

**Rules and Guidelines**  
*for*  
**B.Sc. Engineering in Leather Products**  
**Engineering Programs**



**Institute of Leather Engineering and Technology**  
**University of Dhaka**  
**Dhaka-1209, Bangladesh**

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## Foreword

The Institute of Leather Engineering and Technology (ILET), University of Dhaka offers B.Sc. Engineering (Leather Engineering, Footwear Engineering and Leather Products Engineering) and M.Sc. Engineering (Leather Engineering, Footwear Engineering and Leather Products Engineering) degrees under certain rules and guidelines. These Rules and Guidelines of the Institute of Leather Engineering and Technology have been approved by the academic committee, Board of Governors (BoG) meeting, and finally have been approved by the Academic Council of the University of Dhaka. I wish that respective faculty members as well as students will be benefited from this handbook.

Finally, I would like to express my sincerest gratitude and thanks to my esteemed colleagues, BoG members, industry personnel for their support and cooperation in successful compilation of this handbook.

Professor Dr. Mohammed Mizanur Rahman  
Director  
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## **1. About the Institute**

The Institute of Leather Engineering and Technology (ILET), University of Dhaka was established on 20 June 2011 by merger and integration of the erstwhile “Bangladesh College of Leather Technology” of the Directorate of Technical Education, the ministry of education, the government of Bangladesh with the University of Dhaka with all its assets, funds, rights, interests, properties, etc. and all its employees. Now, the Institute of Leather Engineering and Technology is functioning as an integral part institution of the University of Dhaka and affiliated with Faculty of Engineering and Technology.

This institute has a glorious history which was officially inaugurated on 15 August 1947, just after the end of British rule, by the Ministry of Industry with the name of “East Bengal Tanning Institute” for the development of the tanning industry. The institute started its journey on 10 June 1949 and academic activities were commenced from the year 1952 after the provision of infrastructure. Later, the name of the institute was substituted with “Pakistan Leather Technology”. In 1967, the institute was transferred to the Ministry of Education and supervised under the administrative control of the technical education board to disseminate better academic and educational facilities. After liberation, the institute was renamed as the “Bangladesh College of Leather Technology” and was providing diploma, certificate, and artisan level education on leather technology until 1979. Then the government of Bangladesh started a graduate course in B.Sc. Engineering in Leather Technology under the University of Dhaka from the 1979-1980 academic session. Later, on 20 June 2011, the “Bangladesh College of Leather Technology” was handed over to the University of Dhaka with its resource and manpower and started as a distinct institute of the University of Dhaka.

Under the University of Dhaka, the institute has been commenced its journey with the following objectives–

- (a) to produce qualified manpower and skills in the field of tannery, footwear and leather goods sector.
- (b) to provide quality education leading to Bachelor of Science (B. Sc.), Master of Science (M.Sc.), Master of Philosophy (M.Phil), Doctor of Philosophy (Ph.D.) and Diploma degrees in the Leather Engineering and Technology and related field;
- (c) to initiate, organize and undertake research in the field of Leather Engineering and Technology;
- (d) to provide in-plant and industry-oriented short- and long-term training programs on various fields of leather, footwear, and leather products;

- (e) to provide quality control and laboratory facilities for testing raw materials, consumable, and finished goods;
- (f) to organize seminars, conferences, workshops, exhibitions and other events to disseminate knowledge about cutting-edge technology for raw hides/skins processing and the development of footwear and leather product;
- (g) to provide consultancy and advisory services to institutions, NGOs, private and public sector corporations, who seek such assistance;
- (h) to establish link-programs and research collaborations with various institutions/ organizations within the country and abroad.

### **Administration and Management of ILET**

The ILET is run by the seventeenth statutes under President's order of 1973 and its budget is a part of the university budget. The Vice-Chancellor is the chief executive of the Institute. The Director is the administrative head of the Institute. Administration and Management of the Institute is vested in the following bodies, subject to the approval of their actions by the Syndicate and or Academic Council of the University, as the case may be:

- a. The Board of Governors (BoG), of which the Vice-Chancellor is the Chairman;
- b. The Selection Board for Professorships and Associate Professorships of which the Vice-Chancellor is the Chairman;
- c. The Selection Board for teaching Posts other than Professorships and Associate Professorships of which the Pro-Vice-Chancellor (Academic) is the Chairman;
- d. The Selection Board for appointments to non-teaching posts not below the rank of Section Officers of which the Pro-Vice-Chancellor (Administration) is the Chairman;
- e. The Coordination and Development (C&D) Committee, of which the Director is the Chairman;
- f. The Academic Committee, of which the Director is the Chairman.

At present, the programs are offered by the Institute are as follows with the latest curriculum based on the need of modern tanneries and leather products industries:

1. B.Sc. Engineering in Leather Engineering (4 years; 8 semesters)
2. B.Sc. Engineering in Footwear Engineering (4 years; 8 semesters)
3. B.Sc. Engineering in Leather Products Engineering (4 years; 8 semesters)
4. M.Sc. Engineering in Leather Engineering (1.5 years; 3 semesters)
5. M.Sc. Engineering in Footwear Engineering (1.5 years; 3 semesters)
6. M.Sc. Engineering in Leather Products Engineering (1.5 years; 3 semesters)

ILET aims at creating efficient human resources in the fields of the leather industry, the leather products industry, and the footwear industry. The institute provides its

**Leather Products Engineering**

undergraduate students with the opportunity to participate in industrial training where students are attached to different companies and they relate theories, concepts and techniques learned from the academic courses with real-life experiences. At the end of the final year, our graduate students are involved in project work, report writing, and presentation. The master's students involve in research and writing up a thesis vigorously. We are committed to providing our students, the very best education, and training opportunities designed to enable each and every student to make the best use of their potentials and achieve their ambitions.

ILET has an interdisciplinary team of faculty members having a strong research background. The faculty members have expertise in tannery effluent treatment, leather processing technologies, materials science, environmental chemistry, medicinal chemistry, organometallic chemistry, analytical chemistry and synthetic organic chemistry, nanotechnology for leather engineering, cleaner technologies, product design and development, circular economy, sustainability, supply chain risk management, industry 4.0, and foot comfort. We also conduct outreach activities to disseminate the industrial-scale solutions beyond the University of Dhaka. We provide the expertise needed for pre- and post-implementation assessment of projects, programs, and policies regarding the Leather industry, the Leather products industry, and the Footwear industry.

## 2. Undergraduate Degrees Offered by the Institute

- a) B.Sc. Engineering in Leather Engineering
- b) B.Sc. Engineering in Footwear Engineering
- c) B.Sc. Engineering in Leather Products Engineering

## 3. Graduate Degrees Offered by the Institute

- a) M.Sc. Engineering in Leather Engineering
- b) M.Sc. Engineering in Footwear Engineering
- c) M.Sc. Engineering in Leather Products Engineering

## 4. Course Credit Summary (a) For B.Sc. Engineering Degree

Summary (B.Sc. Engineering in Leather Products Engineering)					
Sl.	Course Type		Credit		
			Theory	Lab	Total
1.	Basic Sciences	Mathematics	12	-	37.5
		Physics	3	1.5	
		Chemistry	15	6.0	
2.	Allied Engineering	Materials Science and Engg. (3)/ Mechanical Engineering (4.5)/ EEE (3)/ CSE (4.5)/ Engineering Drawing (1.5)	12	4.5	16.5
3.	Humanities	Employability Skills (3), Sociology (3)	3	3	6.0
4.	Business Studies	Supply Chain Management for Leather and Leather Products (3), Total Quality Management (TQM) for Leather and Leather Products (3), Cost and Management Accounting (3)	9	-	9.0
5.	Common Courses	Polymer Science and Engineering (4.5)/ Environmental Science & Engineering (4.5)/	6	3.0	9.0
6.	Core Courses	<b>Core Subjects of LPE</b>	<b>54</b>	<b>23.0</b>	<b>88.0</b>
		Project (3)/ Internship (3)/ Viva (2)/ Field Tour (3)	-	<b>11.0</b>	
7.	Grand Total		<b>114</b>	<b>52</b>	<b>166.0</b>

## (b) For M.Sc. Engineering Degree

SL. No.	Title	Credit
		M.Sc. Engg.
1	Total Credits	36
2	Credits for theory courses	21
3	Credits for thesis	15

## 5. Major Research Areas

Tannery Effluent Treatment, Leather Processing Technologies, Materials Science, Environmental Chemistry, Medicinal Chemistry, Organometallic Chemistry, Analytical Chemistry and Synthetic Organic Chemistry, Nanotechnology for Leather Engineering, Cleaner Technologies, Product Design and Development, Circular Economy, Sustainability, Supply Chain Risk Management, Industry 4.0, Foot Comfort etc.

## 6. Rules and Guidelines for B.Sc. Engineering in Leather Products Engineering

The rules and guidelines of the B.Sc. Engineering in Leather Products Engineering have been approved by the Academic Committee meeting dated 29<sup>th</sup> October 2020, BoG meeting dated 11<sup>th</sup> November 2020 and finally have been approved by the Academic Council dated 10<sup>th</sup> December 2020. It will be applicable from Session 2020-2021 and onward.

### 6.1 The B.Sc. Engineering in Leather Products Engineering

The B.Sc. Engineering in Leather Products Engineering program in the Institute of Leather Engineering and Technology, University of Dhaka is a four academic year program. The program comprises eight semesters, each having duration of six academic calendar months to be distributed as follows:

- (a) **Classes** : Fifteen active weeks
- (b) **Preparatory Leave** : Maximum two weeks
- (c) **Semester Final Exam** : Two-three weeks
- (d) **Vacation** : Only the usual vacation of Dhaka University's will be applicable
- (e) **Result publication** : Within two months from the last Date of theory exam is desirable

### 6.2 Admission

Students will be admitted to the institute as per Dhaka University rules. Each year application requirements will be defined by the Central Admission Committee of the University of Dhaka. Institute can define specific requirements of subject-wise score in admission test with the approval of the Central Admission Committee.

### 6.3 Definition of Credit

- (i) For theoretical courses fifteen class-hour of fifty minutes each is defined as one credit.
- (ii) For practical or lab courses thirty lab hours work is defined as one credit.

### 6.4 Credit Requirements for the B.Sc. Engineering Program

- i. Total credits : 166
- ii. Credits for core courses (theory) : 54
- iii. Credits for practical courses : 41
- iv. Credits for basic sciences (mathematics, statistics, physics & chemistry) (theory) : 30
- v. Credit for allied engineering and other common courses (theory) : 18

- vi. Credits for general education (theory) : 12
- vii. Credits for project : 3
- viii. Credits for internship & field tour : 6
- ix. Credit for course viva : 2

### 6.5 Grades and Grade Points

The University Grants Commission (UGC) of Bangladesh approved grading system applies to calculate grade and grade points. Grades and grade points will be awarded on the basis of marks obtained in the written, oral and practical Exam according to the following table

Marks	Letter Grade	Grade Point
80% and Above	A+	4.00
75% to < 80%	A	3.75
70% to < 75%	A-	3.50
65% to < 70%	B+	3.25
60% to < 65%	B	3.00
55% to < 60%	B-	2.75
50% to < 55%	C+	2.50
45% to < 50%	C	2.25
40% to < 45%	D	2.00
Less Than 40%	F	0.00
	I	Incomplete
	W	Withdrawn

- (a) Only "D" or higher grade will be counted as credits earned by a student.
- (b) A student obtaining "F" grade in any course will not be awarded degree.
- (c) CGPA (Cumulative Grade Point Average) is the weighted average of the grade points obtained by a student in all the courses. CGPA will be calculated according to be following formula:  

$$CGPA = \frac{\sum(\text{grade points in a course} \times \text{credits for the course})}{\text{total credits taken}}$$
- (d) In the tabulation process, only the total marks of a student in any course will be rounded-up to next number and the published result of the program will show only the grades earned and the Cumulative Grade Point Average (CGPA) at the end of each semester.

### 6.6 Marks Distribution for a Course:

#### (a) Theory Course

- (i) Attendance : 10%

(ii) In-course exam	30%
(iii) Final exam	60%
Total Marks	100%

**(b) Lab Course**

(i) Lab attendance	: 20%
(ii) Continuous evaluation	: 40%
(iii) Final exam	: 40%
Total Marks	100%

**(c) Project**

(i). Defense	: 40%
(ii) Project Report	: 60%
Total Marks	100%

**(d) Guideline for Attendance Mark**

Attendance (%)	Marks (10)
90 and above	10
85 to 89	08
80 to 84	06
75 to 79	04
60 to 74	02
Less than 60	00

**6.7 Exam Committee Formation**

- (a) At the beginning of each academic semester/session, an exam committee shall be formed for that semester/session by the academic committee of the institute. Chairman of the exam committee will act as a course coordinator for that semester/session. The role of a course coordinator is to monitor the academic activities and report to the director of the institute to avoid any unexpected situation.
- (b) The exam committee will consist of four members proposed by the academic committee of the respective program.
- (c) The committee members are a chairman, two internal members from the institute and one external member outside of the institute.
- (d) The exam committee will be responsible for all exam related activities as per

University rules.

**6.8 Evaluation of the Courses**

The performance of a student in a course will be evaluated in the following ways:

- (a) For a theory course the evaluation will be made on the basis of attendance, quiz/assignment/presentation, in-course exam and final exam.
- (b) For any courses attendance, quiz/assignment/presentation, in- course exam will be evaluated by the course teacher/s and the result must be submitted to the exam committee and controller of exam before commencement to the semester final examination.
- (c) The percentage of attendance of students for each course (according to the format supplied by the Director) along with the attendance sheet must be submitted to the Director of the institute before commence to the semester final examination.
- (d) The in-course exam scripts must be shown to students before the last class of a semester.
- (e) If more than one in-course exam is taken final mark will be calculated by averaging all of them (**best one will not be allowed**).
- (f) For theory course final exams, generally there will be two examiners: course teacher will be the first examiner and the second examiner will be within the institute or from a relevant department of the University of Dhaka. If a suitable examiner is not found from the University of Dhaka, a second examiner may be appointed from other universities with prior permission from the Vice Chancellor.
- (g) (i) The answer scripts of final exam will be evaluated by two examiners and the average mark will be considered as the mark obtained, if the difference of two examiner marks not exceeded 20%.  
(ii) In case of a difference of marks between the two examiners is more than 20% then the script will be evaluated by a third examiner. Marks of nearest two examiners will be taken for average.  
(iii) If the differences of marks of third examiner from the first and second examiner become equal then average of three examiners marks will be obtained mark.
- (h) The assessment of laboratory /practical / field course will be made by observing overall performance of a student during practical (continuous

evaluation), attendance, viva-voce, assignments and evaluation of lab final exam (set by the Institute).

- (i) For fourth year project evaluation will be made on the basis of presentation on project defense and project report.
- (j) For field study evaluation will be made on the basis of written examination or presentation on that field study and field study report.

### 6.9 Requirements to Sit for Course Final Exam

- (i) Students having 75% or more attendance on average is eligible to appear in the semester final Exam.
- (ii) Student having average 60-74% attendance will be allowed to sit for the exam with a fine Tk. 1000.00 (one thousand) in the University central account. In addition to usual fees, institute may include additional fine as per the decision of the Academic Committee.
- (iii) Student having average attendance below 60% will not be allowed to sit for the semester final Exam but may seek re-admission in the program
- (iv) The semester final exam will be arranged centrally by the controller of examination of the University of Dhaka.
- (v) The duration of theory course final exams will be as follows:

Credit	Duration of Exam
3 credits course	3 hours

- (vi) Duration of lab exam will be defined by the institute.

### 6.10 Promotion to the Next Academic Year

A student has to attend courses required for a particular semester, appeared at the annual exams and scored a minimum specified CGPA for promotion to the next year.

Promotion to the next year will be given if a student scores minimum CGPA as follows:

Year Description	CGPA
1 <sup>st</sup> year to 2 <sup>nd</sup> year	CGPA: 2.00
2 <sup>nd</sup> year to 3 <sup>rd</sup> year	CGPA: 2.25
3 <sup>rd</sup> year to 4 <sup>th</sup> year	CGPA: 2.50

### 6.11 Requirements for the Award of the B.Sc. Engineering in Leather Products Engineering Degree

- (a) The student Must earn required credits in a maximum period of six academic years starting from the date of admission at 1<sup>st</sup> year 1<sup>st</sup> semester.
- (b) The student Must obtain CGPA of at least 2.5 out of 4.00 to achieve the B.Sc. Engineering in Leather Products Engineering degree without “F” grade in any course.

### 6.12 Tabulations

- (a) The exam committee will appoint two tabulators.
- (b) Tabulators will receive marks of all courses from the chairman of the Exam committee.
- (c) The two tabulators will independently prepare the tabulation sheets and compare before submitting it to the office of the Controller of Examination through the Chairman of Exam committee.

### 6.13 Improvement Examination

- (a) A student will be allowed a single earliest available chance to clear “F” grade/grades complying with the time requirement for the degree. A student will not be allowed for grade improvement if he or she passes and the final semester result is published.
- (b) A student may sit for improvement exam for courses where grade obtained is less than or equal to “C+” (C plus) and the best grade that a student can be awarded is “B+” (B plus). However, if the grade is not improved the previous grade will remain valid.
- (c) Improvement exam for all odd semesters will always be held with immediate next even semester and the same exam committee will conduct the improvement exam (for example, 1<sup>st</sup> semester improvement exam will be held on immediate 2<sup>nd</sup> semester, 3<sup>rd</sup> semester in improvement exam will be held on immediate 4<sup>th</sup> semester, 5<sup>th</sup> semester improvement exam will be held on immediate 6<sup>th</sup> semester, 7<sup>th</sup> semester improvement exam will be held on immediate 8<sup>th</sup> semester. Improvement exam for all even semesters will always be held with immediate next academic session or batch.
- (d) In case of improvement exam in addition to usual fees a fine will be charged by the institute through its Academic Committee

#### **6.14 Re-admission and Dropout**

- (a) A student may be allowed re-admission for a maximum of two times to complete the B.Sc. Engineering in Leather Products Engineering program.
- (b) A student may seek re-admission provided he or she has at least 30% (thirty percent) attendance in the previous semester or year.
- (c) A student who is unable to get minimum required CGPA even after taking re-admission twice will be dropped out from the academic program.

#### **6.15 Director's Award**

In recognition of excellent academic performance students may be given Director's Merit Award for every batch after completion of the B.Sc. Engineering in Leather Products Engineering program as per following criteria.

- (a) An awardee must not have appeared in any improvement exam during his or her study period.
- (b) An awardee must have CGPA 3.75 or above.
- (c) However, the number of awardees of each group/discipline will not exceed two. In case of equal CGPA the final semester CGPA will be considered to break the tie.

#### **6.16 Other General Regulations**

For any matter not covered in the above guidelines, existing rules of the University of Dhaka will be applicable.

Disciplinary and punishable actions will be applied according to the existing rules of the University of Dhaka.



**B.Sc. Engineering in Leather Products Engineering (B.Sc. Engg. in LPE)  
Semester Wise Course Outline**

<b>Year-1, Semester-1</b>			
<b>Course Code</b>	<b>Course Name</b>	<b>Credit</b>	
		<b>Theory</b>	<b>Lab</b>
LE-101	Fundamentals of Leather Engineering	3	
MTH-101	Algebra and Geometry	3	
PHY-101	Engineering Physics	3	
CHM-101	Inorganic Chemistry	3	
CHM-102	Physical Chemistry	3	
CHM-103	Inorganic and Physical Chemistry Lab		1.5
ME-101	Engineering Drawing		1.5
HUM-101	Employability Skills-I		1.5
LE-102	Field Tour		1.0
	<b>Total</b>	<b>15</b>	<b>5.5</b>
	<b>Semester Total</b>	<b>20.5</b>	

<b>Year-1, Semester-2</b>			
<b>Course Code</b>	<b>Course Name</b>	<b>Credit</b>	
		<b>Theory</b>	<b>Lab</b>
LE-103	Leather Processing-I	3	
LE-104	Leather Processing-I Lab		1.5
CSE-101	Fundamentals of Computer and Information Technology	3	
CSE-102	Fundamentals of Computer and Information Technology Lab		1.5
MTH-102	Calculus	3	
CHM-104	Organic and Collagen Chemistry	3	
CHM-105	Organic and Collagen Chemistry Lab		1.5
PSE-101	Polymer Science and Engineering	3	
PSE-102	Polymer Science and Engineering Lab		1.5
	<b>Total</b>	<b>15</b>	<b>6.0</b>
	<b>Semester Total</b>	<b>21.0</b>	

<b>Year-2, Semester-1</b>			
<b>Course Code</b>	<b>Course Name</b>	<b>Credit</b>	
		<b>Theory</b>	<b>Lab</b>
LE-201	Leather Processing-II (Mineral)	3	
LE-202	Leather Processing-II Lab		1.5
LE-203	Leather Biotechnology	3	
LE-204	Leather Biotechnology Lab		1.5
MTH-201	Differential Equation and Numerical Methods	3	
CHM-201	Analytical Chemistry for Leather and Leather Products	3	
CHM-202	Analytical Chemistry Lab		1.5
EEE-201	Fundamentals of Electrical and Electronics Engineering	3	
PHY-201	Physics and Electronics Lab		1.5
	<b>Total</b>	<b>15</b>	<b>6.0</b>
	<b>Semester Total</b>	<b>21.0</b>	

<b>Year 2, Semester-2</b>			
<b>Course Code</b>	<b>Course Name</b>	<b>Credit</b>	
		<b>Theory</b>	<b>Lab</b>
LE-205	Leather Processing-III (Non-Mineral)	3	
LE-206	Leather Processing-III Lab		1.5
LPE-201	Leather Products Manufacturing-I	3	
LPE-202	Leather Products Manufacturing-I Lab		1.5
CHM-203	Instrumental Analysis of Leather and Leather Products	3	
CHM-204	Chemical Analysis of Leather and Leather Products Lab		1.5
MTH-202	Probability and Statistics	3	
MSE-201	Fundamentals of Materials Science and Engineering	3	
LE-207	Field Tour		1.0
	<b>Total</b>	<b>15</b>	<b>5.5</b>
	<b>Semester Total</b>	<b>20.5</b>	

<b>Year-3, Semester-1</b>			
Course Code	Course Name	Credit	
		Theory	Lab
LPE-301	Leather Products Manufacturing-II	3	
LPE-302	Leather Products Manufacturing-II Lab		1.5
LPE-303	Leather Products Design and Drafting	3	
LPE-304	Leather Products Design and Drafting Lab		1.5
ME-301	Fundamentals of Mechanical Engineering	3	
ME-302	Mechanical Workshop		1.5
ENV-301	Environmental Science and Engineering	3	
ENV-302	Environmental Science and Engineering Lab		1.5
HUM-301	Industrial Sociology	3	
LPE-305	Field Tour		1.0
	<b>Total</b>	<b>15</b>	<b>7.0</b>
	<b>Semester Total</b>	<b>22.0</b>	

<b>Year- 3, Semester-2</b>			
Course Code	Course Name	Credit	
		Theory	Lab
LPE-306	Leather Products Manufacturing-III	3	
LPE-307	Leather Products Manufacturing-III Lab		1.5
LPE-308	Quality Assurance of Leather Products and Allied Materials	3	
LPE-309	Quality Assurance of Leather Products and Allied Materials Lab		1.5
LPE-310	Leather Products Merchandising	3	
LPE-311	Products Quality Analysis Lab		1.5
LPE-312	Fundamentals of Footwear Manufacturing	3	
LPE-313	Footwear Manufacturing Lab		1.5
BUS-301	Supply Chain Management for Leather and Leather Products	3	
	<b>Total</b>	<b>15</b>	<b>6</b>
	<b>Semester Total</b>	<b>21.0</b>	

<b>Year-4, Semester-1</b>			
Course Code	Course Name	Credit	
		Theory	Lab
LPE-401	Leather Garments Manufacturing	3	
LPE-402	Leather Garments Manufacturing Lab		1.5
LPE-403	Synthetic Materials for Leather Products	3	
LPE-404	Lean Manufacturing of Leather and Leather Products	3	
LPE-405	Production Planning and Control for Leather and Leather Products	3	
LPE-406	Application of Computer in Leather Products Design		2
LPE-407	Industrial Utility and Maintenance	3	
LPE-408	Maintenance Workshop		1.5
HUM-401	Employability Skills-II		1.5
	<b>Total</b>	<b>15</b>	<b>6.5</b>
	<b>Semester Total</b>	<b>21.5</b>	

<b>Year-4, Semester-2</b>			
Course Code	Course Name	Credit	
		Theory	Lab
LPE-409	Wastewater and Solid Waste Management	3	
LPE-410	Wastewater and Solid Waste Management Lab		1.5
BUS-401	Total Quality Management (TQM) for Leather and Leather Products	3	
BUS-402	Cost and Management Accounting	3	
LPE-411	Project		3.0
LPE-412	Comprehensive Viva		2.0
LPE-413	Internship		3.0
	<b>Total</b>	<b>9</b>	<b>9.5</b>
	<b>Semester Total</b>	<b>18.5</b>	

**Total Credit: 166.0**

**First Year (1<sup>st</sup> Semester)**

**LE-101: Fundamentals of Leather Engineering**

Credit	Class/week (h)	Total Class (h)
3.0	3.0	45.0

**Learning Objectives:** The aim of this course is:

- To introduce the fundamentals of leather manufacture.
- To provide basic concepts of raw hide and skin processes in leather engineering.
- To deliver knowledge about several types of footwear with distinct features.
- To provide an overview of human foot functions and foot anatomy.
- To make the students to gain fundamentals knowledge about the leather products.

