisual Lecture	Viva and class test.
CLO2	Lecture, Multimedia presentation, Group discussion	Lab performance, Evaluate the report writing.
CLO3	Lecture, Group Discussion, Flip chart presentation, Multimedia presentation.	Lab performance, Presentation, Quiz.
CLO4	Lecture, Video presentation, Whiteboard illustration, Group Discussion, Pictorial, Problem-based teaching method,	Final lab examination and evaluate the report writing, Assignment, Viva, Demonstration, Class test.

Learning Materials:

i. **Recommended Readings**
   a) Tanning Chemistry: The Science of Leather- Anthony D. Covington.
   b) Fundamentals of Leather Manufacture- Heidenmann Eckhart.
   c) The Principle of Leather Manufacture- Procter H.R.

ii. **Supplementary Readings**
   a) Leather Technicians Handbook- Sarphouse J.H.
   b) Possible Defects in Leather Production- Gerhard John.

iii. **Others**: Handout/lecture materials or notes on provided by the course teacher.

Course Code: 0723-FE-2103 Course Title: Footwear Design and Development Credits: 3.0

Rationale of the Course: This course teaches about footwear design and development procedures and other associated issues with footwear fashion. This course includes an introduction to fashion and design, fashion marketing, fashion forecasting, color, product development, design for the environment, and footwear pattern making, preparing students for careers in footwear design and development.

Course Contents:

Elements of design and fashion considerations: Basic concepts of art, fashion and style, elements and theories of design, principle of design, factors affecting product design, stages of fashion cycle, types of consumer adopters, theories of fashion movement.

Fashion forecasting: Introduction, importance, and steps of fashion forecasting, activities involved in fashion forecasting, market research, activities involved in market research.

Fashion marketing: Introduction, objectives, and views of fashion marketing, introduction to fashion merchandising, objectives of fashion merchandising, market segmentation, demographic and psychographics design implication for different customer groups, aspects of consumer/ buyer

behavior, customer profile analysis, customer needs and wants analysis, preparation of design specification sheet.

Color: Theory of color vision, subjective nature of color vision, types of color, interpretation of color, color mixing, dimensions of color, color specification systems, color forecasting.

Product development: Product development procedure, color board preparation, mood board, theme board, motif analysis, creativity analysis, logo design, value addition, design process, cultural value in design.

Pattern making: Introduction to different types of pattern, last masking techniques, outside and inside forms, mean forms, standard construction, techniques of pattern making for upper, lining, interlining, and bottom components of different footwear.

Insole design: Manufacturing process of prefabricated insoles, custom-made insole design process, traditional methods for designing and fabricating insoles, materials used for making insoles, specialized insole design.

Footwear last design and development: Footwear last design, last design using traditional and digital methods, sizing and grading of last, custom shoe last design.

Grading: Introduction, principle, types of grading, pattern grading techniques of upper, lining, bottom, and components.

Design for Environment (DFE): Introduction to DFE, objectives of DFE, environmental issues in DFE, principles of DFE, DFE toolkit, product life cycle assessment, eco-criteria for footwear design.

Course Objectives: The objectives of this course are as follows:

a. To provide an overview and realistic idea of art, fashion, and style related to footwear designing.
b. To provide knowledge about fashion forecasting, fashion marketing, and design for environment.
c. To introduce the necessity of mood board, theme board, motif analysis and research and inspiration in product development.
d. To disseminate ideas about pattern grading, insole design, last design and development.

Course Learning Outcomes (CLOs): Upon completion of this course, students will be able to:

	Course Learning Outcomes (CLOs)	**Learning Level**
CLO1	State the basic concepts of design, fashion, fashion forecasting, fashion marketing, color, product development, pattern-making, insole design, last design, grading, and design for environment.	C1
CLO2	Explain the factors affecting design, fashion cycle, and the importance of fashion forecasting, fashion marketing, color, and pattern-making in footwear design and development.	C2
CLO3	Interpret the pattern-making procedures and analyze the problems in footwear product design and development using modern tools.	C3, C4

CLO4	Illustrate insole and last design, and grading for footwear development using modern tools.	C4
CLO5	Relate product development stages and DFE concept for sustainable footwear design and development.	C5

Mapping of CLO with PLO

CLOs	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12
CLO1	3	-	-	-	-	-	-	-	-	-	-	-
CLO2	3	2	-	-	-	-	-	-	-	-	-	-
CLO3	3	3	2	-	3	-	-	-	-	-	-	-
CLO4	3	3	3	2	3	-	-	-	-	-	-	-
CLO5	3	3	3	3	-	-	3	-	-	-	-	-

Rank: 3-High match, 2-Medium match, 1-Low match.

Mapping of Course Learning Outcomes (CLOs) with the Teaching-Learning and Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Interactive discussion, lecture-discussion with multimedia, and white board illustration	In-course Exam and Final Exam
CLO2	Interactive discussion, lecture discussion with multimedia, and white board illustration	In-course Exam and Final Exam
CLO3	Lecture discussion with multimedia, white board illustration, and problem-based learning (PBL): Identifying the problem to be solved	In-course Exam, and Final Exam
CLO4	Lecture discussion with multimedia, group discussion, literature review, demonstration, and problem-based exercises	Assignment, Group Presentation, and Final Exam
CLO5	Lecture discussion with multimedia, group discussion, literature review, demonstration, and problem-based exercises	Assignment, Group Presentation, and Final Exam

Learning Materials

i) Recommended Reading

a) Karl T. Ulrich, et al.- Product design and development.
b) Michael H. Sharp- A step-by-step guide to producing patterns for footwear production.
c) M Krishan Kumar-Apparel Merchandising.

ii) Supplementary Readings

a) Mike Bexter.- Product Design
b) Stephen Bayley- Design: Intelligence Made Visible

iii) Others: Hand notes/Lecture materials will be provided by the course teacher.

Course Code: 0723-FE-2104 Course Title: Footwear Design and Pattern Making-I Lab Credits: 1.5

Rationale of the Course: Footwear design and pattern making is a prerequisite step for footwear manufacturing. This course covers the design and pattern-making of some basic styles of footwear. Students will be able to acquire fundamental knowledge of footwear design and pattern making.

Course Contents:

1. **Designing and pattern making of classic court shoe:** Preparation, OSH, designing, mean forme, standard pattern, sectional pattern, bottom, and component pattern, defects identification, and modification.
2. **Designing and pattern making of classic oxford shoe:** Designing, mean forme, standard pattern, sectional pattern, bottom, and component pattern, defects identification and modification.
3. **Designing and pattern making of classic derby shoe:** Designing, mean forme, standard pattern, sectional pattern, bottom, and component pattern, defects identification, and modification.
4. **Designing and pattern making of sandal**: Designing, mean forme, standard pattern, sectional pattern, bottom, and component pattern, defects identification, and modification.

Course Objectives: The objectives of this course are as follows:

a. To demonstrate the design techniques for classic court shoe, oxford shoe, derby shoe, and sandal.
b. To provide lessons on the techniques of pattern making for the above-mentioned footwear.
c. To evaluate the developed designs and patterns of the above styles of footwear.

Course Learning Outcomes (CLOs): Upon completion of this course, students will be able to:

	Course Learning Outcomes (CLOs)	**Learning Level**
CLO1	Outline the design features of classic court shoe, oxford shoe, derby shoe, and sandals.	C1, P1
CLO2	Identify required tools, and equipment for designing and pattern making.	C2, P2
CLO3	Perform design and pattern making for classic court shoe, oxford shoe, derby shoe, and sandals.	C3, A2, P3
CLO4	Analyze the developed designs and patterns, and rectify the related problems.	C4, C5, A4, P5

Mapping of CLO with PLO

CLOs	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12
CLO1	3	-	-	-	-	-	-	-	2	-	-	-
CLO2	3	2	-	-	-	-	-	-	2	-	-	-
CLO3	3	3	2	-	-	-	-	-	2	-	-	-
CLO4	3	3	3	3	-	-	-	-	2	-	-	-

Rank: 3-High match, 2-Medium match, 1-Low match

Mapping of Course Learning Outcomes (CLOs) with the Teaching-Learning and Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture, Demonstration, and Hands-on practice	Lab Performance, Final Exam
CLO2	Lecture, Demonstration, and Hands-on practice	Lab Performance, Final Exam
CLO3	Lecture, Demonstration, Hands-on practice, Video presentation, and Problem-based group discussion	Lab Performance, Continuous assessment: Viva, Report, Final Exam
CLO4	Lecture, Demonstration, Hands-on practice, Video presentation, and Problem-based group discussion	Lab Performance, Continuous assessment: Viva, Report, Final Exam

Learning Materials

i. **Recommended Reading**
   a) Michael H. Sharp- A step by step guide to producing patterns for footwear production.
   b) Martin, Shoben, Janet P. Ward - Pattern Cutting and Making Up.
   c) Korn J. (Editor) - Boot and Shoe Production.

ii. **Supplementary Readings**
   a) Miller R. G. (Editor) - Manual of Shoe Making.
   b) Thornton J. H.- Text Book of Footwear Manufacture.

iii. **Others:** Hand notes/Lecture materials will be provided by the course teacher.

Course Code: 0723-FE-2105 Course Title: Footwear Manufacturing-I Credits: 3

Rationale of the Course: This course will provide knowledge about cutting to backpart molding operations sequentially. Students will be able to apply this knowledge during footwear manufacturing.

Course Content

Cutting: Definition, grading and sorting of leather, principle of leather and synthetic material cutting, variation in upper materials and their effects in clicking, cutting methods, material

consumption, job sheet, environmental factors, types of clicking knives, storage of knives, press cutting, clicking faults and remedies, clicking department management.

Preparation for closing: Types, faults, and remedies of skiving, identification markings, stitch marking, methods of stitch marking cleaning, faults of stitch marking, edge and topline treatments, topline treatment faults and remedies, and decorative operations – punching and gimping, broguing, screen printing.

Stitch and seam construction: Needle parts, functions, size and system, thread properties, types, twisting, thread and needle relationship, thread consumption techniques, yarn numbering system, theory of stitch formation, stitch and seam functions, and types.

Reinforcement types and attachment: Types of reinforcement, topline reinforcement, reinforcement for seams, local reinforcement, attaching process of overall reinforcement, faults and remedies of reinforcement attachments, importance of attaching lining and interlining materials, procedure of attaching lining and interlinings by different types of adhesives, continuous and discontinuous coatings, faults and remedies of attaching lining and interlining materials.

Sequence of closing operation: Sequence of operation for upper closing for different types of footwear manufacturing, faults and remedies of upper closing operations.

Upper pre-forming: Purposes of upper pre-forming, types of upper pre-forming, blocking, etc., conditioning, trimming to shape, forepart moulding, faults and remedies of upper pre-forming.

Toe puff and stiffener attaching: Functions and types of toe puff and stiffener used in footwear, attaching system of toe puff and stiffener to the upper- heat activated, hot-melt or print-on, solvent activated, etc., faults and remedies of toe puff and stiffener attachment.

Backpart moulding: Functions and advantages of backpart moulding, moulding techniques and operational parameters, faults and remedies of backpart moulding.

Course Objectives: The objectives of this course are to provide:

a. To provide vast knowledge about cutting and closing operations.
b. To enhance knowledge about different types of stitch and seam construction.
c. To provide detailed knowledge about reinforcement types and pre-lasting operations.

Course Learning Outcomes (CLOs): Upon completion of this course, students will be able to:

	Course Learning Outcomes (CLOs)	**Learning Level**
CLO1	Recall the principle of cutting, preparatory, closing, and backpart molding operations.	C1, A1
CLO2	Explain different types of cutting, preparatory, closing, and backpart molding operations.	C2, A2

CLO3	Apply the knowledge of cutting, closing, and backpart molding operations for footwear manufacturing	C3, A3
CLO4	Analyze faults and remedies of clicking, skiving, closing, upper pre-forming, toe puff attaching, and backpart molding operations.	C4, A4
CLO5	Assess the suitability of preparatory operations, skiving, and selection of needles, threads, seams, and reinforcements for shoe upper.	C5, A5

Mapping of CLO with PLO

CLOs	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12
CLO1	3	-	-	-	-	-	-	-	-	-	-	-
CLO2	3	2	-	-	-	-	-	-	-	-	-	-
CLO3	3	3	2	-	-	-	-	-	-	-	-	-
CLO4	3	3	3	2	-	-	-	-	-	-	-	-
CLO5	3	3	3	3	-	-	-	-	-	-	-	-

Rank: 3-High match, 2-Medium match, 1-Low match

Mapping of Course Learning Outcomes (CLOs) with the Teaching-Learning and Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture, multimedia presentation	In-course Exam, Final Exam
CLO2	Lecture, multimedia presentation, group discussion, demonstration, problem-based learning (PBL)	Assignment, In-course Exam, Final Exam
CLO3	Lecture, multimedia presentation, Literature review, group discussion, problem-based learning (PBL)	Assignment, Group Presentation, In-course Exam, and Final Exam
CLO4	Lecture, multimedia presentation, Literature review, group discussion, problem-based learning (PBL)	In-course Exam, and Final Exam
CLO5	Lecture, Multimedia presentation, group discussion, Literature Review, problem-based learning (PBL)	In-course Exam, Final Exam

Learning Materials

i. Recommended Readings

a) Ravidra S. Goonetilleke-The Science of Footwear.
b) Venkatappaiah B.- Introduction to The Modern Footwear Technology.
c) Thornton J. H.- Text Book of Footwear Manufacture.

ii. Supplementary Readings

a) Swayam Siddha – Product Knowledge.
b) Miller R. G. (Editor) – Manual of Shoe Making.

iii. Others: Handout/lecture material provided by the course teacher.

Course Code: 0723-FE-2106 Course Title: Footwear Manufacturing-I Lab Credits: 1.5

Rationale of the Course: The course is outlined to disseminate thorough knowledge to the students regarding different types of footwear manufacturing. It covers all manufacturing aspects of shoemaking from cutting to finishing. The course provides in-depth cutting, closing, lasting, shoe construction, and finishing knowledge. Moreover, the course is designed to provide essential knowledge related to safety during working in an advanced manufacturing lab and to develop additional skills for the use of sophisticated machinery and equipment in different shoe construction.

Course Content

1. **Cement constructed gents sandal manufacturing:** Preparation, OSH, cutting, closing, lasting, sole attaching, and finishing, defects identification and remedy plan, and materials consumption.
2. **Cement constructed ladies sandal manufacturing:** Preparation, OSH, cutting, closing, lasting, sole attaching, and finishing, defects identification and remedy plan, and materials consumption.
3. **Cement constructed court shoe manufacturing:** Preparation, OSH, cutting, closing, lasting, sole attaching, and finishing, defects identification and remedy plan, and materials consumption.
4. **Cement constructed oxford shoe manufacturing:** Preparation, OSH, cutting, closing, lasting, sole attaching, and finishing, defects identification and remedy plan, and materials consumption.

Course Objectives: Specific objectives of this course are as follows:

a. To enhance detailed manufacturing knowledge of ladies and gents sandal, court, and oxford shoe.
b. To provide in-depth cutting, closing, lasting, shoe construction, and finishing knowledge.
c. To prepare the students with different shoe manufacturing techniques.
d. To provide essential knowledge related to safety and health (OSH) during working with sophisticated machinery and equipment in different types of footwear manufacturing

Course Learning Outcomes (CLOs): Upon completion of the course, the students will be able to:

	Course Learning Outcomes (CLOs)	**Learning Level**
CLO1	Outline the detailed manufacturing knowledge of ladies and gents sandal, court and oxford shoe.	C1
CLO2	Identify the machinery, equipment, and associated risk for specific types of footwear manufacturing.	C2
CLO3	Apply cement construction methods in ladies and gents sandal, court, and oxford shoe manufacturing.	C3, P3, A2
CLO4	Demonstrate the defects identified during ladies and gents sandal, court, and oxford shoe manufacturing.	C4, P4, A3
CLO5	Prepare a defect catalog and remedy plan for modifying the manufacturing process for the specific type of footwear.	C5, P1, A2

Mapping of CLO with PLO

CLOs	PLO 1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO 12
CLO1	3	-	-	-	-	-	-	-	-	-	-	-
CLO2	3	-	-	-	3	-	-	-	2	-	-	-
CLO3	3	-	3	-	3	-	-	-	3	-	-	-
CLO4	3	3	-	3	-	-	-	-	2	-	-	-
CLO5	3	2	3	3	1	-	-	-	2	-	-	-

Rank: 3-High match, 2-Medium match, 1-Low match

Mapping of Course Learning Outcomes (CLOs) with the Teaching-Learning and Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture, Demonstration, and Hands-on practice	Lab Performance, Final Exam
CLO2	Lecture, Demonstration, and Hands-on practice	Lab Performance, Final Exam
CLO3	Lecture, Demonstration, and Hands-on practice	Lab Performance, Viva, Report, Final Exam
CLO4	Lecture, Demonstration, Hands-on practice, Video presentation and Problem-based group discussion	Lab Performance, Viva, Report, Final Exam
CLO5	Lecture, Demonstration, Hands-on practice, Video presentation and Problem-based group discussion	Lab Performance, Viva, Report, Final Exam

Learning Materials

i. Recommended Readings

a) Manual of Shoe Making-R. G. Miller
b) Footwear Materials and Process Technology-A.J. Harvey
c) How Shoes are Made: A behind the scenes look at a real sneaker factory-Wade Motawi

ii. Supplementary Readings

a) Handbook of footwear design and manufacture-A. Luximon
b) Text Book of Footwear Manufacture-J. H. Thornton

iii. Others: Handout/lecture material provided by the course teacher.

Course Code: 0713-EEE-2107 Course Title: Fundamentals of Electrical and Electronics Engineering Credits: 3

Rationale of the course: This course offers a thorough review of electric circuit analysis which is the most fundamental area in electrical and electronics engineering. The course is designed at a very basic level and included in the Leather and allied engineering program as an allied engineering course.

Course Contents

Electrical Engineering: Introduction to Voltage, current, power, energy, D.C. fundamentals, Series- parallel network, Network Theorems, Generators and their characteristics, Motors, and their characteristics, and Speed control process.

AC Current: AC fundamentals, Flow of AC through inductance, capacitance, and resistance in series and parallel; Power in AC Circuit, Power Factor and its improvement; Resonance in AC circuits, Transformer, Poly phase circuits, Induction motors (types and purpose). Sub-station equipment, Distribution board, and sub-distribution board.

System network: Typical distribution circuits, cables, and wiring systems and their selection.

System protection: Types of faults, (transformer and motor) principles of protection, Protective devices.

Electrical hazards: Electrocution, Electric Shock and its factors, Electric current on human body, Identifying and recognizing hazards, PPE**,** protection against shock and fire, earthing and its importance, procedure to be adopted when a person is in contact with a live conductor.

Electronics: Semiconductor physics, Diodes and their uses, Rectifiers, Transistors, Amplifiers, Voltage amplification, Power amplification, Photo sensor, Clippers, Clampers, Transducer, Integrated Circuits.

Course Objectives

a. To provide a comprehensive understanding of the theoretical background in circuit theory.
b. To enable the students to analyze the DC circuits, distribution circuits, cables, and wiring systems.
c. To familiarize them with the basics of AC circuits.

Course Learning Outcomes (CLOs): At the end of the course, students will be able to -

	Course Learning Outcomes (CLOs)	**Learning Level**
CLO1	Explain the theory behind DC circuits, and magnetic circuits and solve complex AC circuits using network theorems.	C2, C3, A3
CLO2	Analyze DC and AC circuits using KVL, KCL, or other analysis methods.	C4, A4
CLO3	Recognize, select, and evaluate measurement devices used in electrical and electronics engineering.	C2, C5, A4
CLO4	Identify the electrical hazards and take protective measures in real-life.	C1, C3, A2

Mapping of CLO with PLO

CLOs	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12
CLO1	3	2	-	-	-	-	-	-	-	-	-	-
CLO2	2	3	-	-	-	-	-	-	-	-	-	-
CLO3	2	3	-	-	-	-	-	-	-	-	-	-
CLO4	2	2	-	-	-	2	2	-	-	-	-	2

Rank: 3-High match, 2-Medium match, 1-Low match

Mapping of CLOs with the Teaching-Learning and Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture, whiteboard illustration, problem-solving exercises	In-course Exam, Final Exam
CLO2	Lecture, slide presentation, problem-solving exercises	Assignment, In-course Exam, Final Exam
CLO3	Lecture, whiteboard illustration, slide presentation	Quiz, In-course Exam, Final Exam
CLO4	Lecture, group discussion, audio-visuals	Case study, Oral presentation, In-course Exam, Final Exam

Learning materials

i. Recommended readings

a) Charles K. Alexander, Matthew N. O. Sadiku – Fundamentals of Electric Circuits (5^{th} edition)
b) Robert Boylestad – Introductory Circuit Analysis (13^{th} edition).
c) R. M. Kerchner, G.F. Corcoran – Alternating Current Circuits, 4th Edition.

ii. Supplementary Readings

a) A Textbook of Electrical Technology (vol: I and II), B. L. Theraja
b) Alternating Current Circuit, George F. Corkoran

iii. Others: Lecture/hand notes provided by the course teachers.

Course Code: 0533-Phy-2108 Course Title: Physics and Electronics Lab Credits: 1.5

Rationale of the course: This course will cover the basic principles of fundamental physics and Electronics through experiments that will help the students getting practical knowledge on how a theory can be applied to practical aspects. It also provides an elementary training to the students on carefulness in handling scientific instruments in a laboratory for accomplishing an experiment successfully.

Course Contents

Part A: Physics

1. Determination of the value of "g" by Kater's reversible pendulum.
2. Verification of Ohm's law and measurement of low resistance by ammeter and voltmeter.
3. Determination of the refractive index of a material of a given prism by a spectrometer.
4. Determination of the grating constant of a plane diffraction grating.
5. Determination of the value Y, η and σ for the material of a given wire by Searle's apparatus.
6. Determination of the modulus of rigidity of a cylindrical wire by dynamic method.

Part B: Electronics

1. Verification of voltage divider and current divider rule.
2. Verification of Thevenin's theorm.
3. Determination of the characteristics of I-V curve of a diode.
4. Verification of the mechanism of half wave rectifier.
5. Study the basic characteristics of logic GATES.

Course Objectives

a. To provide a broad training in physics and electronics principles with laboratory experiments.
b. To assist the students become more proficient in measurements, dimensioning, critical thinking, and data analysis.
c. To help the students to pursue independent research towards the development of new devices and products using sophisticated engineering concepts.

Course Learning Outcomes (CLOs): Upon completion of this course, students will be able to:

	Course Learning Outcomes (CLOs)	**Learning Level**
CLO1	Identify the different physical parameters and their importance in understanding and manipulating voltages, currents and resistances in electronic circuits.	C2, P2, A3
CLO2	Apply experimental techniques on the basis of established theory to determine/compare the values of specific parameters.	C3, A3
CLO3	Design and conduct experiments, as well as to analyze and interpret data.	C3, P3, A3
CLO4	Develop the ability to collaborate with peers in a scientific/lab environment which will eventually help to communicate their ideas with others and function effectively in multidisciplinary terms.	C3, A3
CLO5	Draw meaningful conclusions from the experimental data and present them as a part of a clear, well-organized lab report.	C4, A4

Mapping of CLO with PLO

CLOs	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12
CLO1	3	2	-	-	-	-	-	-	-	-	-	-
CLO2	2	2	-	-	-	-	-	-	-	-	-	-
CLO3	2	2	2	-	2	-	-	-	-	-	-	-
CLO4	2	2	-	-	-	-	-	-	2	2	-	2
CLO5	2	2	-	-	-	-	-	-	-	2	-	2

Rank: 3-High match, 2-Medium match, 1-Low match

Mapping of Course Learning Outcomes (CLOs) with the Teaching-Learning and Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture, Demonstration, and Hands-on practice	Lab Performance, Final Exam
CLO2	Lecture, Demonstration, and Hands-on practice	Lab Performance, Final Exam
CLO3	Lecture, Demonstration, Hands-on practice, Video presentation, and Problem-based group discussion	Lab Performance, Continuous assessment: Viva, Report, Final Exam
CLO4	Lecture, Demonstration, Hands-on practice, Video presentation, and Problem-based group discussion	Lab Performance, Continuous assessment: Viva, Report, Final Exam
CLO5	Lecture, Demonstration, Hands-on practice, Video presentation, and Problem-based group discussion	Lab Performance, Continuous assessment: Viva, Report, Final Exam

Learning materials

i. Recommended readings

a) Charles K. Alexander, Matthew N. O. Sadiku – Fundamentals of Electric Circuits (5^{th} edition)
b) Robert Boylestad – Introductory Circuit Analysis (13^{th} edition).
c) R. M. Kerchner, G.F. Corcoran – Alternating Current Circuits, 4th Edition.

ii. Supplementary Readings

a) A Textbook of Electrical Technology (vol: I & II), B. L. Theraja
b) Alternating Current Circuit, George F. Corkoran

iii. Others: Lecture/hand notes provided by the course teachers.

Course Code: 0541-Math-2109 Course Title: Differential Equations and Numerical Methods Credits: 3

Rationale of the Course: This course is a study of mathematical techniques used to model engineering systems. Differential equations and numerical methods are covered in this course as an introduction. This course deals with the different differential equations, numerical problems, and their real-life applications.

Course Content:

Ordinary Differential Equations: Definition of Differential Equation, Order and Degree; Classification of Differential Equations; Formulation; Solution of first order differential equation by various methods; Solutions of general linear equations of second and higher order with constant co-efficient; Solutions of homogeneous linear equation.

Modeling with First Order Differential Equations: Construction of differential equations as mathematical models (exponential growth and decay, heating and cooling, mixture of solutions, series circuit, logistic growth, chemical reaction, falling bodies). Model solutions and interpretation of results.

Modeling with Second Order Differential Equations: Vibration of a mass on a spring, free and undamped motion; free and damped motion; forced motion; electric circuit problems.

Partial Differential Equations: Formation of partial differential equations, solution of standard types of first order equation and Lagrange's equation, classification of second order partial differential equations, linear partial differential equations of second order and higher order with constant coefficients.

Solution of Equations and Eigenvalue Problems: Solution of algebraic and transcendental equations – Bisection method - Fixed point iteration method – Newton Raphson method – Iterative methods of Gauss Jacobi and Gauss Seidel - Matrix Inversion by Gauss Jordan method - Eigenvalues of a matrix by Power method.

Interpolation and Approximation: Interpolation with unequal intervals – Lagrange's interpolation – Newton's divided difference interpolation – Newton's forward and backward difference formulae.

Numerical Differentiation and Integration: Approximation of derivatives using interpolation polynomials - Numerical integration using Trapezoidal, Simpson's rule – Evaluation of double integrals by Trapezoidal and Simpson's rules.