**Course Contents:**

**Introduction and historical background of leather making:** Definition of hides, skins and leather, define the region of hides and skin, types and sources of hides and skins, world supply position, supply position in Bangladesh.

**Defects of hides and skins:** Definition, pre-mortem and post-mortem defects of hide and skin and their effect on leather, methods of identification of defects, common defects of hides and skins in Bangladesh and their remedies.

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

**Skin structure and its components:** Hierarchy of collagen structure; amino acid sequence,  $\alpha$ -helix, Triple Helix, Isoelectric point, structure of fibrous and globular proteins of connective tissues like keratin, reticulin and elastin; albumin, globulin, mucine, etc.

**Histological structure:** Epidermis, Grain, Junction, Corium, Flesh layer, Flesh. Skin Feature; Hair or wool, Follicles, Erector Pill Muscle, Sweat Glands, Veins and arteries, Elastin. Non-structural components; Glycosaminoglycans (GAGs), Hyaluronic acid, Dermatan Sulfate, chondroitin sulfate A and C, Melanin.

**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 etc. Rubber. Synthetic polymers, Inorganic etc.

**History of Leather products and its classification:** History of leather products, types of leather products, classification of leather goods, terms used in leather goods tools and machinery used in leather goods and garments manufacturing, accessories used in leather products manufacturing, definition of edge construction, types of edge construction, unit operations for leather goods.

**Footwear types and requirements:** Types of footwear- oxford, derby, court, moccasin, sandal, casual, boot, sports, mule, clogs, safety footwear, occupational footwear, fashion footwear etc. Bespoke footwear- meaning of bespoke footwear, advantages and customer of bespoke footwear, contribution of hose to foot comfort, properties of comfortable footwear, causes of customer dissatisfaction for footwear, footwear care.

**Parts of footwear:** Shoe section, parts of upper - vamp, quarter, toe cap, apron, tongue, counter, backstraps, fastenings, toe puff, stiffener, eyelets, trims/ornaments and parts of

lining. Bottom parts- insole, insock, welt, rand, bottom filler, mid sole, runner, sole, heel, shank piece. Parts of sandals.

**Human foot anatomy:** Necessity of foot anatomy, bones, muscles, ligament, nerves and blood vessels, joint, arches, skin etc. development of human foot from infants to adult. Characteristic features of infant, children and adult foot, biometry of human foot, types of foot, foot dynamics- weight bearing foot, walking foot, running foot, gait analysis, foot motion, foot stances, foot care and their relationship to footwear.

**Learning Outcomes:** At the end of the course the students will be able to:

- Understand and explain the concepts involved in histological structure and chemical composition of raw hides and skins.
- Identify the different aspects of leather and their influence on overall manufacturing process.
- Gain fundamentals knowledge about the leather products.
- Know about different types of footwear with characteristic features.
- Know about foot functions and foot anatomy.

**Reference Books:**

1. Anthony D. Covington- Tanning Chemistry The Science of Leather
2. Dutta S.S.-An introduction to the principles of leather manufacture.
3. Sarkar K.T.-Theory and Practice of Leather Manufacture.
4. Sarphouse J.H.-Leather Technicians Handbook.
5. Heidenmann Eckhart - Fundamentals of Leather Manufacture.
6. Procter H.R.-The Principle of Leather Manufacture.
7. Venkatappaiah B.- Introduction to The Modern Footwear Technology
8. Miller R. G. (Editor) - Manual of Shoe Making
9. Carr & Latham-The Technology of Clothing Manufacture
10. Kirsten Jorgensen-Making Leather Clothes
11. Ben and Elizabeth Morris-Making Clothes in Leather
12. Roland Kilgus editor-Clothing Technology from fibre to fashion

**MTH-101: Algebra and Geometry**

Credit	Class/week (h)	Total Class (h)
3.0	3.0	45.0

**Learning Objectives:**

- To know about Inequalities, Vector algebra and vector calculus
- To know about Matrices and Determinants
- To know about Applications of the Algebra in science, engineering and business
- To know about Two and three-dimensional geometry

**Course Contents:**

**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, and general equation of second degree, circle, and system of circle, parabola, and hyperbola.

**Three dimensional geometry:** Plane and lines - 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, curved surfaces, equations of a sphere, section by a plane, tangent plane, standard equations of cone, cylinder and conchoids properties.

**Learning Outcomes:**

- Compute dot and cross product of vectors.
- Find the length of a vector.
- Define basic terms and concepts of matrices and determinants.
- Solve system of linear equations.
- Determine different properties of straight lines, circles and conics with identification of curves.
- Determine directional cosines and directional ratios of straight lines manually with geometric interpretations, and different properties of conics and straight lines in three dimensions.

**Reference Books:**

1. H. Anton, and C.Rorres, Linear Algebra with Applications, 7<sup>th</sup> Edition,
2. S. Lipshutz, Linear Algebra, Schaum's Outline Series.
3. W. Greub, Linear Algebra.
4. Khosh Mohammad, Analytic Geometry and Vector Analysis.
5. J. A. Hummel, Vector Geometry.
6. A.F.M. Abdur Rahman & P.K. Bhattacharjee, Analytic Geometry and Vector Analysis

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**PHY-101: Engineering Physics**

Credit	Class/week (h)	Total Class (h)
3.0	3.0	45.0

**Learning Objectives:**

- To provide a broad training in physics and demonstrate the students on various skills including; expertise with core physics concepts and their applications to relate the

physical phenomenon with the practical problems in engineering purposes, proficiency in problem solving, critical thinking, and analysis.

- In future, it will help the students to function effectively in laboratory environment and pursue independent research towards the development of new devices and products using sophisticated physical concepts.

**Course Contents:**

**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, poisson's ratio, determination of elastic constants, factors affecting elasticity.

**Surface Tension:** Surface energy and surface tension, excess of pressure inside a spherical liquid drop, capillarity.

**Fluid mechanics:** Fluids, types and properties of fluids, fluid statics, fluid flow, equation of continuity, Bernoulli's equation.

**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 law, 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, convection, free and forced convection, domestic and industrial application, ventilation.

**Sound:** Sound wave, sound field, power and intensity, sound pressure level, psycho-acoustics, loudness, pitch, masking, types of noise.

**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 Gauss's 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, Crystal structure, Fundamental types of lattices, Miller indices Wave particle duality, de-Broglie hypothesis, Photo-electric effect, Compton effect.

**Learning Outcomes:** Successful completion of this course will help students with following outcomes:

- Work efficiently in leather, leather products, and footwear industries where proper application of engineering knowledge requires the basics of physics.
- Solve problems with critical thinking and effective communication.
- Ready for entry level research and secured positions in industry.
- Recognition for students in other majors who wish to enhance their understanding and mastery of a broader range of subjects than is provided in their core courses alone.
- Ability to communicate their ideas with others and function effectively in multidisciplinary terms.
- Start career as a practicing engineer in fields such as design, research, development, testing, manufacturing, operations, and service systems.

**Reference Books:**

1. Resnick/Halliday/Krane-Physics, Vol I & II.
2. David Halliday/Robert Resnick/Jearl Walker-Fundamentals of Physics.
3. F.W.Newman and V.H.L.Searl -The General properties of Matter
4. D.S.Mathur- Elements of Properties of Matter
5. Charles Kittel/Herbert Kroemer -Thermal Physics.
6. F.Sears and G.L. Salinger -Thermodynamics, Kinetic Theory and Statistical Thermodynamics
7. S.C.Arora/S. Domkundwar-A Course in Heat & Mass Transfer.
8. Harvey E.White/Francis A. Jenkins-Fundamentals of Optics.
9. ArtherBeiser-Concepts of Modern Physics.
10. C. L. Arora -B.Sc. Physics, Vol-I & II.

**CHM-101: Inorganic Chemistry**

Credit	Class/week (h)	Total Class (h)
3.0	3.0	45.0

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

- This course serves as a cursory to understand the basic concepts involved in inorganic chemistry including periodic properties, acid-base reactions, redox reaction, chemical bond, transition metals and coordination chemistry that will prepare the student for advanced coursework in chemistry as well as in Leather Chemistry.
- It explores the unknown knowledge of different types of bond exist leather.
- The course will provide a foundation for further education in chemical science directed towards materials, energy technology and leather process chemistry.

**Course Contents:**

**Concepts in Chemical Bond:** Concepts and types of chemical bonding, polarization of ions, Fajan’s rule, metallic bond, Pi back bonding, organic metallic compounds, hydrogen bond, intermolecular interaction, London force, van der Waal’s forcners, MOT, VBT, and VSEPR theories.

**Acid-Base concept:** Modern concept of acids and bases, acid and base strength, pH, buffer solution and its mechanism, importance of pH in tanning processes, acid base indicator, equivalent point and end point, acid-base titration, precipitation titration, oxidation-reduction titration, potentiometric titration, strong and weak electrolytes, degrees of dissociation, Oswald dilution law, dissociation constants of weak electrolytes.

**Structure of transition metal complexes:** Synthetic strategies to transition metal complexes, spectroscopy of co- ordination compounds, structure and property relations in 'd' block elements. Aqueous chemistry of chromium, titanium, iron, aluminium and zirconium including their redox behavior, application of transition metal compounds in tanning.

**Theories of Co-ordination:** Coordination or complex compounds, ligands or co-ordinating groups, coordination number, primary and secondary valency, coordination sphere, chelate complexes, application of chelates, nomenclature of coordination compounds, isomerism-structural, geometrical, optical, optical isomerism in 6-coordinate complexes, Werner’s coordination theory, effective atomic number (EAN), limitation of EAN rules, 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 tannings:** Chromium salts, its behavior in solution, variable oxidation state of chromium, color of chromium compounds, structure and bonding of chromium in leather, impact of chromium on the environment, way to avoid Cr(VI) formation in leather, application of chromium compounds in leather.

**Learning Outcomes:** After completion of this course the students will be able to

- Understand the different types of bonding in leather.
- Learn types of bond involved in complex compound, complex ion and chromium-collagen bond formation in leather.
- Explain different oxidation state of transition metal elements especially iron and chromium.
- Explain pH and its implications in different steps of leather tanning process.
- Understand different color of chromium compounds.

**Reference Books:**

1. G. F. Lipotrot- Modern Inorganic Chemistry.
2. F. Albert Cotton, Geoffrey Wilkinson, Paul L. Gaus- Basic Inorganic Chemistry.
3. Esmarch S. Gilreath- Fundamental Concepts of Inorganic Chemistry.
4. S. Z. Haider- Introduction to Modern Inorganic Chemistry.
5. H. J. Emeleous and A. G. Sharpe- Modern Aspects of Inorganic Chemistry.
6. R. D. Madan- Modern Inorganic Chemistry.
7. A. K. De- A Text Book of Inorganic Chemistry.
8. K. N. Upadhyaya- A Text Book of Inorganic Chemistry.

**CHM-102: Physical Chemistry**

Credit	Class/week (h)	Total Class (h)
3.0	3.0	45.0

**Learning Objectives:** The learning objectives of this course are to-

- understand the scientific and mathematical principles underlying their chosen discipline
- understand and explain different laws of physical chemistry
- make analytic in calculating physico-chemical parameters using standard equations
- Increase ability for interpreting the tabulated experimental data for different physical processes.
- Promote knowledge on the basic concepts of the Physical chemistry to enter into the field of engineering education.

**Course Contents:**

**Surface chemistry:** Adsorption and absorption, physical and chemical adsorption, types of adsorption isotherms, theoretical study of adsorption of gas by solid, adsorption of solid from solution, application adsorption.

**Colloid:** True solution, suspension, types of colloid, general methods of preparation and purification, general properties (Physical, colligative, kinetic, optical and electrical properties) of sol, protective action and application of colloid, emulsion, types and preparation of emulsion, emulsifier, stability of emulsions, application of colloids in tanning processes.

**Photochemistry:** Laws of photochemistry - Grothuss-Draper law, Stark-Einstein law and Lambert-Beer Law (derivation and problems). Photo physical processes – Jablonski diagram. Chemiluminescence, fluorescence, phosphorescence, luminescence, photo-sensitization and photoquenching – mechanism and examples. Spectroscopy: Electromagnetic radiation, electromagnetic spectrum - absorption of radiation - electronic, vibrational and rotational transitions.

**Chemical kinetics:** Rate of reaction, order and molecularity, elementary and overall reaction integral rate equation for 1<sup>st</sup>, 2<sup>nd</sup>, and 3<sup>rd</sup> order kinetics, determination of order of reactions, 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 chemical formula & molecular weight from Raoult's Law, their experimental determination, application of colligative properties, osmosis in leather processing.

**Thermodynamics:** Work, heat, energy, internal energy and enthalpy, some thermodynamic terms, first law of thermodynamics, reversible and irreversible processes, isothermal and adiabatic expansion of ideal gas, Joule-Thomson effect, molar heat capacity at constant pressure and constant volume and their relation, second law of

thermodynamics, spontaneous process, entropy, entropy changes for ideal gas, Carnot's cycle, efficiency of a machine, free energy and work function, Gibbs-Helmholtz's equation.

**Learning Outcomes:** Upon completion of the course, the students should be able to

- Use dimensional analysis in solving different types of problems.
- Explain colloid and its implications in different steps of leather tanning process.
- Understand and apply laws of photochemistry and surface chemistry.
- Describe different kinetics law and reaction rate theories.
- Understand & explain four colligative properties.
- Understand and apply laws of thermodynamics in advance courses.

**Reference Books:**

1. G. M. Barrow- Physical Chemistry.
2. W. J. Moore- Physical Chemistry.
3. Bahl And Tuli- Essentials Physical Chemistry.
4. Sharma and Sharma- A Text Book of Physical Chemistry.
5. S. Glasstone-Text Book of Physical Chemistry.
6. P. W. Atkins- Physical Chemistry.
7. Taylor and Taylor- Elementary Physical Chemistry.
8. Moron and Lando- Fundamentals of Physical Chemistry.
9. J. Bruce Brackenridge & Robert M. Rosenberg- The Principle of Physical Chemistry.
10. Samuel H. Maron& Carl F. Prutton- Principle of Physical Chemistry.

**CHM-103: Inorganic and Physical Chemistry Lab**

Credit	Class/week (h)	Total Class (h)
1.5	3.0/Group	45.0/Group

Lab based of the content of CHM-101 and CHM-102

**ME-101: Engineering Drawing**

Credit	Class/week (h)	Total Class (h)
1.5	3.0/Group	45.0/Group

**Learning Objectives:**

- To know about different types of drawing equipment
- To know how to represents letters & numbers in drawing sheet
- To know about different types of projection
- To know projection of points, straight lines, solids etc.
- To know development of different types of surfaces.

**Course Contents:**

Drawing equipment and the use of instruments; Basic drafting techniques, planning of drawing sheet. Dimensioning, types of lines.

Development of surfaces of prism, pyramids, cylinders and cones, Geometrical curves including plane curves; Cycloid, Hypocycloid, and the Involute. Lettering, numbering.

Orthographic projection. Isometric projection. Auxiliary projection. Sectional view. Assembly drawing. Perspective. Drawing of gear tooth profile cam profile.

**Learning Outcomes:** Upon completion of the course, the students should be able to

- know about different types of drawing equipment
- know how to represents letters & numbers in drawing sheet
- know about different types of projection
- know projection of points, straight lines, solids etc.
- know development of different types of surfaces.

**HUM-101: Employability Skills-I**

Credit	Class/week (h)	Total Class (h)
1.5	3.0/Group	45.0/Group

**Learning Objectives:**

- To develop ability to gain key strategies and expressions for communicating with professionals and non-specialists.
- To improve the skills of writing, for example, report or letter writing.

**Course Contents:**

**Language:** Its function as a primary means of communication to the technologist, writing, speaking, listening and reading, difference between written and spoken language, Language appropriate to task. Planning-format, paragraph heading, context, vocabulary etc. Listening, understanding and speaking Skill: Effective Communication between speaker and listener, Techniques of description, Uses of Visual aids. Reading skill: Technical literature, Books, Magazines, and Scientific Journals etc. Definition of Communication:

Sender-Message + Encoding-Medium-Receiver + Decoding-Feed back

**Different types of Communication:** Intrapersonal communication, Interpersonal Communication

Small group Communication, Organizational Communication, Intercultural Communication

Mass Communication etc. Significance of Communication:

Special significance of Communication in corporate and multi-national business organizations.

**Use of Communication by Management:** Written notice, Face-to-face conversation, Group meeting, Seminar/conferences Organizational

Communication Network: Vertical Communications Down-ward Communication and upward Communication, Horizontal Communication, Systems of Communication: Stimulus to Communication, Communication components

**Letter Writing:** Drafting private letters, Applications, Letters of complaint, Letters to the press, Apology and Explanation, Request letters, Business letters-Planning your letters, Selecting formats, Using short-cuts, Evaluating letters.

**Characteristics of Business letters:** Kinds of letter, purpose of 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, Industrial reports etc. Proposals: For new equipment, increasing production, Description of visits, Experiments etc.

Explaining: Process explaining, Complaining, Reporting damage etc.

**Learning Outcomes:**

- Recognize, explain, and use the formal elements of specific genres of organizational communication: white papers, recommendation and analytical reports, proposals, memorandums
- Understand how to critically analyze data from research; incorporate it into assigned writing clearly, concisely, and logically; and attribute the source with proper citation.
- Practice the unique qualities of professional rhetoric and writing style, such as sentence conciseness, clarity, accuracy, honesty, avoiding wordiness or ambiguity, using direct order organization, readability, coherence and transitional devices.

**Reference Books:**

1. Gartside's Model Business Letters and Other Business Documents, Shirley Taylor.
2. Business correspondence and Report Writing, R. C. Sharma & Krishna Mohan.
3. The Complete Degree General English Grammar and Composition, Amjad & Hoq.
4. Advanced Lerner's Degree General English, Chowdhury & Hossain.
5. High School English Grammar & Composition-PC. Wren and H. Martin.
6. Business Communication Systems and Application, Betty R. Ricks & Kay F. Gow, John Wiley & Sons, USA.
7. A University Grammar of English-Randolph Quirk and Sidney Greenbaum.
8. A Practical English Grammar-A.J. Thomson/A.V. Martinet (Latest edition).

**LE-102: Field Tour**

Credit	Class/week (h)	Total Class (h)
1.0	-	-

The students shall have a daylong visit of one relevant industry.

**First Year (2<sup>nd</sup> Semester)**

**LE-103: Leather Processing-I**

Credit	Class/week (h)	Total Class (h)
3.0	3.0	45.0

**Learning Objectives:**

- To know different stages of pre-tanning process
- To understand the importance of different stages of pre-tanning
- To comprehend the chemistry and mechanism of unhairing and liming
- To learn the methods of pre-tanning processes

**Course Contents:**

**Preservation / curing of hides and skins:** Introduction, objectives and principles of preservation, short and long terms preservation, methods of preservation/curing, advantages and disadvantages of different types of curing, factors affecting preservation / curing process.

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

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

**Soaking:** Objects and mechanism of soaking, soaking of green, wet-salted, dry-salted and dried (flint)hides and skins, enzymatic soaking, factors influencing the soaking process, role of hyaluronic acid in soaking, aids and controls in soaking, cleaner methods of soaking, eco-friendly process technologies in soaking; enzymetic soaking, soaking defects and their remedies, Green fleshing- its advantages and limitations for the production of quality leather.

**Unhairing and Liming:** Objectives of unhairing and liming, types of unhairing and liming, hair saving method, hair burning method, advantage and disadvantage of hair saving method and hair burning method,immunization of keratin, swelling of collagen based on Dornan’s theory, mechanism of unhairing, sulphide free unhairing system, enzymetic in unhairing, control of enzymatic unhairing, advantages and disadvantages of enzymatic unhairing, scope for hair utilization or disposal, prevention of H<sub>2</sub>S emissions from lime effluents.

**Fleshing** Objectives of fleshing, types of fleshing, advantage and disadvantage of fleshing.

**Deliming and bating:** Objectives of delimiting and bating, selection of delimiting agents, test of delimiting, mechanism of bating, effect of bating on leather quality, acid bating, alkali bating, advantage and disadvantage of acid bating over alkaline bating, polluting emissions in delimiting and bating, cleaner technologies options (ammonia free) in delimiting and bating, enzyme working mechanism in bating, solvent free degreasing system. Chemistry of proteolytic enzymes used for bating, necessity of bating, Its preparation and controls for desired properties of leather.

**Pickling:** Acid binding capacity of collagen, use of organic acids or salts in pickling, its necessity and controls, concept of, de-pickling.

**Degreasing** Objects and necessity of degreasing, different systems and methods.

**Learning Outcomes:** At the end of the course the students will be able to:

- to explain the necessity of different stages of pre-tanning process
- to elucidate the methods of soaking, liming, de-liming, pickling and degreasing
- demonstrate different process of leather making like soaking, liming, delimiting, bating, pickling and tanning

**Reference Books:**

1. Theory and Practice of Leather Manufacture- K.T. Sarkar
2. Tanning Chemistry, The Science of Leather-Anthony D Covington
3. Possible Defects in Leather Production-Gerhard John
4. Introduction to the Principles of Leather Manufacture- S. S. Dutta, 4th Edn. I. L. T. A.,Calcutta.
5. Chemistry & Technology of Leather-Roddy, O` Flaherty & Lollar, Vol. 2 & 3. Robert E. Kreiger Publishing Co.,N. Y.
6. Chemistry of Tanning Processes – K. H. Gustavson, Academic Press N. Y.
7. Chemistry of Vegetable Tannins –E. Haslam, Academic Press, N. Y.
8. Fundamentals of Leather Manufacture – Eckhart Hidemann.
9. Theory and Practice of Leather Manufacture –K. T. Sarkar, Macmillan India Press, Madras.
10. Leather Technician`s Handbook –J. H. Sharphouse, Vernon Lock Ltd., 125 High Holborn, London W-C1.

**LE-104: Leather Processing-I Lab**

Credit	Class/week (h)	Total Class (h)
1.5	3.0/Group	45.0 /Group

**Learning Objectives:** The aim of this course is to:

- Introduce students to quantitative & qualities methods for conducting meaningful inquiry and practical.
- Enhance the students’ ability to analyze and critically evaluate the issues of practical in the realm of leather manufacturing engineering.
- Enhance knowledge and skills of student for designing and conducting an academic practical independently.

**Course Contents:**

1. Curing of freshly flayed cowhide and goatskin with sodium chloride (Common salt) and its effect on water content at different time interval.
2. Enzyme soaking of cow hides and goat skins
3. Determination of rate of water uptake and degree of swelling of cow hides and goat skins during soaking.
4. Paint unhairing of wet salted goat skins and sheep skins
5. Liming with slaked lime and sodium sulphide with and without enzyme.
6. Delimiting of cow hide with boric acid, lactic acid, ammonium and ammonium sulphate.
7. Bating of goat skins with pancreatic bate.
8. Determination of the rate of acid uptake by cow hides during the pickling.
9. Effect of sodium chloride on pickling
10. Identification of leather based on pore structure (Grain patterns).
11. Manufacture of chrome- tanned leather.

**Learning Outcomes:** At the end of the course the students will be able to:



- Display familiarity with a broad array of methods and approaches that are used within the industry.
- Demonstrate practical competence in critical thinking by presenting and evaluating arguments in an academic fashion.
- Develop a manufacturing hypothesis and frame the manufacturing problem with the correct methodology.
- Know how to write a process recipe using mixed methods of practical.
- Apply practical mythological tools and techniques for conducting research & development in the areas of leather engineering.

**Reference Books:**

1. Theory and Practice of Leather Manufacture- K.T. Sarkar
2. Tanning Chemistry, The Science of Leather-Anthony D Covington
3. Possible Defects in Leather Production-Gerhard John
4. Introduction to the Principles of Leather Manufacture- S. S. Dutta, 4th Edn. I. L. T. A.,Calcutta.
5. Chemistry & Technology of Leather-Roddy, O` Flaherty & Lollar, Vol. 2 & 3. Robert E. Kreiger Publishing Co.,N. Y.
6. Chemistry of Tanning Processes – K. H. Gustavson, Academic Press N. Y.
7. Chemistry of Vegetable Tannins –E. Haslam, Academic Press, N. Y.
8. Fundamentals of Leather Manufacture – Eckhart Hidemann.
9. Theory and Practice of Leather Manufacture –K. T. Sarkar, Macmillan India Press, Madras.
10. Leather Technician`s Handbook –J. H. Sharphouse, Vernon Lock Ltd., 125 High Holborn, London W-C1.

**CSE-101: Fundamentals of Computer and Information Technology**

Credit	Class/week (h)	Total Class (h)
3.0	3.0	45.0

**Learning Objectives:**

- To aim at imparting a basic level computer knowledge for the students.
- To understand how a computer operates, and how a computer process and store data.
- To learn the basic knowledge on a computer network and other associated things related computers.
- To learn the Information and Data management as well as the functionalities of Information System.

**Course Contents:**

**Computer Architecture:** Introduction to computer and its history, Organization and architecture of computer, Internal Mechanism of Computer, Computer hardware and Software, Software classification with its development phases, Operating system and its components.

**Computer Software:** Operating system concepts, Software, Software classification with its development phases, Operating system and its components.

**Computer Programming Basics:** Introduction, Basics of Computer programming, Computer Networks and Internet: Concepts of network, different types of network and topologies, study of LAN concepts and operation, hardware and software for networks, data transmission, network architectures, study of connectivity between LAN and wide area networks, Networking Protocols, Mobile network, Different types of mobile network, GSM, CDMA, World wide web including navigating the internet, Internet services: Telnet, FTP, e-mail, www, internet, Intranet, Bluetooth, Wi-Fi, etc.

**Information and Data Management:** Introduction to Data and Information, Data and Management Strategy, Database Concept, Types of Database, Database Management.

**Information System:** Introduction of Information System, the Decision-Making Process, System Approach to Problem Solving, the Structure of Management Information System, Kinds of Information Systems. Basics of Enterprise Resource Planning (ERP), Evolution of ERP, Enterprise Systems in Large Organizations, Benefits and Challenges of Enterprise Systems

**Learning Outcomes:**

- Makes students aware of the computer and information Technologies, their internal mechanism and classifications.
- Teaches the basic of the Internet, mobile, and wireless communications.
- Students learn the fundamental of computer programming as well as software development process and networking.
- Describes the Information System briefly with real example.

**Reference Books:**

1. S. Frence- Computer Science.
2. Warford- Computer Science.
3. Peter Norton – An Introduction to Computer Science
4. L. Rosch- Hardware Bible, Baraddy Publishing, Indianapolis.
5. Clive Finkelstein – An Introduction to Information Engineering
6. Ian Macdonald - Information Engineering
7. James Martin - Information Engineering: Introduction
8. Kenneth C. Laudon and Jane P. Laudon- Management Information Systems: Managing the Digital Firm
9. James A. O'Brien George M. Marakas - Introduction to Information System

**CSE-102: Fundamentals of Computer and Information Technology Lab**

Credit	Class/week (h)	Total Class (h)
1.5	3.0/Group	45.0/Group

**Learning Objectives:**

- To learn Office Word, Excel and PowerPoint to students.

- To understand the basic of preparing his personnel/business letters, viewing information on Internet (the web), sending emails, using internet banking services etc.
- To understand the basics of computer programming and database

**Course Contents:**

**Operating system:** Students will learn how to operate a computer in two basic environments- dos and windows and to install DOS, windows operating system.

**Word and Power Point:** Students will learn to use a popular word processing software to create a camera-ready test file complete with figures, columns and tables. They will also learn to make presentation for business meeting or any conference.

**Spread sheet:** Students will learn how to use a popular spread sheet to maintain a minor book keeping, statistical and graphical analysis off data.

**Data base:** Students will learn how to design a database structure/table.

**Programming:** student will learn very basic of computer programming.

**Learning Outcomes:**

- Students will learn to use a popular word processor to create a camera-ready test file complete with figures, columns, and tables.
- Students will have the ability to prepare power point and present effectively.
- Students will learn how to use a popular spreadsheet to maintain a minor book keeping, statistical and graphical analysis of data.
- Students can understand how to design a database structure/table.
- Student will learn the basic of computer programming

<b>MTH-102: Calculus</b>		
Credit	Class/week (h)	Total Class (h)
3.0	3.0	45.0

**Learning Objectives:**

- 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.
- To learn integral calculus, to the techniques of integration and to some of the applications of integration to physical problems.
- To learn the application of calculus in commerce and economics.

**Course Contents:**

**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.

**Application of Differential calculus in commerce and economics:** Cost Function, Demand Function, Revenue function, Profit Function, Break-Even Point, Average and Marginal Functions.

**Integral calculus: Integrals:** 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.

**Application of integration to commerce and economics:** Determination of cost function, Determination of Total Revenue Function.

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

**Learning Outcomes:**

- Interpret a function from an algebraic, numerical, graphical and verbal perspective and extract information relevant to the phenomenon modeled by the function.
- Understand the concept of limit and continuity of a function at a point graphically and algebraically using appropriate techniques.
- Interpret the derivative of a function at a point as the instantaneous rate of change and as the slope of the tangent line, and understand the consequences of Rolle 's Theorem and the Mean Value theorem for differentiable functions.
- Evaluate integrals using different techniques of integration.
- Learn how to calculate the area between curves, volumes of solids of revolution, surface area, arc length using integration.

**Reference Books:**

1. H. Anton et al, Calculus with Analytic Geometry.
2. E.W. Swokowski, Calculus with Analytic Geometry.
3. L. Bers& P. Karal, Calculus.
4. S. Lang, A First Course in Calculus.
5. frank s budnick; mathematics for commerce economics and business.

<b>CHM-104: Organic and Collagen Chemistry</b>		
Credit	Class/week (h)	Total Class (h)
3.0	3.0	45.0

**Learning Objectives:** The learning objectives of this course are to-

- Make students understand the fundamental principles of organic chemistry, synthesis and reactivity of important functional groups.
- gain experience to predict the functional group transformations, simple reaction mechanisms, and the synthesis of organic molecules by multi-step synthesis strategies

- Help students to understand the chemical reactions occur during leather processing.
- acquire concepts of metal-collagen cross linking in leather.

**Course Contents:**

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

**Organic tanning agents and compounds:** Chemistry of condensed and hydrolysable tannins proantho cyanidins, dimers, trimers and other oligomers. Chemistry of sulphonyl chloride, quinone, oxazolidine, phosphonium and other organic tanning agents. Methods of preparation of vegetable tannin extracts, spray dried vegetable tannins, generation stability of organic reactive intermediates: carbocations, carboanions, free radicals, carbenes, benzyne, nitrenes, amines, diazonium salt formation, coupling reaction, azo compounds, azo dye, banned amines.

**Amino acids and proteins:** Introduction, classification of amino acids, synthesis of amino acids, physical and chemical properties of amino acids, synthesis of polypeptides, characteristics of proteins, classification of proteins, structure of proteins.

**Molecular structure of collagen:** Arrangement of amino acid, peptide chain, collagen genes and RNA, amino acid composition and primary structure – Double helix structure, collagen triple helix; helix stabilization–synthetic collagen like polypeptides, denaturation, renaturation, stabilization. X-ray diffraction studies of collagen, electron microscopic appearance of collagen.

**Properties of collagen fibre:** diameter, strength, three dimensional weave of collagen in leather, water retention capacity, inter weave, angle of inter weave in leather, bonding, tensile strength, flexibility.

**Collagen crosslinks:** Crosslink, properties of crosslinks - intramolecular and intermolecular crosslinks, difunctional and multifunctional crosslinks, lathyrism and crosslinks, analysis of collagen crosslinks.

**Characterization of collagen:** Chromatographic properties, electrophoretic properties. Microscopy and spectroscopy techniques for collagen morphology. Non-invasive methods of liquid and solid imaging of biological specimen and their relevance to location of defects in hides/skins.

**Learning Outcomes:** Upon completion of this course students will be able to-

- illustrate the hybridization and geometry of atoms and the three-dimensional structure of organic molecules
- explain the fundamental properties, reactivity and stability of an organic molecule based on structure, including conformation and stereochemistry
- understand the behavior of organic tanning material
- gather knowledge on amino acid, protein structure in leather

- enhance knowledge on DNA, three-dimensional collagen structure, crosslinking and strength of leather fibre.

**Reference Books:**

1. Morrison and Boyd- Organic Chemistry.
2. B. S. Bahl and ArunBahl- Organic Chemistry.
3. L. Finar- Organic Chemistry.
4. Andrew Streitwieser, Clayton H. Heathcock, Edward M. Kosower- Introduction to Organic Chemistry.
5. Amend, Mundy, Arnold- General Organic and Biological Chemistry.
6. Fred O. Flaherty, Roddy, T.W Roddy and Robert M. Lollar Ed., 'The Chemistry of Technology of Leather', Robert E. Krieger Publishing Co., New York 1978.
7. Gustavson, K. H., 'Chemistry of Tanning Processes', Academic Press, New York, 1958.
8. Krishnan, V, Ed. 'Trends in Collagen', Proceedings of the Indian Academy of Sciences (Chemical Sciences), Vol. 111, No. 1, Indian Academy of Sciences, Bangalore, 1999.
9. G. N. Ramachandran (Ed) "Chemistry of Collagen, Treatise on collagen Vol.1, Academic Press, 1967.
10. Nimni, M. E.(ed) Collagen: Vol.3, Boca Raton CRC, 1988.

<b>CHM-105: Organic and Collagen Chemistry Lab</b>		
Credit	Class/week (h)	Total Class (h)
1.5	3.0/Group	45.0/Group

Lab based on the content of CHM-104.

<b>PSE-101: Polymer Science and Engineering</b>		
Credit	Class/week (h)	Total Class (h)
3.0	3.0	45.0

**Learning Objectives:**

- To know the background of macromolecular science, importance of monomers and polymers, structure, properties and classification of polymers.
- To understand basic aspects of the solution properties of polymers, interactions and the relationship to chemical structure, including phase behavior and the measurement of molecular weight.
- To gather the basic knowledge of collagen chemistry

**Course Contents:**

**Polymers:** Introduction, classifications, polymerization, mechanisms, polymerization techniques, bulk, solution, suspension, emulsion, solid and liquid phase. polycondensation techniques, melt, solution and interfacial.

**Step-growth polymerization,** Functionality, Crosslinking; PET manufacturing; Chain growth polymerization, Free radical polymerization, Kinetics of free-radical initiation,

termination, chain transfer, Mayo's equation, cage effect, autoacceleration, inhibition and retardation;

Polypropylene manufacturing; Acrylic manufacturing; Atom transfer radical polymerization, ionic polymerization, ring opening polymerization; Nylon-6 manufacturing; Co-polymerization and its importance. Copolymer equation, reactivity ratio, tailor making of copolymer properties; Techniques of chain polymerization; Bulk, solution, emulsion, microemulsion and suspension polymerization; chemical modification of fibres; Polymer solution, Flory's theory; Interaction parameter.

**Molecular weight and its distribution by:** End group analysis, osmometry, light scattering, ultra-centrifugation, gel permeation chromatography, intrinsic viscosity; Spectroscopic methods of polymer characterization such as, FTIR, UV, NMR and others.

**Compounding of polymers** - fillers, plasticizers, antioxidants, UV stabilizers, colouring agents and flame retardants. Polymer processing - compression, moulding, injection, extrusion, calendaring and film casting; Preparation and properties of polyesters, polyamides, epoxy and silicone polymers; Conductive polymers, super absorbent polymers.

Recycling, remoulding, depolymerisation, incineration, biodegradable polymers. Polymer Degradation, Definition, types, different factors affecting polymer degradation, stabilizers etc.

**Learning Outcomes:** After completing the course the students will understand

- the basic concept of monomers, polymers, structure, properties and classifications of polymers by origin, processing, mechanism
- different techniques of polymerization methods and
- the properties and application of common polymeric materials used in leather products and footwear manufacturing.

**Reference Books:**

1. Gowrikar V. R. , Viswanathan N.V. and JayadevSreedhar, "Polymer Science", New Age Publication, New Delhi 2003.
2. Gupta V. B. and Kothari V. K., "Manufacture Fibre Technology", Chapman and Hall Publication, UK 1997.
3. Billmeyer F. M., "Text Book of Polymer science", Wiley Inter Science, New York, 2002.
4. Odion G., "Principles of Polymerization", John Wiley, UK, 2002.
5. Woodings C., "Regenerated Cellulose Fibres", Woodhead Publishing, UK, 2000

**PSE-102: Polymer Science and Engineering Lab**

Credit	Class/week (h)	Total Class (h)
1.5	3/Group	45.0/Group

**Learning Objectives:** This course will make the students skilled about

- Synthesis of different types of polymer
- Identification of different types of polymeric materials and their characterization.
- Viscosity determination polymer etc.

- Application of polymer in leather products manufacturing.

**Course Contents:**

1. Identification of polymers use in leather, footwear and leather products manufacturing.
2. Determination of chemical compositions of selected polymers.
3. Determination of ionic character of selected polymers and surfactants.
4. Determination of viscosity of acrylic, polyurethane, butadiene binders.
5. Determination of electrolyte stability of acrylic, polyurethane, butadiene binders.
6. Determination of solvent stability of acrylic, polyurethane, butadiene binders
7. Determination of film hardness of acrylic, polyurethane, butadiene binders.
8. Determination of adhesive strength 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
11. Determination of flexibility of finish film based on acrylic, polyurethane, butadiene binders.
12. Determination of water resistance of finish film based on acrylic, polyurethane, butadiene binders, silicones-based compounds and nitrocellulose-based compounds
13. Chromatographic analysis of plasticizer.

**Learning Outcomes:** After completion of this course students will be able to

- Identify leather, adhesives, fibers, rubbers and plastics
- Synthesis of different types of polymer and their characterization
- Apply knowledge to find out the application of polymer in leather products manufacturing.
- Determine the viscosity of polymer.
- Application of polymer in leather products manufacturing.

**Reference Books:**

1. Billmeyer F.W. Jr. - Text Book of Polymer Science.
2. Fried J.R. - Polymer Science & Technology.
3. Gowariker V. R. -Polymer Science.
4. Arora M.G. & Singh M. - Polymer Chemistry.
5. Reed R. (Ed.) - Science for Students of Leather Technology.
6. Misra G.S. - Polymer Chemistry.
7. Bienkiewicz K. - Physical Chemistry of Leather Making.
8. Heidemann E. - Fundamentals of Leather Making.
9. Parry D.A.D. & Creamer L.K. - Fibrous Proteins: Scientific, Industrial and Medical aspects.
10. Finar I. L. - Organic Chemistry Volume-II

**Second Year (1<sup>st</sup> Semester)**

**LE-201: Leather Processing-II (Mineral)**

Credit	Class/week (h)	Total Class (h)
3.0	3.0	45.0

**Learning Objectives:**

- To know the mechanism of mineral tannage
- To get idea about various salts used in mineral tannage
- To understand the mechanism of chrome tanning
- To learn about different kind of mineral tannage

**Course Contents:**

**Theory and behaviour of group elements:** Werners co-ordination theory, behavior of group elements, chromium, aluminium, zirconium, iron, titanium, difference between salts of these elements.

**Tanning:** Basic concept, theoretical background, tanning potentials of various metals, non-metals, natural and synthetic materials, tanning characteristics, hydrothermal stability and shrinkage temperatures of various tanning materials.

**Chrome Tanning:** Chromium complexes and their structures, study on the phenomena of hydrolysis, ololation, 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, influence of reducing agent on nature of chrome complexes mechanism of chrome tanning, variable parameters of chrome tanning.

Emission in chrome tanning, environmental impact in chrome tanning, chrome balance in leather manufacturing; optimization of the process parameters, high exhaustion-modification of the tanning process, direct chrome recycling, chrome recovery and reuse, recovery without reuse, chrome-free leather, wet-white concept, chrome free leather-other mineral tannages.

**Aluminium Tanning:** Tanning behaviour of salts of aluminium, study on phenomena of ololation, oxolation and masking in aluminium salts, mechanism of aluminium tannage.

**Zirconium Tanning:** Tanning behaviour of salts of Zirconium, factors affecting Zirconium Tannage, mechanism of zirconium tannage, Tanning behaviour of salts of Iron and Titanium, Tannages involving the use of Sodium silicate and poly phosphates.

**Other tanning Operations:** Titanium tanning, Iron tanning

**Learning Outcomes:**

After completing this course students will be able to gather knowledge about mineral and they can learn how to use various salt in mineral tannage tannage to produce quality leather.

**Reference Books:**

1. Anthony D. Covington- Tanning Chemistry The Science of Leather
2. Dutta S.S.-An introduction to the principles of leather manufacture.
3. Krystof Bienkiewicz - Physical chemistry of leather making.
4. Flaharty, Roddy, Lollar-The chemistry and technology of leather (vol-2and3)

5. Sarkar K.T.-Theory and Practice of Leather Manufacture.
6. Reed R. -Science for Students of Leather Technology.
7. BASF Manual -Pocket Book for the Leather Technologist.
8. Sarphouse J.H.-Leather Technicians Handbook.
9. Heidenmann Eckhart - Fundamentals of Leather Manufacture.
10. Procter H.R.-The Principle of Leather Manufacture.

**LE-202: Leather Processing-II Lab**

Credit	Class/week (h)	Total Class (h)
1.5	3.0/Group	45.0 /Group

**Learning Objectives:** The aim of this course is to:

- Introduce students to quantitative & qualities methods for conducting meaningful inquiry and practical.
- Enhance the students' ability to analyze and critically evaluate the issues of practical in the realm of leather manufacturing engineering.
- Enhance knowledge and skills of student for designing and conducting an academic practical independently.

**Course Contents:**

1. Manufacturing of Shoe upper leather.
2. Manufacturing of lining leather
3. Manufacturing of semi chrome leather
4. Manufacturing of shrunken grain leather
5. Manufacturing of Fur skin leather.
6. Manufacturing of Screen/block printed leather.
7. Manufacturing of Glaze kid leather.
8. Manufacturing of Nubuck leather.
9. Manufacturing of Nappa leather/ suede leather.
10. Manufacturing full vegetable natural crust leather.

**Learning Outcomes:** At the end of the course the students will be able to:

- Display familiarity with a broad array of methods and approaches that are used within the industry.
- Demonstrate practical competence in critical thinking by presenting and evaluating arguments in an academic fashion.
- Develop a manufacturing hypothesis and frame the manufacturing problem with the correct methodology.
- Know how to write a process recipe using mixed methods of practical
- Apply practical mythological tools and techniques for conducting research & development in the areas of leather engineering.

**Reference Books:**

1. Theory and Practice of Leather Manufacture- K.T. Sarkar
2. Tanning Chemistry, The Science of Leather-Anthony D Covington
3. Possible Defects in Leather Production-Gerhard John

4. Introduction to the Principles of Leather Manufacture- S. S. Dutta, 4th Edn. I. L. T. A., Calcutta.
5. Chemistry & Technology of Leather-Roddy, O` Flaherty & Lollar, Vol. 2 & 3. Robert E. Kreiger Publishing Co.,N. Y.
6. Chemistry of Tanning Processes – K. H. Gustavson, Academic Press N. Y.
7. Chemistry of Vegetable Tannins –E. Haslam, Academic Press, N. Y.
8. Fundamentals of Leather Manufacture – Eckhart Hidemann.
9. Theory and Practice of Leather Manufacture –K. T. Sarkar, Macmillan India Press, Madras.

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**LE-203: Leather Biotechnology**

Credit	Class/week (h)	Total Class (h)
3.0	3.0	45.0

**Learning Objectives:** The learning objectives of this course are:

- To familiarize the students with those concepts that are basic to prepare of specimen for sectioning, free hand sectioning, paraffin embedding method, freezing method, staining techniques.
- To understand the bacteriology and mycology.
- To provide knowledge in Biocides, Fungicides and Insecticides.
- To develop biological processes of waste treatment to reduce the impact of pollution.
- To know about merits and demerits of different methods of sterilization.