Initial and Boundary Value Problems for Differential Equations: Runge-Kutta method for solving first-order equations, Milne's and Adams-Bashforth predictor corrector methods for solving first order equations.

Course Objectives: The aims of this course are:

a. To introduce the basics of differential equations and terminologies regarding them.
b. To solve different types of ordinary differential equations and partial differential equations analytically using well-known techniques.
c. To explore the utility of differential equations in modeling numerous physical and biological systems.
d. To demonstrate the importance of selecting the right numerical technique for a particular application and carefully analyzing and interpreting the obtained results.

Course Learning Outcomes (CLOs): Upon completion of the course, the students will be able to –

	Course Learning Outcomes (CLOs)	**Learning Level**
CLO1	Formulate differential equations by removing arbitrary constants from algebraic relations and draw solutions curves using direction field.	C5, A4
CLO2	Classify first-order differential equations as separable, homogeneous, linear, exact, Bernoulli's, etc. and solve them using appropriate methods.	C2, C3, A2
CLO3	Derive higher order differential equations, classify and solve them using appropriate methods.	C3, A2
CLO4	Find numerical approximations to the roots of an equation by Newton method, Bisection Method, Secant Method, etc.	C3, A2
CLO5	Demonstrate the use of interpolation methods to find intermediate values for any given set of points.	C3, A2

Mapping of CLOs with PLOs

CLOs	**PLO1**	**PLO2**	**PLO3**	**PLO4**	**PLO5**	**PLO6**	**PLO7**	**PLO8**	**PLO9**	**PLO10**	**PLO11**	**PLO12**
CLO1	3	3	-	1	-	-	-	-	-	-	-	-
CLO2	3	3	-	1	-	-	-	-	-	-	-	-
CLO3	3	3	-	1	-	-	-	-	-	-	-	-
CLO4	3	3	-	1	-	-	-	-	-	-	-	-
CLO5	3	3	-	1	-	-	-	-	-	-	-	-

Rank: 3-High match, 2-Medium match, 1-Low match.

Mapping of Course Learning Outcomes (CLOs) with the Teaching-Learning and Assessment Strategy

CLOs	**Teaching-Learning Strategy**	**Assessment Strategy**
CLO1	Lecture, group discussion, problem-based learning (PBL): Identifying the problem to be solved	Assignment, In-course Exam, and Final Exam
CLO2	Lecture, group discussion and problem-based exercises	Assignment, In-course Exam, and Final Exam
CLO3	Lecture, group discussion and problem-based exercises	Assignment, In-course Exam, and Final Exam
CLO4	Lecture, group discussion, and problem-based exercises	Assignment, In-course Exam, and Final Exam
CLO5	Lecture, group discussion, and problem-based exercises	Group Presentation, Assignment, In-course Exam, and Final Exam

Learning Materials

i. Recommended Readings

a) S. L. Ross, Differential Equation.
b) D. G. Zill, A First Course in Differential Equations with Applications.
c) H.J.H. Piaggio, An Elementary Featise on Differential Equations.

ii. Supplementary Readings

a) Chapra. S.C., and Canale. R. P., "Numerical Methods for Engineers", Tata, McGraw-Hill, New Delhi, 5th Edition, 2007.
b) Brian Bradie, "A Friendly Introduction to Numerical Analysis", Pearson Education, Asia, New Delhi, 2007.

iii. Others: Handout/lecture material provided by the course teacher.

Course Code: 0723-FE-2201 Course Title: Footwear Manufacturing-II Credits: 3

Rationale of the Course: This core course covers the pre-lasting, lasting, and post-lasting operations of footwear manufacturing. After completing the course, the students will be able to learn different shoe construction techniques. Moreover, they will be able to acquire knowledge of the related machinery of lasting operations.

Course Contents

Upper conditioning: Advantages of upper conditioning, different methods of upper conditioning-soaking/sponging/spraying with water, conditioning fluids, rapid conditioning cabinet, contact mulling, toe steamers etc., operational parameters of upper conditioning, disadvantages of insufficient conditioning.

Insole attaching: Importance of insole attaching to last, attaching systems- tacks and staples, unifast system, adhesive attachment, using tape, etc., stages of insole preparation, insole moulding, faults and remedies of insole attachment.

Lasting: Definition, objectives and principle of lasting, preparatory operations of lasting, methods of lasting, hand lasting procedures, the need of machine lasting, adjustment of lasting machine, machine parts and function and its parameter setting, pulling cycle: toe and forepart, seat and side lasting, problems in lasting operation and their remedies.

Shoe construction: Definition of shoe construction, types of shoe construction, differences among the shoe construction; Direct shoe construction, types of direct shoe construction, cemented construction, moulded construction, types of moulded construction, Californian slip-lasted construction, string lasted construction, Strobel construction, direct sewn construction, direct stitch down construction; Indirect shoe construction, types of indirect shoe construction, Goodyear welted construction, veldtschoen/stitchdown construction, sidewall stitched construction, indirect stitch down construction; Flow chart for different shoe construction techniques.

Machines for shoe construction: Machines used in cemented, stitch down, welted, string lasted, DVP, DIP and other types of construction, principles involved in their working, troubleshooting and preventive maintenance, separate parts planning and inventory control.

Heat setting: Functions of heat setting, methods of heat setting, process and controlling parameters of heat setting operation for different upper materials, parts of heat setting machine, common problems of heat setting and their remedies.

Preparation of upper and soling materials: Preparation of upper materials-leather, coated leathers, PVC and PU coated fabrics, textiles, machineries for upper preparations, preparing soles-leather sole, lacquered soles, PVC, TPR, EVA, crepe rubber, vulcanized rubber soles, etc.; Roughing and scouring operation: differences between roughing and scouring, number of abrasive paper with function, roughing of leather and PU coated fabrics, manual roughing and automatic roughing used in footwear manufacturing.

Adhesive: types, properties, adhesive terminology, water-based adhesive, solvent-based adhesive, hot melt adhesives-polyester, polyamide, mechanism of adhesion, adhesion factors, application methods of adhesive, safety measures of adhesive application, selection of adhesive, adhesive testing, factors affecting good adhesion.

Learning Objectives: The objectives of this course are to provide:

a. To enhance knowledge about pre-lasting, lasting, and post-lasting operations of footwear manufacturing.
b. To provide knowledge about various types of shoe construction methods and adhesives.
c. To provide detailed knowledge about heat setting, preparation of upper and soling materials and machines for shoe construction.

Course Learning Outcomes (CLOs): Upon completion of this course, students will be able to:

	Course Learning Outcomes (CLOs)	**Learning Level**
CLO1	State methods of upper conditioning and insole attaching, lasting, shoe construction, heat setting, preparation of upper and soling materials and properties of the adhesive.	C1, A1
CLO2	Explain upper conditioning and insole attaching methods, lasting, shoe construction, heat setting, preparation of upper and soling materials and properties of the adhesive.	C2, A2
CLO3	Apply the knowledge of pre-lasting, lasting, and post-lasting operations, various construction methods and adhesive applications in footwear manufacturing.	C3, A3
CLO4	Analyze the faults and remedies of pre-lasting, lasting, and post-lasting operations, various construction methods and adhesives application for different types of footwear manufacturing.	C4, A4
CLO5	Assess the suitability of different types of pre-lasting, lasting, and post-lasting operations, various construction methods and adhesives for different types of footwear manufacturing.	C5, A5

Mapping of CLO with PLO

CLOs	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12
CLO1	3	2	-	-	-	-	-	-	-	-	-	-
CLO2	3	2	2	-	-	-	-	-	-	-	-	-
CLO3	3	3	2	2	3	-	-	-	-	-	-	-
CLO4	3	3	2	3	2	-	-	-	-	-	-	-
CLO5	3	3	3	3	2	-	2	-	-	-	-	-

Rank: 3-High match, 2-Medium match, 1-Low match

Mapping of Course Learning Outcomes (CLOs) with the Teaching-Learning and Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture, multimedia presentation, group discussion, literature review	Assignment, In-course Exam, Final Exam
CLO2	Lecture, multimedia presentation, group discussion, literature review	Assignment, Group Presentation, In-course Exam, Final Exam
CLO3	Lecture, multimedia presentation, group discussion	Assignment, Group Presentation, In-course Exam, and Final Exam
CLO4	Lecture, multimedia presentation, group discussion, Problem Based Learning	Group Presentation, In-course Exam, Final Exam
CLO5	Lecture, multimedia presentation, Problem Based Learning	In-course Exam, and Final Exam

Learning Materials

i. Recommended Readings

a) Venkatappaiah B.- Introduction to The Modern Footwear Technology.
b) A. J. Harvey- Footwear Materials and Process Technology
c) Thornton J. H.- Text Book of Footwear Manufacture

ii. Supplementary Readings

a) Ruth Thomson – Making Shoes.
b) Swayam Siddha – Product Knowledge.

iii. Others: Handout/lecture material provided by the course teacher.

Course Code: 0723-FE-2202 Course Title: Footwear Manufacturing-II Lab Credits: 1.5

Rationale of the Course: This course is a core course for footwear manufacturing. The course fulfills the manufacturing of derby, casual, moccasin shoe and boot, selection and collection of last, preparatory operations, lasting, upper and sole preparation, shoe finishing and packaging. After completion of the course, students will be able to manufacture shoe and boot practically.

Course Contents

1. **Cement constructed derby footwear manufacturing:** Preparation, OSH, cutting, closing, lasting, sole attaching, and finishing, defects identification and remedy plan, and materials consumption.
2. **Cement constructed casual footwear manufacturing:** Preparation, OSH, cutting, closing, lasting, sole attaching, and finishing, defects identification and remedy plan, and materials consumption.
3. **Force lasted moccasin footwear manufacturing:** Preparation, OSH, cutting, closing, lasting, sole attaching, and finishing, defects identification and remedy plan, and materials consumption.
4. **Cement constructed boot manufacturing:** Preparation, OSH, cutting, closing, lasting, sole attaching, and finishing, defects identification and remedy plan, and materials consumption.

Course Objectives:

a. To introduce the essential experimental knowledge and skill of different process to manufacture derby, casual, moccasin shoe and boot.
b. To apply theoretical knowledge practically in the field of footwear industries.
c. To develop different processes for manufacturing derby, casual, moccasin shoe and boot.

Course Learning Outcomes (CLOs): Upon completion of this course, students will be able to:

	Course Learning Outcomes (CLOs)	**Learning Level**
CLO1	Outline the detailed manufacturing knowledge of safety derby, casual and moccasin shoe, and boot.	C1, A1, P1
CLO2	Identify the machinery, equipment, and associated risk for specialty types of footwear manufacturing.	C2, A2, P2
CLO3	Apply advanced manufacturing technology and construction method for particular styles in shoe manufacturing.	C3, A3, P3
CLO4	Identify and analyze the relevant defects of manufactured shoes.	C4, A4, P4
CLO5	Prepare a defect remedy plan to modify the existing process in footwear manufacturing.	C5, A4, P5

Mapping of CLO with PLO

CLOs	**PLO1**	**PLO2**	**PLO3**	**PLO4**	**PLO5**	**PLO6**	**PLO7**	**PLO8**	**PLO9**	**PLO10**	**PLO11**	**PLO12**
CLO1	3	-	-	-	2	-	-	-	2	-	-	-
CLO2	3	2	-	-	3	-	-	-	2	-	-	-
CLO3	3	3	2	-	3	-	-	-	2	-	-	-
CLO4	3	3	3	2	3	-	-	-	2	-	-	-
CLO5	3	3	3	3	3	-	-	-	2	-	-	-

Rank: 3-High match, 2-Medium match, 1-Low match

Mapping of Course Learning Outcomes (CLOs) with the Teaching-Learning and Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture, Demonstration, and Hands-on practice	Lab Performance, Final Exam
CLO2	Lecture, Demonstration, and Hands-on practice	Lab Performance, Final Exam
CLO3	Lecture, Demonstration, and Hands-on practice	Lab Performance, Continuous assessment: Viva, Report, Final Exam
CLO4	Lecture, Demonstration, Hands-on practice, Video presentation and Problem-based group discussion	Lab Performance, Continuous assessment: Viva, Report, Final Exam
CLO5	Lecture, Demonstration, Hands-on practice, Video presentation and Problem-based group discussion	Lab Performance, Continuous assessment: Viva, Report, Final Exam

Learning Materials

i. Recommended Readings

a) Thornton J. H.- Text Book of Footwear Manufacture.
b) Swayam Siddha - The Art of Cutting Kid and Goat Skin.
c) Korn J. (Editor) - Boot and Shoe Production.

ii. Supplementary Readings:

a) SATRA Bulletin.
b) Spencer Crookenden - K Shoes -The first 150 years 1842-1992.

iii. Others: Handout/lab procedure manual provided by the course teacher

Course Code: 0531-Chem-2203 Course Title: Polymer Science and Engineering Credits: 3

Rationale of the Course: This course is designed to impart the fundamentals of polymers and their derivatives, bonds, structures, and properties. The course also introduces the knowledge of various polymerization techniques along with associated technologies and emphasizes various environmental aspects.

Course Content

Polymer structure: Concept of polymer, oligomer and macromolecule, classifications of polymer, tacticity, degree of polymerization, contour length, functionality of monomer, molecular forces and chemical bonding in polymers.

Polymerization: Step-reaction (condensation) polymerization: mechanism, polycondensation; Radical chain (addition) polymerization: mechanism-initiation, propagation, termination, kinetics and chain transfer; Ionic polymerization: cationic and anionic polymerization, polymerization by transition metal catalysts, ring opening polymerization; Polymerization technique: Solution, bulk, suspension, emulsion.

Polymer solution: Criteria for solubility, heat of dissolution and solubility parameters, conformation of polymer chains in solutions, nature of polymer molecules in solution, size and shape of macromolecules in solution, effect of molecular weight on solubility, solubility of crystalline and amorphous polymers, viscosity of dilute polymer solutions.

Structure and properties of polymers: Chemical and geometrical structure of polymer molecules, Glass transition temperature (*T*g): Free volume theory, factors affecting on *T*g, melting point, mechanical properties of crystalline polymers.

Molecular weight and size of polymers: Number average, molecular weight average, Z-average and viscosity average molecular weight; distribution of molecular weight; contour length, molecular weight determination methods.

Polymer technology: Polymer compounding and significance, different compounding ingredients for rubber and plastics, crosslinking and vulcanization.

Environmental considerations: Polymer degradation: Definition, types, factors affecting polymer degradation, preventions, recycling, remoulding, depolymerisation, incineration, biodegradable polymers, green synthetic approach of polymer.

Course Objectives

a. To provide knowledge and understanding of polymers, structures, properties and synthetic routes of various polymers.
b. To disseminate knowledge on polymerization techniques, mechanism, and processing.
c. To impart comprehensive knowledge on polymer additives, ultimate applications and environmental aspects.

Course learning outcomes (CLOs): Upon completion of the course, the students will be able to-

	Course Learning Outcomes (CLOs)	**Learning Level**
CLO1	Define and classify polymers, their structures, and configurations.	C1, C2, A1
CLO2	Illustrate different types of polymerization techniques, technological aspects and mechanisms.	C2, A2
CLO3	Correlate different polymer properties with their structure and molecular weight.	C3, A3
CLO4	Compare various determination methods of polymer molecular weight with their pros and cons.	C4, A3
CLO5	Assess the environmental impacts of polymers in real-life applications.	C5, A4

Mapping of CLO with PLO

CLOs	**PLO1**	**PLO2**	**PLO3**	**PLO4**	**PLO5**	**PLO6**	**PLO7**	**PLO8**	**PLO9**	**PLO10**	**PLO11**	**PLO12**
CLO1	3	2	2	-	-	-	-	-	-	-	-	-
CLO2	3	2	3	1	-	-	-	-	-	-	-	-
CLO3	3	2	1	2	1	-	1	-	-	-	-	-
CLO4	3	2	2	1	2	-	-	-	-	-	-	-
CLO5	3	2	2	2		2	2	-	-	-	-	2

Rank: 3-High match, 2-Medium match, 1-Low match

Mapping of Course Learning Outcomes (CLOs) with the Teaching-Learning and Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture, demonstration and problem-based exercises	Group Presentation, In-course Exam, Quiz, Assignment, Final Exam
CLO2	Lecture, multimedia presentation, video presentation, demonstration, group discussion	Group Presentation, In-course Exam; quiz, assignment, case study, Final Exam
CLO3	Lecture, multimedia presentation, literature review, group discussion	Assignment, Quiz, Group Presentation, In-course Exam, and Final Exam
CLO4	Lecture, multimedia presentation, group discussion, literature review, video presentation, demonstration, and problem-based exercises	Quiz, Assessment, Group Presentation, In-course Exam, and Final Exam
CLO5	Lecture, multimedia presentation, group discussion, literature review, video presentation, demonstration, and problem-based learning	Assignment, Quiz, Group presentation, Oral presentation, In-course Exam, and Final Exam

Learning Materials

i. Recommended Readings

a) Charles E. Carraher Jr- Carrahers Polymer Chemistry 8th Edition
b) Gowrikar V. R., Viswanathan N.V. and JayadevSreedhar, "Polymer Science", New Age Publication, New Delhi 2003.
c) Gupta V. B. and Kothari V. K., "Manufacture Fibre Technology", Chapman and Hall Publication, UK 1997.

ii. Supplementary Readings

a) Billmayer F. M., "Text Book of Polymer science", Wiley Inter Science, New York, 2002.
b) Odion G., "Principles of Polymerization", John Wiley, UK, 2002.

iii. Others: Handout/lecture materials provided by the course teacher

Course Code: 0531-Chem-2204 Course Title: Polymer Science and Engineering Lab

Credits: 1.5

Rationale of the Course: This course is based on the theoretical knowledge of polymer science and engineering. The course is designed to provide practical knowledge while working in a polymer chemistry laboratory, developing skills in the use of lab apparatus and equipment mostly used in both qualitative and quantitative analysis of polymeric substances.

Course Content

1. Identification of different polymeric materials in footwear.
2. Determination of relative viscosity of polymeric substances.
3. Determination of molecular weight of different polymers.
4. Synthesis and characterization of resins from the precursors.

5. Preparation of polystyrene /PMMA by suspension polymerization method.
6. Determination of chemical compositions of selected polymers.
7. Determination of solvent stability and ionic character of selected polymers and surfactants.
8. Determination of film hardness of acrylic, polyurethane, butadiene binders.
9. Determination of tensile strength and elongation of the finish film formation by acrylic, polyurethane, butadiene binders
10. Determination of ironing effect of acrylic, polyurethane, butadiene binders.

Course Objectives

a. To familiarize in-depth practical knowledge in the synthesis and characterization of polymeric materials.
b. To develop skills on the determination techniques of polymer molecular weight and kinetics.

Course Learning Outcomes (CLOs): After completion of this course students will be able to-

	Course Learning Outcomes (CLOs)	**Learning Level**
CLO1	Identify different types of polymeric materials using physical and chemical methods.	C2, A2, P2
CLO2	Prepare and characterize different types of polymeric materials.	C3, A2, P3
CLO3	Determine molecular weights of polymers applying different methods.	C3, A2, P3
CLO4	Manipulate and analyze the conventional experimental methods to produce polymer derivatives.	C4, A4, P3
CLO5	Generate reports based on the results practicing the ethical acknowledgement of used sources or avoiding copying from other written sources.	C5, A4, P5

Mapping of CLO with PLO

CLOs	**PLO1**	**PLO2**	**PLO3**	**PLO4**	**PLO5**	**PLO6**	**PLO7**	**PLO8**	**PLO9**	**PLO10**	**PLO11**	**PLO12**
CLO1	3	2	2	-	-	-	-	-	2	-	-	-
CLO2	3	2	1	-	2	-	-	-	-	-	-	-
CLO3	3	2	1	-	-	-	-	-	-	-	-	-
CLO4	3	3	2	-	2	-	-	-	2	-	-	-
CLO5	3	-	2	-	-	-	-	2	-	2	-	2

Rank: 3-High match, 2-Medium match, 1-Low match

Mapping of Course Learning Outcomes (CLOs) with the Teaching-Learning and Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture, Demonstration, Group work	Lab Performance, Quiz test, Continuous Assessment, Report evaluation, Viva, Final Exam
CLO2	Literature review, Demonstration, Video presentation, Hands-on practice, Group work	Lab Performance, Quiz test, Assignment, Report evaluation, Viva, Final Exam
CLO3	Literature review, Video presentation, Group work	Lab Performance, Continuous Assessment, Quiz test, Viva, Report evaluation, Final Exam
CLO4	Demonstration, Hands-on practice, Presentation, Group work, Problem-based exercises	Lab Performance, Continuous Assessment, Case study, Report evaluation, Final Exam
CLO5	Discussion, Multimedia presentation, Lecture Group work	Report evaluation, Final Exam

Learning Materials

i. Recommended Readings

a) Billmeyer F.W. Jr. - Text Book of Polymer Science.
b) Ralph L. Shriner- The Systematic Identification of Organic Compounds
c) Gowariker V. R. -Polymer Science.

ii. Supplementary Readings

a) Arora M.G. & Singh M. - Polymer Chemistry.
b) Charles E. Carraher Jr- Carrahers ***Polymer Chemistry*** 8th Edition

iii. Others: Lab Procedures /lecture material provided by the course teacher

Course Code: 0531-Chem-2205 Course Title: Analytical Chemistr Credits: 3

Rationale of the Course: The aim of the course is to introduce a broad range of modern and classic techniques that are useful in analytical chemistry. The interdisciplinary nature of chemical analysis makes analytical chemistry a vital tool in science, industrial, government, and academic laboratories throughout the world. This course is also helping students to develop an in-depth theoretical understanding to carry out research.

Course Contents

Statistical analysis of data: Evaluation of analytical results, uncertainly in measurement, accuracy and precision, significant figures, sensitivity, selectivity and specificity of chemical reaction, repeatability, reproducibility, errors, rejection of data: the Q test and Grubb's test.

Gravimetric and complexometric methods: Principles of gravimetric methods, conditions for precipitation co-precipitation and post–precipitation, precipitation from homogeneous solution, complexometric titration, metallochromic indicator, buffer solution in EDTA titration.

Chromatographic techniques: Introduction, classification of chromatographic methods, partition and adsorption chromatography, R_f value, illustration of paper, thin layer chromatography (TLC) and column chromatography; ion exchange chromatography: Introduction, exchangers, characteristics, and its applications.

Ultraviolet-Visible spectrometry: Introduction, principle, broad nature of spectrum, instrumentation, Beer-Lambert law, absorption spectrum, and λ_{max}, shifting of λ_{max}: Conjugation, solvent polarity, pH; Woodward-Fieser rules for λ_{max} calculation, analysis of heavy metals and other pollutants.

Atomic absorption spectrometry: Introduction, basic principles, instrumentation, hollow cathode lamp, sample preparation, type of techniques, flame, and types of flame, electrothermal analyzer, different interferences, recent developments, applications.

Environmental analysis: Sampling of wastewater, Analysis of tannery wastewater sample: alkalinity, acidity, Different types of solids, hardness of water, banned amines; Analysis of chrome-tanned leather.

Safety practice in laboratory: Introduction, safety rules, MAK values of working material that involved health hazards, list of harmful materials, emission protection law, prevention of accidents, and first aid in laboratory.

Course Objectives:

a. To provide fundamental knowledge on the accuracy, precision, and errors of experimental results by applying statistical methods.
b. To give an overview of the use of selected classical and instrumental qualitative and quantitative analytical methods.
c. To equip students with skills to solve analytical problems by selecting appropriate analytical tools.

Course Learning Outcomes (CLOs): At the completion of this course students will be able to -

CLOs	Course Learning Outcomes (CLOs)	Learning Level
CLO1	Describe the fundamental statistical analysis and its utilization in calculating statistical parameters.	C1, A1
CLO2	Explain the basics of different analytical methods, their applications, and safety practices in the laboratory.	C2, A2
CLO3	Apply gravimetric, chromatographic, and spectroscopic techniques in qualitative and quantitative analysis.	C3, A2
CLO4	Analyze and compare different qualitative and quantitative results of analytical techniques for authentication.	C4, A3
CLO5	Correlate the analytical techniques for the analysis of finished leather, wastewater, and other environmental contaminants.	C5, A4

Mapping of CLO with PLO

CLOs	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12
CLO1	3	2	-	-	-	-	1	-	-	-	-	-
CLO2	3	2	-	-	2	-	3	-	-	-	-	-
CLO3	3	2	-	-	-	-	2	-	-	-	-	-
CLO4	3	3	-	3	-	-	2	-	-	-	-	-
CLO5	3	3	-	2	-	-	3	-	-	-	-	-

Rank: 3-High match, 2-Medium match, 1-Low match.

Mapping of Course Learning Outcomes (CLOs) with the Teaching-Learning and Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Interactive lecture with whiteboard illustration, Problem practice.	In-course and Final Exam
CLO2	Interactive lecture with whiteboard illustration, Slide presentation, Problem practice.	Quiz and Final Exam
CLO3	Interactive lecture with whiteboard illustration, Slide presentation.	Assignment and Final Exam
CLO4	Interactive lecture with whiteboard illustration, Problem practice, Displaying UV instrument.	In-course and Final Exam
CLO5	Interactive lecture with whiteboard illustration, Case study.	In-course and Final Exam

Learning Materials

i. Recommended Readings

a) Gary D. Christian- Analytical Chemistry.
b) Skoog, West and Holler- Fundamental of Analytical Chemistry.
c) David Harvey- Modern Analytical chemistry.

ii. Supplementary Readings

a) Bryan m. Ham and Aihui Maham-Analytical chemistry.
b) Séamus Higson- Analytical chemistry.

iii. Others: Handout/lecture material provided by the course teacher

Course Code: 0531-Chem-2206 Course Title: Analytical Chemistry Lab Credits: 1.5

Rationale of the course: The course is designed to provide practical knowledge related to safety during working in an analytical laboratory, development of skills for the use of lab apparatus and equipment's using mainly advanced titration methods, and quantitate analysis by spectrophotometric method.

Course content

Determination of hardness (complexometry), sulphite (iodometry), suphide(iodimetry), chloride (Volhard method), Ammonium(titrimetry), gravimetric determination of metal like lead, calcium, aluminum, Determination of total organic carbon in soil sample, Spectrophotometric determination of Fe(II), ammonium and sulphate from the supplied sample solution, Determination of Calcium(II) in a calcium compound/tablet; Analysis of fat, oil, and soap.

Course Objectives:

a. To introduce the fundamental knowledge and skill of different laboratory experiments based on titration, gravimetry, and spectrophotometry.
b. To determine toxic metals and other toxic chemicals both in leather and tannery effluents.

Course Learning Outcomes (CLOs): At the end of the course, students will be able to -

	Course Learning Outcomes (CLOs)	**Learning Level**
CLO1	Explain the theoretical principles of classical analytical methods within titration, and various techniques within gravimetric and spectroscopic methods.	C2, A3
CLO2	Apply the volumetric and gravimetric and spectroscopic methods to carry out laboratory scale experiments and environmental analysis based on manipulation ability and understanding.	C3, P2, A2
CLO3	Demonstrate the analysis of fat, oil, and soap. Articulate laboratory measurements and data, including units, significant figures, precision, and accuracy.	C3, P3, A3
CLO4	Demonstrate knowledge of good laboratory practices, professionalism, ethical behavior, and teamwork by turning in required reports and completing laboratory work in a regular basis.	C3, P3, A3

Mapping of CLO with PLO

CLOs	**PLO1**	**PLO2**	**PLO3**	**PLO4**	**PLO5**	**PLO6**	**PLO7**	**PLO8**	**PLO9**	**PLO10**	**PLO11**	**PLO12**
CLO1	3	2	-	-	1	-	-	-	-	-	-	-
CLO2	3	2	2	-	2	-	2	-	-	-	-	-
CLO3	3	2	-	-	-	-	-	-	-	-	-	-
CLO4	2	2	-	-	-	-	-	2	2	2	-	2

Rank: 3-High match, 2-Medium match, 1-Low match.

Mapping of Course Learning Outcomes (CLOs) with the Teaching-Learning and Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Interactive Lecture, Group Discussion, Demonstration, Hands-on practice, and Group work	Quiz, Viva Voce, Report evaluation, Final Exam
CLO2	Lecture, Demonstration, Hands-on practice, and Group work	Presentation, Report evaluation, Final Exam
CLO3	Lecture, Demonstration, Hands-on practice, and Group work	Quiz, Viva Voce, Report evaluation, Final Exam
CLO4	Lecture, Demonstration, Hands-on practice, and Group work	Report evaluation, Final Exam

Learning materials

i. **Recommended readings**
   a) Gary D. Christian- Analytical Chemistry.
   b) John Kenkel- Analytical Chemistry for Technicians.
   c) Vogel A. I. - Text Book of Quantitative Chemical Analysis.

ii. **Supplementary Readings**
   c) P. K. Sarker - Analytical Chemistry for Leather Manufacture.
   d) Fifield and Haines-Environmental Analytical Chemistry.

iii. **Others:** Lecture notes and Lab procedure provided by the course teachers.

Course Code: 0715-ME-2207 Course Title: Fundamentals of Mechanical Engineering

Credits: 3

Rationale of the Course: This course is designed with different basic mechanical theories of rigid bodies, solids, thermodynamics, heat transfer, fluid mechanics, welding, and their mechanisms. After completing the course, students will be able to possess an understanding of different mechanical operations along with their potential application in the footwear industry.

Course Content

Engineering statics: General principles of statics, Vectors, Statics of particles, Equilibrium of rigid bodies, Internal forces and moments, Friction, Centroids and Moments of inertia.

Engineering dynamics: Kinematics of Particles**,** Rectilinear and curvilinear motion of particles, position vector, velocity and acceleration, derivative of vector functions, Newton's second law of motion- dynamic equilibrium

Mechanics of solid: Introduction to mechanical response of materials and stress-strain relationships, Modulus of elasticity and modulus of rigidity, Shear stress, axial stress in composites, Centrifugal and Thermal stresses; Statically indeterminate members, Stresses in thin-walled and thick-wall members, torsion, column theory.

Thermodynamics: Fundamental concepts and definitions, laws of thermodynamics, thermodynamic processes and cycles, introduction to steam generator units, detail study of boiler,

vapor power cycles-ranking, reheat, internal combustion engines, steam turbines, compressor, measurements and automatic control mechanism.

Heat transfer: Different modes of heat transfer-conduction, convention, and radiation, one dimensional steady state conduction of heat in solid plane wall, radiation heat transfer, the laws of black-body radiation, sources of energy.

Fluid mechanics and Pumps: Hydraulics properties of fluids, surface tension and capillary tubes, basic hydrostatic equation, pressure head of a liquid, pressure gauges, flow of fluids, Bernoulli's equation, and equation of continuity. laminar flow and turbulent flow, head loss due to friction in a pipe, fluid flow measurements, pump types, Characteristics and applications of reciprocating and centrifugal pumps.

Welding: Gas welding: principle, equipment used, gas storage and safety measures. Gas cutting. Arc welding: principle, equipment used; AC and DC arc welding, electrodes, shielded arc welding: TIG, MIG and plasma arc welding; electrical resistance welding. Lathe machine and accessories.

Course Objectives:

a. To provide the fundamental knowledge of different mechanical theories associated with leather and footwear industries.
b. To introduce the students to the statics, dynamics, mechanics, and weldings of solids.
c. To develop the basic understanding of thermodynamics as well as fluid mechanics.

Course Learning Outcomes (CLOs): Upon completion of this course, students will be able to:

	Course Learning Outcomes (CLOs)	**Learning Level**
CLO1	State the basic concepts of different mechanical theories including statics, dynamics, thermal, solid, and fluid mechanics.	C1, A1
CLO2	Explain the mechanisms behind engineering statics, dynamics, heat transfer, pump, and welding along with thermodynamics, solid, and fluid mechanics.	C2, A2
CLO3	Apply the mechanical theories in real-life problem solving.	C3, A2
CLO4	Relate the concepts of mechanics in different areas of footwear manufacturing machinery.	C4, A3

Mapping of CLO with PLO

CLOs	**PLO1**	**PLO2**	**PLO3**	**PLO4**	**PLO5**	**PLO6**	**PLO7**	**PLO8**	**PLO9**	**PLO10**	**PLO11**	**PLO12**
CLO1	3	-	-	-	-	-	-	-	-	-	-	-
CLO2	3	1	-	-	1	-	-	-	-	-	-	-
CLO3	3	2	2	3	2	-	-	-	-	-	-	2
CLO4	3	2	3	3	2	-	-	-	-	-	-	-

Rank: 3-High match, 2-Medium match, 1-Low match

Mapping of Course Learning Outcomes (CLOs) with the Teaching-Learning and Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture, multimedia presentation, literature review and problem-based exercises	Group Presentation, Assignment, oral presentation, In-course Exam and Final Exam
CLO2	Lecture, group discussion and problem-based exercises, literature review.	Group Presentation, In-course Exam and Final Exam
CLO3	Lecture, multimedia presentation and problem-based learning: Identifying the problem to be solved	Assignment, Group Presentation, In-course Exam and Final Exam
CLO4	Lecture, multimedia presentation, group discussion, demonstration, and problem-based exercises	Group Presentation, Case study, Assignment, In-course Exam and Final Exam

Learning Materials

i. Recommended Readings

a) Khurmi R.S., and Gupta J.K., (2020), "Thermal Engineering", S. Chand and Company Limited, New Delhi.
b) Holman J.P., (2004) "Heat Transfer", 9th Edition, Tata McGraw Hill Publishing Co. Ltd., New Delhi.
c) Rogers G.F.C., and Mahew Y.R., (1967), "Engineering Thermodynamics: Work and Heat Transfer", 4th Edition (Reprinted), Longman Pub Group.

ii. Supplementary Readings

a) Ferdinand P. Beer., and E. Russell Johnston, Jr. (2016), "Vector Mechanics for Engineers Statics and Dynamics", Eleventh Edition, McGraw-Hill Education.

iii. Others: Hand notes/Lecture materials will provide by the course teacher.

Course Code: 0715-ME-2208 Course Title: Mechanical Workshop Practice Credits: 1.5

Rationale of the Course: This course is based on 0715-ME-2208 to make students competent to know and practice different types of machinery, gas and arc welding, different types of fitting works, study and practice on pumps, power generators, engines and turbines.

Course Content

1. Use of Hand Tools and Machine Tools
2. Prepare cutting press knives using knife cutting and bending machine
3. Work on lathe machine
4. Work on milling machine
5. Practice with drilling machine
6. Practice with shaper and grinding machine
7. Perform on gas welding machine
8. Perform on arc welding machine and TIG welding

9. Study on pump and its accessories
10. Study on power generating engines.

Course Objectives:

a. To introduce students to different cutting knife preparations.
b. To familiarize students with pumps, compressors, power generators, and engines.
c. To provide skills in gas, arc, and TIG welding.
d. To develop skills on lathe, shaper, milling, drilling, and grinding machines.

Course Learning Outcomes (CLOs): Upon successful completion of this course, students will be able to

	Course Learning Outcomes (CLOs)	**Learning Level**
CLO1	Demonstrate different basic tools, equipment, and machines.	C2, A1, P1
CLO2	Illustrate the operating principles and techniques of different machinery like lathe, drilling, milling, shaper, etc.	C3, A2, P2
CLO3	Manipulate and operate different mechanical machinery in real-life practices.	C3, P3, A3
CLO4	Correlate those mechanical operations in leather and footwear machinery.	C4, A3, P3
CLO5	Solve any technical issues while operating those machinery.	C5, A4, P4

Mapping of CLOs with PLOs

CLOs	**PLO1**	**PLO2**	**PLO3**	**PLO4**	**PLO5**	**PLO6**	**PLO7**	**PLO8**	**PLO9**	**PLO10**	**PLO11**	**PLO12**
CLO1	3	-	-	-	-	-	-	-	-	-	-	-
CLO2	3	2	2	-	-	-	-	-	-	-	-	-
CLO3	3	2	2	1	3	-	-	-	2	-	-	3
CLO4	2	1	-	1	-	-	-	-	-	-	-	2
CLO5	3	2	3	2	2	-	-	-	2	-	-	-

Rank: 3-High match, 2-Medium match, 1-Low match

Mapping of Course Learning Outcomes (CLOs) with the Teaching-Learning and Assessment Strategy

CLOs	**Teaching-Learning Strategy**	**Assessment Strategy**
CLO1	Demonstration and problem-based exercises presentation.	Viva, report evaluation, and final exam
CLO2	Group discussion, demonstration of problem-based exercises, multimedia presentation	Viva, report evaluation, and final exam
CLO3	Demonstration, identifying the problem to be solved	Group presentation, quiz, report evaluation and final exam

CLO4	Multimedia presentations, group discussions, demonstrations and problem-based exercises	Group presentation, viva, report evaluation, quiz, and final exam
CLO5	Multimedia presentations, group discussions, demonstrations and problem-based exercises	Group presentation, viva, report evaluation, quiz, and final exam

Learning Materials

i. **Recommended Readings**
   a) Khurmi R.S. and Gupta J.K. "A Text Book of Work Shop Technology", 1st Edition (Reprinted 1981), S. Chand and Company Limited, New Delhi.
ii. **Supplimentary Readings**
   a) Chapman, W.A.J., "Workshop Technology Part 1", 5th Edition (1972)
iii. **Others:** Handout/lecture material provided by the course teacher

Course Code: 0723-FE-2210 Course Title: Field Tour-II Credits: 1

Rationale of the Course: This course is designed to offer first-hand exposure to the business operations and processes that are usually performed in the workplace. Industrial visits will provide the students with a practical perspective of the concepts and theories that are taught to them. It will also help to keep the brilliant students up-to-date with knowing about the prevalent technologies and significant changes happening in the market.

Course Content

In 2nd Year 2nd Semester, students will visit a reputed footwear industry limited.

Discuss with the company supervisor about any project or assignment/task. Try to understand the systems in your workplace – Processes, Organization, and Administrative. Record all the work done or knowledge gained. Maintain logbook and give feedback to guide teacher.

Course Objectives

a. To build a learning intervention that is intertwined with practical, hands-on skill enhancement knowledge to ensure that student's learning is not focused solely on theoretic approaches.
b. To make a good relationship with various footwear companies and increase their networking opportunities.

Course learning outcomes (CLOs): At the completion of this course students will be able to:

	Course Learning Outcomes (CLOs)	Learning Level
CLO1	Provide a description of the operations, workstations, plants, machines, assembly lines, and management involved in the footwear industry and engage in discussions with knowledgeable professionals.	C2, A3, P2
CLO2	Improve abilities in collaborating effectively with others, expressing ideas clearly and concisely, and working efficiently in a group setting.	C2, A3
CLO3	Prepare technical documents and give verbal presentations on completed industrial tour work.	C3, C4, A4

Mapping CLOs with PLOs

CLOs	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12
CLO1	3	-	-	-	3	-	-	-	-	3	-	2
CLO2	2	-	-	-	-	-	-	-	2	2	-	2
CLO3	2	-	-	-	-	-	-	-	-	3	-	2

Rank: 3-High match, 2-Medium match, 1-Low match.

Mapping of Course Learning Outcomes (CLOs) with the Teaching-Learning and Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Class Lecture, Display and Demonstration	Presentation and viva, Report Evaluation
CLO2	Class Lecture, Display and Demonstration,	Presentation and viva, Report Evaluation
CLO3	Discussion, Discussion and Motivation, Self-study	Presentation and viva, Report Evaluation

Learning Materials

i. Recommended Readings

a) Writing the Winning Thesis or Dissertation: A Step-by-Step Guide - By Allan A. Glatthorn, Randy L. Joyner.
b) Relevant books, handbooks, patents and manuals.

Course Code: 0723-FE-3101 Course Title: Footwear Manufacturing-III Credits: 3

Rationale of the Course: This course is a core course in footwear engineering. By following the standard operating procedure (SOP), a student will be able to manufacture footwear as per the required quality. This course will prove an opportunity to enhance knowledge about the preparation of upper and soling materials, sole cementing and bonding, footwear inspection, packaging, and shipment.

Course Contents

Sole cementing and bonding: Importance of sole attaching, types of sole attaching systems, adhesives used in sole bonding, chemical preparation of soling materials, upper cementing for sole attaching- margin cementing, roller cementing, automatic cementing, hot-melt adhesive application. Sole cementing-overall cementing, margin cementing, spray cementing, drying, drying uppers, heat reactivation, pressing, faults and remedies in sole attaching.

Heel attaching: Types and purposes of heel, attachment process of heel to footwear- inside and outside heel attaching method, considering points in heel attaching- number, length and position of heel pin, pin quality, heel design features and material quality; Shank- type, size, position and materials properties, insole thickness and material properties, heel seat area and insole reinforcement; Heel nailing machines-parts, functions and operating process.

Chilling and last slipping: Importance of chiller used in footwear production, parts and functions of chiller used in footwear production, controlling parameters of chiller, last slipping.

Shoe finishing and shoe room treatment: Importance of shoe finishing and shoe rooming, purposes of shoe finishing, principles of shoe finishing, finishing materials types and their properties, stages of shoe finishing, types of shoe finishing, considering points in shoe finishing- leather uppers, non-leather uppers, bottom part finishing, health and safety issues in shoe finishing, operational sequence in treeing department.

Footwear inspection: Defect vs defective footwear, principles of footwear inspection, basic checkpoints for a pair of shoes, footwear sample inspection, footwear wear test technique, footwear materials inspection in warehouse, cutting and closing departments, inspection in lasting and making room, list of common defects in a pair of shoes, footwear repairing, principles of footwear repairing, x-ray detection.

Packaging and shipping of footwear: Definition, purposes of packaging, materials used in footwear packaging, structure of corrugated paper and its characteristics, material efficiency in packaging, eco-design consideration in packaging, uses of silica gel and micro-pak in mould prevention, specification of packaging, list of packaging items.

Course Objectives: The objectives of this course are to provide:

a. To provide knowledge about sole cementing and bonding, chilling and last slipping and heel attaching.
b. To disseminate detailed knowledge about shoe finishing and shoe room treatment.
c. To equip student with vast knowledge about footwear inspection, packaging and shipping of footwear.

Course Learning Outcomes (CLOs): Upon completion of this course, students will be able to:

	Course Learning Outcomes (CLOs)	Learning Level
CLO1	Explain different techniques of sole cementing and bonding, heel attaching, chilling and last slipping, shoe finishing and shoe room treatments, inspection, packaging, and shipping of footwear.	C1, C2, A1
CLO2	Apply the basic knowledge of footwear manufacturing from sole bonding to footwear packaging and shipping.	C3, A2
CLO3	Analyze the fault and remedies occur during sole cementing and bonding, heel attaching, chilling, and last slipping, shoe finishing and shoe room treatments, inspection, packaging, and shipping of footwear.	C4, A3
CLO4	Evaluate different aspect of sole cementing and bonding, heel attaching, chilling and last slipping, shoe finishing and shoe room treatments, inspection, packaging, and shipping of footwear.	C5, A3

Mapping of CLO with PLO

CLOs	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12
CLO1	3	-	-	-	-	-	-	-	-	-	-	-
CLO2	3	3	2	-	2	-	-	-	-	-	-	-
CLO3	3	3	3	3	-	-	-	-	-	-	-	-
CLO4	3	3	2	3	2	-	-	-	-	-	-	-

Rank: 3-High match, 2-Medium match, 1-Low match.

Mapping of Course Learning Outcomes (CLOs) with the Teaching-Learning and Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture, Multimedia presentation, Group discussion	Assignment, Group presentation, In-course Exam, Final Exam
CLO2	Lecture, Multimedia presentation, Group discussion	Assignment, Group presentation, In-course Exam, Final Exam
CLO3	Lecture, Multimedia presentation, problem-based learning (PBL)	In-course Exam, Final Exam
CLO4	Lecture, Multimedia presentation, problem-based learning (PBL)	In-course Exam, Final Exam

Learning Materials

i. **Recommended Readings**
   a. Miller R. G. (Editor) – Manual of Shoe Making.
   b. Venkatappaiah B.- Introduction to the Modern Footwear Technology.
   c. Thornton J. H.- Text Book of Footwear Manufacture

ii. **Supplementary Readings**
   a. A. J. Harvey- Footwear Materials and Process Technology
   b. Thornton J. H.-Text Book of Footwear Materials.

iii. **Others**: Handout/lecture material provided by the course teacher.

Course Code: 0723-FE-3102 Course Title: Footwear Manufacturing-III Lab Credits: 1.5

Rationale of the Course: This practical course is outlined to disseminate thorough knowledge to the students regarding sports and monk shoe manufacturing. It covers all manufacturing aspects of shoemaking from cutting to finishing. Moreover, the course is designed to provide essential skills related to safety during working in an advanced manufacturing lab.

Course Content

1. **Cement constructed sports shoe manufacturing:** Preparation, OSH, cutting, closing, lasting, sole attaching, and finishing, defects identification and remedy plan, and materials consumption.
2. **Strobel constructed sports shoe manufacturing:** Preparation, OSH, cutting, closing, lasting, sole attaching, and finishing, defects identification and remedy plan, and materials consumption.
3. **String lasted sports shoe manufacturing:** Preparation, OSH, cutting, closing, lasting, sole attaching, and finishing, defects identification and remedy plan, and materials consumption.
4. **Cement constructed monk shoe manufacturing:** Preparation, OSH, cutting, closing, lasting, sole attaching, and finishing, defects identification and remedy plan, and materials consumption.

Course Objectives: Specific objectives of this course are as follows:

a. To enhance detailed manufacturing knowledge of sports and monk shoes.
b. To provide in-depth cutting, closing, lasting, shoe construction, and finishing knowledge.
c. To prepare the students with different shoe construction methods.
d. To provide essential knowledge related to occupational safety and health (OSH) during working with sophisticated machinery and equipment.

Course Learning Outcomes (CLOs): Upon completion of the course, the students will be able to:

	Course Learning Outcomes (CLOs)	Learning Level
CLO1	Outline the detailed manufacturing knowledge of sports, and monk shoe.	C1, P1, A1
CLO2	Identify the machinery, equipment, and associated risk for specific types of footwear manufacturing.	C2, P2, A2
CLO3	Apply different shoe construction methods in sports and monk shoe manufacturing.	C3, P3, A2
CLO4	Demonstrate the defects identified during sports and monk shoe manufacturing.	C4, P4, A3
CLO5	Prepare a defect catalog and remedy plan for upgrading the manufacturing process.	C5, P1, A2

Mapping of CLO with PLO

CLOs	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12
CLO1	3	-	-	-	-	-	-	-	-	-	-	-
CLO2	3	-	-	-	1	-	-	-	2	-	-	-
CLO3	3	-	2	-	2	-	-	-	3	-	-	-
CLO4	3	3	2	3	3	-	-	-	2	-	-	-
CLO5	3	2	3	2	3	-	-	-	2	-	-	-

Rank: 3-High match, 2-Medium match, 1-Low match

Mapping of Course Learning Outcomes (CLOs) with the Teaching-Learning and Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture, Demonstration, and Hands-on practice	Lab Performance, Final Exam
CLO2	Lecture, Demonstration, and Hands-on practice	Lab Performance, Final Exam
CLO3	Lecture, Demonstration, and Hands-on practice	Lab Performance, Continuous assessment: Viva, Report, Final Exam
CLO4	Lecture, Demonstration, Hands-on practice, Video presentation and Problem-based group discussion	Lab Performance, Continuous assessment: Viva, Report, Final Exam
CLO5	Lecture, Demonstration, Hands-on practice, Video presentation and Problem-based group discussion	Lab Performance, Continuous assessment: Viva, Report, Final Exam

Learning Materials

i. Recommended Readings

a) Handbook of footwear design and manufacture-A. Luximon
b) How Shoes are Made: A behind the scenes look at a real sneaker factory-Wade Motawi
c) Thornton J. H.- Text Book of Footwear Manufacture.

ii. Supplementary Readings

a) A.J. Harvey- Footwear Materials and Process Technology.
b) Miller R. G. (Editor)- Manual of Shoe Making.

iii. Others: Handout/lecture material provided by the course teacher.

Course Code: 0531-Chem-3103 Course Title: Instrumental Analysis Credits: 3

Rationale of the Course: This course covers in-depth knowledge of design, operational techniques, principles, and practical applications of modern instrumental methods used in chemical analysis. Using a combination of chromatographic and spectroscopic problem-based learning approaches, the critical thinking and analytical skills of the student will be improved and will assist them in developing their theoretical knowledge to do advanced research.

Course Contents

Gas chromatography: Introduction, classification, principles of gas-liquid chromatography, gas-solid chromatography, techniques of gas-liquid chromatography, phases, oven, columns, detectors: types of detectors, application of GC in chemical analysis.

High-Performance liquid chromatography: Basic concept, instrumentation of HPLC, stationary phases: Normal and reversed-phase, mobile phase, sample injector, selection of column, UV-visible and RI detectors, Peak tailing and fronting, effect of temperature in HPLC, comparison of HPLC with GLC, application of HPLC.

Infrared spectrometry: Basic principle, types of vibration modes, selection rule, parameters determining the position and intensity of bands, characteristic absorption bands of functional groups, influence of substituent, polarity and hydrogen bonding on IR peaks, application of IR spectrum for chemical and leather analysis.

Nuclear Magnetic Resonance Spectroscopy: Fundamental theory, NMR active nucleus, solvents, chemical shift and factors affecting chemical shift, shielding and de-shielding effect, application of ^{1}H-NMR spectrum in organic compounds and leather chemicals analysis.

Mass Spectrometry: Introduction, principle, isotopic peaks, ionization methods: EI, ESI, CI, fragmentation pattern of simple molecules, applications.

Thermal analysis: Thermogravimetric analysis (TGA): Introduction, objectives, instrumentation, classification, interpretation of TGA curve, factors affecting TGA curve, application in leather science; basic principle of differential thermal analysis (DTA) and differential scanning calorimetry (DSC).

Characterization of collagen: Chromatographic properties, electrophoretic properties, microscopy and spectroscopy techniques for collagen morphology, X-ray diffraction studies of collagen, non-invasive methods of liquid and solid imaging of biological specimens and their relevance to location of defects in hides/skins.

Course Objectives:

a. To improve the analytical knowledge on purification, identification and quantification of the chemical components from their mixture or impurities.
b. To develop the ability to analyze organic and other chemicals by the combination of spectroscopic data such as infrared spectroscopy, nuclear magnetic resonance spectroscopy, and mass spectrometry.
c. To provide in-depth knowledge on the thermal stability of leather, synthetic polymers, and footwear materials using TGA and DSC.

Course Learning Outcomes (CLOs): Upon completion of this course, students will be able to:

	Course Learning Outcomes (CLOs)	**Learning Level**
CLO1	Describe the physical laws and working principles, instrumentation, and applications of HPLC and GC as well as compare the different aspects of HPLC and GC.	C2, C4, A2
CLO2	Analyze and interpret IR, NMR, and Mass spectrum of different compounds and elucidate the structure of unknown compounds.	C4, C5, A3
CLO3	Relate the basic principles and significance of TGA, DTA, and DSC techniques and compare the related curves.	C4, A3
CLO4	Characterize collagen through the study of FT-IR, X-ray diffraction, and mechanical and optical properties of collagen fibers.	C4, A3

Mapping of CLO with PLO

CLOs	**PLO1**	**PLO2**	**PLO3**	**PLO4**	**PLO5**	**PLO6**	**PLO7**	**PLO8**	**PLO9**	**PLO10**	**PLO11**	**PLO12**
CLO1	3	1	-	1	3	-	-	-	-	-	-	-
CLO2	3	2	-	2	3	-	-	-	-	-	-	-
CLO3	3	2	2	2	3	-	-	-	-	-	-	-
CLO4	2	3	2	3	3	-	-	-	-	-	-	-

Rank: 3-High match, 2-Medium match, 1-Low match

Mapping of Course Learning Outcomes (CLOs) with the Teaching-Learning and Assessment Strategy

CLOs	**Teaching-Learning Strategy**	**Assessment Strategy**
CLO1	Lecture, multimedia presentation, demonstration and problem-based exercises.	In-course Exam; Final Exam
CLO2	Lecture, group discussion and problem-based exercises on instrumental analysis.	In-course Exam; Final Exam
CLO3	Lecture, showing sophisticated instruments, Identifying the problems to be solved.	In-course Exam, Final Exam
CLO4	Lecture, audiovisual presentation, multimedia presentation, group discussion, demonstration, and problem-based exercises.	Quiz, Final Exam

Learning Materials

i. Recommended Readings

a) Gary D. Christian- Analytical Chemistry.
b) John Kenkel- Analytical Chemistry for Technicians.
c) Sharma B. K. - Instrumental Methods of Chemical Analysis.

ii. Supplementary Readings

a) Sarker P. K. - Analytical Chemistry for Leather Manufacture.
b) Williams D. H. and Ian Fleming- Spectroscopic methods in Organic chemistry.

iii. Others: Handout/lecture material provided by the course teacher

Course Code: 0531-Chem-3104 Course Title: Chemical Analysis of Leather and Leather Products Lab Credits: 1.5

Rationale of the Course: This practical course is based on theoretical knowledge of analytical chemistry and instrumental methods of analysis. The course is designed to provide essential knowledge related to safety during working in an advanced analytical laboratory, and the development of skills for the use of sophisticated instruments and equipment in different chemical analysis. The course is also designed to develop instrumental and analytical skills to conduct research work.