**Course Contents:**

**Histology of hides, skins and leather:** Preparation of specimen for sectioning, different method of sectioning; methods for staining, stock solutions for staining; mounting techniques, quick test for defect identification.

**Bacteriology:** Bacteria and its morphology, functions of bacteria, biological needs of bacteria, nomenclature, classification, structure, nutritional requirements; growth of an organism in a medium; infection and immunity, dissociation and association of bacteria; different methods of staining of bacteria.

**Mycology:** Introduction, spores and its types; classification of moulds, morphology of moulds, biochemistry of moulds, laboratory technique for the study of mould; microbiological problems of leather industry and their remedy.

**Biocides, Fungicides and Insecticides:** Biocides- definition, classification and chemistry of bactericides, fungicides and insecticides; diseases and defects on hides, skins and leather caused by bacteria, insects and moulds with their remedy; application of bactericides, fungicides and insecticides in leather industry.

**Control of microorganism:** General principles of microbial control, control of undesirable microorganisms by physical means, chemical disinfectants and their use; sterilization and its kinds, method and means of sterilization, merits and demerits of different methods of sterilization; cause of sterilization failure; pasteurization.

**Microbial fermentation:** Methods of microbial fermentation, types of fermentations, fermentation equipment; preparation of media, preparation of inoculums, separation and purification of products.

**Enzymology:** Enzyme in leather industry; microbial cells in leather and allied industries; principle of industrial enzymology, enzyme activity; source of enzyme, selection of micro-organisms, mechanism of enzyme biosynthesis, manipulation of enzyme biosynthesis; particular technical enzyme preparation of amyolytic, cellulose, proteolytic, lactase, proteases, lipases, glucose oxidase, catalase, glucose isomase enzymes.

**Learning Outcomes:** After completion of this unit the students will able to:

- Familiarize the students with those concepts that are basic to prepare of specimen for sectioning, free hand sectioning, paraffin embedding method, freezing method, staining techniques.
- Understand the bacteriology and mycology.
- Provide knowledge in Biocides, Fungicides and Insecticides.
- Conduct different biological processes of waste treatment to reduce the impact of pollution.
- Learn about merits and demerits of different methods of sterilization.
- Evaluate and interpret quantitative data using the scientific method
- Able to practice safety and proper techniques in the laboratory

**Reference Books:**

1. Stanbury P.F. and Whitaker A. - Principles of Fermentation Technology, Pergamon Press, 1984.
2. Lechniger -Biochemistry: The Molecular Basis of Cell Structure and Function, 2nd edition, Kalyani Publishers, Ludhjana, 1978.
3. Stent G.S. and Calendar C. - Molecular Genetics: An Introductory Narrative, 2nd Edition, Freeman, San Francisco, 1978.
4. Wiseman A.-Topics in Enzyme and Fermentation Biotechnology' (Several volumes). Vol.2.
5. R.Puvanarishnan, Susil C. Dhar- Enzyme Technology In Beamhouse Practice.
6. Srivastava S. and Singhal V. — Fundamentals of Microbiology.
7. J. Nicklin [et al] — Microbiology.
8. Tortora [et al] — Microbiology An Introduction.
9. Prescott [et al] — Microbiology.
10. P. Chakraborty — A Text book of Microbiology.

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**LE-204: Leather Biotechnology Lab**

Credit	Class/week (h)	Total Class (h)
1.5	3.0/Group	45.0/Group

**Learning Objectives:** The learning objectives of this course are:

- To familiarize the students with the basic of comparative microscopic study of Cow hides /Buffalo hides /Goat skin/Sheep skin at liming, bating, tanning and finishing stages.

- To practice counting of bacteria in raw hides and skins, tape water, drain water, soak liquor, bate liquor and tannery drain liquor.
- To isolate and identify of moulds in pelts, wet-blue, and vegetable tanned and finished leathers, stored leather, and shoe and leather goods.
- To provide knowledge in Biocides, Fungicides and Insecticides.
- To develop biological processes of waste treatment to reduce the impact of pollution.
- To prepare glue and gelatin from hides and skins/fleshing/ bones,
- To produce of neat's foot oil from hooves.
- To produce of Sausage casing from spleens. Stomach, etc.
- To manufacture of musical string from stomach.
- To produce of protein binder from blood.
- To develop of blood meal for poultry.
- To produce of different enzymes from slaughterhouse by- products.
- To determine of degree of activity of enzyme.

**Course Contents:**

1. Section cutting, staining and mounting of samples.
2. Microscopic study of leather defects due to moulds/ insect/bacteria/fungi.
3. Comparative microscopic study of Cow hides /Buffalo hides /Goat skin/Sheep skin at liming, bating, tanning and finishing stages.
4. Cultivation, isolation, staining and identification of bacteria.
5. Counting of bacteria in raw hides and skins, tape water, drain water, soak liquor, bate liquor and tannery drain liquor.
6. Isolation and identification of moulds in pelts, wet-blue, and vegetable tanned and finished leathers, stored leather, and shoe and leather goods.
7. Preparation of glue and gelatin from hides and skins/fleshing/ bones.
8. Preparation of Neat's foot oil from hooves.
9. Preparation of Sausage casing from spleens. Stomach, etc.
10. Preparation of musical string from stomach.
11. Preparation of protein binder from blood.
12. Preparation of blood meal for poultry.
13. Preparation of Tallow from hides and skins/ fleshing.
14. Preparation of different enzymes from slaughterhouse by- products.
15. Determination of degree of activity of enzyme.

**Learning Outcomes:** After completion of this unit the students will able to:

- Familiarize the students with the basic of comparative microscopic study of Cow hides /Buffalo hides /Goat skin/Sheep skin at liming, bating, tanning and finishing stages. Understand the bacteriology and mycology.
- Perform counting of bacteria in raw hides and skins, tape water, drain water, soak liquor, bate liquor and tannery drain liquor.
- Conduct different biological processes of waste treatment to reduce the impact of pollution.

- Prepare glue and gelatin from hides and skins/fleshing/ bones.
- Develop Sausage casing from spleens. Stomach, etc.
- Prepare different enzymes from slaughterhouse by- products.
- Manufacture musical string from stomach, protein binder from blood, blood meal for poultry.
- Determine the degree of activity of enzyme.

**Reference Books:**

1. Stanbury P.F. and Whitaker A. - Principles of Fermentation Technology, Pergamon Press, 1984.
2. Lechniger -Biochemistry: The Molecular Basis of Cell Structure and Function, 2nd edition, Kalyani Publishers, Ludhjana, 1978.
3. Stent G.S. and Calendar C. - Molecular Genetics: An Introductory Narrative, 2nd Edition, Freeman, San Francisco, 1978.
4. Wiseman A.-Topics in Enzyme and Fermentation Biotechnology' (Several volumes). Vol.2.
5. R.Puvanarishnan, Susil C. Dhar- Enzyme Technology In Beamhouse Practice.
6. Srivastava S. and Singhal V. — Fundamentals of Microbiology.
7. J. Nicklin [et al] — Microbiology.
8. Tortora [et al] — Microbiology An Introduction.
9. Prescott [et al] — Microbiology.
10. P. Chakraborty — A Text book of Microbiology.

**MTH-201: Differential Equation and Numerical Methods**

Credit	Class/week (h)	Total Class (h)
3.0	3.0	45.0

**Learning Objectives:**

- To introduce the basics of differential equations and terminologies regarding them.
- To solve different types of ordinary differential equations and partial differential equations analytically using well-known techniques.
- To explore the utility of differential equations in modeling numerous physical and biological systems.
- To determine the approximate numerical solutions of mathematical problems that cannot always be solved by conventional analytical techniques.
- To demonstrate the importance of selecting the right numerical technique for a particular application, and carefully analyzing and interpreting the results obtained.

**Course Contents:**

**Ordinary Differential Equation:** 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.

**Modelling 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.

**Modelling 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. Finite difference methods for solving two-point linear boundary value problems.

**Learning Outcomes:**

- Formulate differential equations by removing arbitrary constants from algebraic relations and draw solutions curves using direction field. Construct and analyze graphical displays to summarize data.
- Classify first-order differential equations as separable, homogeneous, linear, exact, Bernoulli's etc. and solve them using appropriate methods.
- Know about higher order differential equations, their classifications and solve them using appropriate methods.
- Find numerical approximations to the roots of an equation by Newton method, Bisection Method, Secant Method, etc.
- Find numerical solution to a system of linear equations by Gaussian Elimination and backward substitution.
- Demonstrate the use of interpolation methods to find intermediate values for any given set of points.

**Reference Books:**

1. S. L. Ross, Differential Equation.

2. D. G. Zill, A First Course in Differential Equations with Applications.
3. H.J.H. Piaggio, An Elementary Treatise on Differential Equations.
4. Grewal. B.S., and Grewal. J.S., "Numerical methods in Engineering and Science", Khanna Publishers, New Delhi, 9<sup>th</sup> Edition, 2007.
5. Gerald. C. F., and Wheatley. P. O., "Applied Numerical Analysis", Pearson Education, Asia, New Delhi, 6<sup>th</sup> Edition, 2006.
6. Chapra. S.C., and Canale. R. P., "Numerical Methods for Engineers, Tata, McGraw-Hill, New Delhi, 5<sup>th</sup> Edition, 2007.
7. Brian Bradie. "A friendly introduction to Numerical analysis", Pearson Education, Asia, New Delhi, 2007.

CHM-201: Analytical Chemistry for Leather and Leather Products		
Credit	Class/week (h)	Total Class (h)
3.0	3.0	45.0

**Learning Objectives:** The major objectives of this course are to:

- Acquire fundamental knowledge on errors and statistics, gravimetric and volumetric methods chromatographic techniques analytical spectrometry, chemical analysis of leather and related chemicals, environmental analysis, laboratory automation and safety practice in laboratory.
- The course gives an overview of important use of selected classical and instrumental chemical quantitative analytical methods in leather manufacturing and a short introduction to their basic theory.

**Course Contents:**

**Introduction:** Evaluation of analytical results, units in measurements, uncertainty in measurement, accuracy and precision, Selectivity, Sensitivity, Specificity of chemical reaction, errors, minimization of errors, significant figure and computation, rejection of data- the Q test. Sampling.

**Gravimetric and volumetric methods:** Principles of gravimetric methods, conditions for precipitation co-precipitation and post-precipitation, precipitation from homogeneous solution. Principles of volumetric analysis, complexometric titration.

**Chromatographic techniques:** Introduction, principles, classification of chromatographic methods, partition and adsorption chromatography, instrumentation and application of paper, thin layer chromatography (TLC) and column chromatography.

**Ultraviolet-Visible spectrometry:** Introduction, principle, absorption laws, deviation from Beer's Law, instrumentation, principles, applications, molar extinction coefficient, measuring unknown concentration, absorbing species, absorption spectrum and  $\lambda_{max}$ , shifting of  $\lambda_{max}$ , solvent polarity effect on  $\lambda_{max}$ , Woodward-Fieser rules for  $\lambda_{max}$  calculation, application of transmission spectrophotometry to dyes.

**Chemical analysis of leather and related chemicals:** Tanning materials- Routine analysis of vegetable, analysis of chrome extract:  $Cr_2O_3$ , basicity.

**Analysis of leather:** moisture content, fats content, ash content, nitrogen and hide substance, degree of tannage, pH of leather sample, analysis of chrome tanned leather, alum tanned leather; formaldehyde tanned leather; Leather auxiliaries: casein, shellac, oils,



fats, waxes, acid value, saponification value, iodine value, unsaponifiable matter; determination of sulphide in alkaline liquors, determination of hydroxyproline in materials containing collagen.

**Environmental analysis:** Sampling procedures of waste water for analysis. Analysis of tannery wastewater sample: alkalinity, acidity, total solids, dissolved solids, suspended solids, sulphate, sulphide, chromium, settle able solid, banned amines, Identification of carcinogenic amine from a mixture of dyes, identification of benzidine-based dye.

**Laboratory automation:** Introduction, approaches to laboratory automation, principles of automation, planning for laboratory automation, automated instruments, microprocessor-controlled instruments: “smart” instruments, computers in analytical chemistry.

**Safety practice in laboratory:** Introduction, MAK values of working material that involved health hazard, list of harmful materials, carcinogenic working materials, emission protection law, danger symbols, regulations concerning the transportation of materials classified as dangerous goods, prevention of accidents and first aid in laboratory, hazard and hazard agents identification, hazard classification, hazard control, safety management, safety promotion and awareness creation, safety and emergency provisions.

**Learning Outcomes:** On completing this course:

- The students will have a theoretical and practical understanding of advanced analytical instruments.
- They will be able to analyze leather and leather related chemicals.
- They will be able to assess the quality of leather, footwear and leather products.
- They will be able to work in environmental research.

**Reference Books:**

1. Gary D. Christian- Analytical Chemistry
2. John Kenkel- Analytical Chemistry for Technicians
3. Skoog, West and Holler- Fundamental of Analytical Chemistry
4. Browning D. R. - Chromatography
5. Hatakeyama T. and Quinn F.X. - Thermal analysis.
6. Vogel A. I. - Text Book of Quantitative Chemical Analysis
7. P. K. Sarker - Analytical Chemistry for Leather Manufacture.
8. Dr. Sethi P.D. - High Performance Liquid Chromatography.
9. Hamilton, Hamiltoan-Thin Layer Chromatography.
10. Fifield and Haines-Environmental Analytical Chemistry.
11. UNIDO- Tannery and Environment.

**CHM-202: Analytical Chemistry Lab**

Credit	Class/week (h)	Total Class (h)
1.5	3.0/Group	45.0/Group

**Learning Objectives:** The learning objectives of this course are:

- To apply practical knowledge in analytical chemistry.
- To introduce the fundamental knowledge and skill of different tests in determining moisture content, fat content, acid value pH in leather and leather chemicals.

- To determine toxic metals and other toxic chemicals both in leather and tannery effluents.

**Course Contents:**

1. Determination of moisture content and pH in synthetic tanning materials.
2. Determination of acid value in supplied samples.
3. Determination of Iron in vegetable tanning extracts.
4. Determination of Chromium in vegetable tanning extracts.
5. Determination of Chromium in chrome tanning extracts.
6. Determination of chloride in alkaline tannery waste water.
7. Determination of hydroxyproline in collagen containing materials.
8. Determination of fat and other soluble substances in shoe upper leather.
9. Determination of originally combined SO<sub>3</sub> existing as neutralized sulphuric ester.
10. Determination of total free fatty acids: qualitative identification of surface-active groups.

**Learning Outcomes:** Upon completion of this course the students will be able to

- Analyze leather chemicals.
- Find out the amount of unused chemicals in tannery waste.
- Interpret different analytical quantitative experimental knowledge and skill to determine moisture content/pH in leather and in synthetic tanning materials.
- Learn the concentration of Cr, Fe in tannery waste liquor.

**Reference Books:**

1. Gary D. Christian- Analytical Chemistry
2. John Kenkel- Analytical Chemistry for Technicians
3. Vogel A. I. - Text Book of Quantitative Chemical Analysis
4. Sarker P.K. - Analytical Chemistry for Leather Manufacture.

**EEE-201: Fundamentals of Electrical and Electronics Engineering**

Credit	Class/week (h)	Total Class (h)
3.0	3.0	45.0

**Learning Objectives:**

- Understand the fundamentals of electronics within the field of electrical engineering.
- Understand diode circuits and models.
- Know how to use and analyze distribution circuits, cables and wiring systems
- Analyze amplifier circuits with feedback.
- Design electronic circuits for sensors

**Course Contents:**

**Electrical Engineering:** D.C. Current: D.C. fundamentals, Network Theorems, Generators & their characteristics, Motors & their characteristics, Speed control process.

**A.C. Current:** A.C. fundamentals, Flow of A.C. through inductance, capacitance and resistance Flow of A.C. through inductance, resistance and capacitance in series and in parallel, Power in A.C. Circuit, Power Factor and Power Factor Improvement, Resonance

in AC circuits, Transformer, Poly phase circuits, Induction motors. Its types & purpose. Sub-station equipment (HT, LT Switch gear etc.), Distribution board and sub-distribution board.

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

System protection: Types of faults, (transformer & motor) principles of protection, Protective devices-circuit breaker, Switches, starter etc.

**Electrical hazards:** 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 & Transducer, Integrated Circuit.

**Learning Outcomes:**

- Conduct standard tests and measurements, and to conduct, analyze, and interpret experiments related to electrical engineering technology.
- Recognize a variety of exciting high-tech products and systems enabled by electronics.
- Manipulate voltages, currents and resistances in electronic circuits.
- Demonstrate familiarity with basic electronic components and use them to design simple electronic circuits.

**Reference Books:**

1. A Textbook of Electrical Technology (vol: I & II), B. L. Theraja
2. Alternating Current Circuit, George F. Corkoran
3. Principles of Electronics, V.K. Mehta
4. Power System, V.K. Mehta

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**PHY-201: Physics and Electronics Lab**

Credit	Class/week (h)	Total Class (h)
1.5	3.0/Group	45.0/Group

**Learning Objectives:** The Objective of this course is to provide a broad training in Physics and Electronics principles with laboratory experiments. Demonstrate the students on various skills including; expertise with core physics concepts and basic electronic principles and their applications. This course will help the students to relate the physical phenomenon with the practical problems in engineering purposes, proficiency in measurements and dimensioning, critical thinking and data analysis. In future, it will help the students to function effectively in laboratory environment and conduct independent research towards the development of new devices and products using sophisticated physical concepts.

**Course Contents:**

**Part A: Physics**

1. Determination of the value  $Y$ ,  $\eta$  and  $\sigma$  for the material of a given wire by Searle's apparatus.
2. Determination of the modulus of rigidity of a cylindrical wire by dynamic method.
3. Determination of the thermal conductivity of bad conductor by Lee's method.
4. Determination of the specific heat of a liquid by the method of cooling.
5. Determination of the value of "g" by Kater's reversible pendulum.
6. Determination of the wavelength of sodium light by Newton's ring.
7. Verification of Ohm's law and measurement of low resistance by ammeter and voltmeter.
8. Determination of the refractive index of a material of a given prism by a spectrometer.
9. Determination of the grating constant of a plane diffraction grating.
10. Determination of the optical rotation of sugar solution (at six different concentrations) with the help of a polarimeter.

**Part B: Electronics**

1. Verification of KCL and KVL.
2. Verification of Norton's and Thevenin's theorem.
3. Study the characteristic of a general purpose and Zener diode.
4. Study the characteristic of a transistor in CB configuration.
5. Study the characteristic of a transistor in CE configuration.
6. Study the characteristic of a single stage amplifier.
7. Study the basic characteristic of logic gates.
8. Study the basic characteristic of SCR and TRIAC.
9. Study the basic operation of different sensors and Transducers.
10. Study the basic operation of Microprocessors.

**Learning Outcomes:**

- Successful completion of this course will help students with following outcomes:
- Work efficiently in leather, leather products, and footwear industries where proper application of engineering knowledge requires the basics of physics and electronics.
- Design and conduct experiments, as well as to analyze and interpret data.
- Communicate their ideas with others and function effectively in multidisciplinary terms.
- Start career as a practicing engineer in fields such as design, research, development, testing, manufacturing, operations, and service systems.
- Continue to learn through advance study or engagement in professional development activities within physics, electrical engineering or other technical fields.

**Reference Books:**

1. David Halliday/Robert Resnick/Jearl Walker-Fundamentals of Physics.
2. F.W.Newman and V.H.L.Searl -The General properties of Matter
3. D.S.Mathur- Elements of Properties of Matter
4. Paul D. Malvino - Electronic principles.
5. F.Sears and G.L. Salinger -Thermodynamics, Kinetic Theory and Statistical Thermodynamics
6. S.C.Arrora/S. Domkundwar-A Course in Heat & Mass Transfer.
7. Harvey E.White/Francis A. Jenkins-Fundamentals of Optics.
8. V. K. Mehta- Principles of Electrical Engineering and Electronics.
9. B.L. Therera and A.K. Therera - Solid State Electronics

### Second Year (2<sup>nd</sup> Semester)

#### **LE-205: Leather Processing-III (Non-Mineral)**

Credit	Class/week (h)	Total Class (h)
3.0	3.0	45.0

#### **Learning Objectives:**

- To know about the stages involved in post-tanning
- To get idea about mechanical operation before wet finishing
- To comprehend the significance of neutralization in post-tanning
- To know about non mineral tannins and tanning process.
- To learn the process of fatliquoring and re-chroming
- To know about combination tannage

#### **Course Contents:**

**Mechanical Operations prior to post tanning:** sammying, splitting, shaving, weighting.

**Wetback and washing:** Objects, use of surface-active agents, acidification, rinsing.

**Bleaching:** Different methods of leather bleaching, factors effecting bleaching. Bleaching of vegetable and chrome-tanned leather, effect of bleaching on leather quality.

**Re-chroming:** Objects, chrome syntan, use of basic chrome sulphate, chrome syntan, chrome stable fat liquor, glutaraldehyde etc. in re-chroming, controls during re-chroming.

**Neutralization:** Objects, iso-electrical points and neutralization, principles of neutralization for chrome tanned leather, factors effecting neutralization, selection of proper neutralizing agents, controls of neutralization, test for neutralization, neutralization and its impact on subsequent leather processing.

**Re-tanning and combination tannage:** Introduction, objects of re-tanning, types of materials used in re-tanning and semi-chroming, advantages and disadvantages of retanning and combination tannage, factors affecting retanning and combination tannage.

**Vegetable tannins and tanning:** classification of vegetable tannins, physico-chemical 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, mechanism of vegetable tanning, factors affecting vegetable tannage, process of vegetable

tanning, manufacturing process of different vegetables tanning, pollution load of vegetable tanning, cleaner method of vegetable tanning.

**Synthetic tannins:** Introduction, classification, general chemistry of syntans; their classification, general methods of manufacture properties and use of different types of syntans in leather manufacture, mechanism of tanning with syntans, collagen-syntan interaction, effect of syntan on dyeing and retaining auxiliaries, environmental aspects, cleaner processing.

**Aldehyde tannage:** Concept of aldehyde tanning, mechanism of aldehyde tanning, environmental aspects, cleaner processing, different aldehydes used for tanning, factors involved in tannages, properties of leather tanned with different aldehydes.

**Oil tanning:** Objectives, theory of oil tanning, application of oil tanning for the production of chamois leather, conditions for oil tanning, environmental aspects, cleaner processing.

**Dyeing and Fat-liquoring:** Leather dyes and their application, factors affecting dyeing process, dyeing defects. Fat liquoring: objectives, classification of fat liquor, natural and synthetic fatliquors, theory and mechanism of fatliquors, theory and behavior of emulsions, emulsifiers, stability of emulsion, application of fat liquors, distribution of fat and oils in leather, controls of fat liquoring, effects of fatliquors on physical properties, fatliquors used in water repellent leather, modern trends in fatliquoring, curring and stuffing using fats and oils.

**Mechanical and manual operations of re-tanned leather:** Objectives of Setting out, Vacuum drying, Tunnel/overhead drying, Vibrating staking, Toggle drying, Trimming, Dry vacuum.

**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, flesh coating, staining/color impression, ground coating, season coating, top coating, ironing, glazing, plating, selection.