Course Contents

Analysis of Leather: Sulphated ash, fat content, chromic oxide content, Cr^{6+} and other trace metals content, formaldehyde, moisture, nitrogen content, and shrinkage temperature of the leather sample; Extraction of collagen and characterization.

Analysis of Chrome liquor: Chromic oxide, sulphate, hydroxide content.

FT-IR and TGA analysis of sole materials.

Course Objectives: The learning objectives of this course are:

a. To introduce the essential experimental knowledge and skills of different tests to determine moisture content, nitrogen content, thermal stability of leather, and synthetic tanning materials, and total fat in leather samples.
b. To apply practical knowledge in analytical chemistry in the leather and allied engineering field.
c. To determine toxic metals like total chromium, lead, and cadmium by atomic absorption spectroscopy (AAS) and chromium (VI) by UV-VIS spectrophotometer.

Course Learning Outcomes (CLOs): Upon completion of this course, students will be able to:

CLOs	Course Learning Outcomes (CLOs)	Learning Level
CLO1	Perform different physical and chemical tests to determine pH, fat content, moisture content, ash content, and shrinkage temperature of leather samples.	C3, P3, A3
CLO2	Apply the titrimetric method (IUC-8) to determine the chromic oxide content in finished leather and chrome liquor samples and determine nitrogen in leather by Kjeldahl method.	C3, P3, A4
CLO3	Demonstrate complexometric and gravimetric methods to determine sulphate from chrome liquor and utilize thermogravimetry and FT-IR to analyze the leather and different synthetic sole materials.	C3, P3, A3

CLO4	Estimate the concentration of total Cr, Pb, Cd and Cr (VI) in leather and effluent samples by spectroscopic method.	C5, P4, A4
CLO5	Write laboratory reports that integrate mathematical, tabular, and graphical representations of data which compare and contrast theoretical predictions and experimental measurements and draw pertinent conclusions.	C4, P3, A4

Mapping of CLO with PLO

CLOs	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12
CLO1	3	2	2	-	-	-	-	-	-	-	-	-
CLO2	3	3	2	2	-	-	-	-	-	-	-	-
CLO3	3	2	1	3	2	-	-	-	-	-	-	-
CLO4	3	2	2	2	2	2	2	-	-	-	-	-
CLO5	3	2	-	-	-	-	-	-	-	2	-	-

Rank: 3-High match, 2-Medium match, 1-Low match.

Mapping of Course Learning Outcomes (CLOs) with the Teaching-Learning and Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Interactive lecture, Group discussion, Demonstration, Hands-on practice, and Group work	Quiz, Viva voce, Report evaluation, Final Exam
CLO2	Lecture, Demonstration, Hands-on practice, and Group work	Presentation, Report evaluation, Final Exam
CLO3	Lecture, Demonstration, Hands-on practice, and Group work	Quiz, Viva Voce, Report evaluation, Final Exam
CLO4	Lecture, Demonstration, Hands-on practice, and Group work	Report evaluation, Final Exam
CLO5	Lecture and whiteboard illustration	Report evaluation

Learning Materials

i. Recommended Readings

a) Gary D. Christian- Analytical Chemistry.
b) John Kenkel- Analytical Chemistry for Technicians.

ii. Supplementary Readings:

a) Sarker P. K. - Analytical Chemistry for Leather Manufacture.

iii. Others: Handout/lab procedure manual provided by the course teacher

Course Code: 0723-FE-3105 Course Title: Environmental Science and Engineering Credits: 2

Rationale of the Course: Environmental Science and Engineering is a fundamental course for undergraduate engineering students which gives stresses real-time knowledge and skills on the environment. The course will help to deal with various environmental pollutions and their mitigations.

Course Content

Concept of Environment: Definition and concept of environment, types and components of environment, Biodiversity, man-environment relationships.

Air Pollution: Introduction, composition of air, sinks of atmospheric gases, chemical reactions occur in different spheres, smog formation in air, major sources of air pollution and impact on the environment, greenhouse effect, acid rain and its effect, air pollutant and their characteristics, hazardous air pollutants (HAPs).

Soil Pollution: Introduction, sources of soil pollution, detrimental effects of soil pollutants, disease caused by soil pollution, treatment of soil pollutants, control of soil pollution.

Leather and Leather Products Industry and Environment: Manufacturing process sequences and their environmental implications, major chemical inputs and wastes in cutting, sewing, assembling, and finishing.

Waste Management: definition of waste, integrated waste management, transformation of solid waste, Recovery of residues of effluents, organic materials, dissolved salts, energy; recycling of lime/sulphide liquors, dehair; high chrome exhaustion techniques in chrome tanning, chrome recovery and recycling, oil and grease recovery, disposal of effluents.

Environmental Management System (EMS), Policies and Legislation: Concept and certification process of EMS, Environmental legislation in Bangladesh, Environment Conservation/Protection Act and Rules.

Course Objectives

a. To introduce the students to basic concepts of the environment, environmental pollution, and environmental management system.
b. To identify the impacts of different natural and anthropogenic activities on the environment and their remediation.
c. To impart knowledge on industry-specific solid waste management practices and energy recovery approaches.

Course Learning Outcomes (CLOs): The course is designed to achieve the following outcomes-

	Course Learning Outcomes (CLOs)	**Learning Level**
CLO1	Describe the basic concepts of the environment, environmental pollution, integrated waste management, and environmental management system.	C1, A1
CLO2	Explain the causes and effects of environmental pollution and their remediation.	C2, A2
CLO3	Compare and analyze different techniques to ensure proper waste management approaches in footwear and related industries.	C3, C4, A3

Mapping of CLO with PLO

CLOs	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12
CLO1	3	1	-	-	-	3	3	2	-	-	-	2
CLO2	3	3	2	-	2	3	3	2	-	-	-	3
CLO3	3	3	3	1	2	3	3	-	-	-	-	3

Rank: 3-High match, 2-Medium match, 1-Low match

Mapping of Course-Learning Outcomes (CLOs) with the Teaching-Learning and Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture, Multimedia presentation, white board illustration, problem-based exercises, group discussion	Quiz, In-course exam; Final Exam
CLO2	Lecture, multimedia presentation, problem-based Learning (PBL): Identifying the problems to be solved	Assignment, Group presentation, In-course exam, Final exam
CLO3	Lecture, multimedia presentation, group discussion, analyze and compare through various case-studies	Assignment, In-course Exam, Final Exam

Learning Materials

i. Recommended Readings

a) Fifield & Haines. -Environmental Analytical Chemistry.
b) Roy M. Harrison-Pollution causes, Effects, and Control.
c) B.K. Sharma and H. Kaur-Environmental Chemistry.

ii. Supplementary Readings

a) Besselievie, B.E. and Schwartz, M. "The Treatment of Industrial wastes", 2nd edn., McGraw Hill.
b) Infogate, GTZ, "Treatment of Tannery Waste Water", GmbH, Frankfurt, Germany, 2002.

iii. Others: Handout/lecture material provided by the course teacher

Course Code: 0715-ME-3107 Course Title: Materials Science and Engineering Credits: 3

Rationale of the Course: This course intends to introduce students to the behavior of materials directly linked to their fundamental structures, and how structures and properties may be altered through processing. It will help the students understand the structure of solids, the mechanical, thermal, electrical, magnetic, and optical properties of materials, and the characterization technique.

Course Content

Materials: Basic concept, classification of materials, smart and intelligent materials, nanotechnology, and recent developments.

Structure of crystalline solids: Introduction, unit cells, metallic crystal structures, density computations, polymorphism and allotropy, crystal systems; crystallographic points, directions, and planes: point coordinates, crystallographic directions, crystallographic planes, linear and planar densities, close-packed crystal structures; crystalline and noncrystalline materials, polycrystalline materials, anisotropy, noncrystalline solids.

Mechanical properties: Tensile strength, plastic deformation, true stress and strain, elastic recovery after plastic deformation, compressive, hardness, variability of material properties, design/safety factors, dislocation, characteristics of dislocations, slip and slip systems, generalized creep behavior, stress and temperature effect, viscoelastic deformation.

Thermal and electrical properties: Heat capacity, thermal expansion, materials of importance invar and other low expansion alloys, thermal conductivity and thermal stresses, electrical conduction, semiconductivity, semiconductor devices, electrical conduction in ionic ceramics and in polymers, dielectric behavior, capacitance, field vectors and polarization, types of polarization, phonons, frequency dependence of the dielectric constant, dielectric strength, dielectric materials, ferroelectricity, piezoelectricity.

Magnetic properties: Basic concepts, diamagnetism, paramagnetism, ferromagnetism, antiferromagnetism and ferrimagnetism. Influence of temperature on magnetic behavior, domains and hysteresis, magnetic anisotropy, soft and hard magnetic materials, magnetic storage, superconductivity.

Optical properties: Light interactions with solids, atomic and electronic interactions, optical properties of metals, optical properties of nonmetals, refraction, reflection, absorption, transmission, color, opacity, and translucency in insulators, applications of optical phenomena, luminescence, materials of importance-light emitting diodes (LED), photoconductivity, LASERs, optical fibers in communications.

Characterization techniques: X-ray diffraction, structure determination from powder patterns, influence of crystal symmetry and multiplicities on powder pattern, neutron diffraction, SEM, EDX, TEM, XPS, AFM, and VSM.

Composite materials: Particle-reinforced composites: large-particle composites, dispersion-strengthened composites, fiber-reinforced composites, influence of fiber length, influence of fiber orientation and concentration, the fiber phase, the matrix phase, polymer-matrix composites, metal-matrix composites, glass material, phase transition, carbon-carbon composites, processing of fiber-reinforced composites, hybrid composites, structural composites, laminar composites, sandwich panels, materials of importance-nano and biocomposites.

Course Objectives: The objectives of this course are as follows:

a. To provide the students with the fundamental characteristics of materials and their applications in the respective fields.
b. To introduce various concepts of characterization techniques for different types of materials.
c. To provide in-depth knowledge on the design, development, and fabrication of diversified materials.

Course Learning Outcomes (CLOs): Upon completion of the course, the students will be able to -

	Course Learning Outcomes (CLOs)	**Learning Level**
CLO1	Define and explain the fundamental structures of solid materials.	C1, C2, A1
CLO2	Correlate the structures with the physico-mechanical and electromagnetic properties of materials.	C3, A2
CLO3	Apply the knowledge of materials science to enhance and radically improve existing and future technology.	C3, A2
CLO4	Analyze and interpret the results obtained from different characterization techniques of materials.	C4, C5, A3

Mapping of CLO with PLO

CLOs	**PLO1**	**PLO2**	**PLO3**	**PLO4**	**PLO5**	**PLO6**	**PLO7**	**PLO8**	**PLO9**	**PLO10**	**PLO11**	**PLO12**
CLO1	3	-	-	-	-	-	-	-	-	-	-	-
CLO2	3	-	-	-	-	-	-	-	-	-	-	-
CLO3	3	3	2	3	-	2	-	-	-	-	-	-
CLO4	3	3	2	3	3	2	1	-	-	-	-	-

Rank: 3-High match, 2-Medium match, 1-Low match.

Mapping of Course Learning Outcomes (CLOs) with the Teaching-Learning and Assessment Strategy

CLOs	**Teaching-Learning Strategy**	**Assessment Strategy**
CLO1	Interactive discussion, lecture discussion with multimedia, and whiteboard illustration	In-course Exam and Final Exam
CLO2	Interactive discussion, lecture-discussion with multimedia, and whiteboard illustration	In-course Exam and Final Exam
CLO3	Lecture discussion with multimedia, white board illustration, and problem-based learning (PBL): Identifying the problem to be solved	Assignment, In-course Exam, and Final Exam
CLO4	Lecture discussion with multimedia, group discussion, literature review, demonstration, and problem-based exercises	Assignment, Group Presentation, In-course Exam, and Final Exam

Learning Materials

i. Recommended Readings

a) Materials Science and Engineering-An Introduction -W. D. Callister Jr.
b) The Science and Engineering of Materials -D. R. Askeland, P. Phulé.
c) Foundations of Materials Science and Engineering -W. F. Smith.

ii. Supplementary Readings

a) Introduction to Physical Metallurgy, Avner.
b) Strength of Materials, Andrew Pytel, Ferdin and L. Singer.

iii. Others: Handout/lecture material provided by the course teacher.

Course Code: 0417-Hum-3109 Course Title: Industrial Sociology Credits: 2

Rationale of the Course: This course provides the students with a basic understanding of the role of social processes, social institutions, and social interactions in their lives and integrates the knowledge drawn from their own degree backgrounds. Industrial sociology concerns the production of goods and services in society and the nature of the social relations involved in this production process.

Course Content

Introduction to Sociology: Definition, Nature, Scope, Importance, Social Interactions, Social Groups, Social Institutions.

Culture and Related Concepts: Types, Elements, Role of Culture in Organization, Socialization and Personality, Work Behavior, Work Environment, Work Ethics and Work Culture.

Interpersonal Relations: Interpersonal Behavior, Formation of Personal Attitudes, Language and Communication, Motivations and Emotions, Public Opinion.

Social Stratification: Factors of Social Stratification, Caste and Class, Power, Prestige, and Authority, Social Mobility, Migration.

Human Ecology: Ecological Processes, Ecosystem, and Energy, Ecosystem and Physical Environment, Solid Waste Disposal, Pollution.

Population Dynamics: World Population Growth and Distribution, Population Dynamics in Bangladesh, Causes and Consequences of Urbanization, Population Policy in Bangladesh.

Community Development: Scope and Subject Matter of Community Development, Processes of Community Development, Community Development Programs in Bangladesh, Community Organization and Related Services.

Deviance and Crime: Crime as a Social and Cultural Phenomenon, Crime and Social Organization, Organized Crime, Culture Based Crime, Economics of Crime.

Sociology of Change and Development: Social Change and Development, Dynamics of Social Change, Role of NGOs in Development, World System and Development, Gender and Development.

Course Objectives

a. To describe the basic sociological concepts, theories, and methods to analyze societal phenomena.
b. To introduce students to basic social processes of society, social institutions, and patterns of social behavior.
c. To impart sociological knowledge of core areas and substantive topics and the ability to critically think about them.

Course Learning Outcomes (CLOs): After this course, students will be able to -

	Course Learning Outcomes (CLOs)	Learning Level
CLO1	Identify and connect the basic ideas and terminology in the study of sociology, human ecology and apply the knowledge in real-life.	C1, C2, A2
CLO2	Explain the major methods and concepts used in the systematic study of society.	C3, A2
CLO3	Relate work culture, work ethics, and ethical behavior in real-life.	C4, A3
CLO4	Critically analyze society, its phenomena using sociological theories, and social problems and their impacts on individuals.	C5, A3

Mapping of CLO with PLO

CLOs	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12
CLO1	2	1	-	1	-	2	-	2	2	-	-	3
CLO2	2	2	-	1	-	2	-	2	2	2	-	3
CLO3	2	2	-	2	-	2	-	3	2	2	-	3
CLO4	3	3	-	2	-	3	-	3	2	2	-	3

Rank: 3-High match, 2-Medium match, 1-Low match.

Mapping of Course Learning Outcomes (CLOs) with the Teaching-Learning and Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture, interactive discussion, audio-visuals	In-course Exam, Final Exam
CLO2	Lecture, group discussion, case study, audio-visuals	Assignment, In-course Exam, Final Exam
CLO3	Lecture, audio-visual lectures	Assignment, Case Study, In-course Exam, Final Exam
CLO4	Audio-visual lecture, multimedia presentation, and group discussion	Quiz, Group Presentation, In-course Exam, Final Exam
CLO5	Lecture, multimedia presentation	In-course Exam, and Final Exam

Learning Materials

i. Recommended Readings

a) Schaefer, R. T. (2009). *Sociology: A Brief Introduction* (10th ed.). McGraw-Hill.
b) Ian Glover-Engineers in Britain: A Sociological Study of the Engineering Dimension.
c) Stewart, E. W. and Glynn, J. A. (1979). *Introduction to Sociology* (3rd Ed). McGraw-Hill.

ii. Supplementary Readings

a) Gerald G Marten-Human Ecology: Basic Concepts for Sustainable Development.
b) Dealey, James Quayle and Ward, Lester, Frank-A Text Book of Sociology.

iii. Others: Other materials or notes will be provided by the course teacher**.**

Course Code: 0541-Math-3111 Course Title: Probability and Statistic Credits: 3

Rationale of the Course: This course is designed to introduce students to the fundamental ideas and logic behind statistical reasoning. In addition, students will be guided through the process of developing an understanding of the subject's significance to the sectors in which they choose to further their education.

Course Content:

Introduction: Historical development of the subject, collection of data-primary data, and secondary data.

Frequency distribution: Grouped frequency distribution and their presentation in the form of frequency polygon and histogram.

Measures of central tendency: (i) Mean: (a) Arithmetic Mean (b) Geometric Mean (c) Harmonic Mean (ii) Median (iii) Mode, their definitions, computations, advantages, disadvantages and uses.

Measures of dispersion: Absolute measure, (a) Range (b) Mean deviation (c) Quartile deviation (d) Standard deviation, Relative measure, Coefficient of variation, their definitions, computations and uses.

Moment, skewness and kurtosis: Their definitions, computations and uses.

Correlation and regression: Correlation-Ideas of correlation, measurement of correlation. Pearsonian correlation co-efficient, and spearman's rank correlation co-efficient. Multiple correlations, Regression-Ideas about simple regression, equation of the regression line, estimation of the parameters of the regression line.

Probability: Simple idea of probability, different definitions related to probability, addition law of' probability for mutually exclusive and not mutually exclusive events, multiplication law of probabilities for dependent and independent events, discrete and continuous random variables, mathematical expectation, conditional probability, probability distribution: (i) Binomial, (ii) Poisson, Simple idea about normal distribution and its probability curve.

Test of significance: Some definitions related to the test of significance.

T-test: (a) Comparison of a sample mean with a known population mean when S.D. is known and when S.D. is not known. (b) Comparison of means of two samples when S.D. is known and also when it is unknown, (c) Paired t-test, its practical use in Leather/Footwear/Leather Product Industry. χ^2-test: simple application and its practical use in industry.

Sampling: Definition of population, sample, parameter, census, etc. simple random sampling, stratified random sampling, their definitions, computations, uses, advantages and disadvantages.

Design of experiment: Basic principles of experimental design, ideas about CRD, RBD.

Course Objectives:

a. To provide the basic foundations of statistics with applications in real life.
b. To provide knowledge on descriptive statistics, correlation, regression, probability, and probability distributions for both continuous and discrete random variables.
c. To discuss the theory and its applications for real-life problem-solving and inquiry.
d. To provide students with hands-on experience in using statistical theory and methods to perform different statistical analyses and interpret results.

Course Learning Outcomes (CLOs): Upon completion of the course, the students will be able to -

	Course Learning Outcomes (CLOs)	Learning Level
CLO1	State the fundamental concepts of different terminologies related to statistics.	C1, A1
CLO2	Describe the theories and methods to perform different statistical analyses.	C2, A2
CLO3	Calculate, interpret, and communicate the correlation coefficient and simple linear regression model.	C3, A2
CLO4	Analyze the data related to correlation, regression, probability, and probability distributions for both continuous and discrete random variables.	C4, A3
CLO5	Justify the appropriate statistical data based on experiment conditions and assumptions.	C5, A3

Mapping of CLOs with PLOs

CLOs	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12
CLO1	3	2	-	-	-	-	-	-	-	-	-	-
CLO2	3	3	-	-	-	-	-	-	-	-	-	-
CLO3	3	3	-	-	-	-	-	-	-	-	-	1
CLO4	3	3	2	3	-	-	-	-	-	-	-	2
CLO5	3	3	2	3	-	-	-	-	-	-	-	2

Rank: 3-High match, 2-Medium match, 1-Low match.

Mapping of Course Learning Outcomes (CLOs) with the Teaching-Learning and Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture and problem-based exercises	Assignment, In-course Exam, and Final Exam
CLO2	Lecture, group discussion and problem-based exercises	Assignment, In-course Exam, and Final Exam
CLO3	Lecture, guided reading and problem-based learning (PBL): Identifying the problem to be solved	Assignment, In-course Exam, and Final Exam
CLO4	Lecture, group discussion, and problem-based exercises	Assignment, In-course Exam, and Final Exam
CLO5	Lecture, group discussion, and problem-based exercises	Group Presentation, Assignment, In-course Exam, and Final Exam

Learning Materials

i. Recommended Readings

a) An introduction to Statistics and Probability, Dr. Nurul Islam.
b) Research Methodology (Methods and Techniques), C.R. Kothar.

ii. Supplementary Readings

a) Business Statistics (Fourteenth Edition), Dr. S.P. Gupta and Dr. M.P. Gupta.

iii. Others: Handout/lecture material provided by the course teacher.

Course Code: 0723-FE-3112 Course Title: Footwear Design and Pattern Making-II Lab

Credits: 1.5

Rationale of the Course: This core course provides the current trends of footwear design in the existing market. It covers the technical know-how for designing and pattern making of casual, moccasin, and sports shoe, and boot.

Course Contents:

1. **Designing and pattern making of casual shoe:** Designing, mean forme, standard pattern, sectional pattern, bottom, and component pattern, defects identification, and correction.
2. **Designing and pattern making of moccasin shoe:** Designing, mean forme, standard pattern, sectional pattern, bottom, and component pattern, defects identification, and correction.
3. **Designing and pattern making of boot shoe:** Designing, mean forme, standard pattern, sectional pattern, bottom, and component pattern, defects identification, and correction.
4. **Designing and pattern making of sports shoe:** Designing, mean forme, standard pattern, sectional pattern, bottom, and component pattern, defects identification, and correction.

Course Objectives:

a. To demonstrate design for casual, moccasin, sports shoes, and boot.
b. To provide lessons on pattern engineering for casual, moccasin, sports shoes, and boot.
c. To evaluate the patterns in terms of accuracy, defect identification, and rectification.

Course Learning Outcomes (CLOs): Upon completion of this course, students will be able to:

	Course Learning Outcomes (CLOs)	**Learning Level**
CLO1	Outline the design features of casual, moccasin, sports shoes, and boot.	C1, P1
CLO2	Explain and draw the designs of casual, moccasin, sports shoes, and boot with specifications.	C2, P3
CLO3	Perform pattern making of casual, moccasin, sports shoes, and boot according to specific design.	C3, A2, P3
CLO4	Evaluate the quality of patterns and rectify the related problems.	C5, A4, P3

Mapping of CLO with PLO

CLOs	**PLO1**	**PLO2**	**PLO3**	**PLO4**	**PLO5**	**PLO6**	**PLO7**	**PLO8**	**PLO9**	**PLO10**	**PLO11**	**PLO12**
CLO1	3	-	-	-	-	-	-	-	2	-	-	-
CLO2	3	3	3	-	2	-	-	-	2	-	-	-
CLO3	3	3	3	-	2	-	-	-	2	-	-	-
CLO4	3	3	3	3	-	-	-	-	2	-	-	-

Rank: 3-High match, 2-Medium match, 1-Low match

Mapping of Course Learning Outcomes (CLOs) with the Teaching-Learning and Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture, Demonstration, and Hands-on practice	Lab Performance, Final Exam
CLO2	Lecture, Demonstration, and Hands-on practice	Lab Performance, Final Exam
CLO3	Lecture, Demonstration, Hands-on practice, Video presentation, and Problem-based group discussion	Lab Performance, Continuous assessment: Viva, Report, Final Exam
CLO4	Lecture, Demonstration, Hands-on practice, Video presentation, and Problem-based group discussion	Lab Performance, Continuous assessment: Viva, Report, Final Exam

Learning Materials

i. **Recommended Reading**
   a) Michael H. Sharp- A step by step guide to producing patterns for footwear production.
   b) Martin, Shoben , Janet P. Ward - Pattern Cutting and Making Up.
   c) Korn J. (Editor) - Boot and Shoe Production.

ii. **Supplementary Readings**
   a) Miller R. G. (Editor) - Manual of Shoe Making.
   b) Thornton J. H.- Text Book of Footwear Manufacture.

iii. **Others:** Hand notes/Lecture materials will be provided by the course teacher.

Course Code: 0723-FE-3201 Course Title: Non-Leather Upper Materials for Footwear-I

Credits: 2

Rationale of the Course: The primary objective of this course is to provide vast knowledge about various types of natural and synthetic fibers and their compatibility as a footwear upper material. The students will be able to understand why usage of synthetic upper material is booming instead of leather upper.

Course Contents

Textile fibre and yarn making: Classification of textile fibres, natural and synthetic fibres with composition, physical and chemical structure of fibres, properties of different fibres, advantages, disadvantages and uses of different natural and synthetic fibres- cotton, bast, jute, wool, nylon, polyester, rayon, etc., yarn making operations, suitability of different yarn types as sewing threads.

Textile fabrics: Types of woven, knitted, braid and non-woven fabrics, manufacturing procedure of different fabrics, such as nylon, polyester, cotton, jute, etc., principles of different weaving systems (shaft and jacquard weaving), principles of cloth construction, basic weaves and variations, physical properties, advantages, disadvantages and uses of different fabrics as footwear upper and lining materials and comparison of different textile fabrics (woven, weft knits, warp knits, braids, wool felt, and bonded leather).

Synthetic coated fabrics: Polyurethane coated fabrics- transfer coated fabrics, manufacturing procedure, PU compounding, top coating, adhesive coating, fabric attachment, drying, cooling and stripping the PUCF; Coagulated PUCFs-Dip-coagulated PUCFs, fabric dipping, coagulating,

washing, drying and finishing; Polyvinyl Coated Fabrics- Production of PVCCFs- formulation, coating the fabric, base fabrics, PU/PVCCFs. Physical and chemical properties, advantages, disadvantages and uses of PVC and PU coated fabrics as footwear upper and lining materials.
Poromeric materials: Physical properties and layers of poromeric materials, surface skin and microporous coating, interlayer, substrate and manufacturing procedure of poromeric materials, advantages, disadvantages and uses of poromeric materials in footwear industry.
Polymeric materials: Description of jellies as polymeric materials in footwear manufacturing, uses of polymeric materials for moulded footwear manufacture, advantages and disadvantages of polymeric materials as footwear upper.
Bonded leather fibres: Physical and chemical structure and properties of bonded leather fibre, manufacturing procedure and uses of bonded leather fibre as footwear upper, advantages and disadvantages of bonded leather fibre as footwear upper.

Course Objectives:

a. To provide knowledge about textile fiber and yarn making, textile fabrics, synthetic coated fabrics.
b. To disseminate knowledge about poromeric materials, polymeric materials and bonded leather fibers.
c. To introduce student with different types of non-leather materials which are used in footwear industry.

Course Learning Outcomes (CLOs): Upon completion of this course, students will be able to:

	Course Learning Outcomes (CLOs)	**Learning Level**
CLO1	Recall properties of textile fabrics, synthetic coated fabrics, poromeric materials, polymeric materials and bonded leather fibres.	C1, A1
CLO2	Explain the physical and chemical structure of textile fabrics, synthetic coated fabrics, poromeric materials, polymeric materials and bonded leather fibers.	C2, A2
CLO3	Modify different types of non-leather materials to improve the quality like natural leather which are used in footwear industry.	C3, A2
CLO4	Compare the non-leather material with natural leather material in terms of properties, structure.	C4, A3

Mapping of CLO with PLO

CLOs	**PLO1**	**PLO2**	**PLO3**	**PLO4**	**PLO5**	**PLO6**	**PLO7**	**PLO8**	**PLO9**	**PLO10**	**PLO11**	**PLO12**
CLO1	3	-	-	-	-	-	-	-	-	-	-	-
CLO2	3	2	2	-	-	-	-	-	-	-	-	-
CLO3	3	3	3	2	-	-	-	-	-	-	-	-
CLO4	3	3	2	3	2	-	2	-	-	-	-	-

Rank: 3-High match, 2-Medium match, 1-Low match

Mapping of Course Learning Outcomes (CLOs) with the Teaching-Learning and Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture, Multimedia presentation, Group discussion	Assignment, In-course Exam, Final Exam
CLO2	Lecture, Multimedia presentation, Group discussion	Assignment, Group Presentation, In-course Exam, Final Exam
CLO3	Lecture, Multimedia presentation, Group discussion	Assignment, In-course Exam, and Final Exam
CLO4	Lecture, Multimedia presentation, Group discussion	Assignment, In-course Exam, and Final Exam

Learning Materials

i. Recommended Readings

a) Hannelore Eberle et al., Clothing Technology from Fibre to Fashion.
b) Janet Wilson, Classic and Modern Fabrics.
c) Gail Baugh, The Fashion Designer's Textiles Directory.

ii. Supplementary Readings

a) Ruth Thomson – Making Shoes.
b) Thornton J. H.-Text Book of Footwear Materials.

iii. Others: Handout/lecture material provided by the course teacher

Course Code: 0723-FE-3202 Course Title: Footwear Design and Development-III Lab

Credits: 1.5

Rationale of the Course: Footwear design and pattern making is a very important step for footwear manufacturing. This core course covers design and pattern making of several types of footwear such as monk shoe, army boot, safety shoe, orthopedic shoe and baby shoe.

Course Content

1. **Development of a complete set of sectional patterns for monk shoe:** Preparation, OSH, mean and standard forme, sectional and bottom components pattern, defects identification and remedy plan.
2. **Development of a complete set of sectional patterns for army boot:** Preparation, OSH, mean and standard forme, sectional and bottom components pattern, defects identification and remedy plan.
3. **Development of a complete set of sectional patterns for safety shoe** Preparation, OSH, mean and standard forme, sectional and bottom components pattern, defects identification and remedy plan.
4. **Development of a complete set of sectional patterns for orthopedic shoe:** Preparation, OSH, mean and standard forme, sectional and bottom components pattern, defects identification and remedy plan.

5. **Development of a complete set of sectional patterns for baby shoe:** Preparation, OSH, mean and standard forme, sectional and bottom components pattern, defects identification and remedy plan.

Course Objectives:

a. To demonstrate detailed design based on monk shoe, army boot, and provided sample shoe
b. To practice pattern making for monk shoe, safety shoe, army boot, orthopedic shoe, baby shoe
c. To evaluate the developed patterns

Course Learning Outcomes (CLOs): Upon completion of this course, students will be able to:

	Course Learning Outcomes (CLOs)	**Learning Level**
CLO1	Recall and duplicate the designing and pattern-making of monk shoe, safety shoe, army boot, orthopedic shoe, baby shoe.	C1, A1, P1
CLO2	Identify the tools, equipment, and associated risk for the development of pattern for particular shoe.	C2, A2, P2
CLO3	Perform pattern making for monk shoe, safety shoe, army boot, orthopedic shoe and baby shoe.	C3, A2, P3
CLO4	Fix the defects during pattern development and find out the solution of identified problems.	C4, A4, P4
CLO5	Evaluate the existing problems of the developed footwear patterns and validate the quality of the developed patterns for footwear manufacturing.	C5, A4, P5

Mapping of CLO with PLO

CLOs	**PLO1**	**PLO2**	**PLO3**	**PLO4**	**PLO5**	**PLO6**	**PLO7**	**PLO8**	**PLO9**	**PLO10**	**PLO11**	**PLO12**
CLO1	3	-	-	-	-	-	-	-	2	-	-	-
CLO2	3	2	-	-	-	-	-	-	2	-	-	-
CLO3	3	3	2	-	-	-	-	-	2	-	-	-
CLO4	3	3	3	2	-	-	-	-	2	-	-	-
CLO5	3	3	3	3	-	-	-	-	2	-	-	-

Rank: 3-High match, 2-Medium match, 1-Low match

Mapping of Course Learning Outcomes (CLOs) with the Teaching-Learning and Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture, Hands on demonstration, Group Discussion	Lab Performance, Final Exam
CLO2	Lecture, Hands on demonstration, Group Discussion	Lab Performance, Final Exam
CLO3	Lecture, Hands on demonstration, Group Discussion	Lab Performance, Viva, Report, Final Exam
CLO4	Lecture, Demonstration, Hands-on practice, Video presentation, Problem-based group discussion	Lab Performance, Viva, Report, Final Exam
CLO5	Lecture, Demonstration, Hands-on practice, Video presentation, Problem-based group discussion.	Lab Performance, Viva, Report, Final Exam

Learning Materials

i. **Recommended Reading**
   a) Michael H. Sharp- A step by step guide to producing patterns for footwear production.
   b) Martin, Shoben, Janet P. Ward - Pattern Cutting and Making Up.
   c) Korn J. (Editor) - Boot and Shoe Production.

ii. **Supplementary Readings**
   a) Miller R. G. (Editor) - Manual of Shoe Making.
   b) Thornton J. H. - Text Book of Footwear Manufacture.

iii. **Others:** Hand notes/Lecture materials will be provided by the course teacher

Course Code: 0723-FE-3203 Course Title: Testing of Footwear and Allied Materials

Credits: 3

Rationale of the Course: This course emphasizes on the quality assessment of different physical characteristics of leather, footwear, and allied materials. It imparts a comprehensive knowledge on different physical testing methods related to footwear manufacturing. Upon completion of the course, students will be able to attain thorough knowledge of quality control in footwear production.

Course Contents:

Introduction: Objectives of carrying out physical testing of footwear and allied materials, classification of physical testing methods, Popular thumb tests for upper leathers, disadvantages of thumb tests.

Sampling for physical testing: Introduction, statistical aspects of the sampling problem, collection of samples, sections of leather, sampling positions, conditioning of test pieces.

Physical tests for footwear upper and lining materials: Strength tests of different upper/lining materials- tear strength, tensile strength and extension at break, lastometer test, vamp flex test,

bally flexing test, Martindale abrasion, chisel scuff test, colour fastness- rubbing, heat, contact and light, Different test methods for water vapour permeability, softness test and absorption of upper and lining materials.

Physical tests for soling materials: Sole abrasion resistance, Sole flexing resistance tests- ross flex, Bennewart flexing, belt flex, Strength of soling materials- tensile strength and extension at break, tear strength, split tear strength and stitch holding strength, compression set resistance, oil swelling resistance, rubber hardness measurement for various soling and heel materials,

Physical tests for insole materials: Insole strength- three directions of test, tensile properties of semi-rigid materials, tensile properties of flexible materials, Durability of insoles- flexing index, abrasion resistance

Tests for complete and safety footwear: Measuring ultimate peel strength, rapid sole adhesion, heat resistance, whole shoe flexing, whole shoe water proofness, Heel attachment strength.

Tests for safety footwear: Impact resistance of toe cap, compression resistance, electrical resistance. Penetration resistance of metal insole. Upper, insole and sole interlayer bond strength, insulation against heat, insulation against cold, resistance to fuel oil, corrosion resistance of metallic part.

Tests for footwear accessories: Tests for shoe laces, zippers, buckles, threads, eyelets, D-ring, O-ring, velcro, elastic, toe puff, and stiffener.

Course Objectives:

a. To familiarize students with various theoretical aspects of the physical characteristics of leather, footwear, and allied materials.

b. To describe processing steps involved in the physical testing of leather, footwear and allied materials.

c. To make the students competent in the field of quality assessment in footwear production.

Course Learning Outcomes (CLOs): Upon completion of the course, the students will be able to:

	Course Learning Outcomes (CLOs)	**Learning Level**
CLO1	Explain different thumb tests of various upper leather, collection of samples for lab tests and sampling positions.	C1, C2, A1
CLO2	Describe different tests according to standard procedures for upper and lining leather, footwear and allied materials.	C2, A2
CLO3	Compare and select quality leather, and other materials for particular footwear manufacturing.	C3, A2
CLO4	Analyze and compare different quality parameters of different leather and allied materials for specialized shoe.	C4, A3
CLO5	Justify and follow the standard quality of different footwear.	C5, A3

Mapping of CLOs with Program Learning Outcomes (PLOs)

CLOs	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12
CLO1	3	2	-	-	-	-	-	-	-	-	-	-
CLO2	3	2	-	-	-	-	-	-	-	-	-	-
CLO3	3	2	-	-	-	-	-	-	-	-	-	-
CLO4	3	3	2	3	-	-	-	-	-	-	-	1
CLO5	3	3	2	3	-	-	-	-	-	-	-	2

Rank: 3-High match, 2-Medium match, 1-Low match

Mapping of Course Learning Outcomes (CLOs) with the Teaching-Learning and Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture, Multimedia presentation, demonstration and problem-based exercises	Group Presentation, In-course Exam; Final Exam
CLO2	Lecture, group discussion and Multimedia presentation	Group Presentation, In-course Exam; Final Exam
CLO3	Lecture, guided reading and problem-based learning (PBL): Identifying the problem to be solved	Assignment, Group Presentation, In-course Exam, and Final Exam
CLO4	Lecture, group discussion, literature review, and problem-based exercises (PBE)	Group Presentation, In-course Exam, and Final Exam
CLO5	Lecture, group discussion, multimedia presentation literature review, and problem-based exercises	Group Presentation, Assignment, In-course Exam, and Final Exam

Learning materials

i. Recommended readings

a) An Introduction to the Principles of Physical testing of Leather -Dutta S.S.
b) Society of Leather Technologists and Chemists-Official Methods of Analysis- 1996.
c) Testing and Quality Assessment of footwear and Footwear Materials- B. Venkatappiah, CLRI 1999

ii. Supplementary Readings

a) SATRA Owner's manual
b) Lecture Notes on Leather- P.S. Venkatachalam

iii. Others: Handout/lecture material provided by the course teacher

Course Code: 0723-FE-3204 Course Title: Testing of Footwear and Allied Materials Lab

Credits: 1.5

Rationale of the Course: This course focuses on the various practical aspects of physical testing of different shoe upper leather, lining leather, sole, insole and allied materials. It also provides quality testing of complete shoe, safety shoe and shoe accessories. At the end of the course, learners will be able to recognize the quality of materials and complete footwear.

Course Contents:

1. Determination of tensile strength and % elongation at break of upper leather, stitch tear strength, tongue tear strength of shoe upper leather.

2. Determination of tear strength, split tear strength, distension and strength of grain crack of shoe upper leather.

3. Determination of Determination of flexing endurance (Vamp flexing/Bally flexing).

4. Determination of water vapour permeability, softness and resistance to water penetration of upper and lining leather.

5. Determination of scuff resistance of leather.

6. Determination of colour fastness to circular rubbing and heat resistance of finish film.

7. Determination of adhesion of finish using dead weight.

8. Determination of perspiration resistance for upper and lining materials used in footwear.

9. Determination of pilling and abrasion of synthetic/fabrics materials.

10. SATRA sole adhesion test of complete shoe.

11. Determination of sole flexing resistance tests- Bennewart flexing, SATRA-BATA belt flex.

12. Tests for insole, shoe lace, eyelet, toe puff and counters, zipper, threads, reinforcements, touch and close fasteners

Course Objectives: The objectives of this course are:

a. To introduce the essential experimental knowledge of different tests to assess the quality of materials and shoe.
b. To familiarize students with various standard operating procedures involved in physical testing of leather, footwear and allied materials.
c. To develop skills for analysis and critical evaluation of different raw materials for specific shoe manufacturing.

Course Learning Outcomes (CLOs): Upon completion of the course, the students will be able to:

	Course Learning Outcomes (CLOs)	**Learning Level**
CLO1	Describe the quality testing using SOPs for upper and lining leather, sole, insole, and other allied materials.	C1, A1, P1
CLO2	Demonstrate and perform different tests according to SOPs for upper leather, lining leather, sole, insole, and allied materials.	C2, C3, A2, P2
CLO3	Compare and identify the best leather and other raw materials for different footwear.	C4, A3, P3
CLO4	Evaluate shoe upper, lining, sole leather, synthetic sole and other footwear accessories with standard quality parameters.	C5, A3, P3
CLO5	Interpret and measure the standard quality of complete footwear.	C5, A4, P4

Mapping of CLOs with PLOs

CLOs	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12
CLO1	3	3	-	-	1	-	-	-	2	-	-	-
CLO2	3	3	-	-	2	-	-	-	2	-	-	-
CLO3	3	3	-	3	3	-	-	-	2	-	-	-
CLO4	3	3	2	2	3	-	-	-	2	-	-	2
CLO5	3	2	2	2	3	-	-	-	2	-	-	2

Rank: 3-High match, 2-Medium match, 1-Low match

Mapping of Course Learning Outcomes (CLOs) with the Teaching-Learning and Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture, Demonstration, Hands-on practice, and Group work	Lab Performance, Continuous assessment: Report, Final Exam
CLO2	Lecture, Demonstration, Hands-on practice, and Group work	Lab Performance, Continuous assessment: Viva, Report, Final Exam
CLO3	Lecture, Demonstration, Hands-on practice, and Group work	Lab Performance, Continuous assessment: Viva, Report, Final Exam
CLO4	Lecture, Demonstration, Hands-on practice, and Group work	Lab Performance, Continuous assessment: Viva, Report, Final Exam
CLO5	Lecture, Demonstration, Video presentation and Problem-based group discussion	Demonstration, Continuous assessment: Group presentation

Learning Materials

i. Recommended readings

a) An Introduction to the Principles of Physical testing of Leather.-Dutta S.S.
b) Society of Leather Technologists and Chemists-Official Methods of Analysis- 1996.
c) Testing and Quality Assessment of footwear and Footwear Materials- B. Venkatappiah, CLRI 1999

ii. Supplementary Readings

a) SATRA Owner's manual
b) Lecture Notes on Leather- P.S. Venkatachalam

iii. Others: Handout material provided by the course teacher

Course Code: 0723-FE-3205 Course Title: Leather Products Manufacturing Credits: 3

Rationale of the Course: This course is designed to impart fundamental knowledge on leather products design and manufacturing. The course equips students with the familiarization of the production technology of leather products. At the end of the course, students will be able to design and manufacture of basic leather products.

Course Content:

Introduction: History of leather products, leather products as apparel and types of leather products, classification of leather goods, terms used in leather goods, tools and machinery, accessories and lining materials, edge construction and finishing, unit operations for leather goods.

Pattern making: Introduction, classification of pattern, indication of pattern, copied pattern, transferring the pattern, material consumption, and costing.
Fabrication technology of leather products: Introduction, preparatory process, bench operations, creasing, edge dyeing or staining, punching, riveting, eyeleting, cementing, edge folding, marking, stamping, embossing, printing, construction method, and assembling.
Shaping techniques: Introduction, types, dart, pleat, lining, interlining, fusing: constructions, advantages, process, requirements, equipment, and quality control.
Body proportion and measurement: Basic concepts, division into eight golden sections, application, and construction, construction of golden rectangle, classification of body type with features, body measurement for garments manufacturing.
Jacket and Waist Coat: Introduction, classification, measurements, designing, pattern making, block making, and manufacturing, finishing of jacket, sleeve, collar, pocket for jacket manufacturing.
Money bag and photo frame: Introduction, types, raw materials, perspective drawing, list of components, measurement instruction, total pattern making, leather consumption, splitting and skiving instruction, construction and assembling.

Course Objectives

a. To provide fundamental knowledge on leather products manufacturing.
b. To enhance the skills on leather goods pattern-making process.
c. To understand the unit operations for leather goods and garments manufacturing.
d. To equip the students with modern techniques for body proportion and measurement systems in leather garments manufacturing.

Course Learning Outcomes (CLOs): Upon completion of the course, the students will be able to:

	Course Learning Outcomes (CLOs)	**Learning Level**
CLO1	State the fundamental concepts about leather goods and garments.	C1, A1
CLO2	Explain the concepts of unit operations involved in leather goods and garments manufacturing.	C2, A2
CLO3	Prepare and modify different types of patterns involved in leather goods and leather garments manufacturing.	C3, A2
CLO4	Illustrate the measurement techniques of body proportion and relates to the manufacturing process.	C4, C5, A3

Mapping of CLO with PLO

CLOs	**PLO1**	**PLO2**	**PLO3**	**PLO4**	**PLO5**	**PLO6**	**PLO7**	**PLO8**	**PLO9**	**PLO10**	**PLO11**	**PLO12**
CLO1	3	-	-	-	-	-	-	-	-	-	-	-
CLO2	3	-	3	-	-	-	-	-	-	-	-	-
CLO3	3	2	3	-	-	-	-	-	-	-	-	-
CLO4	3	2	2	-	-	-	-	-	-	-	-	-

Rank: 3-High match, 2-Medium match, 1-Low match.

Mapping of Course Learning Outcomes (CLOs) with the Teaching-Learning and Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture, Multimedia presentation and Literature review	In-course Exam; Final Exam
CLO2	Lecture, group discussion and problem-based exercises, Literature review	Group Presentation, In-course Exam; Final Exam
CLO3	Lecture, problem-based learning (PBL), demonstration.	Assignment, In-course Exam, and Final Exam
CLO4	Lecture, multimedia presentation, group discussion, demonstration, and problem-based exercises	Assignment, In-course Exam, and Final Exam

Learning Materials

i. **Recommended readings**
   a) Carrand Latham, The Technology of Clothing Manufacture.
   b) Francesca Sterlacei, Leather Apparel Design.
   c) Moseley, G.C., Leather Goods Manufacture.

ii. **Supplementary Readings**
   a) Batsford, Fashion with Leather.
   b) Hamlyn, Leatherwork –A step by step Guide.

iii. **Others:** Handout/lecture material provided by the course teacher

Course Code: 0723-FE-3206 Course Title: Leather Products Manufacturing Lab Credits: 1.5

Rational of the Course: This course contains details about the leather products manufacture through cutting, Pre assembling, assembling, bench operations, sewing and finishing operations. The course will also equip the students with knowledge and understanding of production technology of leather goods and garments manufacturing which includes knowledge in pattern construction, designing and styling development and production.

Course Contents

1. **Tooling technique and Pattern making:** Introduction of tools and their uses and tooling technique. Introduction of pattern cutting technique, basic and working pattern making.
2. **Manufacturing of waist belts:** Designing, pattern making, cutting, splitting, skiving, assembling, stitching, final preparation, finishing, costing
3. **Manufacturing of cardholder:** Designing, pattern making, cutting, splitting, skiving, assembling, stitching, final preparation, finishing, costing.
4. **Manufacturing of Wallet:** Designing, pattern making, cutting, splitting, skiving, assembling, stitching, final preparation, finishing, costing.
5. **Manufacturing of Ladies purse :** Designing, pattern making, cutting, splitting, skiving, assembling, stitching, final preparation, finishing, costing.
6. **Manufacturing of ladies bag:** Designing, pattern making, cutting, splitting, skiving, assembling, stitching, final preparation, finishing, costing.

7. **Manufacturing of waistcoat:** Construction of basic block, pattern making, grading, cutting, splitting, skiving, assembling, stitching, final preparation, finishing, costing:
8. **Manufacturing of skirt:** Construction of basic block, pattern making, grading, cutting, splitting, skiving, assembling, stitching, final preparation, finishing, costing

Course Objectives: The objectives of this course are:

a. To familiarize students with the various practical aspects of Leather products manufacturing.
b. To foster an understanding of the importance of pattern engineering.
c. To enable the students to apply various techniques of design in making leather goods and garments.
d. To make the students competent in the field of pattern drafting and grading.
e. To provide comprehensive knowledge about the organization and management of leather goods and garments manufacturing.

Course Learning Outcomes (CLOs): Upon completion of the course, the students will be able to –

	Course Learning Outcomes (CLOs)	**Learning Level**
CLO1	Recognize various tools and tooling techniques.	C1, A1, P1
CLO2	Explain the concepts of pattern making for leather goods and leather garments.	C2, A2, P2
CLO3	Use various machineries involved in leather products manufacturing.	C3, A2, P2
CLO4	Assemble different types leather goods and garments.	C3, A2, P3
CLO5	Evaluate different quality parameter of leather goods and leather garments.	C4, A2, P3

Mapping of CLOs with PLOs

CLOs	**PLO1**	**PLO2**	**PLO3**	**PLO4**	**PLO5**	**PLO6**	**PLO7**	**PLO8**	**PLO9**	**PLO10**	**PLO11**	**PLO12**
CLO1	3	-	-	-	2	-	-	-	-	-	-	-
CLO2	3	-	3	-	-	-	-	-	-	-	-	-
CLO3	2	-	-	-	3	-	-	-	-	-	-	-
CLO4	2	-	3	-	2	-	-	-	-	-	2	1
CLO5	2	3	-	-	-	2	-	-	-	-	-	3

Rank: 3-High match, 2-Medium match, 1-Low match.

Mapping of Course Learning Outcomes (CLOs) with the Teaching-Learning and Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture, Demonstration, Hands-on practice, and Group work	Lab Performance, Viva, Report, Final Exam
CLO2	Lecture, Demonstration, Hands-on practice, and Group work	Lab Performance, Viva, Report, Final Exam
CLO3	Lecture, Demonstration, Hands-on practice, and Group work	Lab Performance, Viva, Report, Final Exam
CLO4	Lecture, Demonstration, Hands-on practice, and Group work	Lab Performance, Viva, Report, Final Exam
CLO5	Lecture, Demonstration, Hands-on practice, and Group work	Lab Performance, Viva, Report, Final Exam

Learning materials

i. Recommended readings

a) Martin M. Shoben, Pattern Cutting and Making up
b) Francesea Sterlacci, Leather Apparel Design.
c) Europa Lehrmittel, Clothing Technology

ii. Supplementary Readings

a) Hamlyn, Leatherwork –A step-by-step Guide.
b) Jongensen, Making Leather Clothes.

iii. Others: Handout/lecture material provided by the course teacher

Course Code: 0723-FE-3207 Course Title: Supply Chain Management Credits: 3

Rationale of the Course: This course is designed as a core course to deliver SCM related knowledge to the students. It comprises understanding the basic structure of the footwear industry's supply chain, supply chain performance drivers, designing an agile supply chain network, demand forecasting, outsourcing decisions and lead time management.

Course Contents

Understanding the Supply Chain: Supply chain, supply chain 4.0, types of supply chains and examples, strategic, tactical, and operational decisions in supply chains, process view of a supply chain, the importance of supply chain flows, structure of supply chain in the footwear industry.

Supply Chain Performance and Drivers: Competitive and supply chain strategies, achieving strategic fit, expanding strategic scope, a framework for structuring drivers, Facilities, Inventory, Transportation, Information, Sourcing, Pricing, Obstacles to achieving fit.

Demand Forecasting in a Supply Chain: The role of forecasting in a supply chain, Characteristics of forecasts, Components of forecasts and forecasting methods, Basic approach to demand forecasting, Time series forecasting methods, Measures of forecast error.

Sourcing Decisions in a Supply Chain: The Role of Sourcing in a Supply Chain, Supplier Scoring and Assessment, Supplier Selection and Contracts, Design Collaboration, The Procurement Process, Sourcing Planning and Analysis, Making Sourcing Decisions in Practice.

Strategic Lead Time Management: Time-based competition, time-based process mapping, logistics pipeline management, lean thinking.

Designing the Distribution Network Design in the Supply Chain: The role of distribution in the supply chain, Factors influencing distribution network design, Design options for a distribution network, E-business and the distribution network, distribution networks in practice, a strategic framework for facility location, Multi-echelon networks, Gravity methods for location, Plant location models, Supply Chain Decisions Under Uncertainty in Practice.

JIT and Quick Response Logistics: The philosophy, logistics implication, Vendor Managed Inventory.

Agility and Agile Supply Chain: The concept of market winner and market qualifier, How to combine lean and agile mindsets (pareto curve, decoupling point).

Managing the Global Pipeline: The tradeoffs among the logistics costs, concepts of centralization, focused factories and postponement.

Advanced Planning and Scheduling in Supply Chain Management: Understanding and solving logistics and supply chain problems, advanced planner and scheduler.

Course Objectives: The objectives of this course are as follows:

a. To describe the fundamentals of SCM including its role in an organization and integrating firms in a supply chain.
b. To explain the various concepts in SCM like coordination, planning for uncertainty, supply contracts, logistics management, outsourcing and procurement management.
c. To demonstrate various analytical methods and tools so that students can be able to measure and evaluate various facets of supply chain performance.
d. To understand the practices in SCM that differentiate successful firms from others.
e. To explore the challenges in SCM through a real industry project.

Course Learning Outcomes (CLOs): Upon completion of this course, students will be able to:

	Course Learning Outcomes (CLOs)	**Learning Level**
CLO1	Identify and state the basic structure and functions of supply chain management for the footwear industry.	C1, A1
CLO2	State and describe the supply chain activities and their performance drivers for the footwear industry.	C1, C2, A2
CLO3	Apply different mathematical models along with modern tools for demand forecasting, sourcing decisions, lead time management, and overall planning in the supply chain and compare their results.	C3, C4, A3
CLO4	Design distribution network and agile supply chain network to manage the global pipeline.	C5, A3

Mapping of CLO with PLO

CLOs	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12
CLO1	3	-	-	-	-	-	-	-	-	-	-	-
CLO2	3	1	-	-	-	-	-	-	-	-	-	-
CLO3	3	3	-	3	3	-	-	-	-	-	-	-
CLO4	3	3	3	3	-	-	-	-	-	-	-	-

Rank: 3-High match, 2-Medium match, 1-Low match.