**Finishing techniques:** Shoe upper leather, nappa leather, glaze kid leather, nubuck leather, suede leather, patent leather, corrected grain leather, pull-up leather, clothing leather

**Learning Outcomes:** After completing this course students will be able to

- understand the necessity of post-tanning processes
- know about non mineral tannins and tanning process
- manufacture different types of leather

#### **Reference Books:**

1. Sarkar, K.T., "Theory and Practice of Leather Manufacture".
2. Dutta. S.S., "An Introduction to the Principles of Leather Manufacture"
3. Wilson, J. A., "The chemistry of Leather Manufactures" Vol. II
4. Gustavson, K. H., "The Chemistry of Tanning Process"
5. Flaherty, Roddy, Lollar, "The Chemistry and Technology of Leather" Vol. II.
6. Anthony D. Covington, 'Tanning Chemistry, The Science of Leather'.
7. Gerhard John, 'Possible Defects in Leather Production'
8. E. Haslam, Chemistry of Vegetable Tannins –Academic Press, N. Y.
9. Eckhart Hidemann 'Fundamentals of Leather Manufacture'

10. J. H. Sharphouse, Leather Technician`s Handbook, Vernon Lock Ltd., 125 High Holborn, London W-C1.

**LE-206: Leather Processing-III Lab**

Credit	Class/week (h)	Total Class (h)
1.5	3.0 /Group	45.0/Group

**Learning Objectives:** The aim of this course is to:

- Introduce students to quantitative & qualities methods for conducting meaningful inquiry and practical.
- Enhance the students' ability to analyze and critically evaluate the issues of practical in the realm of leather manufacturing engineering.
- Enhance knowledge and skills of student for designing and conducting an academic practical independently.

**Course Contents:**

1. Manufacturing of corrected grain finish leather
2. Manufacturing of glaze/plate finish leather
3. Manufacturing of Embossed finish leather
4. Manufacturing of spray finish leather
5. Manufacturing of curtain coating finish leather
6. Manufacturing of Roll coating finish leather

**Learning Outcomes:** At the end of the course the students will be able to:

- Display familiarity with a broad array of methods and approaches that are used within the industry.
- Demonstrate practical competence in critical thinking by presenting and evaluating arguments in an academic fashion.
- Develop a manufacturing hypothesis and frame the manufacturing problem with the correct methodology.
- Know how to write a process recipe using mixed methods of practical.
- Apply practical mythological tools and techniques for conducting research & development in the areas of leather engineering.

**Reference Books:**

1. Dutta S.S.-An introduction to the principles of leather manufacture.
2. Krystof Bienkiewicz - Physical chemistry of leather making.
3. Flaharty , Roddy , Lollar-The chemistry and technology of leather (vol-2&3)
4. Sarkar K.T.-Theory and Practice of Leather Manufacture.
5. Reed R. -Science for Students of Leather Technology.
6. BASF Manual -Pocket Book for the Leather Technologist.
7. Sarphouse J.H.-Leather Technicians Handbook.
8. Heidenmann Eckhart - Fundamentals of Leather Manufacture.
9. Procter H.R.-The Principle of Leather Manufacture.
10. McLaughlin.George D. - The Chemistry of Leather Manufacture.
11. Gustavson K.H.- The Chemistry of Tanning Processes.

**LPE-201: Leather Products Manufacturing-I**

Credit	Class/week (h)	Total Class (h)
3.0	3.0	45.0

**Learning Objectives:** The objective of this course is to provide the best interpretation of modern leather products manufacture based on current scientific knowledge. It provides the students to be able to know about-

- Cutting techniques of leather and other materials
- Splitting techniques of leather and other materials
- Skiving techniques of leather and other materials
- Introduction of different types of lining and reinforcement materials
- Features of different stitches
- Types of pattern etc.
- To know the different technology which involve the manufacturing procedures of leather products.

**Course Contents:**

**Pattern making:** Introduction, Concept of pattern making, Classification of pattern, Indication of pattern, Copied pattern, commercial pattern, Ready to wear garments pattern, Transferring the pattern, free hand drawing, 3D-2D concept, allowance, two dimensional drawing, pattern making for hand bags, personal leather goods and belts, different shaped Pattern making, Pattern joining.

**Cutting operations for leather products:** Introduction. Automatic cutting, classifying cutting systems for leather goods, manual die cutting, NC die cutting, automatic die cutting, universal die cutting, advantages of automatic die cutting systems, die-less cutting system, specifications of cutting systems. advantages of continuous cutting systems, special cutting procedure for certain leather products, works to be done before cutting, during cutting and after cutting, qualification of a good cutter, norms of pattern placement on leather and cutting norms, wastage determination, types of wastage, principle of hand cutting, straight line, curved line cutting, advantage and limitation of cutting techniques used for the production of leather products.

**Splitting:** Introduction, types and techniques of splitting, parts and function of splitting machine. Trouble shooting of splitting, procedure of splitting, process control of splitting, acceptance criteria of splitting. thickness adjustment, sharpening of blade, control during splitting.

**Skiving:** Introduction, types of skiving, parts and function of skiving machine. Trouble shooting of skiving, procedure of skiving, process control of skiving, acceptance criteria of skiving. Thickness adjustment, angular cutting, sharpening of bell knife. Adjustment of bell knife and pressure foot, Control during skiving.

**Hand stitching:** Introduction, types of hand stitching, Types of stitch, sewing needles, lacing needle, thread, techniques of hand stitching, braiding technique.

**Thread:** Introduction, Thread twist 'Z' and 'S' twist, Properties of thread, Selection of ideal thread, Thread sizing, Thread and needle relationship.

**Construction of Gussets:** Introduction, types of gussets, plain gusset, “V” gussets, flat gussets, three parts gussets (plain), three parts gussets (double).

**Joining techniques:** Definition of stitch, seam and sewing. Types of stitch and their properties. Types of seam - Constructional seam-open seam, closed seam, taped seam, top-stitched seam, flat-felled seam, butted seam, silked seam, Brooklyn seam, welted seam, piped seam. Decorative seam, Lacing / Thonging, cable stitching, glove stitching, moccasin stitch.

**Money bag:** Introduction, types & use, raw materials, perspective drawing, list of components, measurement instruction, total pattern making, leather consumption, splitting and skiving instruction, construction and assembling.

**Learning Outcomes:** After completion of this course students will be able to –

- Identify genuine and artificial leather
- Know right accessories for right leather products
- Hand tools needed for leather products making
- Folding techniques for different lines
- Different types of pattern
- Features of Different types of stitch etc.
- Provides the basic theoretical knowledge about leather products manufacturing.
- Skill development in total pattern making, leather consumption, splitting and skiving instruction, construction and assembling.
- Acquire a comprehensive knowledge in the fundamentals of Leather Products (Money bag) manufacturing.

**Reference Books:**

1. Anne & Jane Cope-Leatherwork
2. Carr & Latham-The Technology of Clothing Manufacture
3. Kirsten Jorgensen-Making Leather Clothes
4. Ben and Elizabeth Morris-Making Clothes in Leather
5. Sylvia Grainger-Leatherwork
6. Mary and E.A. Manning-Leatherwork
7. Francesca Sterlacei-Leather Apparel Design
8. Martin M. Shoben & Janet P. Ward-Pattern Cutting and making Up
9. Moseley, G.C-Leather Goods Manufacture
10. Batsford-Fashion with Leather
11. Hamlyn-Leatherwork –A step-by-step Guide.
12. Jane E. Garner-The Complete Handbook of Leather crafting.

**LPE-202: Leather Products Manufacturing-I Lab**

Credit	Class/week (h)	Total Class (h)
1.5	3.0/Group	45.0 /Group

**Learning Objectives:** This course will guide the students to learn about –

- The use of different machines used for leather products making
- Identification of genuine leather from artificial leather

- Acquaintance with different types of embellishments, accessories, hand tools, lining and reinforcement materials
- Cutting techniques of leather
- Folding techniques for different shaped edges
- Making of different types of pattern
- Different seams for leather products manufacture
- Joining techniques for different types leather products manufacture
- Making of different types of pattern
- Manufacture of different types of leather products

**Course Contents:**

**Introduction of tools and their uses and tooling techniques.**

**Hand cutting Exercise on pattern paper:**

Cutting practice with hand knife on different shaped curve and straight line drawn on Cutting Practice Sheet.

**Hand Cutting Practice on Synthetics/ Artificial Leather/ Coated fabrics:**

Cutting practice on synthetics/ artificial leather/ coated fabrics.

**Machine Cutting Practice on Synthetics/ Artificial Leather/ Coated fabrics/Leather:**

Cutting practice on synthetics/ artificial leather/ coated fabrics/leather with different types of single edge and double edge dies.

Introduction to different types of sewing machine and their parts and function.

Introduction to sewing machine needle, its parts and function. Sewing Practice on different shaped line of supplied paper with various sewing machine.

**Upper Preparation:**

Skiving- open raw edge skive, closed raw edge skive, lapped skive, folded skive, corner skive, matrix skive, splitting, eyeleting, embossing, perforating.

**Edge treatment:**

Raw edge, Burnishing, Folding/Beading (convex curve, concave, curve)

Binding: i) English/U-Binding/Slipper binding/Flat Binding/channel binding, ii) French/Paris/Hand turnover binding, iii) Italian Binding. Slip beading, Bagged edge/Rolled Top line, Ghillie top line, collars, gimping and punching.

**Seams:** Closed seam-plain closed seam, Brooklyn seam, French/Silked seam, Reversed Closed Seam, Welted seam, piped seam, Blind seam, Lapped seam, welted and piped seam. Decorative seam: i) cable stitching, ii) Glove, iii) Fancy and mock stitching.

**Joining techniques:** Hand stitching, thong or lacing technique, button or rivet attaching.

**Pattern cutting:** Introduction of pattern cutting technique, consideration of allowance, Basic, working and cutting pattern making.

**Manufacturing of the following Leather Products:**

- a) Coin Purse
- b) Key Case
- c) Money Bag

**Learning Outcomes:** This course will provide the opportunity of the basic practical skills to know different seams for leather products manufacture, know different types of joining

techniques for leather products manufacture, make different types of pattern, manufacture of different types of leather products.

**Reference Books:**

1. Anne & Jane Cope-Leatherwork
2. Carr & Latham-The Technology of Clothing Manufacture
3. Kirsten Jorgensen-Making Leather Clothes
4. Ben and Elizabeth Morris-Making Clothes in Leather
5. Sylvia Grainger-Leatherwork
6. Mary and E.A. Manning-Leatherwork
7. Francesca Sterlacei-Leather Apparel Design
8. Martin M. Shoben & Janet P. Ward-Pattern Cutting and making Up
9. Moseley, G.C-Leather Goods Manufacture
10. Batsford-Fashion with Leather
11. Hamlyn-Leatherwork –A step-by-step Guide.
12. Jane E. Garner-The Complete Handbook of Leather crafting.

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**CHM-203: Instrumental Analysis of Leather and Leather Products**

Credit	Class/week (h)	Total Class (h)
3.0	3.0	45.0

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

- An introduction to analytical chemistry for leather and leather products manufacture and an overview of important analytical methods and their range of application in leather within detection of inorganic, organic and other toxic compounds.
- Important analytical quantitative techniques from classical methods, electrochemical methods, spectrochemical/spectrophotometric methods, and separation techniques are reviewed.
- The course also includes risk assessment of chemical experiments, important steps and procedures in analytical chemistry, and evaluation/interpretation of results.
- The course gives an overview of important use of selected classical and instrumental chemical quantitative analytical methods leather product manufacturing and a short introduction to their basic theory.

**Course Contents:**

**Gas chromatography:** Introduction, classification, principles of gas-liquid chromatography, gas-solid chromatography, techniques of gas-liquid chromatography, carrier gas, sample injector, gas chromatograph columns and detectors: different types of detectors- thermal conductivity detector (TCD), flame ionization detector (FID), electron capture detector (ECD), nitrogen/phosphorus detector (NPD), qualitative and quantitative, Application of gas-liquid chromatography in leather industries.

**High-Performance liquid chromatography:** Basic concept, comparison of HPLC with gas-liquid chromatography, apparatus for HPLC, solvent delivery, sample injector, selection of column Different detectors: - UV and RI detectors, Qualitative and quantitative

analysis, effect of temperature in HPLC, application of HPLC.

**Thermal techniques:** Basic principles of Differential thermal analysis (DTA), Differential scanning calorimetry (DSC), Thermogravimetry (TG), application in leather science.

**Infrared spectrometry:** Basic principles of IR, Types of vibrations, characteristics regions of the spectrum, the parameters determining the position and intensity of bands, experimental technique, characteristic absorption bands and functional groups, Influence of substituent, polarity, ring size, hydrogen bonding, conjugation, application of IR spectrum for chemical analysis.

**Nuclear magnetic resonance spectrometry:** Fundamental theory, NMR active nucleus, instrumentation, solvents, chemical shift and factors affecting chemical shift, application of <sup>1</sup>H-NMR, application of <sup>1</sup>H-NMR spectrum in leather chemical analysis.

**Atomic absorption spectrometry:** Introduction, basic principles, instrumentation, sample preparation, type of techniques, effect of flame temperature, chemical and spectral interference, recent developments, applications.

**Learning Outcomes:** Upon completion of this course the students will be able to

- Interpret different analytical quantitative techniques from classical methods, electrochemical methods, spectrochemical / spectrophotometric methods, and separation techniques.
- Learn about risk assessment of chemical experiments, important steps and procedures in analytical chemistry, and evaluation/interpretation of results.
- Understand and use of selected classical and instrumental chemical quantitative analytical methods and a short introduction to their basic theory.

**Reference Books:**

1. Gary D. Christian- Analytical Chemistry
2. John Kenkel- Analytical Chemistry for Technicians
3. Sharma B. K. - Instrumental Methods of Chemical Analysis
4. Browning D. R. - Chromatography
5. Hatakeyama T. and Quinn F.X. - Thermal analysis.
6. Vogel A. I. - Text Book of Quantitative Chemical Analysis
7. Sarker P.K. - Analytical Chemistry for Leather Manufacture.
8. Williams D. H. and Ian Fleming- Spectroscopic methods in Organic chemistry.
9. Kalsi P.S. - Spectroscopy of organic compounds.
10. Dr. Sethi P.D. - High Performance Liquid Chromatography.
11. Banwel I C. N. -Fundamentals of Molecular Spectroscopy.

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**CHM-204: Chemical Analysis of Leather and Leather Products Lab**

Credit	Class/week (h)	Total Class (h)
1.5	3.0/Group	45.0/Group

**Learning Objectives:** The learning objectives of this course are:

- To apply practical knowledge in analytical chemistry.
- To introduce the essential experimental knowledge and skill of different tests to determine moisture content, pH in leather and synthetic tanning materials, total fat

in sulphated oils.

- To determine Formaldehyde, Azo colorants, phthalates, VOC, aldehyde, Nitrogen Content, preservative, tetrachlorophenol-, trichlorophenol-, dichlorophenol-, monochlorophenol-isomers, ethoxylated alkylphenols and of *N-methyl-2-pyrrolidone (NMP)*.
- To determine total Chromium, Lead, Cadmium and aluminum by Atomic Absorption Spectroscopy (AAS) and Chromium (VI) by UV-VIS spectrophotometer.

**Course Contents:**

1. Determination of moisture content/pH in finished leather samples.
2. Determination of chloride content in finished leather.
3. Determination of sulfated ash content of finished leather.
4. Determination of acidity of shoe upper and garments leather.
5. Determination of chromic oxide content in finished leather.
6. Determination of collagen content of finished leather.
7. Determination of Formaldehyde content in leather.
8. Determination of Azo colorants (carcinogenic aromatic amines) content in dyed leather.
9. Determination of phthalates content in leather, leather products and *footwear materials*.
10. Determination of VOC & aldehyde emissions.
11. Determination of Nitrogen Content (Kjeldahl) and Hide Substance Content of Leather.
12. Determination of the preservative (TCMTB, PCMC, OPP, OIT) content in leather by liquid chromatography.
13. Determination of tetrachlorophenol-, trichlorophenol-, dichlorophenol-, monochlorophenol-isomers and pentachlorophenol content.
14. Determination of ethoxylated alkylphenols.
15. Chemical determination of *N-methyl-2-pyrrolidone (NMP)* in leather.
16. Determination of total Chromium in leather samples by Atomic Absorption Spectroscopy (AAS).
17. Determination of total Lead and Cadmium in leather samples by Atomic Absorption Spectroscopy (AAS).
18. Photometric determination of Chromium (VI) by UV-VIS spectrophotometer.
19. Determination of thermal behavior of crust leather by TGA.
20. Determination of thermal behavior of finished leather by TGA
21. Determination of thermal behavior of PU, PVC, rubber by TGA.
22. Identification of leather, PU, PVC, rubber by FT-IR.

**Learning Outcomes:** Upon completion of this course the students will be able to

- Apply practical analytical chemistry knowledge for leather manufacture
- Interpret different analytical quantitative experimental knowledge and skill to determine moisture content/pH in leather and in synthetic tanning materials.
- Determine Formaldehyde, Azo colorants, phthalates, VOC, aldehyde, Nitrogen

Content, preservative, tetrachlorophenol-, trichlorophenol-, dichlorophenol-, monochlorophenol-isomers, ethoxylated alkylphenols and of *N-methyl-2-pyrrolidone (NMP)*.

- Learn the concentration of Cr, Pb, Cd and Cr(VI) by spectroscopic method.

**Reference Books:**

1. Gary D. Christian- Analytical Chemistry
2. John Kenkel- Analytical Chemistry for Technicians
3. Skoog, Holler and Nieman- Principles of Instrumental Analysis
4. Hatakeyama T. and Quinn F.X. - Thermal analysis.
5. Vogel A. I. - Text Book of Quantitative Chemical Analysis
6. Sarker P.K. - Analytical Chemistry for Leather Manufacture.

**MTH-202: Probability and Statistics**

Credit	Class/week (h)	Total Class (h)
3.0	3.0	45.0

**Learning Objective:**

- To provide the basic foundations of statistics with applications in real life.
- To provide knowledge on descriptive statistics, correlation, regression, probability, and probability distributions for both continuous and discrete random variable.
- To discuss the theory and how to apply and use the theory for real life problem-solving and inquiry.
- To provide students with hands on experience in using the statistical theory and methods to perform the different statistical analyses and to interpret results.

**Course Contents:**

**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:** Mean (a) Arithmetic Mean (b) Geometric Mean, (c) Harmonic Mean, Median (iii) Mode, Their definition, computation, Advantage, Disadvantage and uses.

**Measures of dispersion:** Absolute measure, (a) Range (b) Mean deviation (c) Quartile deviation (d) standard deviation, Relative measure, Coefficient of variation, their definition, computation and uses.

**Moment, skewness and kurtosis:** Their definition, computation and uses.

**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, Probability distribution (i) Binomial, (ii) Poisson, (iii) Simple idea about normal distribution and its probability curve.

**Estimation:** Simple idea about estimation

**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.

**Test of significance:** some definitions related to 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 two samples means when S.D. is known and also when it is unknown,

(c) Paired t test, its practical use in Leather/Footwear/Leather Product Industry.

$\chi^2$  test-Simple application and its practical use in Industry.

**Sampling:** Definition of population, sample, parameter, census etc.

Simple Random Sampling, Stratified random sampling, their definition, computation, use, advantage & disadvantage.

**Design of experiment:** Basic principles of experimental design, Ideas about CRD, RBD.

**Learning Outcomes:**

- Demonstrate the ability to apply fundamental concepts in exploratory data analysis.
- Construct and analyze graphical displays to summarize data.
- Compute and interpret measures of center and spread of data
- Calculate, interpret and communicate the correlation coefficient and simple linear regression model.
- Utilize basic concepts of probability including independence and conditional probability to calculate, interpret and communicate event probabilities both for discrete and continuous random variables.
- Determine the appropriate probability distribution based on experiment conditions and assumptions.

**Reference Books:**

1. An introduction to Statistics and Probability, Dr. Nurul Islam
2. Business Statistics (Fourteenth Edition), Dr. S.P. Gupta & Dr. M.P. Gupta
3. Research Methodology (Methods & Techniques), C.R. Kothar

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**MSE-201: Fundamentals of Materials Science and Engineering**

Credit	Class/week (h)	Total Class (h)
3.0	3.0	45.0

**Learning Objectives:** The objective of this course is

- to highlight the students on the properties and behavior of various materials

**Course Contents:**

**Materials:** Basic concept of materials science and engineering, classification of materials, materials of the future, smart and intelligent materials, nanotechnology, an overview of material science and engineering and its recent developments.

**Mechanical properties of materials:** Concept of stress and strain, elastic deformation, stress-strain behavior, elasticity, elastic properties of materials, tensile properties, plastic

deformation, tensile properties, true stress and strain, elastic recovery after plastic deformation, compressive, shear, and torsional deformations, hardness. Variability of material properties, design/safety factors, dislocation, characteristics of dislocations, slip, slip systems, generalized creep behavior, stress and temperature effect, viscoelastic deformation.

**Thermal and electrical properties of materials:** Heat capacity, thermal expansion, materials of importance invar and other low expansion alloys, thermal conductivity and thermal stresses, electrical conduction, semiconductivity, Hall effect, semiconductor devices, electrical conduction in ionic ceramics and in polymers, dielectric behavior, capacitance, field vectors and polarization, types of polarization, polaron, phonons, frequency dependence of the dielectric constant, dielectric strength, dielectric materials, ferroelectricity, piezoelectricity, conducting polymers, polymer electrolytes; interaction between polymer and salts, polymer in salt and salt in polymer electrolytes.

**Magnetic properties materials:** 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 of materials:** 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; components, step index, graded index optical fiber design, free electron theory, energy bands, charge transport.

**Characterization of materials:** X-ray diffraction, structure determination from powder patterns, influence of crystal symmetry and multiplicities on powder pattern, limitation of powder methods, neutron diffraction, applications, advantages and disadvantages, electron microscope, electron diffraction applications, transmission electron diffraction applications, transmission electron microscopy (TEM), scanning electron microscopy (SEM), analytical electron microscopy (AEM), thermal analysis such as TGA, DSC, DTA, elemental analysis.

**Metals and alloys (Nonferrous and ferrous):** Properties and uses, Wrought iron, cast iron, steel, alloy steel, stainless steel. Aluminum and its alloys, copper and its alloys, nickel alloys- properties, uses and composition. Effects of alloying. Heat treatment of steel. Identification of metal. Metal joining. Oxidation and degradation, corrosion and corrosion protection.

**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, ceramic-matrix composites, glass material, phase transition, interpretation of phase diagrams, carbon-carbon composites, processing of fiber-reinforced composites, hybrid composites, structural composites, laminar composites,



sandwich panels, materials of importance-nanocomposites in tennis balls, biomaterials and advanced ceramics.

**Learning Outcomes:** At the end of this course, the students will

- Understand the properties of various materials.
- Have knowledge about the methods to characterize them.
- Aware about the selection criteria of synthetic material for Leather industries

**Reference Books:**

1. Introduction to Physical Metallurgy, Avner
2. Strength of Materials, Andrew Pytel, Ferdin and L. Singer
3. Strength of Materials,-R.S. Khurmi
4. An Introduction to Metallurgy, A.H. Cottrell
5. Materials Science and Engineering-An Introduction -W. D. Callister Jr.
6. The Science and Engineering of Materials -D. R. Askeland, P. Phulé.
7. Foundations of Materials Science and Engineering -W. F. Smith.
8. Solid State Chemistry and its Applications,2<sup>nd</sup> edition- John Wiley & Sons.
9. Solid Polymer Electrolytes -F. M. Gray.
10. Physical Chemistry -P. W. Atkins, J. D. Paula.
11. Ionic Liquids in Polymer Systems -R. D. Rogers, C. S. Brazel.