Mapping of Course Learning Outcomes (CLOs) with the Teaching-Learning and Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Interactive discussion, lecture-discussion with multimedia, and whiteboard illustration	In-course Exam and Final Exam
CLO2	Interactive discussion, lecture-discussion with multimedia, and whiteboard illustration	Assignment, In-course Exam, and Final Exam
CLO3	Lecture discussion with multimedia, whiteboard illustration, and problem-based learning (PBL)	In-course Exam, and Final Exam
CLO4	Lecture discussion with multimedia, group discussion, literature review, demonstration, and problem-based exercises	Assignment, Group Presentation, and Final Exam

Learning Materials

i. **Recommended Reading**
   a) K. Shridhra Bhat, "Logistics and Supply Chain Management".
   b) S. Chopra and Mendil, "Supply chain management, strategy, planning and operation", Pearson Education, Asia, 2/2004.
   c) B.S. Sahay, "Supply Chain Management, for Global Competitiveness", Macmillan Bangladesh Limited, 1999.

ii. **Supplementary Readings**
   a) G. Raguram and N. Rangarajan, "Logistics and Supply Chain Management-Cases and concept", Macmilla
   b) M. Hugos, Essentials of Supply Chain Management, Wiley.

iii. **Others**: Hand notes/Lecture materials will be provided by the course teacher.

Course Code: 0417-Hum-3208 Course Title: Employability Skills-II Credits: 1.5

Rationale of the Course: This course is designed to help students identify the knowledge and skills required for obtaining and keeping employment. Upon successful completion of the course, students are expected to have employability skills that will allow them to do effective presentations, write properly, be career-oriented, and have the ability to work independently.

Course Content

1. **Self-management skills:** Basics of self-management, stress management, ability to work independently, emotional intelligence, role play on avoiding a stressful situation, self-reflection, strength and weakness analysis, self-motivation, goal setting, and time management.
2. **Teamwork:** Working across different ages irrespective of gender, race, religion or political persuasion, working as an individual and as a member of a team, knowing how to define a role as part of the team, applying teamwork to a range of situations e.g., futures planning, crisis problem solving, identifying the strengths of the team members, coaching and mentoring skills including giving feedback.
3. **Problem-solving:** Problem identification, creative, innovative, and practical solution, and solving them, solving problems in teams, applying a range of strategies to problem-solving, using mathematics including budgeting and financial management to solve problems, applying problem-solving strategies across a range of areas, resolving customer concerns in relation to complex projects issues.
4. **Entrepreneurial skills:** Presenting the power of entrepreneurship, exercise on interviewing an entrepreneur, and self-assessment of entrepreneurial qualities.
5. **Writing concept note (CN) and proposal of a business plan:** Prepare the contents of a CN and proposal, set scoring criteria for the CN and proposal, and prepare CNs and proposals for various types of footwear products.
6. **Writing business plan:** Basic business plan guidelines, writing business plans for various types of footwear products, break-even analysis, preparation of budget template, project work plan, and measurable project performance indicators.
7. **Writing a technical and financial project proposal:** Basic guidelines for technical and financial project proposal, write a technical and financial project proposal for different technical aspects of the footwear industry of Bangladesh.
8. **Presentation skill development:** Presentation and public speaking, rules for effective speaking, improving skills in non-verbal and verbal communication, the beauty of rhythm and voice modulation, presentation techniques, preparing the contents, tips for preparing attractive and powerful PowerPoint presentation, main challenges or barriers of presentation and public speaking, methods for overcoming the fear and obstacles during presentation, importance of rehearsals, common mistakes in presentation and public speaking, tips for smart speech, discussions on world-famous public speech with the audio-visual record, making interactive presentation slides and presenting the business plan/project proposal and self-assessment.

Course Objectives: The learning objectives of this course are:

a. To develop an ability to gain key strategies and expressions for communicating with professionals and non-specialists.
b. To enhance interpersonal and soft skills for professional development.
c. To develop essential skills required to increase productivity, efficiency, and effectiveness.
d. To develop problem-solving, confidence-building, organizational, team working skills.
e. To prepare the students with all the employability skills as per the demand of the job market.

Course Learning Outcomes (CLOs): Upon completion of the course, the students will be able to:

	Course Learning Outcomes (CLOs)	**Learning Level**
CLO1	Describe professionalism and self-management skills required to opt appropriately in the working environment.	C1
CLO2	Explain the interpersonal and soft skills required for professional development.	C2
CLO3	Coordinate and carry out teamwork and problem-solving activities to develop enhanced productivity, efficiency, and effectiveness.	C3, P2, P3
CLO4	Compare and execute different types of communication and other essential interpersonal soft skills.	C4, P4, A3
CLO5	Design and review project proposals for leather/footwear/leather products manufacturing industries.	C5

Mapping of CLO with PLO

CLOs	**PLO1**	**PLO2**	**PLO3**	**PLO4**	**PLO5**	**PLO6**	**PLO7**	**PLO8**	**PLO9**	**PLO10**	**PLO11**	**PLO12**
CLO1	-	-	-	-	1	-	-	-	3	3	-	3
CLO2	-	-	-	-	1	-	-	-	3	3	-	3
CLO3	-	3	3	-	1	-	-	-	3	3	-	3
CLO4	-	-	-	-	1	-	-	-	3	3	2	3
CLO5	-	3	3	2	1	-	-	-	3	-	3	3

Rank: 3-High match, 2-Medium match, 1-Low match.

Mapping of Course Learning Outcomes (CLOs) with the Teaching-Learning and Assessment Strategy

CLOs	**Teaching-Learning Strategy**	**Assessment Strategy**
CLO1	Interactive discussion, lecture discussion with multimedia, and Group work.	Continuous Assessment, Group Presentation, and Final Exam
CLO2	Interactive discussion, lecture discussion with multimedia, white board/ flip chart illustration, metaplan, and Group work.	Continuous Assessment, Group Presentation, Viva, and Final Exam
CLO3	Interactive discussion, lecture discussion with multimedia, and Group work.	Continuous Assessment, Group Presentation, and Final Exam
CLO4	Interactive discussion, lecture discussion with multimedia, white board/ flip chart illustration, metaplan, and Group work.	Continuous Assessment, Group Presentation, Viva, and Final Exam
CLO5	Interactive discussion, lecture discussion with multimedia, and Group work.	Continuous Assessment, Assignment, Group Presentation, and Final Exam

Learning Materials

i. **Recommended Readings**
   a) An Introduction to Employability Skills-Arvind M Nawale, Mahesh M Nivargi, Manisha B Gahelot.
   b) The Complete Book of Business Plan- Secrets to Writing Powerful Business Plans-Joseph A. Covello and Brian J. Hazelgren.
   c) The Complete Presentation Skills Handbook-Suzy Siddons.

ii. **Supplementary Readings**
   a) The Journey-Book on Secrets of Employability Skills-Dr. Hari Prasad. N, Dr. Soundria. S. M
   b) Talk Like TED: The 9 Public-Speaking Secrets of the World's Top Minds-Carmine Gallo.

iii. **Others:** Handout/lecture material provided by the course teacher.

Course Code: 0723-FE-3209 Course Title: Footwear Merchandising Credits: 2

Rationale of the Course: This course will deliver the most important knowledge about the key roles of merchandisers and merchandising process involved in the footwear industry through which the students will be able to prepare themselves for being a good merchandiser. This course will disseminate knowledge about merchandise planning, prototype preparation, costing and negotiation with buyers, order confirmation process, shipment management and visual merchandising.

Course Contents:

Introduction to Footwear Merchandising: Merchandising, merchandiser, functions and roles of merchandiser, terminologies used in merchandising, defining customers, fashion seasons, market positioning, merchandise range, categories of footwear merchandising, process flow of merchandising, global footwear market, fashion shows in merchandising.

Merchandise Planning: The importance, problems and key factors of planning, stock turn and stock intake planning, prototype, QS (Quotation sample), SS (Size sets), CS (confirmation sample) approval from buyer; Purchase Order and Performa Invoice.

Prototype Preparation: Specification sheet check, preparation, coordination and confirmation of pattern cutting, detailed drawings and mini- markers; Preparation, coordination and confirmation of patterns; Checking of assembled footwear according to specification sheet and accepted footwear assembly techniques; Procedure and method of prototype sent for test report.

Costing and Negotiation with Buyer: Pricing and costing, costing and pricing procedure, LO calculation procedure, SOT (standard operating time), SAM (Standard Allowed Minute), method of TNA (Time and Action), FOB calculation, negotiation with buyer.

Order Confirmation: "Production capacity VS order quantity", product order, CAPA based order confirmation, P.O checking procedure.

Coordination and Management: Procedure and method of order execution, procedure of shipping and documentation, method of coordination with shipping and documentation department; Merchandiser roles in production department, planning department, quality department.

Visual Merchandising: Introduction to visual merchandising, virtual and dynamic visual merchandising, functions of a visual merchandiser, elements of visual merchandising, types of

visual merchandising displays, visual merchandising techniques, problems in visual merchandising.

Course Objectives: The objectives of this course are as follows:

a. To disseminate knowledge about the basic and visual of merchandising.
b. To equip students with knowledge and theories of merchandise plan, prototype preparation, costing and negotiation.
c. To introduce students how to create pre-production plan and manage production follow-up.
d. To coordinate and manage footwear shipment.

Course Learning Outcomes (CLOs): Upon completion of this course, students will be able to:

	Course Learning Outcomes (CLOs)	**Learning Level**
CLO1	State the basic concepts of footwear merchandising.	C1, A1
CLO2	Interpret the stages of merchandising, prototype preparation, costing, and negotiation with the buyer.	C2, A2
CLO3	Understand the order confirmation system and apply it using modern tools.	C2, C3, A2
CLO4	Analyze and investigate the problems in merchandising activities and design and apply appropriate techniques, using modern tools to solve the problems.	C3, C4, C5, A3
CLO5	Analyze the components of visual merchandising and design appropriate visual merchandising in the retail merchandising system.	C5, A3

Mapping of CLOs with PLOs

CLOs	**PLO1**	**PLO2**	**PLO3**	**PLO4**	**PLO5**	**PLO6**	**PLO7**	**PLO8**	**PLO9**	**PLO10**	**PLO11**	**PLO12**
CLO1	3	-	-	-	-	-	-	-	-	-	-	-
CLO2	3	-	-	-	-	-	-	-	-	-	-	-
CLO3	3	3	3	-	3	-	-	-	-	-	-	-
CLO4	3	3	2	2	3	-	-	-	-	-	-	-
CLO5	3	3	3	3	-	-	-	-	-	-	-	-

Rank: 3-High match, 2-Medium match, 1-Low match.

Mapping of Course Learning Outcomes (CLOs) with the Teaching-Learning and Assessment Strategy

CLOs	**Teaching-Learning Strategy**	**Assessment Strategy**
CLO1	Interactive discussion, lecture-discussion with multimedia, and whiteboard illustration	In-course Exam and Final Exam
CLO2	Interactive discussion, lecture with multimedia, and whiteboard illustration	In-course Exam and Final Exam

CLO3	Lecture with multimedia, whiteboard illustration, and problem-based learning (PBL)	In-course Exam, and Final Exam
CLO4	Lecture with multimedia, group discussion, literature review, demonstration, and problem-based exercises	Assignment, Group Presentation, In-course Exam, and Final Exam
CLO5	Lecture with multimedia, group discussion, literature review, demonstration, and problem-based exercises	Assignment, Group Presentation, and Final Exam

Learning Materials

i. **Recommended Reading**
   a) A J Chuter, Introduction to clothing production management.
   b) Gini Stephens Frings (1999): Fashion: From concept to consumer, Prentice-Hill Inc.
   c) Grace I kunz, Merchandising: Theory, Practice and Principles.

ii. **Supplementary Readings**
   a) Harry B. Watton (1992.). New Product Planning, Prentice Hall Inc.
   b) M Krishan Kumar-Apparel Merchandising

iii. **Others**: Hand notes/Lecture materials will be provided by the course teacher.

Course Code: 0723- FE-3210 Course Title: Field Tour-III Credits: 1

Rationale of the Course: This course will provide the students with a practical perspective of the concepts and theories that are taught to them. It will also introduce students with knowledge about modern technology, and machinery used in the footwear industry.

Course Content

In 3rd Year 2nd Semester, students will visit a reputed footwear industry limited.

Discuss with the company supervisor about any project or assignment/tasks. Try to understand the systems in your work place – Processes, Organization, Administrative. Record all the work done or knowledge gained. Maintain logbook and give feedback to guide teacher.

Course Objectives

a. To build a learning intervention that is intertwined with practical, hands-on skill enhancement knowledge to ensure that student's learning is not focused solely on theoretic approaches.
b. To make a good relationship with various footwear companies and increase their networking opportunities.

Course learning outcomes (CLOs): At the completion of this course students will be able to:

	Course Learning Outcomes (CLOs)	Learning Level
CLO1	Provide a description of the operations, workstations, plants, machines, assembly lines, and management involved in the footwear industry and engage in discussions with knowledgeable professionals.	C2, A3, P2
CLO2	Improve abilities in collaborating effectively with others, expressing ideas clearly and concisely, and working efficiently in a group setting.	C2, A3
CLO3	Prepare technical documents and give verbal presentations on completed industrial tour work.	C3, C4, A4

Mapping CLOs with PLOs

CLOs	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12
CLO1	3	-	-	-	3	-	-	-	-	3	-	2
CLO2	2	-	-	-	-	-	-	-	2	2	-	2
CLO3	2	-	-	-	-	-	-	-	-	3	-	2

Rank: 3-High match, 2-Medium match, 1-Low match.

Mapping of Course Learning Outcomes (CLOs) with the Teaching-Learning and Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Class Lecture, Display and Demonstration	Presentation and viva, Report Evaluation
CLO2	Class Lecture, Display and Demonstration,	Presentation and viva, Report Evaluation
CLO3	Discussion, Discussion and Motivation, Self-study	Presentation and viva, Report Evaluation

Learning Materials

i. Recommended Readings

a) Writing the Winning Thesis or Dissertation: A Step-by-Step Guide - By Allan A. Glatthorn, Randy L. Joyner.
b) Relevant books, handbooks, patents and manuals.

Course Code: 0723-FE-4101 Course Title: Manufacturing of Specialty Footwear Credits: 3

Rationale of the Course: This course is designed as a core course to impart education about safety footwear, army boot manufacturing, smart footwear production, manufacturing of minimal footwear, high-performance outdoor footwear, washable footwear, and development of children's footwear.

Course Contents:

Safety footwear: Definition of safety, protective and occupational footwear, types, functions, uses and advantages of safety footwear, comfort, ergonomics and other features of safety footwear, safety footwear materials, and construction, meaning of different symbols used in safety footwear, maintenance of safety footwear, consideration for selecting safety footwear.
Army boot: Types and functions of army boot, advantages, essential requirements and specifications, and the manufacturing process of army boot.
Smart footwear: Introduction to smart footwear, motivation to change towards smart footwear, difference between state-of-the-art footwear and smart footwear, types and benefits of smart footwear, essential requirements of smart footwear, technology used in smart footwear, implementation and barriers of the vision of smart footwear.
Minimal footwear: Introduction to minimal footwear, barefoot vs common footwear, types and importance of minimal footwear, benefits of running with minimal footwear, challenges of using minimal footwear, factors affecting choosing minimal footwear, design characteristics of minimal footwear, biomechanics of minimal footwear.
High-performance outdoor footwear: Importance of high-performance outdoor footwear, essential features - comfort, thermoregulation, moisture management, and disposal, protection, water resistance, durability, etc.; Manufacturing process-fit and digital last assessment, upper design, using membranes, bottom construction, assessing moisture management of materials, assessing moisture management of footwear, sole design, wearer expectations, labeling.
Manufacture of washable footwear: Introduction, features of washable footwear, washability of components, uses and maintenance, soling materials and sole bonding, washability testing, and washing instruction.
Children's footwear: Children's feet, functions of children's footwear, essential requirements, development, fitting, and problems of children's footwear.

Course Objectives: The objectives of this course are as follows:

a. To provide an overview of army, safety, and smart footwear.
b. To enable the students to comprehend washable and high-performance outdoor footwear
c. To provide a comprehensive understanding of children and minimal footwear features and construction.
d. To familiarize the students with specialty footwear.

Course Learning Outcomes (CLOs): Upon completion of this course, students will be able to:

	Course Learning Outcomes (CLOs)	**Learning Level**
CLO1	State different types of specialty and children's footwear with their corresponding features.	C1, A1

CLO2	Explain the manufacturing process of safety, smart, minimal, high-performance outdoor, washable, children's footwear, and army boots.	C2, A2
CLO3	Apply new designs and technological advancements to smart footwear and other specialty and children's footwear.	C3, A2
CLO4	Distinguish the advanced feature-based footwear from the basic styles in different aspects.	C4, A3

Mapping of CLOs with PLOs

CLOs	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12
CLO1	3	-	-	-	-	-	-	-	-	-	-	-
CLO2	3	2	-	-	-	-	-	-	-	-	-	-
CLO3	3	3	3	2	-	-	-	-	-	-	-	-
CLO4	3	3	3	3	-	-	-	-	-	-	-	-

Rank: 3-High match, 2-Medium match, 1-Low match

Mapping of Course Learning Outcomes (CLOs) with the Teaching-Learning and Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture, Multimedia presentation, group discussion, interactive discussion, whiteboard illustration	Assignment, In-course Exam; Final Exam
CLO2	Lecture, multimedia presentation, video presentation	In-course Exam; Final Exam
CLO3	Lecture, multimedia presentation, whiteboard illustration, interactive discussion	Oral Presentation, Case study, In-course Exam, and Final Exam
CLO4	Lecture, multimedia presentation, interactive discussion, whiteboard illustration, case study	Assignment, In-course Exam, and Final Exam

Learning Materials

i. Recommended Readings

a) Ravidra S. Goonetilleke-The Science of Footwear.
b) Miller R. G. (Editor) – Manual of Shoe Making.
c) Korn J. (Editor) – Boot and Shoe Production.

ii. Supplementary Readings

a) Ruth Thomson – Making Shoes.
b) Swayam Siddha – Product Knowledge.

iii. Others: Handout/lecture material provided by the course teacher

Course Code: 0723-FE-4102 Course Title: Manufacturing of Specialty Footwear Lab Credits: 1.5

Rationale of the Course: This core course fulfills the manufacturing of special types of footwear like safety footwear, army boot, orthopedic footwear, and children's footwear. After completion of the course, students will be able to learn the detailed manufacturing process practically.

Course Contents:

1. **Cement constructed safety footwear manufacturing:** Preparation, OSH, cutting, closing, lasting, sole attaching, and finishing, defects identification and remedy plan, and materials consumption.
2. **Cement constructed army boot manufacturing:** Preparation, OSH, cutting, closing, lasting, sole attaching, and finishing, defects identification and remedy plan, and materials consumption.
3. **Cement constructed children's footwear manufacturing:** Preparation, OSH, cutting, closing, lasting, sole attaching, and finishing, defects identification and remedy plan, and materials consumption.
4. **Cement constructed orthopedic footwear manufacturing:** Preparation, OSH, cutting, closing, lasting, sole attaching, and finishing, defects identification and remedy plan, and materials consumption.

Course Objectives: The learning objectives of this course are as follows:

a. To deliver practical knowledge from cutting to shoe finishing and packaging processes.
b. To manufacture safety footwear, army boot, children's footwear, and orthopedic footwear.
c. To identify defects during manufacturing of specialty types of footwear and their rectifications.
d. To provide essential knowledge related to occupational safety and health (OSH) during working with sophisticated machinery and equipment in specialty types of footwear manufacturing.

Course Learning Outcomes (CLOs): Upon completion of this course, students will be able to:

	Course Learning Outcomes (CLOs)	**Learning Level**
CLO1	Outline the detailed manufacturing knowledge of safety footwear, army boot, children's footwear, and orthopedic footwear.	C1, A1, P1
CLO2	Identify the machinery, equipment, and associated risk for specialty types of footwear manufacturing.	C2, A2, P1
CLO3	Utilize advanced technology and apply different shoe construction methods for specialty types of footwear in the field of footwear industries over the world.	C3, A2, P2
CLO4	Analyze the identified defects during safety footwear, army boot, children's footwear, and orthopedic footwear manufacturing.	C4, A3, P3
CLO5	Prepare a defect catalog and remedy plan for modifying the existing manufacturing process for the specific type of footwear.	C5, A3, P3

Mapping of CLOs with PLOs

CLOs	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12
CLO1	3	-	-	-	-	-	-	-	-	-	-	-
CLO2	3	-	-	-	3	-	-	-	2	-	-	-
CLO3	3	-	3	-	3	-	-	-	3	-	-	-
CLO4	3	3	-	3	-	-	-	-	3	-	-	-
CLO5	3	2	3	3	2	-	-	-	3	-	-	-

Rank: 3-High match, 2-Medium match, 1-Low match

Mapping of Course Learning Outcomes (CLOs) with the Teaching-Learning and Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture, Demonstration, and Hands-on practice	Lab Performance, Final Exam
CLO2	Lecture, Demonstration, and Hands-on practice	Lab Performance, Final Exam
CLO3	Lecture, Demonstration, and Hands-on practice	Lab Performance, Continuous assessment: Viva, Report, Final Exam
CLO4	Lecture, Demonstration, Hands-on practice, Video presentation and Problem-based group discussion	Lab Performance, Continuous assessment: Viva, Report, Final Exam
CLO5	Lecture, Demonstration, Hands-on practice, Video presentation and Problem-based group discussion	Lab Performance, Continuous assessment: Viva, Report, Final Exam

Learning Materials

i. Recommended Reading

a) Handbook of footwear design and manufacture-A. Luximon
b) How Shoes are Made: A behind the scenes look at a real sneaker factory-Wade Motawi
c) The Manufacture of Boots and Shoes: Being a Modern Treatise of All the Processes of Making and Manufacturing Footgear-F. Y. Golding

ii. Supplementary Readings

a) Text Book of Footwear Manufacture- J. H. Thornton.
b) Footwear Materials and Process Technology-A.J. Harvey.

iii. Others: Hand notes/Lecture materials will be provided by the course teacher.

Course Code: 0611-FE-4104 Course Title: Computer Aided Design Credits: 1.5

Rationale of the Course: The course will provide an overview of how computer-aided design and CAD software like Shoe master and Crispin can be applied to the traditional skills of pattern cutting, grading, fashion design and manufacturing. Student will learn to use various CAD/CAM software packages which include Shoe master and Crispin. The course also will help student how to use CAD software for designing and pattern making skills for footwear.

Course Contents:

1. Demonstrating and practice different types of tools used in CAD/CAM Software.
2. 2D scanning of mean forme and standard pattern and producing complete set of patterns for classic derby shoe.
3. 3D scanning of derby shoe last, making e-last and modification of the last.
4. Developing style lines, flattening and producing complete set of patterns for classic derby shoe.
5. Grading of upper, lining, bottom and component patterns for classic derby shoe.
6. Developing of complete set of patterns with size range for classic lady's sandal.
7. Developing of complete set of patterns with size range for classic gent's sandal.
8. Developing of complete set of patterns with size range for classic sports shoe.
9. Developing of complete set of patterns with size range for classic moccasin shoe.
10. Developing of complete set of patterns with size range for classic boot.
11. Preparation of a detailed Bill of Materials (BOM), consumption and costing for classic derby shoe.
12. Demonstration of troubleshooting of CAD/CAM software and related accessories.

Course Objectives: The objectives of this course are as follows:

a. To gather the essential experimental knowledge and skill of different process to design a footwear product using special software and computer.
b. To practice pattern developments and grading by using latest shoe designing software like shoemaster and crispin.
c. To apply theoretical knowledge practically in the field of footwear industries and develop the sector technically as well as economically.

Course Learning Outcomes (CLOs): Upon completion of this course, students will be able to:

	Course Learning Outcomes (CLOs)	**Learning Level**
CLO1	Demonstrate the function of different tools used in CAD software including shoemaster and crispin.	C2, A1, P1
CLO2	Identify the machinery, equipment, and associated risk for specific types footwear pattern development.	C2, A2, P2
CLO3	Implement the practical knowledge for preparing complete set of pattern on different style by using CAD/CAM software.	C3, A3, P3
CLO4	Compare a set of pattern for a particular style using CAD/CAM software with manual pattern making and fix the defect.	C4, A4, P4
CLO5	Prepare remedy plan for pattern making defect and develop detailed Bill of Materials (BOM), consumption and costing for specific footwear.	C5, A5, P4

Mapping of CLO with PLO

CLOs	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12
CLO1	3	-	-	-	2	-	-	-	2	-	-	-
CLO2	3	2	-	-	3	-	-	-	2	-	-	-
CLO3	3	3	2	-	3	-	-	-	2	-	-	-
CLO4	3	3	3	2	3	-	-	-	2	-	-	-
CLO5	2	2	3	3	3	-	-	-	2	-	-	-

Rank: 3-High match, 2-Medium match, 1-Low match

Mapping of Course Learning Outcomes (CLOs) with the Teaching-Learning and Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture, Demonstration, Practical	Class Test, Report, Direct Assessment, Final Exam
CLO2	Lecture, Demonstration, Panel-Discussion, Practical, Practical Problem-solving	Class Test, Report, Direct Assessment, Final Exam
CLO3	Lecture, Demonstration, Group Discussion, Practical, Cooperative Learning, Problem-solving, Videotapes, Debate.	Class Test, Report, Viva Voce, Indirect Assessment, Final Exam
CLO4	Lecture, Demonstration, Video presentation, Problem-based group discussion, Case studies, Problem-solving, Cooperative Learning.	Class Test, Report, Viva Voce, Indirect Assessment, Final Exam
CLO5	Lecture, Demonstration, Video presentation, Problem-based group discussion, Problem-solving, Cooperative Learning.	Class Test, Report, Viva Voce, Indirect Assessment, Final Exam

Learning materials

i. **Recommended readings:**
   a) Harrington, J.- Computer Integrated Manufacturing.
   b) Singh, N.- Systems Approach to Computer-Integrated Design and Manufacturing.
   c) Boothroyed G.- Assembly Automation and Product Design.

ii. **Supplementary Readings**
   a) Pivecka J.- Practical Handbook on Shoe Production
   b) American Shoe Making, Shoe Trades Publishing Co.

iii. **Others:** Lecture notes and Lab procedure provided by the course teachers.

Course Code: 0723-FE-4105 Course Title: Industrial Utility and Maintenance Credits: 3

Rationale of the Course: The course is designed to teach students the fundamentals of industrial utilities and issues with functionality caused by deposition, corrosion, and biofouling. This course will provide students with knowledge of the maintenance of various machinery of leather and footwear industries, total productive maintenance, and also laboratory safety and maintenance.

Course Contents:

Air conditioning, Psychometric chart and psychometric processes: Comfort condition, Principle of air conditioning, Application in leather and footwear industry; Refrigeration equipment, Refrigerant; Calculation of simple air conditioning system, Distribution system, Humidifier, De-humidifier, Cooling tower; Use of psychometric chart and psychometric process.

Materials handling equipment: Issues and importance of material handling, selection, and classification of material handling equipment, various types of conveyors equipment-belt, screw, chain, flight, bucket elevator, pneumatic, hydraulic, cranes, and forklifts; Application of material handling equipment in footwear industries.

Machine erection, lubrication and maintenance: Floor preparation, foundation, machine fixation, leveling, lubricant, types, general properties, functions, lubrication system; Types of maintenance, planning and organizing maintenance, preparation of maintenance schedule.

Maintenance of cutting machine: Introduction, parts and functions, process control of cutting, adjustments of die cutting machine, regular maintenance operations of die cutting machine, troubleshooting of die cutting machine; laser cutting machine-introduction, basic operation procedure, safety cautions, regular maintenance, and troubleshooting of laser cutting machine.

Maintenance of splitting, skiving, sewing machine: Tools and equipment required for splitting, skiving, and sewing operations, regular maintenance, preventive maintenance, cleaning the hook race and feeding systems, spare parts replacement, and troubleshooting.

Maintenance of lasting and bottom preparation machine: Tools and equipment of backpart moulding, toe lasting, seat and side lasting, heat setting, sole press and polishing machines, regular maintenance, preventive maintenance, cleaning, spare parts replacement, and troubleshooting.

Total productive maintenance (TPM): Introduction, objectives of TPM, benefits of TPM, OEE (Overall Equipment Efficiency), six big losses analysis, 4M+E analyze, pillars of TPM, step by step to successful TPM, difficulties faced in TPM implementation, case studies on operational performance in footwear industry of Bangladesh.

Course Objectives: The objectives of this course are as follows:

a. To introduce the different industrial utilities and their proper maintenance.
b. To impart knowledge on different machine parts and their functions for leather and footwear production.
c. To provide in-depth knowledge on the maintenance and their applications of leather and footwear machinery.

Course Learning Outcomes (CLOs): Upon completion of the course, the students will be able to:

	Course Learning Outcomes (CLOs)	**Learning Level**
CLO1	Define different terms and state various principles used in industrial utility and maintenance	C1, A1
CLO2	Explain the field of industrial utility and maintenance and also describe its role in leather and footwear manufacturing.	C2, A2

CLO3	Explain and apply various types of maintenance strategies and their purposes in various leather and footwear manufacturing machineries.	C3, A2
CLO4	Apply the most common techniques of machine tools and their maintenance in leather and footwear industrial field.	C3, A2
CLO5	Solve the routine maintenance problems of leather and footwear industries including inputs, outputs and safety considerations.	C4, A3

Mapping of CLOs with PLOs

CLOs	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12
CLO1	3	-	-	-	-	-	-	-	2	-	-	-
CLO2	3	-	-	-	-	-	-	-	2	-	-	-
CLO3	3	1	2	-	-	-	-	-	2	-	-	-
CLO4	3	2	3	-	2	3	-	-	2	-	-	1
CLO5	2	2	3	-	2	3	-	-	2	-	-	2

Rank: 3-High match, 2-Medium match, 1-Low match

Mapping of Course Learning Outcomes (CLOs) with the Teaching-Learning and Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture, multimedia presentation, literature review and problem-based exercises	Group Presentation, Assignment, oral presentation, In-course Exam and Final Exam
CLO2	Lecture, group discussion and problem-based exercises, literature review.	Group Presentation, In-course Exam and Final Exam
CLO3	Lecture, multimedia presentation and problem-based learning: Identifying the problem to be solved	Assignment, Group Presentation, In-course Exam and Final Exam
CLO4	Lecture, multimedia presentation, group discussion, demonstration, and problem-based exercises	Group Presentation, Case study, Assignment, In-course Exam and Final Exam
CLO5	Lecture, multimedia presentation, group discussion, demonstration, and problem-based exercises	Group Presentation, Case study, Assignment, In-course Exam and Final Exam

Learning Materials

i. Recommended Readings

a) Pivecka J. - Practical Handbook on Shoe Production
b) Joel Levitt - Handbook of Maintenance Management (Volume 1) Second Edition

ii. Supplementary Readings

a) Assomac-The Innovation Notebooks for The Leather Goods Industry

iii. Others: Handout/lecture material provided by the course teacher

Course Code: 0411-Hum-4107 Course Title: Cost and Management Accounting Credits: 3

Rationale of the Course: This course provides knowledge of cost behavior and terminology, cost elements, accounting system, and costing techniques. The course emphasizes on analysis of cost behavior, evaluation performance and business economics. At the end of the course, students will have a thorough understanding of the areas of cost ascertainment, cost control and cost management in a complicated manufacturing environment of footwear industry.

Course Contents:

Cost Accounting

Introduction: Meaning, scope, objectives, advantages, financial accounting vs cost accounting, factors influencing the design of a cost, limitations, characteristics of an ideal cost accounting system, installation of costing system-steps, difficulties, measures to overcome the difficulties, cost unit, methods of costing types, development of cost accounting.

Cost Behavior and Terminology: Basic cost behavior patterns, economic, accounting and other cost patterns, product costing concept need for knowledge of cost behavior, methods of estimating cost relationship.

Cost Elements and Accounting System: Costing for materials, costing for labour, and costing for overheads; job order costing, contract costing and process costing.

Costing Techniques: Standard costing, costing of by-products and joint products, direct costing. Costing of leather products, material, labour, power and overhead expenses, foreign exchange mechanisms, exchange rates; foreign exchange exposure management – risks, strategies to reduce risk, budget: types of budgets, budgeting, and control in leather products industries.

Management Accounting

Introduction: Definition, difference between financial accounting and cost accounting, relationship with financial accounting, uses in planning and control.

Analysis of Cost Behaviour: Variable, fixed and mixed, cost-volume-profit analysis. Analysing cost for pricing and short-rum decision: BEP analysis, cost for decision making, differential cost analysis.

Evaluation Performance: Variance analysis, financial statement, analysis, and interpretation.

Business Economics: The roles of engineers in business and corporation, time value of money, simple and compound interest, types of investment; Types of economic analysis: present, future and annual worth analysis, cost-benefit analysis, internal rate of return analysis; Incremental analysis depreciation: Straight line depreciation, declining balance method, MACRS, sum of years method etc., after tax cash flow analysis, inflation and its impact on economic decision, capital budgeting and rationing, sensitivity analysis.

Course Objectives: The objectives of this course are as follows:

a. To know about terminology, cost elements, cost accounting, and behavior
b. To impart adequate knowledge on cost accounting systems, costing techniques, and management accounting.
c. To deliver the problem-solving know-how in the areas of cost and management accounting in a complicated manufacturing environment.

Course Learning Outcomes (CLOs): Upon completion of the course, the students will be able to:

	Course Learning Outcomes (CLOs)	**Learning Level**
CLO1	Outline and explain the different concepts of managerial accounting, cost accounting, and business economics.	C1, C2, A1
CLO2	Identify and explain different types of cost behavior, and costing techniques to control the product and related costs.	C2, C3, A2
CLO3	Analyze overhead costing according to nature, behavior, function and control, and methods of distribution of factory overhead to the production department.	C4, A3
CLO4	Evaluate cost-volume-profit analysis for pricing and short-run decision.	C5, A3
CLO5	Create a profit plan, standard costing, and relevant costs for decision-making.	C6, A4

Mapping of CLOs with PLOs

CLOs	**PLO1**	**PLO2**	**PLO3**	**PLO4**	**PLO5**	**PLO6**	**PLO7**	**PLO8**	**PLO9**	**PLO10**	**PLO11**	**PLO12**
CLO1	3	-	-	-	-	-	-	-	-	-	-	-
CLO2	3	-	-	-	-	-	-	-	-	-	-	-
CLO3	3	2	-	2	1	-	-	-	-	-	2	-
CLO4	3	2	-	2	2	-	-	-	-	-	2	-
CLO5	3	3	2	3	1	-	-	-	-	-	3	-

Rank: 3-High match, 2-Medium match, 1-Low match

Mapping of Course Learning Outcomes (CLOs) with the Teaching-Learning and Assessment Strategy

CLOs	**Teaching-Learning Strategy**	**Assessment Strategy**
CLO1	Interactive discussion, lecture discussion with multimedia, and white board illustration	In-course Exam and Final Exam
CLO2	Interactive discussion, lecture discussion with multimedia, and white board illustration	In-course Exam and Final Exam
CLO3	Lecture discussion with multimedia, white Board illustration, and problem-based learning (PBL): Identifying the problem to be solved	Assignment, In-course Exam, and Final Exam

CLO4	Lecture discussion with multimedia, group discussion, literature review, demonstration, and problem-based exercises	Assignment, Group Presentation, In-course Exam, and Final Exam
CLO5	Lecture discussion with multimedia, group discussion, literature review, demonstration, and problem-based exercises	Assignment, Group Presentation, In-course Exam, and Final Exam

Learning Materials

i. Recommended Readings

a) Accounting Principles, Kieso and Kimmel.
b) Managerial accounting (Text Book) Garrison, R. H., & Noreen, E. W. (7th / Latest edition) Boston: Irwin/McGraw-Hill.
c) Cost Accounting: A Managerial Emphasis, Horngren CT, 15th / Latest edition publisher Pearson.

ii. Supplementary Readings

a) Cost Accounting (Text Book), S.P Iyengar, Latest Edition, 2017-2018, Sultan Chand & Sons
b) Theory & Practice of Costing (Reference Book), Basu & Das, Latest, 2018-19

iii. Others: Handout/lecture material provided by the course teacher.

Course Code: 0723-FE-4109 Course Title: Total Quality Management Credits: 3

Rationale of the Course: This course emphasizes the TQM framework, barriers, and benefits resulting in beneficial effects on organizational development in the competitive business. After completion of the course, students will learn about strategic lead time management and quality systems and be able to lead a team, production line, and a business organization.

Course Contents:

Introduction: Modern concept of quality and its measurement, quality redefined, identification of quality characteristics: quality of design conformance and performance, Deming's principles on quality and productivity, quality costs and their interpretations, basic concepts of TQM, TQM framework.

Statistical Quality Control: Control and measurement of quality, elementary SPC tools: Control charts, Process capability analysis, Design of experiments, Acceptance sampling plans: OC curves, single and double sampling plane, rectifying inspection, AOQ.

TQM Principles: Quality statements, Customer focus, Customer orientation, Customer satisfaction, Customer complaints, Customer retention - Continuous process improvement, PDCA cycle, 5S, Kaizen, Supplier partnership, Partnering, Supplier selection, Supplier Rating.

TQM Tools and Techniques I: The seven traditional tools of quality, New management tools, Six-sigma: Concepts, methodology, applications in Leather/Footwear/Leather Products industries; Benchmarking, Benchmarking processes, FMEA, Stages, Types.

TQM Tools and Techniques II: Quality circles, Quality Function Deployment (QFD) Taguchi quality loss function, PM Concepts, improvement needs, Performance measures, BPR; application of TQM tools in Leather/Footwear/Leather Product industries, BSTI, ASTM.

Quality Systems: Need for ISO 9000- ISO 9000-2000 Quality System, Elements, Documentation, Quality auditing- QS 9000, ISO 14000 Concepts, Requirements and Benefits, Quality Council, Leadership, Employee involvement, Motivation, Empowerment, Team and Teamwork, Recognition and Reward.

Strategic Lead Time Management: Time based competition, time-based process mapping, logistics pipeline management. Lean thinking, Lean operations, Push-pull production concepts, KANBAN, Kaizen, Toyota approach, Seven elements of JIT system for planning and control.

Lean Manufacturing: Introduction, Stability of Lean System, Just in Time, JIDOKA (Automation with a Human Touch), Worker Involvement and Systematic Planning Methodology.

Course Objectives: The objectives of this course are as follows:

a. To provide the fundamentals of total quality management related to footwear industry.
b. To develop core knowledge of various TQM principles, tools and techniques.
c. To familiarize the concept of international quality standards and recognition in the footwear industry.
d. To introduce students with the basics of strategic lead time management and lean manufacturing techniques.

Course Learning Outcomes (CLOs): Upon completion of this course, the students will be able to:

	Course Learning Outcomes (CLOs)	**Learning Level**
CLO1	State the different principles of quality management and statistical analysis with the help of various measuring principles.	C1, A1
CLO2	Explain different principles of TQM tools and their field of applications in footwear manufacturing.	C2, A2
CLO3	Apply the TQM tools and standards to measure different quality parameters for leather and footwear.	C3, A3
CLO4	Solve the technical problems associated with quality using various TQM analysis tools.	C4, A3

Mapping of CLO with PLO

CLOs	**PLO1**	**PLO2**	**PLO3**	**PLO4**	**PLO5**	**PLO6**	**PLO7**	**PLO8**	**PLO9**	**PLO10**	**PLO11**	**PLO12**
CLO1	3	-	-	-	-	-	-	-	-	-	-	-
CLO2	3	-	-	-	2	-	-	-	-	-	-	-
CLO3	3	2	-	1	3	-	-	-	-	-	-	1
CLO4	3	2	-	2	3	-	-	-	2	-	-	2

Rank: 3-High match, 2-Medium match, 1-Low match

Mapping of Course Learning Outcomes (CLOs) with the Teaching-Learning and Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture, Multimedia presentation, demonstration and problem-based exercises	Group Presentation, In-course Exam; Final Exam
CLO2	Lecture, group discussion and problem-based exercises	Group Presentation, In-course Exam; Final Exam
CLO3	Lecture, guided reading and problem-based learning (PBL): Identifying the problem to be solved	Assignment, Group Presentation, In-course Exam, and Final Exam
CLO4	Lecture, multimedia presentation, group discussion, literature review, demonstration, and problem-based exercises	Group Presentation, In-course Exam, and Final Exam

Learning Materials

i. **Recommended Readings**
   - **a)** Dale H. Besterfiled, et al., "Total Quality Management", Pearson Education Asia, Third Edition, Indian Reprint, 2006.
   - **b)** Suganthi, L and Anand Samuel, "Total Quality Management", Prentice Hall (India) Pvt. Ltd., 2006.

ii. **Supplementary Readings**
   - **a)** James R. Evans and William M. Lindsay, "The Management and Control of Quality", (6th Edition), South-Western (Thomson Learning), 2005.

iii. **Others:** Handout/lecture material provided by the course teacher.

Course Code: 0723-FE-4111 Course Title: Non-leather materials for Footwear-II

Credits: 2

Rationale of the Course: This core course includes different types of non-leather materials for footwear. Students will be able to learn and recognize the appropriate synthetic materials for footwear and modify their characteristics accordingly.

Course Contents:
Rubber sole: Sources, types, applications in footwear, different compounding ingredients and functions, molding operation, natural rubber soles, crepe- simple sheet material, vulcanized composition rubber, dandelion and Guayule rubber, molded latex rubber, limitation of rubber formation.
Thermoplastic rubber sole (TPR): Essence of thermoplastic rubber, elements of polyester and polybutadiene, synthesis of synthetic polyisoprene, styrene-butadiene rubber, SBS block copolymer, chemical structure, applications in footwear, compounding ingredients, vulcanizing techniques, effects of heat on the physical structure of TPR cross-links, processing and molding, and special characteristics.

Resin and vulcanized rubber: Raw rubber, compounding ingredients, molding process, properties, advantages and disadvantages of resin and vulcanized rubber.

Polyvinyl Chloride (PVC) sole: Polyvinyl chloride & its copolymers, properties, applications in footwear, compounding ingredients and molding process, advantages, and disadvantages of PVC sole.

Polyurethane (PU) soles: Polyurethane (PU), synthesis of PU, applications in footwear, types, and features of PU soles, compounding ingredients of PU, molding techniques and equipment used in the fabrication of polymer footwear such as injection molding, calendaring, reaction injection molding (RIM), blow molding, etc., mechanism of hydrolysis, advantages, and limitations of PU.

Ethylene Vinyl Acetate (EVA): Composition, molding, and post-curing, sole forming sheets, injection molding, thermoforming, design and fit, sizing and flexing, and properties.

Cellular soles: Importance of density for cellular soles, properties, and manufacture, types-microcellular vulcanized rubber, sponge rubber, EVA, polyurethane, expanded thermoplastics.

Expanded thermoplastic polyurethane midsole (E-TPU): Introduction, properties-hardness, compression set, shock absorption, rebound resilience, tensile strength and elongation at break, split tear strength, adhesion, discoloration, hydrolysis, whole shoe cushioning for the midsole.

Insocks/footbeds: Importance, properties, materials-PU, PVC, latex rubber, SBR, polyethylene, effect of increasing insock thickness, the role of insock in wearer comfort-fit, cushioning, shear absorption, hose, surface friction, texture, cosseting, sweat absorption, odor absorption, quality and durability of insocks, and special applications.

Course Objectives: The objectives of this course are as follows:

a. To provide a brief understanding of different types of non-leather materials in footwear manufacturing.
b. To comprehend the use of synthetic materials as an alternative to leather.
c. To explore different types of bottom materials used in the footwear industry.

Course Learning Outcomes (CLOs): Upon completion of this course, students will be able to:

	Course Learning Outcomes (CLOs)	**Learning Level**
CLO1	Identify the different types of non-leather materials used in footwear manufacturing.	C1, A1
CLO2	Understand the basic concept of different types of synthetic materials' properties and their relevant applications.	C2, A2
CLO3	Use of different type's polymeric materials for various purposes during shoe manufacturing.	C3, A3
CLO4	Compare different types of non-leather materials on a variety of operations and relate them according to the requirements.	C4, A4
CLO5	Evaluate the properties and applications of non-leather materials on the basis of their performances.	C5, A4

Mapping of CLOs with PLOs

CLOs	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12
CLO1	3	-	-	-	-	-	-	-	-	-	-	-
CLO2	3	2	-	-	-	-	-	-	-	-	-	-
CLO3	3	3	2	-	-	-	-	-	-	-	-	-
CLO4	3	3	3	2	-	-	-	-	-	-	-	-
CLO5	3	3	3	3	-	-	-	-	-	-	-	-

Rank: 3-High match, 2-Medium match, 1-Low match

Mapping of Course Learning Outcomes (CLOs) with the Teaching-Learning, and Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture, multimedia presentation, group discussion, whiteboard illustration	In-course Exam; Final Exam
CLO2	Lecture, multimedia presentation, and video presentation	Assignment, In-course Exam; Final Exam
CLO3	Lecture, video presentation, and multimedia presentation	Oral presentation, In-course Exam, and Final Exam
CLO4	Lecture, whiteboard illustration, and multimedia presentation	In-course Exam, and Final Exam
CLO5	Lecture, whiteboard illustration, and multimedia presentation	Assignment, In-course Exam, and Final Exam

Learning Materials

i. Recommended Readings

a) Miller R. G. (Editor) – Manual of Shoe Making.
b) Venkatappaiah B.- Introduction to The Modern Footwear Technology.
c) Korn J. (Editor) – Boot and Shoe Production.

ii. Supplementary Readings

a) SATRA Bulletin.
b) Spencer Crookenden - K Shoes –The first 150 years 1842-1992.

iii. Others: Handout/lecture material provided by the course teacher.

Course Code: 0723-FE-4112 Course Title: Non-leather Materials for Footwear Lab Credits: 1.5

Rationale of the Course: This course is a core course for footwear manufacturing. The course fulfills the general concept, necessity and selection of non- leather footwear materials at the different stage of shoe manufacturing. After completion of the course, students will be able to assess the quality of synthetic polymeric materials or textile fabrics completely practically.

Course Contents:

1. Identification of different types of fibers and fabrics such as woven (denim, drill cloth), non-woven, knitted, etc.
2. Determination of dimension, size percentage, and porosity of fabrics.
3. Determination of fabric's weight per unit area and thickness.
4. Determination of various strengths of fabrics.
5. Determination of abrasion resistance of fabrics.
6. Determination of water repellency and water absorption of fabrics.
7. Identification of different types of soling materials.
8. Determination of hydrolysis of PU soling material and PU-coated fabrics.
9. Determination of abrasion (Martindale) resistance of synthetic upper and soling materials.
10. Determination of color rub fastness and light fastness of fabrics, and coated fabrics.
11. Determination of seam strength of fabrics and coated fabrics
12. Determination of coating adhesion of PU and PVC-coated fabrics.
13. Determination of water vapour permeability and absorption of coated fabrics.
14. Injection moulding of PVC and TPR sole.
15. Manufacturing of PU sole through pouring and reaction injection moulding.

Course Objectives: The objectives of this course are as follows:

a. To introduce the essential experimental knowledge and skill for assessing the quality of different types of non-leather footwear materials.
b. To apply theoretical knowledge practically specially in the branch of non-leather footwear materials.
c. To develop different types of synthetic polymeric materials which enhance the quality of footwear.

Course Learning Outcomes (CLOs): Upon completion of this course, students will be able to:

	Course Learning Outcomes (CLOs)	**Learning Level**
CLO1	Recall the process to assess the quality of non-leather footwear materials.	C1, A1, P1
CLO2	Identify the machinery, equipment, chemical and associated risk for assessing the quality of non-leather materials.	C2, A2, P2
CLO3	Classify the properties of fabrics and polymeric materials for footwear manufacturing.	C3, A3, P3
CLO4	Identify and analyze the relevant properties of synthetic materials used in manufacturing shoes.	C4, A4, P4
CLO5	Develop a new synthesized method to modify the existing properties of non-leather materials in footwear manufacturing.	C5, A4, P5

Mapping of CLOs with PLOs

CLOs	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12
CLO1	3	-	-	-	2	-	-	-	2	-	-	-
CLO2	3	2	-	-	3	-	-	-	2	-	-	-
CLO3	3	3	2	-	3	-	-	-	2	-	-	-
CLO4	3	3	3	2	3	-	-	-	2	-	-	-
CLO5	3	3	3	3	3	-	-	-	2	-	-	-

Rank: 3-High match, 2-Medium match, 1-Low match

Mapping of Course Learning Outcomes (CLOs) with the Teaching-Learning and Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture, Demonstration, Practical, Group Discussion	Class test, Report, Final Exam
CLO2	Lecture, Demonstration, Practical, Group Discussion	Class test, Report, Final Exam
CLO3	Lecture, Demonstration, Practical, Group Discussion	Indirect Assessment, Class test, Report, Viva Voce, Final Exam
CLO4	Lecture, Demonstration, Practical, Group Discussion, Problem based learning, Video Presentation, Co-operative Learning	Continuous Assessment, Class test, Report, Viva Voce, Final Exam
CLO5	Lecture, Demonstration, Practical, Group Discussion, Problem based learning, Video Presentation, Co-operative Learning	Continuous Assessment, Class test, Report, Viva Voce, Final Exam

Learning materials

i. **Recommended readings:**
   a) Society of Leather Technologists & Chemists - Official Methods of Analysis
ii. **Supplementary Readings**
   a) P. K. Sarker - Analytical Chemistry for Leather Manufacture.
   b) Fifield and Haines-Environmental Analytical Chemistry.
iii. **Others:** Lecture notes and Lab procedure provided by the course teachers.

Course Code: 0723-FE-4201 Course Title: Wastewater and Solid Waste Management

Credits: 3

Rationale of the Course: Wastewater and Solid Waste management is intended to disseminate knowledge on different methods of existing and advanced effluent treatments and footwear industry solid waste management. The course provides up-to-date knowledge on the integrated waste management of footwear industries.

Course Contents:

Principal industries attributed for water pollution: Types of water pollution – physical, chemical and biological pollution. Hazardous effects of water pollution on land, ground water, surface water, aquatic life, and sea. Ecological system and water pollution.

Tannery effluents: Source of liquid wastes in tanneries, effluent from beam house, tanning, and post-tanning operations, their nature, most toxic ingredients in tannery wastewater, chemistry and characteristics of environmental parameters-total solids, total dissolved solids, volatile matters, DO, BOD_5, COD, TOC, TDS, ammonia, nitrogen, protein content, chlorides, alkalinity, pH, sulphide, total coliform count, polyphenol, and metal contents.

Treatment of industrial wastewater: Principles of physical treatments: screening, mixing, equalization, sedimentation, filtration; principles of chemical treatment: coagulation, flocculation, precipitation, ion exchange, use of alkali, neutralization, flotation, oxidation/reduction, distillation; objectives of biological wastewater treatment and various processes.

Primary treatment: Main objectives of primary treatment- primary treatment units- collection system of discharged waste water in tanneries-screening- equalization of waste water.

Secondary treatment: Principles of biological treatment, different processes involved in secondary treatment system- lagoon treatment- aeration system-trickling filter- systematic design of these systems- bio-technology in effluent treatment, activated sludge process - its modifications, RBC, oxidation ditch, aerated lagoon, bio-filter, anaerobic baffled reactor, UASB reactor. Waste stabilization pond, design and operation of biological nitrification, de-nitrification system, and floating aquatic plant system.

Tertiary treatment: UV treatments, ozonolysis, chlorination, reverse osmosis. Concept of CETP and ETP, and disposal of sludge.

In-plant management for pollution reduction: House-keeping, segregation of waste streams, reduction of water use, chemical use, recycling and reuse of chemicals and water, water footprint.

Solid waste management: Sources of solid waste in leather and footwear industries, trimming of finished leather, cutting, skiving, waste from upper, buffing dust, shaving dust, waste from lining materials- PVC, PU, Cotton, waste from reinforcement materials-PVC, PU, rubber, PVA, cotton, metals, eyelets, textile, laces, paper, inner box, wooden pallets, cartoon, adhesives, waste from post-consumer; integrated waste management: prevention, reduction, reuse, recycling, energy recovery and disposal.

Course Objectives: The objectives of this course are as follows:

a. To provide the basic concepts of wastewater treatment, its design and management after defining the significance of terms and parameters used in wastewater engineering.
b. To imply technical issues and the management of resources and solid waste, appropriate methods for storage, collection, transfer, treatment and disposal methods.