**LE-207: Field Tour**

Credit	Class/week (h)	Total Class (h)
1.0	-	-

The students shall have a daylong visit of one relevant industry.

**Third Year (1<sup>st</sup> Semester)**

**LPE-301: Leather Products Manufacturing-II**

Credit	Class/week (h)	Total Class (h)
3.0	3.0	45.0

**Learning Objectives:** The learning objectives of this course are:

- To know the different terms of finished leather.
- To know the different cutting techniques.
- To know the different technology which involve the manufacturing procedures of leather products.

**Course Contents:**

**Introduction:** Finished Leather, Composition of finish film, Classification of finished leather, Theory of film formation. Finishing defects. Edge coloring, Edge dyeing machines, Manual dyeing machine, Semiautomatic and automatic dyeing machines.

**Machine Cutting:** Introduction, Arm type clicking press, parts and their function of arm type clicking machine, procedure, process control, acceptance criteria and Troubleshooting of arm type clicking press, traveling head press, Beam press, Technology modules on automatic die cutters, advantage of automatic die cutting system.

**Preparation phase:** Introduction, Preparation operations, applying eyelets, rivets, studs and similar details, preparing belt loops, splitting for equalizing the leather, performances and levels of automation for splitting. Skiving process. Edge folding, applying adhesives for joining leather components.

**Embossed printing:** Introduction, Printing of small component part. Printing perforating watchstraps. Process control, procedure and acceptance criteria of embossing.

**Sewing machines:** Types of sewing machine and their properties, Parts of sewing machine and their functions. Feeding system and feeding mechanism of sewing machine. Theory of stitch formation.

**Needle:** Definition, Parts of needle and their functions, Needle identification---needle size, needle point, needle system; Selection of sewing needle.

**Thread:** Introduction, Thread twist ‘Z’ and ‘S’ twist, Properties of thread, Selection of ideal thread, Thread sizing, Thread and needle relationship.

**Construction of Gussets:** Introduction, types of gussets, plain gusset, “V” gussets, flat gussets, three parts gussets (plain), three parts gussets (double).

**Joining techniques:** Definition of stitch, seam and sewing. Types of stitch and their properties. Types of seam - Constructional seam-open seam, closed seam, taped seam, top-stitched seam, flat-felled seam, butted seam, silked seam, Brooklyn seam, welted seam, piped seam. Decorative seam, Lacing / Thonging, cable stitching, glove stitching, moccasin stitch.

**Waist belt and Wrist watch belt:** Introduction, types & use, raw materials, perspective drawing, list of components, measurement instruction, total pattern making, leather consumption, splitting and skiving instruction, construction and assembling.

**Passport Case:** Introduction, types & use, raw materials, perspective drawing, list of components, measurement instruction, total pattern making, leather consumption, splitting and skiving instruction, construction and assembling.

**Photo frame:** Introduction, types & use, raw materials, perspective drawing, list of components, measurement instruction, total pattern making, leather consumption, splitting and skiving instruction, construction and assembling.

**File folder:** Introduction, types & use, raw materials, perspective drawing, list of components, measurement instruction, total pattern making, leather consumption, splitting and skiving instruction, construction and assembling.

**Learning Outcomes:** Upon successful completion of this course students will be able to:

- Acquire the basic theoretical knowledge about leather products manufacturing.
- Develop skill in total pattern making, leather consumption, splitting and skiving
- Instruction, assembling and construction of leather products.
- Acquire a comprehensive knowledge in the fundamentals of Leather Products manufacturing.

**Reference Books:**

1. Anne & Jane Cope-Leatherwork
2. Carr & Latham-The Technology of Clothing Manufacture
3. Kirsten Jorgensen-Making Leather Clothes
4. Ben and Elizabeth Morris-Making Clothes in Leather

5. Sylvia Grainger-Leatherwork
6. Mary and E.A. Manning-Leatherwork
7. Francesca Sterlacei-Leather Apparel Design
8. Martin M. Shoben& Janet P. Ward-Pattern Cutting and making Up
9. Moseley, G.C-Leather Goods Manufacture
10. Batsford-Fashion with Leather
11. Hamlyn-Leatherwork –A step-by-step Guide.
12. Jane E. Garner-The Complete Handbook of Leather crafting.

5. Sylvia Grainger-Leatherwork
6. Mary and E.A. Manning-Leatherwork
7. Francesca Sterlacei-Leather Apparel Design
8. Martin M. Shoben& Janet P. Ward-Pattern Cutting and making Up
9. Moseley, G.C-Leather Goods Manufacture
10. Batsford-Fashion with Leather

**LPE-302: Leather Products Manufacturing-II Lab**

Credit	Class/week (h)	Total Class (h)
1.5	3.0/Group	45.0

**Learning Objectives:**

- To know the tooling techniques.
- To know the decorative techniques of leather.
- To know the different techniques of leather products manufacturing (pattern making, marking, attaching, folding, stamping, stitching, finishing operations etc.)

**Course Contents:**

**Leather decoration techniques:** Stamping, engraving, batik, screen-printing, molded work, embroidery, carving, beveling, shading, appliqué, perforating.

**Pattern cutting:** Introduction of pattern cutting technique, consideration of allowance, lining construction, working pattern making.

**Manufacturing of the following Leather Products:**

- a) Wallet
- b) Ladies Bag
- c) Gents Bag
- d) School Bag
- e) Photo frame
- f) Ladies Purse
- g) Passport case
- h) File folder

**Learning Outcomes:** Upon successful completion of this course, students will be able to:

- Interpret the skill to design and develop new diversified products.
- Develop new and sustainable manufacturing method for the competitive global market.
- Identify different faults in manufacturing process.
- Acquire effective managing capacity.

**Reference Books:**

1. Anne & Jane Cope-Leatherwork
2. Carr & Latham-The Technology of Clothing Manufacture
3. Kirsten Jorgensen-Making Leather Clothes
4. Ben and Elizabeth Morris-Making Clothes in Leather

**LPE-303: Leather Products Design and Drafting**

Credit	Class/week (h)	Total Class (h)
3.0	3.0	45.0

**Learning Objectives:**

- To have complete knowledge on the basic terms of product designing.
- To create own designed product with specific purpose.
- To be able to apply the principles of design to any product.

**Course Contents:**

**Art & Design:** definition, idea and discussion on art, design, motif, fashion, style, fads, craze, newness, crafts. Application of design, style, fashion, motif in leather products. Exploration of design, source and influence available for a leather products design, sketching variety of products styles and design covering men's and women's wear in 2D and 3D, effective use of line, shape, color, pattern, and texture on leather products, presenting design themes, stimulating presentation or balanced, logical and readable solutions.

**Free hand drawing:** Line (straight and curve), triangle, circle, ellipse, rectangle, Tone (silver tone, first tone, second tone, third tone,) Composition, Proportion, Illustration using water colour, Poster colour, Colour pencil, Pastel colour. Different colour terms, Theory, vision, matching, Basic scheme,3-dimensins, subjective nature of colour vision. Motif analysis, Drawing composition, Design in dimension, Texture fixation, Colour composition in design creativity analysis. Products sketching technique.

**Design and techniques for leather products:** Planning the design and selecting the skin, creating a design/spec sheet. Elements of design-line, space, value color, texture, composition. Line in leather design-preparation of leather for line, tracing. Use of body proportions, leather and other materials in garments manufacture, visual and verbal analysis, assignment of finished garment. Boutique, screen print, applique techniques.

**Design Analysis:** Subjective judgment taste and aesthetics subjectivity, Objectivity; High and low cultural values in design, Means of production Changing language from craft workshops to factory assembly line, Criticism in Fashion design Issues of luxury and utility. The value of design Costing and negotiating design project, Market segmentation, Demographic and psychographics design implication for different customer groups, aspects of consumer /buyer behavior, Customer profiles, Customer needs and wants, Pricing strategies, Method of distribution retail, Mail order and future strategies. Designers problem of a personality perspective.

**Concepts of patterns:** Introduction, concept of patterns, procedure of making various types pattern, transferring patterns, placement of pattern. rectangular pattern, curved pattern.

**Product development:** Procedure of product development, story board, theme board, colour board preparation, motif analysis, logo design, value addition, research and inspiration, cultural value in design.

**Style, design variations and Modifications:** Block preparations of men's women's and children clothing. Panel styling and perspective design implements, Different Sleeves, Collars, Necklines, Hemlines, Facings, Button-stands designing and style variations. Lowered armhole adaptation, extend and dropped shoulder adaptation (body with sleeve and yoke).

**Pattern Grading and Enlargement for goods, men's and women's clothing:** Introduction, history, size and measurements, system development, grading methodology, system of enlargement, body measurement and system analysis for enlargement procedure and calculations followed by standard sizing charts.

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

- Demonstrate and apply knowledge of basic leather products designing, including pattern making.
- Employ the various stages of the product design.
- Demonstrate understanding of and apply the principles of fashion designing.
- Improve academic and theoretical knowledge of designing.

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**LPE-304: Leather Products Design and Drafting Lab**

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Credit	Class/week (h)	Total Class (h)
1.5	3.0/Group	45.0/Group

**Learning Objectives:**

- To be able to apply practically the principles of design to any type of leather product
- To be expertise on making any kind of patterns.
- To be able to apply practically the principles of design to any type of leather garments
- To create own designed product.

**Course Contents:**

**A. Manufacturing Techniques of the following items-**

1. Preparation of Theme Board
2. Design and Development of various types of small goods.
3. Different Size Modifications
4. Design and Development of ladies bags
5. Preparation and Grading techniques of pattern for ladies' bag.
6. Design and Development of gents' bags
7. Preparation and Grading techniques of pattern for gents' bag

**B. Design, development and grading of the following items**

1. Men's and women's outer wear preparation and Grading techniques:

- a) Different types of jacket block
- b) Different types of trouser/pant block
- c) Different types of waist coat block
- d) Different types of Sleeve, collar block
- e) Different types of Skirt block

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

- Prepare any kind of men's and women's leather goods.
- Make any kind of grading to the pattern.
- Create different size modifications.
- Prepare various types of bags.
- Prepare any kind of men's and women's wear.
- Make any kind of grading to the pattern.
- Create different size modifications.

**Reference Books:**

1. Pattern Cutting & Making up- Martin M. Shoben
2. Leather Apparel Design – Francesea Sterlacci
3. Clothing Technology- Europa Lehrmittel
4. Fashion With Leather- Bastford
5. Making Leather Clothes- Jongensen.
6. Pattern Cutting for Women's Outerwear- Gerry Cooklin.
7. Metric Pattern Cutting for Children's Wear and Baby Wear- Winifred Aldrich
8. Grading for the Fashion Industry- Talyon Shoben
9. Pattern Drafting and Making up- Bella Kapoor
10. Pattern Grading for Men's Cloths- Cooklin

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**ME-301: Fundamentals of Mechanical Engineering**

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Credit	Class/week (h)	Total Class (h)
3.0	3.0	45.0

**Learning Objectives:**

- Ability to identify, formulate and solve mechanical engineering problems based on data interpretation, design, experiment and analysis of results.
- Successfully apply fundamental mathematical, scientific, and engineering technology principles in formulating and solving mechanical engineering technology problems;
- Successfully implement theory in one or more core mechanical engineering technology areas of practice in a sustainable manner;
- Ability to work in teams on multi-disciplinary projects in industry and research organizations.
- Ability to self-learn modern engineering tools, techniques, skills and contemporary engineering practice, necessary for engineering work.

**Course Contents:**

**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, convection, 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:** 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.

**Pumps- types:** characteristics and application of reciprocating and centrifugal pumps.

**Learning Outcomes:** Upon completion of this course the students will be able to

- to identify, formulate and solve mechanical engineering problems based on data interpretation, design, experiment and analysis of results.
- apply fundamental mathematical, scientific, and engineering technology principles in formulating and solving mechanical engineering technology problems;
- implement theory in one or more core mechanical engineering technology areas of practice in a sustainable manner;
- work in teams on multi-disciplinary projects in industry and research organizations.
- to self-learn modern engineering tools, techniques, skills and contemporary engineering practice, necessary for engineering work.

**Reference Books:**

1. Thermal Engineering, R.S. Khurmi
2. Heat Transfer, Holman
3. Engineering Thermodynamics, Rogers

**ME-302: Mechanical Workshop**

Credit	Class/week (h)	Total Class (h)
1.5	3.0/Group	45.0/Group

**Learning Objectives:**

- To introduce students to different pipe fittings
- To equip students with steam generating unit, pumps, compressor, power generator, Engines, and Turbines.

**Course Contents:**

Introduction to different pipe fittings, Study of Steam Generating Unit, Pumps, Compressor, Power Generator, Engines, (petrol, diesel and gas), Turbines.

**Learning Outcomes:** Upon completion of this course students will be able to

- Learn about different pipe fittings

- Attain practical knowledge on steam generating unit, pumps, compressor, power generator, Engines, and Turbines.

**Reference Books:**

1. Thermal Engineering, R.S. Khurmi
2. Heat Transfer, Holman
3. Engineering Thermodynamics, Rogers

**ENV-301: Environmental Science and Engineering**

Credit	Class/week (h)	Total Class (h)
3.0	3.0	45.0

**Learning Objectives:** The learning objectives of this course are to

- Provide the basics about three major types of pollutions (water pollution, air pollution and soil pollution) that degrade the environmental quality poses a serious threat to human health worldwide.
- Inform about the volume, types of discharge, how they pollute the water, air and soil, causing ecological imbalance and the spreading of different kinds of fatal and contagious disease among the workers and other individuals.
- Aware about the health and safety policies developed for the workers to reduce the accidents in the leather products industry and how to use the emergency facilities in case of a problem.

**Course Contents:**

**Concept of Environment:** Definition and concept of environment; Types and components of Environment (Lithosphere, Atmosphere, Hydrosphere, Biosphere); Scope and multidisciplinary nature of the subject; Man-environment relationships; Public awareness – Earth Summits, recent Conventions on climate change

**Introduction to biodiversity:** definition, genetic, species and ecosystem diversity. Bio-amplification of food chain. Sustainable development and significance of sustainable development in environmental related issues.

**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, global and modeling climate change, greenhouse gases and greenhouse effect, acid rain and its effect, air pollutant and their characteristics, hazardous air pollutant (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, waste generation, separation, storage, collection, transformation of solid waste, transfer and transport, disposal water and air pollution control. Purification and reuse of water during leather

processing, low float techniques using updated equipment, recycling of individual process liquors. International standard and exposure limits.

**Recovery, regeneration, reuse and disposal of wastes:** Recovery of residues of effluents, organic materials, dissolved salts, energy, solid waste, recycling of lime /sulphide liquors, dehair, high chrome exhaustion techniques in chrome tanning, chrome recovery and recycling, oil and grease recovery, disposal of effluents.

**Biodegradability and biodegradation:** Introduction, methods of measuring biodegradation, characteristics of tannery discharges, biological treatment of tannery effluents.

**Concept on environmental management and Environmental Management System (EMS);** Management of water pollution, Environmental quality measurement (ISO:14000), Implication of Agenda-21; Functions of management--forecasting, planning, organizing, motivating, coordinating, controlling, and communicating, leadership, directing, and decision making.

**Environmental Policies and Legislation:** Environmental legislations in Bangladesh, environment protection act, air (prevention and control of pollution) act, water (prevention and control of pollution) act, wildlife protection act, forest conservation act, solid and hazardous waste management rules, biomedical waste rules, responsibilities of generators, role and responsibility of pollution control boards.

**Learning Outcomes:** Upon completion of this course the students will be able to

- Understand the diverse environmental problems, looking at causal linkages between pollution sources, exposure pathways and impacts to environmental quality and human health.
- Know the adverse effect associated with different operations exposure to chemicals, biological and physical hazards, and proper management procedures required for personal safety from potential risks.
- Understand and design the type of effluent treatment plant that is required for treating the wastes for their reuse or safe disposal to the environment.
- Illustrate the safety recommendation and regulations for the workers working in the leather products industries.

**Reference Books:**

1. Thierry Chambolle-Environment and Tannery
2. DE A.K. - Environmental chemistry
3. Society of Leather Technologists & Chemists - Official Methods of Analysis (1996).
4. UNIDO- Tannery and Enviroment.
5. Chhatwal, G.R.-Environmental Analysis.
6. Mensink Ir. J.S.-Environmental Quick Scan Leather Products.
7. Chhatwal G .R. - Encyclopedia of Environmental Analysis (vol. 1, 2 &3)
8. Fifield & Haines. -Environmental Analytical Chemistry.
9. Environmental Chemistry-B.K. Sharma and H. Kaur.
10. Roy M. Harrison-Pollution causes, Effects, and Control.

**ENV-302: Environmental Science and Engineering Lab**

Credit	Class/week (h)	Total Class (h)
1.5	3.0/Group	45.0/Group

Lab based of the content of ENV-301.

**HUM-301: Industrial Sociology**

Credit	Class/week (h)	Total Class (h)
3.0	3.0	45.0

**Learning Objectives:**

- To obtain sociological knowledge of core areas and substantive topics and the ability to think critically about them
- To introduce students to the basic social processes of society, social institutions and patterns of social behavior.
- To train students to understand and to interpret objectively the role of social processes, social institutions and social interactions in their lives.
- To demonstrate advanced understanding of key linkages between ecosystem and social processes and how they relate to human-nature interactions, and to integrate this understanding with knowledge drawn from their own degree backgrounds.

**Course Contents:**

**Introduction to Sociology:** Definition, nature, scope, importance, Social Interactions, Social Groups, Social Institutions.

**Culture and Related Concepts:** Definition of Culture, Types, Elements, Role of Culture in Organization, Socialization and Personality.

**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, Population and Development.

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

**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.

**Learning Outcomes:**

- Explain the major methods and concepts it used in the systematic study of society.
- Describe various social structures in societies and methods and degrees of social stratification.
- Explain the major social groups that function in society, including racial and ethnic groups.
- Explain processes of socialization, and how socialization operates in different societies and cultures.
- Explain major methods of social control, including political and legal systems, and be able to explain the concept of deviance.
- Explain the role of gender in society.
- Describe how the tools of analysis and methods of sociology are applicable to work and involvement in their community.
- Identify and connect basic ideas and terminology found in the study of human ecology.
- Critically evaluate sources of information about human ecology.
- Associate specific relations between science and/or technology and human population growth, and place them in a historical context.

**Reference Books:**

1. A Text Book of Sociology, Dealey, James Quayle and Ward, Lester, Frank
2. Engineers in Britain: A Sociological Study of the Engineering Dimension, Ian Glover
3. Introduction: Sociology and Engineering, Ian A. Glover, Michael P. Kelly
4. Human Ecology: Basic Concepts for Sustainable Development, Gerald G Marten
5. Allport, G. W. (1985). UThe Historical Background of Modern Social PsychologyU. New York, Random House.
6. Bernard, A. and T. Burgess (2004). USociologyU, Cambridge University Press.
7. DuBrin, A. J. (2007). UHuman Relations: Interpersonal Job Oriented SkillsU. New York, Prentice Hall.

**LPE-305: Field Tour**

Credit	Class/week (h)	Total Class (h)
1.0	-	-

The students shall have a daylong visit of one relevant industry.

**Third Year (2<sup>nd</sup> Semester)**

**LPE-306: Leather Products Manufacturing-III**

Credit	Class/week (h)	Total Class (h)
3.0	3.0	45.0

**Learning Objectives:** This course helps student:

- To familiarize students with the various theoretical and practical aspects of Leather products manufacturing

- To foster an understanding of the importance of pattern engineering
- To describe Processing steps involved in the making of leather goods and garments
- To acquaint the students with different machineries involved in the products manufacture
- To enable the students to apply various techniques of design in making leather goods and garments
- To make the students competent in the field of pattern drafting and grading
- To provide comprehensive knowledge about the Organization and management of leather goods and garments manufacturing

**Course Contents:**

**Fabrication Technology of Leather Products:** Introduction, preparatory process, Bench operations, Creasing, edge dyeing or staining, punching, riveting, eyeletting, cementing, edge folding. marking, stamping, embossing. Construction method and assembling.

**Lining material & their use:** Silk, satin, velvet, rayon, poplin, moirette/silkette, fabric of mercerized cotton, printed cotton, drill, laminate, Polyesters, wool and far, quality, Polynesia.

**Box work:** Hinges and fastenings, box covering, jewelry box work.

**Ladies Bags:** Types of bag, Materials for bags, tools and equipment for bags manufacture, no-gusset bag shapes, one-gusset bag shapes, two-gusset bag shapes, joining one-and two-gusset bags, attaching straps to gussets, flap fastening, pockets, pockets, making a one-gusset bag pattern, making stitch holes, attaching gussets, box-type bag, general working order, bag fastening-tongue and loop, double tongue and loop, loop and toggle, loop and bead/toggle/button strap and buckle, turn lock, draw string, zips, flaps and straps.

**Executive bags:** Introduction, raw materials, perspective drawing, list of components, measurement instruction, total pattern making, leather consumption, splitting and skiving instruction, construction and assembling.

**Luggage:** Introduction, raw materials, perspective drawing, list of components, measurement instruction, total pattern making, leather consumption, splitting and skiving instruction, construction and assembling.

**Upholstery:** Introduction, tools, materials, frames, stripping upholstery, use of foam, upholstered stools, 'Drop-in 'loose seats, occasional and dining chairs, restoration of antique chairs, pouffes, replacing springing and webbing, stile and collar cutting, planning and cutting covering material, buttoning, show-wood upholstery, fluting, refurbishing wing easy chair, re-upholstery of Chippendale period easy chair, re-upholstery of a Victorian-style buttoned-back chair, restoration of a Victorian twist-leg chair, upholstery of bed headboards.

**Outer and inner wear:** ladies jacket, Waist coat, Blazer, Men's parka, Children wear, Collar and sleeve construction, Neck line, hem lines variations, Assembling of different components.

**Hand gloves:** Anatomy of hand gloves, types of hand gloves, Machinery and Equipments, materials, perspective drawing, measurement instruction, total pattern making, leather

consumption, splitting and skiving instruction, construction and assembling and sewing of hand gloves.

**Trouble Shooting:** Defects identification in different steps of Leather Products manufacture and their remedies.

**Packaging and labeling:** Introduction, functions and purpose, factors influencing packaging, types of packaging, requirements of export packing, packaging policies and strategies, re-use and multiple packaging, ecological packaging. Packaging materials, labeling, functions of label, classification of labels, role of labeling in packaging.

**Health and safety:** Fire-risk & prevention / precaution, types of combustion & risks, fire fighting methods & equipment, Hazards- Solvent hazards, mechanical & electrical hazards; ventilation & working environment, ergonomics, fatigue, accidents factors, lighting methods, Occupational safety & health act.

**Learning Outcomes:** Upon completion of this course the students will be able to

- Describe Fabrication Technology of Leather Products Manufacturing.
- Design leather bags, Wallets, Leather garments, leather hand gloves etc.
- Prepare the complete pattern for various types of leather products,
- Select the lining materials and stiffer for particular leather products.
- Ensure the OSH practice in a leather products factory.
- Select the proper package and label.

**Reference Books:**

1. Anne & Jane Cope-Leatherwork
2. Carr & Latham-The Technology of Clothing Manufacture
3. Kirsten Jorgensen-Making Leather Clothes
4. Ben and Elizabeth Morris-Making Clothes in Leather
5. Sylvia Grainger-Leatherwork
6. Mary and E.A. Manning-Leatherwork
7. Francesca Sterlacei-Leather Apparel Design
8. Martin M. Shoben& Janet P. Ward-Pattern Cutting and making Up
9. Moseley, G.C-Leather Goods Manufacture
10. Batsford-Fashion with Leather
11. Hamlyn-Leatherwork –A step-by-step Guide.
12. Jane E. Garner-The Complete Handbook of Leather crafting.

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**LPE-307: Leather Products Manufacturing-III Lab**

Credit	Class/week (h)	Total Class (h)
1.5	3.0/Group	45.0

**Learning Objectives:** Specific objectives of this course are:

- To familiarize students with the various practical aspects of Leather products manufacturing
- To foster an understanding of the importance of pattern engineering

- To describe Processing steps involved in the making of leather goods and garments
- To enable the students to apply various techniques of design in making leather goods and garments
- To make the students competent in the field of pattern drafting and grading
- To provide comprehensive knowledge about the organization and management of leather goods and garments manufacturing

**Course Contents:**

1. Manufacturing of Executive bag.
2. Manufacturing of Laptop bag
3. Manufacturing of Travel bag
4. Manufacturing of Gents lunch bag
5. Manufacturing of Luggage
6. Manufacturing of Tissue Box
7. Manufacturing of Table decorations,
8. Manufacturing of upholstery items
9. Manufacturing of Hand gloves.
10. Manufacturing of Gourd Skirt.

**Learning Outcomes:** Upon completion of this course the students will be able to

- Run various machineries involve leather products manufacturing.
- Prepare the complete pattern for various types of leather products,
- Design and manufacture leather bags, Wallets, Leather garments etc.

**Reference Books:**

1. Anne & Jane Cope-Leatherwork
2. Carr & Latham-The Technology of Clothing Manufacture
3. Kirsten Jorgensen-Making Leather Clothes
4. Ben and Elizabeth Morris-Making Clothes in Leather
5. Sylvia Grainger-Leatherwork
6. Mary and E.A. Manning-Leatherwork
7. Francesca Sterlacei-Leather Apparel Design
8. Martin M. Shoben& Janet P. Ward-Pattern Cutting and making Up
9. Moseley, G.C-Leather Goods Manufacture
10. Batsford-Fashion with Leather

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**LPE-308: Quality Assurance of Leather Products and Allied Materials**

Credit	Class/week (h)	Total Class (h)
3.0	3.0	45.0

**Learning Objectives:** Specific objectives of this course are:

- To familiarize students with the various theoretical and practical aspects of physical characteristic of leather, leather products and allied materials.
- To describe Processing steps involved for physical testing of leather, leather products and allied materials.

- To acquaint the students with different machineries involved in the physical testing of leather, leather products and allied materials.
- To make the students competent in the field of quality control of leather products industry.

**Course Contents:**

**Introduction:** Objects of carrying out physical testing of finished leather, few popular thumb tests for Bag upper leathers, Luggage upper leather, Garments Leather and synthetic upper materials, advantage and disadvantage of thumb tests, classification of physical testing methods.

**Sampling:** Introduction, statistical aspects of the sampling problem, collection of samples, sections of finished Bag upper leathers, Luggage upper leather, Garments Leather, sampling positions, conditioning of test samples.

**Strength and stretch of leather:** Different strength tests for upper and lining leather of money bag, wallet, file folder, Office bag, ladies bag. luggage, brief case, Leather Jacket, Trouser, Skirt, etc.

**Tests for upper and lining materials:** Different comfort and general properties tests for upper and lining leather of money bag, wallet, file folder, Office bag, ladies bag. Luggage, brief case Leather Jacket, Trouser, Skirt.

**Tests for finish film:** Introduction, bond strength between the leather surface and the finish film, how to improve this bondage, heat resistance of finish film, cold crack resistance, light fastness of finish film, wet and dry rub fastness, test for bleeding, water fastness, elasticity of finish film, resistance to solvent, resistance to washing and cleaning agents, resistance to dressing agents, resistance to water stains, moisture fastness, resistance to plasticizer, resistance to buffing of suede leather, resistance to ageing.

**Tests for Synthetic Lining/ Cambrelle:** Tensile strength, Trouser tear strength, Brusting strength.

**Test for Accessories:** Laces: Breaking strength and elongation at break, Bodkin attachment strength, abrasion resistance, lace to eyelet abrasion test. Hook, Eyelet's, D-Rings: Attachment in leather, corrosion test, Breaking strength. Buckles: Corrosion test, Tensile strength, strength buckle and strap attachment.

**Tests for Zipper:** Security of interlocking of textile chain to lateral load, Opening resistance, Grip pull-off test, Top stop attachment, Bottom stop attachment. Security of attachment of retainer to lateral load.

**Tests for Velcro-** Peel strength, strength after repeated closing test, shear strength; Elastics limit of useful extension, resistance to repeated extension.

**Reinforcement-** Tensile properties, and the extension at which it breaks, tear strength, seam holding strength; trim attachment- attachment strength, security of decoration-abrasion resistance of trims – drum method, security of attachment of stones or inlays;

**Test for Threads-** Breaking strength, abrasion resistance, colour properties;

**Test for Complete Luggage and Briefcase:** Strength of handles, straps, attachments of Luggage and Briefcase, snatch and impact drop tests, rolling road test for wheeled luggage, Water resistance test, Static and Dynamic Loading test.

**Test for Complete Bags:** Strength of handles, straps, attachments, seams, buckles and trims; corrosion resistance of metal components.

**Test for Complete Belt:** Strength test, Buckle attachment strength, Grain crack test, Corrosion resistance of metal components.

**Test for Adhesive:** Peel or Stripping Strength of Adhesive Bonds (180 degree peel), Bond strength, and shear strength.

**Test for Industrial and Safety Hand Gloves:** Cut Resistance test, puncture resistance test, flame resistance test, resistance to contact heat, resistance to convective heat, resistance to radiant heat, resistance to small splashes of molten metal, resistance to big splashes of molten metal.

**Learning Outcomes:** Upon completion of this course the students will be able to

- Describe the physical properties of leather.
- Select the best leather and materials for particular leather products.
- perform various physical tests for leather, leather products and allied materials.

**Reference Books:**

1. Society of Leather Technologists and Chemists-Official Methods of Analysis-1996.
2. Dutta S.S. - An Introduction to the Principles of Physical testing of Leather.
3. O'Flaherty, William. And Roddy-The Chemistry and Technology of Leather, Vol-IV
4. Heidemann E. -Fundamentals of Leather Manufacturing.
5. Dutta S.S. - An Introduction to the Principles of Leather Manufacture.
6. John Arthur Wilson-Modern Practice In Leather Manufacture.
7. Venkatachalam P.S. - Lecture Notes on Leather.
8. SATRA Owner's Manual – SATRA, UK

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**LPE-309: Quality Assurance of Leather Products and Allied Materials Lab**

Credit	Class/week (h)	Total Class (h)
1.5	3.0/Group	45.0/Group

**Learning Objectives:** Specific objectives of this course are:

- To familiarize students with the various practical aspects of physical characteristic of leather, leather products and allied materials.
- To describe Processing steps involved for physical testing of leather, leather products and allied materials.
- To acquaint the students with different machineries involved in the physical testing of leather, leather products and allied materials.
- To make the students competent in the field of leather testing.

**Course Contents:**

1. Determination of tensile strength and % of elongation at break.
2. Determination of tear strength / stitch tear strength / tongue tear strength/ split tear strength.
3. Determination of flexing endurance.



4. Determination of water-vapor permeability of leather.
5. Determination of water vapor absorption and their co-efficient.
6. Determination of scuff, heat resistance of leather.
7. Determination of wash fastness, of leather used in products manufacture.
8. Determination of break/pipiness/wrinkles of supplied leather.
9. Determination of adhesion of finish film of supplied finished.
10. Different tests of money bag, wallet, file folder, Office bag, ladies bag. Luggage, brief case Leather Jacket, Trouser, Skirt.
11. Determination of wash fastness, of leather used in products manufacture.
12. Determination of break/pipiness/wrinkles of supplied leather.
13. Determination of adhesion of finish film of supplied finished.
14. Different thread tests.
15. Determination of light fastness for upper materials used in products.
16. Determination of perspiration resistance for upper materials used in products.
17. Determination of Rub fastness for upper materials used in products.
18. Different tests of accessories.
19. Different tests of gloves

**Learning Outcomes:** Upon completion of this course the students will be able to

- Perform the test various physical tests for leather, leather products and allied materials.
- Select the best leather and materials for particular leather products.
- Compare the leather products, leather and allied materials with standard.

**Reference Books:**

1. Society of Leather Technologists and Chemists-Official Methods of Analysis-1996.
2. Dutta S.S. - An Introduction to the Principles of Physical testing of Leather.
3. O'Flaherty, William. And Roddy-The Chemistry and Technology of Leather, Vol-IV
4. Heidemann E. -Fundamentals of Leather Manufacturing.
5. Dutta S.S. - An Introduction to the Principles of Leather Manufacture.
6. John Arthur Wilson-Modern Practice In Leather Manufacture.
7. Venkatachalam P.S. - Lecture Notes on Leather.
8. SATRA Owner's Manual – SATRA, UK

**LPE-310: Leather Products Merchandising**

Credit	Class/week (h)	Total Class (h)
3.0	3.0	45.0

**Learning Objectives:**

- To introduce students to leather products merchandising.
- To acquaint students with leather products merchandising and management education to empower them to be well equipped professionals.

**Course Contents:**

**Merchandising – The concept:** concept of fashion: Style vs Fashion: The fashion life cycle: Trends, Fads, Classics, Basic merchandise vs Fashion Merchandise: Design elements and principles; Structural changes in the Fashion industry: Responsibilities and traits of a merchandiser: Definition of Merchandising; 4 p's of marketing: Understanding Target market: Segmentation strategies and approach, categories of data collection; Merchandising planning and control tools.

**The Process of Line development:** Fashion trend research: Color, leather and trim research: Definition of line planning and development; Phases in product development of an apparel product; Importance and use of Interactive online Fashion information services, Pattern Design Systems and Product Management systems in the leather products industry.

**Merchandise Resources:** Merchandise wholesaler- distributors: Definition of imports, trade shows: Resident buying offices, types of buying offices; Definition of sourcing: Sourcing options: Factors in sourcing: The sourcing process; Inspection and Sampling procedures: Types of samples: Responsibilities for quality assurance: Specification sheet and its importance: The international care labelling system.

**Costing and Pricing strategies:** Cash flow: Balance sheet: Income statement: Gross margin return on inventory; The Pricing formula: Pricing strategies; Bill of materials and its importance: Costing principles: Costing strategies: Cost sheet.

**Planning sales and Inventory:** Merchandising planning structures: The 4-5-4 planning calendar; Basic stock method: Percentage variation method: Stock to sale ratio method; Open- to – buy method: Assortment planning; Computerized planning systems: Sources of planning information.

**Terms of Purchase:** Purchase order: Kinds of purchase order: Types of discount; Payment terms: Transportation terms: Transportation arrangements: Electronic data interchange; Vendor partnerships: Vendor matrix: The Distribution center.

**Supply chain Management:** Objectives: Importance: Sectors in the leather goods supply chain; Demand activated manufacturing architecture (DAMA); Just in time strategy: Quick response, elements for effective QR.

**Learning Outcomes:** After completion of this course students will be able

- To know about leather products merchandising.
- To get management education to be well equipped professional.

**Reference Books:**

1. Rosenau and Wilson “Apparel merchandising – The line starts here” Fairchild publications,2001
2. Donellan, John “Merchandise Buying and management” Fairchild Publications, 2001
3. Glock, Ruth E. and Kunz, Grace I. "Apparel Manufacturing - 3rd Edition" Prentice Hall, 1995
4. Clark, James “Fashion Merchandising-Theory and practice” Palgrave Macmillan, 2012
5. Grose, Virginia “Basics Fashion Management 01: Fashion Merchandising” AVA Publishing, 2011

6. Rabolt, Nancy J. and K. Judy “Concepts and Cases in Retail and Merchandise Management” Fairchild Publications, 1997
7. Khurana, P.K “Export Management” Galgotia publishing house, 2001
8. Kumar and Mittal “Export management” Anmol Publications, 2002

**LPE-311: Products Quality Analysis Lab**

Credit	Class/week (h)	Total Class (h)
1.5	3.0 /Group	45.0/Group

**Learning Objectives:** This course will assist the students to know about

- How to develop specification sheet of various leather products
- How to design layout for various products using computer programming.
- How to develop BOM sheet of various leather products
- How to allocate resources of various leather products
- Ho to develop production planning and scheduling using computer program for various leather products
- How to carry out Time study & Motion study for various leather products to improve productivity.
- How to develop MRP sheet of various leather products

**Course Contents:** Experiments and computational work involving:

1. **Spec sheet development:** Various leather goods and garments like wallets, bags, purses, card holders, jackets, trousers, waist coats, skirts etc.
2. **Computerized layout design:** Various leather goods and garments like wallets, bags, purses, card holders, jackets, trousers, waist coats, skirts etc.
3. **BOM sheet development:** Various leather goods and garments like wallets, bags, purses, card holders, jackets, trousers, waist coats, skirts etc.
4. **Production planning:** Various leather goods and garments like wallets, bags, purses, card holders, jackets, trousers, waist coats, skirts etc.
5. **Production scheduling:** Various leather goods and garments like wallets, bags, purses, card holders, jackets, trousers, waist coats, skirts etc.
6. **Resources allocation, machine loading and optimization:** Various leather goods and garments like wallets, bags, purses, card holders, jackets, trousers, waist coats, skirts etc.
7. **Time study & Motion study:** Various leather goods and garments like wallets, bags, purses, card holders, jackets, trousers, waist coats, skirts etc.
8. **Development of MRP sheet:** Various leather goods and garments like wallets, bags, purses, card holders, jackets, trousers, waist coats, skirts etc.

**Learning Outcomes:** This course will assist the students to skill on

- How to develop specification sheet of various leather products
- How to design layout for various products using computer programming.
- How to develop BOM sheet of various leather products
- How to allocate resources of various leather products

- Ho to develop production planning and scheduling using computer program for various leather products
- How to carry out Time study & Motion study for various leather products to improve productivity.
- How to develop MRP sheet of various leather products

**Reference Books:**

1. Jay Heizer, Barry Render, Chuck Munson- Operations Management: Sustainability and Supply Chain Management (13th Edition)
2. Jay Heizer, Barry Render- Operations Management (11th Edition)
3. Gideon Halevi- Handbook of Production Management Methods
4. Larry P. Ritzman, Lee J. Krajewski, and Manoj K. Malhotra- Operations Management: Processes and Supply Chains
5. Nicholas J. Aquilano and Richard B. Chase- Production and Operations Management
6. 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
7. Kim Hua Tan and Rupert Matthews- Operations Strategy in Action: A Guide to the Theory and Practice of Implementation
8. K.C Jain, L.N Aggarwal.- Production planning control and Industrial Management,
9. Martand Telsang- Industrial Engineering and Production Management,
10. Panneer Selvam.- Production and Operation Management

**LPE-312: Fundamentals of Footwear Manufacturing**

Credit	Class/week (h)	Total Class (h)
3.0	3.0	45.0

**Learning Objectives:** The learning objectives of this course are:

- To know about human foot
- To know about different types of footwear and its feature
- To know about different types of Last and its contraction
- To know about shoe sizing system
- To get ideas on cutting, closing and lasting
- To know the Features and constructions
- To gather ideas on shoe room and finishing

**Course Contents:**

**Human Foot:** Function of foot, types of foot, normal foot, foot’s section, Foot Anatomy- Bones, muscles, tendons, ligaments, nerves and blood vessels, joint, arches, skin etc. foot anatomy of infants and children, development of human foot from infants to adult- characteristic features of infant, children and adult foot, Biometry of the human foot, details of foot parameters. Foot Measurement- Necessity, Biometry, foot parameters and measuring procedure.

**Footwear:** Definition, history of footwear, foot gear, Purpose of footwear, comfortable footwear, types of footwear – oxford, derby, moccasin, mule, boot, sandal, clog, pump, safety footwear, occupational footwear, sports shoe styles and fashion of footwear, features of comfortable shoes, shoes and foot ills, Shoe Anatomy- Shoes section, parts of upper and lining, out soles, mid sole, counter.

**Last:** Last and it's importance, difference between last and feet, last features for different styles of footwear, classification of last, defects of last, measurement of last, symmetric and asymmetric lasts, custom made last, after care of last/storage of last.

**Shoe sizing and Fitting:** Principle of shoe sizing, history of shoe sizing, length size, shoe size classification- UK shoe sizing, parish point, American shoe sizing, centimeter scale, Mondo point, comparison among different shoe sizing systems, conversion of sizes from one scale to another, standardize shoe sizes, fitting- definition and Principles ,different fitting systems.

**Cutting:** Definition of Cutting, Principles of Cutting, Cutting of upper components, Hand cutting tools, Hand cutting process, Press cutting, Clicking press knives, environmental factors, Storage of knives, Modern clicking presses, Advantages of various types of cutting machines, press cutting process, Safety method of clicking, Comparison between hand cutting and machine cutting, Sorting of leather for cutting.

**Closing:** Definition, preparatory operations- identification marking, notch marking, size and marking, stitch marking, Lining stamping, Punching/Perforation, Gimping, Blocking, Preforming, Reinforcing, Embossing, Crimping, Splitting, Skiving, Edge coloring, Burnishing, Folding, Binding, Top line treatment, Eyeletting, Punching, Edge burnishing etc.

**Lasting:** Definition, functions of lasting, principle of lasting, methods of lasting, hand lasting procedures.

**Features and constructions:** Sandal, court shoe, oxford shoe, derby shoe- selection of materials, designing and pattern cutting, materials cutting, assembling, closing and lasting and sole attaching.

**Shoe room and finishing:** The aims and objects of finishing and their utility, upper leather dressing, cleaning and shoe lacing, upper leather cleaning and dressing, fitting the sock, shoe lacing and packaging.

**Learning Outcomes:** Upon successful completion of this course students will be able to:

- know about human foot
- know about different types of footwear and its feature
- know about different types of Last and its contraction
- know about shoe sizing system
- get ideas on cutting, closing and lasting
- know the Features and constructions
- gather ideas on shoe room and finishing

**Reference Books:**

1. Venkatappaiah B. -Introduction to The Modern Footwear Technology-
2. Miller R.G. (Editor) -Manual of Shoe Making

3. Korn J. (Editor) -Boot and Shoe Production
4. Thornton J. H. -Text Book of Footwear Manufacture
5. Spencer Crookenden -K Shoes -The first 150 years 1842-1992
6. Ruth Thomson -Making Shoes
7. Swayam Siddha -Product Knowledge
8. Swayam Siddha -The Skill of Seam Reducing
9. Thornton J. H. -Text Book of Footwear Materials

<b>LPE-313: Footwear Manufacturing Lab</b>		
Credit	Class/week (h)	Total Class (h)
1.5	3.0 /Group	45.0/Group

**Learning Objectives:** The learning objectives of this course are

- To gather knowledge on how to design a footwear
- To gather knowledge on how to make pattern for a shoe
- To gather knowledge on how to manufacture various types of shoe

**Course Contents:**

1. Identification of shoes, identification of parts and components of shoes.
2. Foot measurement and foot impression taking techniques.
3. Handling and introduction of working tools of footwear.
4. Mean forme-making technique, dead forme, standard making.
5. Working pattern making technique
6. Sandal making: Toe peg, toe band, v-strap, instep- band, crossed bands, multi-straps.
7. Men's Shoe making- Oxford shoe, Gibson/Derby shoe, Brogue shoe, Monk shoe, Army boot, Riding boot, orthopedic shoe, miner's boot, moccasin, Slippers.
8. Women's Shoe Making- Fancy shoes, Court shoe, Mule, Bar Shoe, Tie Shoe, Ankle Strap, Sling- back.

**Learning Outcomes:** After learning this course students

- can contribute significantly to design and manufacture of various types of footwear

**Reference Books:**

1. Venkatappaiah B. -Introduction to The Modern Footwear Technology-
2. Miller R.G. (Editor) -Manual of Shoe Making
3. Korn J. (Editor) -Boot and Shoe Production
4. Thornton J. H. -Text Book of Footwear Manufacture
5. Spencer Crookenden -K Shoes -The first 150 years 1842-1992
6. Ruth Thomson -Making Shoes
7. Swayam Siddha -Product Knowledge
8. Swayam Siddha -The Skill of Seam Reducing
9. Thornton J. H. -Text Book of Footwear Materials
10. DR. Davidsohn J. & Davidsohn A. - Polishes - Their Raw Materials and Manufacture

**BUS-301: Supply Chain Management for Leather and Leather Products**

Credit	Class/week (h)	Total Class (h)
3.0	3.0	45.0

**Learning Objectives:**

- Understand the fundamentals of Supply Chain Management (SCM) including its role in an organization and in integrating firms in a supply chain.
- Understand the various concepts in SCM like coordination, planning for uncertainty, supply contracts, logistics management, outsourcing and procurement management.
- Apply various analytical methods and tools so that students are able to measure and evaluate various facets of supply chain performance.
- Understand practices in SCM that differentiate successful firms from others.
- Understand the challenges in SCM through a real industry project.

**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, examples of supply chains.

**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.

**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, The Impact of Uncertainty on Network Design Decisions, Discounted Cash Flow Analysis, Representations of Uncertainty, Evaluating Network Design Decisions Using Decision, Evaluation of Supply Chain Design Decisions Under Uncertainty, Making Supply Chain Decisions Under Uncertainty in Practice.

**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, Forecasting in practice.

**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,

**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.

**Learning Outcomes:**

- To learn the strategic importance of goods supply, chain design, planning, and operation for every firm.
- To convey how supply chain drives may be used on a conceptual level during supply chain design, planning and operation to improve performance.
- To gain knowledge of logistics and supply chain methodologies
- To understand how logistical decision and impact on the performance of the firm as well as the entire supply chain.

**Reference Books:**

1. K.Shridhra Bhat, “Logistics and Supply Chain Management”.
2. S. Chopra and Mendil, “Supply chain management, strategy, planning and operation”, Pearson Education, Asia, 2/2004.
3. B.S. Sahay, “Supply Chain Management, for Global Competitiveness”, Macmillan Bangladesh Limited, 1999.
4. G. Raguram and N. Rangarajan, “Logistics and Supply Chain Management-Cases and concept”, Macmillan.

**Fourth Year (1<sup>st</sup> Semester)**

**LPE-401: Leather Garments Manufacturing**

Credit	Class/week (h)	Total Class (h)
3.0	3.0	45.0

**Learning Objectives:** The learning objectives of this course are:

- To understand basic concept and mechanism clothing design.
- To introduce the essential facts and development method in different ladies skirt, waist coat, trouser, children wear, men’s and women’s wear manufacturing.
- To acquaint students with design and construction of slicker, princess line coat, duster, wrap over/clutch, frock coat, pelerine, logger's cruiser utility.