Course Learning Outcomes (CLOs): Upon completion of the course, the students will be able to:

	Course Learning Outcomes (CLOs)	Learning Level
CLO1	State the basic terminologies and sources related to wastewater and solid wastes.	C1, A1
CLO2	Explain the characteristics of different wastes generated from leather and footwear industries.	C2, A2
CLO3	Apply the basic principles of wastewater and solid waste treatment with recovery of possible resources.	C3, A2
CLO4	Analyze and design effective treatment plants for both liquid and solid wastes for leather and footwear industries.	C4, A3

Mapping of CLOs with PLOs

CLOs	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12
CLO1	3	-	-	-	-	-	-	-	-	-	-	-
CLO2	3	1	-	1	-	-	-	-	-	-	-	-
CLO3	3	2	2	2	2	-	2	-	-	-	-	-
CLO4	3	2	3	2	3	-	3	-	-	-	-	-

Rank: 3-High match, 2-Medium match, 1-Low match

Mapping of Course Learning Outcomes (CLOs) with the Teaching-Learning and Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture, Multimedia presentation, white board illustration, problem-based exercises, group discussion	Quiz, In- course exam; Final Exam
CLO2	Lecture, multimedia presentation, Problem based Learning (PBL): Identifying the problems to be solved	Assignment, Group presentation, In-course exam, Final exam
CLO3	Lecture, multimedia presentation, group discussion, analyze and compare through various case-studies	Assignment, In-course Exam, Final Exam
CLO4	Lecture, multimedia presentation, group discussion, analyze and compare through various case-studies	Assignment, In-course Exam, Final Exam

Learning Materials

i. Recommended Readings

a) Metcalf and Eddy, H. "Tchobanoglous, G. and Burton, F.L. (Ed), Waste water Engineering, treatment, disposal and reuse", 3rd edn. Tata-McGraw Hill Publishing, New Delhi 1991.

b) Metcalf and Eddy, "Wastewater Engineering, Treatment and Reuse", Tata McGraw Hill, New Delhi, 2003.

c) Gilbert M. Masters, "Introduction to Environmental Engineering and Science", 2nd edition, Pearson Education (2004).

ii. Supplementary Readings

a) Besselievie, B.E. and Schwartz, M. "The Treatment of Industrial wastes", 2nd edition, McGraw Hill.
b) Infogate, GTZ, "Treatment of Tannery Waste Water", GmbH, Frankfurt, Germany, 2002.

iii. Others: Handout/lecture material provided by the course teacher

Course Code: 0723-FE-4202 Course Title: Waste Management Lab Credits: 1.5

Rationale of the course: The course is designed to develop the skills to measure the basic environmental parameters related to wastewater and solid waste management. It provides the comprehensive practical knowledge to design and develop modern waste management approaches.

Course Contents:

1. Determination of dissolved oxygen (DO) in water.
2. Determination of biological oxygen demand (BOD) of industrial wastewater.
3. Determination of chemical oxygen demand (COD) industrial wastewater.
4. Determination of chloride content in wastewater sample by Volhard method.
5. Determination of total solids (TS, TSS, VSS, and FS) in wastewater/ sludge samples.
6. Determination of NO_3- content in wastewater sample.
7. Determination of MLVSS, MLSS, SVI, and VSS/SS ratio of a given sludge sample.
8. Preparation of glue and gelatin from raw trimmings, fleshing waste, wet blue trimmings, shaving dust
9. Experimental study on dechroming and chrome recovery process.
10. Extraction of fat from solid waste of the leather industry.

Course Objectives:

a. Graduates will learn to analyze industrial wastewater, which will help them to implement the appropriate industrial wastewater treatment facility in the industries.
b. Analysis of heavy metals and solids will help students to understand the ecological movement of these materials in the ecosystem.
c. To enrich students' skills about proper disposal and waste management approaches for leather and footwear industries.

Course learning outcomes (CLOs): Upon completion of this course, students will be able to:

CLOs	Course Learning Outcomes (CLOs)	Learning Level
CLO1	Describe the analytical tools and techniques for measuring the environmental parameters.	C2, A1, P2
CLO2	Perform different experiments for the determination of different environmental pollutants using modern analytical tools and instruments.	C3, A2, P2
CLO3	Analyze and evaluate the experimental results to monitor the environmental quality of tannery effluents and solid wastes.	C4, C5, A4, P4
CLO4	Design and implement strategic approaches for wastewater and solid waste management.	C6, A4, P4

Mapping of CLOs with PLOs

CLOs	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12
CLO1	3	1	-	-	-	-	1	-	-	-	-	-
CLO2	3	2	-	-	2	-	2	-	2	-	-	-
CLO3	3	2	2	3	2	-	3	-	2	-	-	-
CLO4	3	2	3	3	3	-	3	-	2	-	2	2

Rank: 3-High match, 2-Medium match, 1-Low match

Mapping of Course Learning Outcomes (CLOs) with the Teaching-Learning and Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Interactive Lectures, Group Discussions, Demonstrations, Hands-on practice, and Group work	Quiz, Viva Voce, Report evaluation, Final Exam
CLO2	Interactive Lectures, Demonstrations, Hands-on practice, and Group work	Presentation, Report evaluation, Final Exam
CLO3	Interactive Lecture with illustration, Demonstration, Hands-on practice, and Group work	Quiz, Viva Voce, Report evaluation, Final Exam
CLO4	Lecture, Demonstration, Hands-on practice, and Group work	Report evaluation, Final Exam

Learning materials

i. **Recommended readings:**
   a) Society of Leather Technologists & Chemists - Official Methods of Analysis
ii. **Supplementary Readings**
   a) P. K. Sarker - Analytical Chemistry for Leather Manufacture.
   b) Fifield and Haines-Environmental Analytical Chemistry.
iii. **Others:** Lecture notes and Lab procedure provided by the course teachers.

Course Code: 0723-FE-4203 Course Title: Production Planning and Quality Control Credits: 3

Rationale of the Course: The course emphasizes production systems, facility location, and efficient production layout. This course will pronounce how to conduct an analysis of demand forecasting for production, and inventory management. Moreover, students will learn in detail knowledge of work and method study and its application in footwear production.

Course Contents:

Introduction to production management: Production, production system, functions of manufacturing firms, basic production management function, the strategies of decision making in footwear industry, concept of productivity and calculations, multi-factor productivity, key variables for improved labor productivity, ethics, social responsibility, and sustainability.

Facility planning and layout design: Strategic importance of layout decisions, layout design considerations, types of layout, warehousing and storage layouts, problems related to layouts, staffing and balancing work cells, assembly-line balancing, line-balancing heuristics.
Inventory management: Basic ideas of inventory, functions of inventory, types of inventory, managing inventory, ABC analysis, terms used in inventory management, cycle counting, inventory models, basic economic order quantity (EOQ) model, quantity discount model, probabilistic models and safety stock, probabilistic demand and example.
Demand forecasting: Basic concept of forecasting, types of forecasts, strategic importance of forecasting for leather products industry, steps in forecasting, overview of qualitative methods, and quantitative approaches, time-series forecasting, common measures of error, least squares method for demand forecasting, multiple-regression analysis, monitoring and controlling forecasts, tracking signal, adaptive smoothing.
Capacity planning: Definition, design capacity, effective capacity, determinants of effective capacity, capacity requirement, developing capacity alternatives, evaluating alternatives.
Operation scheduling and sequencing: Basic concepts of short time scheduling, scheduling flow, forward and backward scheduling, scheduling criteria, Gantt charts, assignment method, sequencing jobs, FCFS, SPT, EDD, LPT, critical ratio, Johnson's rule for sequencing, linear programming, transportation model, network analysis, critical Path Method (CPM), programme evaluation and review technique (PERT).
Work study: Method study, Purpose and Techniques used, and Procedure. Precautions when introducing new methods, Relationship with work measurement. Work measurement, purpose and techniques used, Rating, Elements, Break points, Basic time, Use of allowances. Activity sampling, definition, purpose and procedures, use of pilot study, Interpretation of results. Production studies, machine utilization, operator performances, and Hok.

Course Objectives: The objectives of this course are as follows:

a. To provide the basic concepts on production systems, production layout, and quality control.
b. To impart knowledge on inventory, demand forecasting, operation scheduling, and sequencing for production management.
c. To disseminate in-depth knowledge for the implementation of tools and techniques related to work and method studies.

Course Learning Outcomes (CLOs): Upon completion of the course, the students will be able to:

	Course Learning Outcomes (CLOs)	**Learning Level**
CLO1	State and follow the basic concept of production systems, capacity planning, and facility planning.	C1, A1
CLO2	Estimate and prepare layout design and inventory management system of the footwear industry.	C2, C3, A2

CLO3	Compare and interpret the demand forecasting method, capacity planning and operation scheduling procedure for the production system.	C4, A3
CLO4	Evaluate and justify work-study and method-study techniques for productivity improvement	C5, A3

Mapping of CLOs with PLOs

CLOs	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12
CLO1	3	1	-	-	-	-	-	-	-	-	-	-
CLO2	3	2	2	-	2	-	-	-	-	-	-	-
CLO3	3	3	2	2	2	-	-	-	-	-	-	2
CLO4	3	3	-	3	3	-	-	-	2	-	-	2

Rank: 3-High match, 2-Medium match, 1-Low match

Mapping of Course Learning Outcomes (CLOs) with the Teaching-Learning and Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture, Multimedia presentation, demonstration and problem-based exercises (PBE)	In-course Exam; Final Exam
CLO2	Lecture, group discussion and Multimedia presentation	Group Presentation, In-course Exam; Final Exam
CLO3	Lecture, group discussion, guided reading and problem-based learning (PBL): Identifying the problem to be solved	Assignment, Group Presentation, In-course Exam, and Final Exam
CLO4	Lecture, group discussion, literature review, and problem-based exercises (PBE)	In-course Exam, and Final Exam

Learning materials

i. Recommended Readings

a) Jay Heizer, Barry Render, Chuck Munson- Operations Management: Sustainability and Supply Chain Management (13th Edition).
b) Ja y Heizer, Barry Render- Operations Management (11th Edition).
c) Gideon Halevi- Handbook of Production Management Methods.

ii. Supplementary Readings

a) Nicholas J. Aquilano and Richard B. Chase- Production and Operations Management.
b) Edward S. Pound, Jeffrey H. Bell, and Mark L. Spearman- Factory Physics for Managers: How Leaders Improve Performance in a Post-Lean Six Sigma World.

iii. Others: Handout/lecture material provided by the course teacher

Course Code: 0723-FE-4205 Course Title: Sports Footwear Manufacturing Credits: 3

Rationale of the Course: Sports Footwear Manufacturing The course will provide an opportunity for students to gather knowledge on different types of sports shoes, sports footwear manufacturing process, biomechanics behind sports shoes, fitting and testing of sports shoes.

Course Contents:

Introduction: Types of sports footwear, the need of sports footwear, brand, anatomy, performance attributes in sports footwear design, uses and motivators for sports footwear, and durability of sports footwear; world athletic shoe regulations, technical requirements, and compliance, barefoot and athletic shoes.

Sports footwear manufacturing: Essential requirements for sports footwear, product and process development of sports footwear, patterns for sports footwear, manufacturing processes of sports footwear, technologies involved in sports footwear manufacturing, guidelines for upper materials, constructions, soles, and other materials of sports footwear.

General considerations in sports footwear: Materials, lasting techniques, upper designs and cuts, bottom preparation, the outer sole, midsole and wedges, other components and designs, sports-specific shoes, and current use of textiles in sports shoes, studs, cleats, or spikes in sports footwear.

Functional sports footwear: Functional design of sports footwear, functional fit, and comfort of sports footwear, the shape of the last, fastening systems, sports shoe sizing system, functional materials and components in sports footwear, properties of materials and components, and injuries related to sports footwear and its prevention.

Fitting of sports footwear: Criteria for fitting of sports footwear, alignment of lasts, toe area fitting, joint fit, instep fit, instep fit and facings, backpart fit, insocks, and footbeds for sports footwear.

Biomechanics behind sports footwear design: Footwear requirements, surfaces, biomechanical look at running, ground reaction forces, rear-foot movement, shock-absorbing mechanisms, and energy return.

Testing for sports footwear: Assessing for performance and durability, color fastness, fasteners, shock absorption, and energy return, slip resistance and traction, flexing, safety tests, water resistance tests, trough tests, sole adhesion tests.

Professional footwear for specific sports: Footwear for athletics-running, field sports, basketball, bowls and bowling, boxing and wrestling, cricket, cycling, equestrian boots, golf, racquet sports, skiing, skating boot, and football boots.

Course Objectives: The objectives of this course are as follows:

a. To provide an overview of sports footwear considerations and manufacturing.
b. To equip students with materials and design considerations of sports footwear.
c. To understand sports footwear biomechanics.
d. To familiarize students with different tests related to sports footwear.
e. To provide an overview of professional footwear for specific sports.

Course Learning Outcomes (CLOs): Upon completion of this course, the students will be able to:

	Course Learning Outcomes (CLOs)	**Learning Level**
CLO1	Understand the manufacturing and construction techniques of sports footwear.	C2, A2
CLO2	Identify the various types of materials and explain design considerations for better-fitting sports footwear.	C2, A2
CLO3	Apply the principle of biomechanics in sports footwear production.	C3, A3, P3
CLO4	Analyze the performance of sports footwear through various tests.	C4, A4, P4
CLO5	Explain the different aspects of professional footwear for specific sports and related biomechanics.	C5, A4, P4

Mapping of CLOs with PLOs

CLOs	**PLO1**	**PLO2**	**PLO3**	**PLO4**	**PLO5**	**PLO6**	**PLO7**	**PLO8**	**PLO9**	**PLO10**	**PLO11**	**PLO12**
CLO1	3	-	-	-	-	-	-	-	-	-	-	-
CLO2	3	2	-	-	-	-	-	-	-	-	-	-
CLO3	3	3	3	2	3	-	2	-	-	-	-	-
CLO4	3	3	3	3	2	-	-	-	-	-	-	-
CLO5	3	3	3	3	-	2	-	-	-	-	-	-

Rank: 3-High match, 2-Medium match, 1-Low match

Mapping of Course Learning Outcomes (CLOs) with the Teaching-Learning and Assessment Strategy

CLOs	**Teaching-Learning Strategy**	**Assessment Strategy**
CLO1	Interactive discussion, lecture discussion with multimedia, and white board illustration	In-course Exam and Final Exam
CLO2	Interactive discussion, lecture discussion with multimedia, and white board illustration	In-course Exam and Final Exam
CLO3	Lecture discussion with multimedia, white board illustration, and problem-based learning (PBL)	In-course Exam, and Final Exam
CLO4	Lecture discussion with multimedia, group discussion, literature review, demonstration, and problem-based exercises	Assignment, Group Presentation, In-course Exam, and Final Exam
CLO5	Lecture discussion with multimedia, group discussion, literature review, demonstration, and problem-based exercises	Assignment, Group Presentation, and Final Exam

Learning Materials

i. Recommended Readings

a) Ravidra S. Goonetilleke-The Science of Footwear.

b) Miller R. G. (Editor) – Manual of Shoe Making.
c) Korn J. (Editor) – Boot and Shoe Production.

ii. Supplementary Readings

a) Ruth Thomson – Making Shoes.
b) Swayam Siddha – Product Knowledge.

iii. Others: Handout/lecture material provided by the course teacher.

Course Code: 0723-FE-4206 Course Title: Capstone Project Credits: 3

Rationale of the Course: The course is designed to encourage students to think critically, solve challenging problems,and develop skills such as oral communication, research skills, teamwork, and goal setting. It teaches them to successfully complete the projects within financial and ethical boundaries and to be able to gain an insight of the latest trends and applications ongoing in the respective fields and to communicate with society and professionals both in verbal and written form in a successful manner.

Course Contents:

Experimental and theoretical investigation of various problems related to Leather, Environmental Science and related Engineering will be carried out. The topic should provide an opportunity to the student in developing initiative, creative ability and engineering judgment. Individual study will be required. At the end of term, the student is expected to complete the preliminary literature review/survey, select the topic for study, complete theoretical study and basic research methodology on the topic and submit an individual detailed report for evaluation.

Course Objectives:

a. To make the students capable of taking new professional challenges.
b. To ensure utilization of gathered knowledge in solving new real-life problems.

Course Learning Outcomes (CLOs): Upon completion of this course, students will be able to:

	Course Learning Outcomes (CLOs)	**Learning Level**
CLO1	Identify, analyze and formulate a leather engineering problem and use project management skill for obtaining its solution considering potential of social and environmental impact on leather sector.	C1, C5
CLO2	Apply the industrial state of the art leather technology for verifying, validating, detecting accuracy and develop a leather engineering based real-life problem into an engineering solution using modern tools.	C3
CLO3	Demonstrate the concept of professional ethics, confidentiality, leather and related industrial sector standards and explain the impact of leather engineering solutions on society and environment.	C2
CLO4	Deliver designed project findings through oral presentations, demonstrations, and written technical report format.	C2, C3

Mapping of CLOs with PLOs

CLOs	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12
CLO1	3	2	2	-	-	-	-	-	2	-	2	-
CLO2	-	-	-	2	3	-	-	-	-	-	-	2
CLO3	-	-	-	-	-	3	2	2	-	-	-	-
CLO4	2	-	-	-	-	-	-	-	-	3	-	2

Rank: 3-High match, 2-Medium match, 1-Low match

Mapping of Course Learning Outcomes (CLOs) with the Teaching-Learning and Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Discussion, Discussion and encouragement, Self-study, Discussion and Motivation, Final report, proofreading	Project defense and report evaluation by external as well as internal
CLO2	Discussion, Lecture, Discussion and Motivation, Final report, proofreading	
CLO3	Lecture, Final report, proofreading	
CLO4	Discussion and demonstration, Routine discussion, Final report, proofreading	

Learning Materials

i. Recommended Readings

a) Writing the Winning Thesis or Dissertation: A Step-by-Step Guide - By Allan A. Glatthorn, Randy L. Joyner.

b) Relevant books, scientific journals, handbooks, patents and manuals

Course Code: 0723-FE-4208 Course Title: Comprehensive Viva Credits: 2.5

Rationale of the Course: Comprehensive viva is designed to judge the student's overall academic performance in the studied courses.

Course Content:

The comprehensive viva voce examination should be based on both theoretical and practical knowledge. It is based on all the courses the students have studied, the basic science, and core courses of footwear engineering.

Course Objectives: The objectives of this course are as follows:

a. To familiarize students with formal interviews.

b. To judge students' performance based on the subject knowledge.

Course Learning Outcomes (CLOs): Upon completion of this course, students will be able to:

	Course Learning Outcomes (CLOs)	**Learning Level**
CLO1	Present personal etiquette in front of a formal interview panel.	C3, A2, P2
CLO2	Demonstrate communicative skills to an interview panel.	C3, A2, P2
CLO3	Deliver the acquired knowledge effectively to the interview panel.	C3, A2, P2

Mapping of CLOs with PLOs

CLOs	**PLO1**	**PLO2**	**PLO3**	**PLO4**	**PLO5**	**PLO6**	**PLO7**	**PLO8**	**PLO9**	**PLO10**	**PLO11**	**PLO12**
CLO1	3	2	-	-	-	-	-	-	-	3	-	3
CLO2	3	2	-	-	-	-	-	-	-	3	-	3
CLO3	3	3	3	-	-	-	-	-	-	3	-	3

Rank: 3-High match, 2-Medium match, 1-Low match

Learning Materials

All the books of all the semesters and the journals, databases, real problems of leather and allied sector.

Course Code: 0723-FE-4210 Course Title: Internship Credits: 3

Rationale of the Course: The internship course is designed to involve students to the real work environment in the industry. Students will be able to familiarize themselves with the state-of-the-art production technologies, innovation, diversified materials and products.

Course Content:

Introduction, factory environment, factory layout, material handling, R&D, cutting, closing, lasting, finishing department, OHS, quality control, and waste management.

Course Objectives: The objectives of this course are as follows:

a. To expose students to the real working environment and get acquainted with the organization structure, business operations, and administrative functions.
b. To have hands-on experience in unit operation and unit processes involved in the footwear manufacturing process.
c. To familiarize with the cutting-edge technology in footwear manufacturing.
d. To enhance industry-academia collaboration and cooperation.

Course learning outcomes (CLOs): At the completion of this course students will be able to:

	Course Learning Outcomes (CLOs)	**Learning Level**
CLO1	Demonstrate knowledge and skills in the type of manufacturing process, distribution, and supply chain and their parameters.	C2, A2
CLO2	Utilize technical resources and perform in the actual working environment.	C3, A2
CLO3	Analyze, and evaluate layout, process, production, and efficiency.	C4, C5 A3
CLO4	Generate technical documents and deliver oral presentations.	C5, A3

Mapping CLOs with PLOs

CLOs	**PLO1**	**PLO2**	**PLO3**	**PLO4**	**PLO5**	**PLO6**	**PLO7**	**PLO8**	**PLO9**	**PLO10**	**PLO11**	**PLO12**
CLO1	3	2	-	-	-	-	-	-	-	-	-	2
CLO2	3	2	3	-	-	-	-	-	-	-	-	2
CLO3	3	2	2	-	-	-	-	-	-	3	-	2
CLO4	2	2	2	-	-	2	-	-	-	-	-	2

Rank: 3-High match, 2-Medium match, 1-Low match.

Mapping of Course Learning Outcomes (CLOs) with the Teaching-Learning and Assessment Strategy

CLOs	**Teaching-Learning Strategy**	**Assessment Strategy**
CLO1	Class Lecture, Display, and Demonstration,	Participation and performance, Presentation, Report Evaluation
CLO2	Class Lecture, Display, and Demonstration,	
CLO3	Discussion, Self-study, Discussion, and Motivation	
CLO4	Class Lecture, Display, and Demonstration,	

Learning Materials

i. Recommended Readings

a) Writing the Winning Thesis or Dissertation: A Step-by-Step Guide - By Allan A. Glatthorn, Randy L. Joyner.

b) Why (and How) to Take a Plant Tour by David M. Upton and Stephen E. Macadam, published on Harvard Business Review

Part D

20. Grading/Evaluation

1. Grading Scale: The letter grade system shall be used to assess the performance of the student and shall be as follows:

Marks Obtained	Grade	Grade point	Grade Description
80% or above	A+	4.00	***Grade A*****:** Excellent performance; all course objectives achieved; objectives met in a consistently outstanding manner.
75% to less than 80%	A	3.75	
70% to less than 75%	A-	3.50	
65% to less than 70%	B+	3.25	***Grade B*****:** Very good performance; significantly more than the majority (at least two-thirds) of the course objectives achieved; objectives met in a consistently thorough manner.
60% to less than 65%	B	3.00	
55% to less than 60%	B-	2.75	
50% to less than 55%	C+	2.50	***Grade C*****:** Satisfactory performance; at least majority of the course objectives achieved; objectives met satisfactorily.
45% to less than 50%	C	2.25	
40% to less than 45%	D	2.00	***Grade D:*** Minimally acceptable performance; less than majority but more
Less than 40%	F	0.00	***Grade F*****:** Failed in the course
Incomplete	I	-	-
Withdrawn	W	-	-

2. Grades: In the points-based grading system, there is a total number student can earn in a particular course, based on class attendance, in-course exam and final exam scores for a theoretical course and for a practical course it will be the summation of marks obtained from class attendance, lab reports, class test, viva and final exam. Thus, grade point of a particular course is the summation of possible marks distribution. Provided that, a fraction number in grading calculation shall be considered as the next higher consolidated number.

3. Grade Point Average (GPA) and Cumulative Grade Point Average (CGPA): GPA obtained in all the courses passed/completed by a student in a Semester. 'F' grades will not be counted for GPA calculation. GPA of a Semester will be calculated as follows:

$$\text{GPA} = \frac{\sum(Grade\ points\ in\ a\ course \times Credits\ for\ the\ course)}{Total\ credits\ \ of\ a\ semester}$$

The Cumulative Grade Point Average (CGPA) gives the cumulative performance of the student from first semester up to any other semester to which it refers and is computed by dividing the total grade points accumulated up to the date by the total credit hours.

$$\frac{\sum(GPA \times Credits\ in\ a\ semester)}{\sum(Total\ credits\ of\ \ all\ semester)}$$

Both GPA and CGPA will be rounded off to the second place of decimal for reporting.

For promotion from First Year to Second Year, a student requires to earn a minimum CGPA (calculated for first and second semesters combined) of 2.00. For promotion from second to third year and third to fourth year, a student requires to earn a minimum CGPA of 2.25. Students who failed in courses, but have earned the required CGPA will be promoted to next year on probation. Those on probation shall appear at the retake examination and must pass the failed course(s) to be allowed to continue studies in the next year.

4. Course Withdrawal: If a student is unable to complete any semester (Semester-I and/or Semester-II) due to illness, accident or any other valid reason etc., he/she may apply to the Registrar through the Director of the institute for total withdrawal from the Semester before the start of semester final examination.

5. Incomplete (I) courses: Incomplete 'I' grade is indicative of a situation where a student, for non-academic reasons beyond his control, is unable to complete the full requirements of the course

for not being able to sit for the Semester Final Examination. Students who fail a course are also said to have an incomplete course. Meanwhile, the student concerned will be promoted to the next semester. Provided that, for promotion from First Year to Second Year, a student requires to earn a minimum CGPA (calculated for first and second semesters combined) of 2.00. For promotion from second to third year and third to fourth year, a student requires to earn a minimum CGPA of 2.25. If a student has incomplete course, he/she can clear though retake examination in next two semester. Any incomplete or failed course prevents a student from receiving a degree. A student can't earn the degree if they have any incomplete or failed courses.

6. Retake: A student will be allowed maximum of two chances to clear F grade/grades with the immediate next batches by complying with the time requirement for the degree including final year (4^{th} year). He/she shall repeat the course(s) like a regular student with prior application to the Director of the institute. A student getting F grade in any theory course (courses) has to attend only the final examination for that (those) course (courses). In that case, the maximum grade obtainable in any course by the student shall be B+.

7. Grade Improvement: A student may sit for improvement exam for courses where grade obtained is less than or equal to C+ (grade point-2.50) and the best grade that a student can be awarded is B+. A student will not be allowed for grade improvement if he or she passes and the final semester result is published. However, if the grade is not improved the previous grade will remain valid.

8. Dropout/ Re-admission: A student failing to get promotion may seek re-admission to study with the following batch. In the case of re-admission, all previously earned grades for the two semesters of that year will be cancelled. For re-admission, he or she has at least 30% (thirty percent) attendance in the previous semester or year. A student may take re-admission only 2 times. If required, a student may take re-admission in the same class, but the Degree must be completed within 6 years. Re-admission will be allowed only after the approval of the Academic Committee of ILET. A student failing to get minimum required CGPA even after taking re-admission twice will be dropped out of the program.

Course Learning Outcomes (CLOs) Attainment Report

Course Learning Outcomes (CLOs)	Assessment										
	SFE (Summative) 80%				CA (Formative) 20%						CLO Attainment (%)
	Incourse / Class Test/Mid-Semester (30%)		Final Examination (60%)		MCQ / Quiz (10%)		Assignment/ Case Study (5%)		Presentation (5%)		
	AM	AC	AM	AC	AM	AC	AM	AC	AM	AC	
CLO1											
CLO2											
CLO3											
CLO4											
CLO5											
CLO6											
CLO7											

AM: Actual Marks = (Given Marks/Total Given Marks of Component) × (% of the Course)

AC: Assessment Contribution; M=Average Marks in % and W = Weightage=C/T

Attainment (A) = $\sum_{i=1}^{M}(M_i \times W_i)$

Or Marks of CLO1 = (% marks distributed Assessment Type1×% Overall) + (% marks distributed Assessment Type-2×% Overall) + (% marks distributed Assessment Type-3×% Overall) +.....