**Course Contents:**

**Background:** History of leather product, pre-history of Renaissance /Renaissance to industrial revolution, Industrial revolution to the present day.

**Clothing:** Introduction, Clothing culture and communication, the individual and dress, fashion men's /women's wear, materials, choosing patterns, cutting patterns, fitting garments, stitching.

**Clothing Design:** Development of a collection, fashion, fashion accessories, elements of cutting, types of cutting, cutting of straight lines, curves, diagonal, cutting of various patterns with notches, importance of notches, lining cutting.

**Pockets:** Development of different pocket and flap, gusset pocket and flap, Piping pocket, False pocket.

**Collars:** Pattern construction and Development of different collars.

**Skirt:** Different parts of simple skirt, ladies straight skirt, construction of basic skirt block, pleats construction, grading for skirts, modification in basic skirt, design & construction of flayed skirt-paneled skirt, components attachment -pockets-pleats.

**Waist Coat:** Construction of basic waist coat block, Different parts of waist coat, Classification of different waist coat. Modification and design development of different waist coat.

**Jacket:** Construction of different parts of simple jacket, pattern control, matching of leather grain and color, area necessary, cutting of a simple jacket, control of cutting jackets, cutting of lining, size and models.

**Trouser:** Design and development of Different parts of a simple trouser, basic trouser block, construction of trouser with pleats, components attachment-zip.

**Safari jacket:** Design and development of Different parts of safari jacket, collar construction, sleeve construction, modification to basic block, design & pattern making, fabrication.

**Children's wear:** Liberty cap, sun hat, ankle sock, tight, pants, bib, tee shirt, leggings.

**Boys and Girls wear:** Plain suit, splash suit.

**Men's and Women's wear:** Slicker, princess line coat, duster, wrap over/clutch, frock coat, pelerine, logger's cruiser utility.

**Learning Outcomes:** Upon successful completion of this course students will be able to:

- Use techniques and skills essential for the development of design and fashion.
- Obtain a comprehensive knowledge in the development of basic block, design & pattern making.
- Develop new method to produce different ladies skirt, waist coat.
- Critically analyze to control the quality in leather garments manufacturing.
- Develop skill in total pattern making, quality control, assembling and construction.

**Reference Books:**

1. Roland Kilgus- Clothing Technology
2. Attwater W. A.- Leathercraft
3. Moseley G. C. - Leather Goods Manufacture
4. Kathryn Mc Kelvey- Fashion Source Book.
5. Francesca Sterlacci- Leather Apparel Design.
6. Martin M. Shoben & Janet P. Ward- Pattern Cutting and making up.
7. Batsford - Fashion with leather.

**LPE-402: Leather Garments Manufacturing Lab**

Credit	Class/week (h)	Total Class (h)
1.5	3.0 /Group	45.0/Group

**Learning Objectives:** The learning objectives of this course are:

- To perceive basic working knowledge for the development of the leather garment design.
- To introduce the essential facts and development method in different ladies skirt, waist coat.
- To obtain a comprehensive practical knowledge in the development of basic block, design & pattern making.

**Course Contents:**

**Pockets:** Manufacturing of different pleated pocket and flap, gusset pocket and flap, Piping pocket, False pocket.

**Collars:** Pattern construction and manufacturing of different collars.

**Waist Coat:** Construction of basic waist coat blocks, Manufacturing of different waist coat.

**Skirt:** Construction of basic skirts block, Manufacturing of different skirts.

**Jacket:** Pattern construction and manufacturing of different jackets.

**Trouser:** Construction of basic trousers block, Manufacturing of different trousers.

**Children's wear:** Construction of basic children wear block, Manufacturing of different children dresses, liberty cap, sun hat, ankle sock, tights, pants, bibs, tee shirts, leggings.

**Boys and Girls wear:** Construction of basic boys and girls dress blocks, Manufacturing of different dresses for boys and girls.

**Learning Outcomes:** Upon successful completion of this course students will be able to:

- Use practical knowledge and skills essential for the development of design and fashion.
- Receive a comprehensive practical knowledge in the development of basic block, design& pattern making.
- Develop new method to produce different ladies skirt, waist coat.
- Critically analyze to maintain the quality in leather garments manufacturing.
- Understand basic working knowledge for the development of the leather garment design.
- Develop skill in total pattern making, quality control, assembling and construction.

**Reference Books:**

1. Roland Kilgus- Clothing Technology
2. Attwater W. A.- Leathercraft
3. Moseley G. C. - Leather Goods Manufacture
4. Kathryn Mc Kelvey- Fashion Source Book.
5. Francesca Sterlacci- Leather Apparel Design.

6. Martin M. Shoben & Janet P. Ward- Pattern Cutting and making up.
7. Batsford - Fashion with leather.

**LPE-403: Synthetic Materials for Leather Products**

Credit	Class/week (h)	Total Class (h)
3.0	3.0	45.0

**Learning Objectives:**

- To provide an overview of materials science and technology related with leather goods and footwear as a basis for understanding how structure/property/processing/application relationships are developed and used for different types of materials in leather products manufacturing.
- To know the polymeric materials and their properties and applications in leather products manufacturing.
- To know how the polymer modification techniques help to modify the properties of polymer.
- To know about the properties, applications and manufacturing requirements of different types of artificial leather/synthetic materials used in leather goods manufacturing.
- To know the properties, applications and manufacturing requirements of dressing materials, polishes, and accessories used in leather goods manufacturing.

**Course Contents:**

**Polymeric Materials used for leather-products manufacture:** Introduction, properties and applications of polymeric materials-- PVC, ABS, PS, PU, PP, EVA, PE, Nylon, Acrylics, fibre reinforced plastics type of materials and their quality, materials for quality assurance.

**Modifications of polymeric materials for different Leather Products components:** Polymer blending, high polymer blends, plasticization, other additives, fillers, antioxidants, flame-retardants, stabilizers, colorants and pigments, post reactions of polymers.

**Moulding techniques and equipment:** Moulding techniques and equipment used in fabrication of polymer products such as injection moulding, calendaring, reaction injection moulding (RIM), DVP, blow moulding etc.

**Coated Fabrics:** **Coated fabrics:** Introduction, types of coated fabrics, backers and coating materials used in coated fabrics, direct coating and transfer coating, poromers, PVC coated fabrics, PU coated fabrics, rubber coated fabrics and their properties & application in leather products industry, comparison between leather and synthetics, Manufacturing techniques of different types of coated fabrics, advantages and disadvantages of coated fabrics compared to leather.

**Lining Materials:** Properties and applications of following lining materials in leather goods industry: Drill Cloth, Suger Coated Fabrics & other synthetic lining materials, Different lining Leather.

**Leather Products dressing materials:** Introduction, objectives of products dressing, finish identification of leather, selection of dressing system and materials, Different

products & shoe dressing materials; cleaner, waxes-abrasives wax, repairing wax, burnishing wax, polishing wax, fillers, renovators, etc.

**Learning Outcomes:** Students will be able

- To know the identification characteristics and applications of various polymeric materials.
- To know the polymer modification techniques.
- To know the properties, applications and manufacturing requirements of various lining and adhesive materials for leather goods manufacturing.
- To know the properties, applications and manufacturing requirements of different types of dressing materials and polishes used in leather products manufacturing.

**Reference Books:**

1. Dr. Davidsohn J. & Davidsohn A - Polishes - Their Raw Materials and Manufacture
2. Billmeyer F.W. Jr- Text Book of Polymer Science
3. Gowariker V.R-Polymer Science
4. Arora M.G & Singh M- Polymer Chemistry
5. P Winding C.C & Hiatt G.D- Polymeric Materials
6. Dr. (Mrs.) Ganga Radhakrishnan & Dr. Ponswarry Rajalingam- Polymeric Materials for Footwear
7. L.H.Sperling -Introduction to Physical Polymer Science
8. A.J. Harvey.-Footwear materials & Process Technology.
9. Sormenath Ganguly- Comprehensive footwear Technology.

**LPE-404: Lean Manufacturing of Leather and Leather Products**

Credit	Class/week (h)	Total Class (h)
3.0	3.0	45.0

**Learning Objectives:**

- To implement lean manufacturing concepts in the factories.
- To get idea on tools of lean manufacturing.

**Course Contents:**

**Introduction:** The mass production system; Origin of lean production system; Necessity; Lean revolution in Toyota; Systems and systems thinking; Basic image of lean production; Customer focus; Muda (waste).

**Stability of Lean System:** Standards in the lean system; 5S system; Total Productive Maintenance; standardized work; Elements of standardized work; Charts to define standardized work; Man power reduction; Overall efficiency; standardized work and Kaizen; Common layouts.

**Just in Time:** Principles of JIT; JIT system; Kanban; Kanban rules; Expanded role of conveyance; Production leveling; Pull systems; Value stream mapping.

**JIDOKA (Automation with a Human Touch):** Jidoka concept; Poka-Yoke (mistake proofing) systems; Inspection systems and zone control; Types and use of Poka-Yoke systems; Implementation of Jidoka.

**Worker Involvement and Systematic Planning Methodology:** Involvement; Activities to support involvement; Quality circle activity; Kaizen training; Suggestion Programmes; Hoshin Planning System (systematic planning methodology); Phases of Hoshin Planning; Lean culture

**Learning Outcomes:** The student will be able to practice the principles of lean manufacturing like customer focus, reduction of MUDA, just in time, Jidoka and Hoshin planning.

**Reference Books:**

1. Dennis P.,” Lean Production Simplified: A Plain-Language Guide to the World's Most Powerful Production System”, (Second edition), Productivity Press, New York,2007.
2. Liker, J., “The Toyota Way: Fourteen Management Principles from the World's Greatest Manufacturer”, McGraw Hill, 2004.
3. Michael, L.G., “Lean Six SIGMA: Combining Six SIGMA Quality with Lean Production Speed”,McGraw Hill, 2002.
4. Ohno, T., “Toyota Production System: Beyond Large-Scale Production”, Taylor & Francis, Inc., 1988.
5. Rother, M., and Shook, J.,’ Learning to See: Value Stream Mapping to Add Value and Eliminate MUDA”, Lean Enterprise Institute, 1999.

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**LPE-405: Production Planning and Control for Leather and Leather Products**

Credit	Class/week (h)	Total Class (h)
3.0	3.0	45.0

**Learning Objectives:** Students have

- to get the idea on production systems, how to select the facility location, how to make the efficient production layout, how to conduct an analysis to demand forecasting for production management, how to manage inventory, how to carried out the work and method study in the leather products industry, and how to conduct operations scheduling and sequencing for leather products industry. Students also will get knowledge on how to implement the tools and techniques to manage the production in the leather products industry supply chain.

**Course Contents:**

**Introduction to production management:** production, production system, essential functions of manufacturing firms, basic production management function, the strategies of decision making in the leather production industry, productivity challenge, strategies of improving productivity in leather goods industry, concept of productivity, productivity

calculations, multi-factor productivity, productivity variables, key variables for improved labor productivity, ethics, social responsibility, and sustainability.

**Demand Forecasting:** basic concept of forecasting, types of forecasts, strategic importance of forecasting for leather products industry, steps in forecasting, forecasting approaches, overview of qualitative methods, overview of quantitative approaches, time-series forecasting, methods of forecasting, common measures of error, least squares method for demand forecasting, multiple-regression analysis, monitoring and controlling forecasts, tracking signal, adaptive smoothing, advanced forecasting techniques.

**Facility planning and layout design:** strategic importance of layout decisions, layout design considerations, layout strategies, types of layout, warehousing and storage layouts, fixed-position layout, process-oriented layout, problems related to process oriented layout, staffing and balancing work cells, repetitive and product-oriented layout, problems related to product-oriented layout, assembly-line balancing, line-balancing heuristics.

**Inventory management:** basic ideas of inventory, importance of inventory, functions of inventory, types of inventory, managing inventory, ABC analysis, terms used in inventory management, cycle counting, inventory models, inventory models for independent demand, basic economic order quantity (EOQ) model, production order quantity model, quantity discount model, probabilistic models and safety stock, probabilistic demand, probabilistic example.

**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, importance of short-term 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), critical path and determination of minimum member of works.

**Work Study:** Method study, Purpose and Techniques used, Procedure of select, Record, Examine, Develop, Install and Maintain. 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 and operator performances, Hok (operator hours per 100kg production), Machine interference.

**Production cost concept and break- even analysis:** cost of production, concept of cost, cost unit, classification of cost, analysis of production cost, break –even analysis, break – even point, cost-volume- profit (CVP) analysis.

**Learning Outcomes:** From learning this course the students can understand

- the basic of production systems, capacity planning, facility planning and layout design demand forecasting, leather products industry's inventory management, work and method study for productivity improvement and line balancing, materials resource planning and operation scheduling and sequencing.

**Reference Books:**

- Jay Heizer, Barry Render, Chuck Munson- Operations Management: Sustainability and Supply Chain Management (13th Edition)
- Jay Heizer, Barry Render- Operations Management (11th Edition)
- Gideon Halevi- Handbook of Production Management Methods
- Larry P. Ritzman, Lee J. Krajewski, and Manoj K. Malhotra- Operations Management: Processes and Supply Chains
- Nicholas J. Aquilano and Richard B. Chase- Production and Operations Management
- 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
- Kim Hua Tan and Rupert Matthews- Operations Strategy in Action: A Guide to the Theory and Practice of Implementation
- K.C Jain, L.N Aggarwal.- Production planning control and Industrial Management,
- MartandTelsang- Industrial Engineering and Production Management,
- PanneerSelvam.- Production and Operation Management

**LPE-406: Application of Computer in Leather Products Design**

Credit	Class/week (h)	Total Class (h)
2.0	4.0 /Group	60.0/Group

**Learning Objectives:**

- To know how to design various types of leather goods using CAD software
- To know how to design various types of leather garments using CAD software
- To understand how to make various types of pattern using plotter.

**Course Contents:**

**Manufacturing Techniques of the following items-**

**Leather Goods:**

- Leather Key rings (Triangular, Rectangular, Circular, Pentagon, Polygon etc.)
- Leather Mobile cover
- Leather ladies bag
- Address-card holder in leather material
- Leather Money Bag
- Leather Vanity Bag
- Leather Belts for Gents
- Ladies Bags
- Gents Bags
- Executive Bags

- Laptop Bags
- File Folder
- Travel Bags
- Tote Bags

**Leather Garments:**

**1. Men's wear preparation and Grading techniques:**

- Block preparation.
- Bolero type waistcoat
- Gilet type waistcoat

**2. Women's wear preparation and Grading:**

- Block preparation.
- Ladies jacket
- Skirt grading.

**3. Different Size Modifications of various types of leather garments**

**Learning Outcomes:** Upon completion of this course students will be able-

- To know how to design various types of leather goods using CAD software
- To know how to design various types of leather garments using CAD software
- To understand how to make various types of pattern using plotter.

**Reference Books:**

- Pattern Cutting & Making up- Martin M. Shoben
- Leather Apparel Design – Francesea Sterlacci
- Clothing Technology- Europa Lehrmittel
- Fashion With Leather- Bastford
- Making Leather Clothes- Jongensen.
- Pattern Cutting for Women's Outerwear- Gerry Cooklin.
- Metric Pattern Cutting for Children's Wear and Baby Wear- Winifred Aldrich
- Grading for the Fashion Industry- Taylon Shoben
- Pattern Drafting and Making up- Bella Kapoor
- Pattern Grading for Men's Cloths- Cooklin

**LPE-407: Industrial Utility and Maintenance**

Credit	Class/week (h)	Total Class (h)
3.0	3.0	45.0

**Learning Objectives:**

- Define and explain the maintenance function and its objectives.
- Understand the main forms of maintenance and their application.
- To optimize the reliability of equipment and infrastructure.
- To train personnel in specific maintenance skills.
- To improve operational safety.

**Course Contents:**



**Air conditioning:** Comfort condition, Principle of air conditioning, Application to Leather Product industry; Refrigeration equipment, Refrigerant.

**Psychometric chart and psychometric processes;** calculation of simple air conditioning system, Distribution system, Humidifier, De-humidifier, Cooling tower.

**Thermal power plants:** Basic principles and cycles used; Steam power plants; Diesel power plants; gas power plants; combined cycle power plant, regeneration.

**Boiler:** Boiler types, mountings, accessories, boiler efficiency.

**Material 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.

**Lubrication:** Lubricant, types, general properties, functions, lubrication system.

**Machine erection:** Floor preparation, foundation, machine fixation, leveling.

**Maintenance:** Types of maintenance, planning and organizing maintenance, preparation of maintenance schedule. Maintenance of various machineries of tannery/foot wear and other leather product industries.

**Learning Outcomes:**

- Discuss the field of industrial maintenance and describe its role in manufacturing
- Explain the skills and preparation needed for jobs in industrial maintenance
- Describe specific procedures for ensuring safety in the workplace
- Describe types of maintenance strategies and their purpose
- Explain the purpose of mechanical drive systems used in manufacturing
- Identify the most common machine tools and their uses
- Describe how electric devices work and identify common electrical tests and maintenance tasks
- Describe how industrial process systems work, including inputs, outputs, and safety considerations

**Reference Books:**

1. Sharphouse - Leather Technicians Hand books.
2. Pivecka J. - Practical Handbook on Shoe Production.
3. Boothroyd G.- Assembly Automation and Product Design
4. Miller R. G. (Editor) - Manual Of Shoe Making
5. Miller R.G. (Editor) -Manual of Shoe Making
6. Thornton J. H. -Text Book of Footwear Manufacture
7. G. R. Nagpal, G R. Khanna- Power Plant Engineering
8. V. Ganesan-Internal combustion engines
9. W.F.Stoecker & J.W. Jones-Air Conditioning and Refrigeration
10. Assomac-The Innovation Notebooks for The Leather Goods Industry

**LPE-408: Maintenance Workshop**

Credit	Class/week (h)	Total Class (h)
1.5	3.0/Group	45.0/Group

**Learning Objectives:** Specific objectives of this course are as follows.

- To practice how to create comfort working condition in different season during the production.
- To demonstrate different power generation unit this can support the production floor.
- To demonstrate different material handling equipment.
- To give idea how to check machine comfort by spirit level.
- To demonstrate different Leather-Products machineries maintenance.

**Course Contents:**

1. Study the Air Conditioning and controlling system to create comfort.
2. Study the distribution of conditioned air through ducts or pipes.
3. Study the Humidifier, Dehumidifier and cooling tower.
4. Study the control and maintenance of emergency power supply unit (Diesel power unit) of our institute.
5. Study the use of different material handling equipments like belt-conveyor, wooden horses and forklifts etc.
6. Study the use of different Lubricants and hydraulic oils which are directly used in Leather-Products machineries.
7. Use of spirit level to check the comfort machine operations.
8. Check and fill the hydraulic oil up to the level of the machine of Travelling head hydraulic press.
9. Check and sharp the band saw of the leather splitting machine.
10. Check and sharp the circular cutter of skiving machine.
11. Check and adjust the operating pressure of different pneumatic sewing and finishing machine of Leather-Products.
12. Check the operating condition of central pneumatic compressor.

**Learning Outcomes:** Upon completion of this course students will be able-

- To control air conditioning system and create production floor comfort.
- To understand the use of different kind of ducts and pipes.
- To know the appropriate use of Humidifier, Dehumidifier and cooling tower.
- To know the appropriate use of different kind of power units.
- To understand different types of materials handling equipments.
- To know the use of different Lubricants and hydraulic oils.
- To know the Use of spirit level.
- To know the maintenance of the machine of Travelling head hydraulic press.
- To know the maintenance of the leather splitting machine.
- To know the maintenance of the skiving machine.
- To know the maintenance of the pressure gauge.
- To know the maintenance of the pneumatic compressor.

**Reference Books:**

1. Sharphouse - Leather Technicians Hand books.

**Fourth Year (2<sup>nd</sup> Semester)**

**LPE-409: Wastewater and Solid Waste Management**

Credit	Class/week (h)	Total Class (h)
3.0	3.0	45.0

**Learning Objectives:**

- To describe methods of advanced effluent treatment for higher discharge standards and effluent re-use.

**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.

**Types of tannery effluent:** Effluent from beam house operations, tan yard processes and finishing processes, their nature, most toxic ingredients in tannery waste water.

**Tannery Effluents:** Source of liquid wastes in tanneries; Characterization and assessment of critical environmental parameters. Chemistry and Characteristics of Environmental Parameters-Total solids, total dissolved solids, volatile matters, BOD<sub>5</sub>, COD, TOC, TDS, ammonia, nitrogen, protein content, chlorides, alkalinity, pH, sulphide, DO, total coliform count, polyphenol, metal content.

**Processes for the treatment of industrial wastewater** - principles of physical treatment: screening, mixing, equalization, sedimentation, filtration - principles of chemical treatment: coagulation, flocculation, precipitation, ion exchange, use of alkali, CaO, neutralization, flotation, oxidation/reduction, distillation - objectives of biological wastewater treatment and various process.

**Primary Treatment:** Main objects of primary treatment- primary Treatment units- Collection system of discharged waste water in tanneries- screening- equalisation of waste water.

**Secondary Treatment:** Principles of secondary treatment- Different processes involved in secondary treatment system- Lagoon treatment- aeration system- trickling filter- systematic design of these systems- bio-technology in effluent treatment.

**Tertiary Treatment:** UV treatment, ozonolysis, chlorination, reverse osmosis. Concept of CETP, disposal of sludge.

**Principle of biological treatment:** derivation of bacterial growth kinetics. Process design and operation of attached growth, suspended growth and hybrid process: activated sludge process - its modifications, trickling filter, RBC, oxidation ditch, aerated lagoon, biofilter, anaerobic baffled reactor, UASB reactor. Waste stabilization pond, design and operation of biological nitrification, de-nitrification system; Floating aquatic plant system.

**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 foot print.

**Source of Solid Waste in Leather Products Industry:** Trimming of finished leather, cutting, skiving, waste from upper, buffing dust, sewing dust, waste from lining materials-

- Pivecka J. - Practical Handbook on Shoe Production.
- Boothroyd G.- Assembly Automation and Product Design
- Miller R. G. (Editor) - Manual Of Shoe Making
- Miller R.G. (Editor) -Manual of Shoe Making
- Thornton J. H. -Text Book of Footwear Manufacture
- G. R. Nagpal, G R. Khanna- Power Plant Engineering
- V. Ganesan-Internal combustion engines
- W.F.Stoecker & J.W. Jones-Air Conditioning and Refrigeration
- Assomac-The Innovation Notebooks for The Leather Goods Industry

**HUM-401: Employability Skills-II**

Credit	Class/week (h)	Total Class (h)
1.5	3.0/Group	45.0/Group

**Learning Objectives:**

- To develop ability to gain key strategies and expressions for communicating with professionals and non-specialists.
- To improve the skills of writing, for example, business plan.
- To improve the presentation skills
- To gain insight on how to deliver good presentation

**Course Contents:**

**Writing Concept of Business Plan:** Writing of business plan for various types of leather and leather products.

**Presenting business plan:** Making interactive presentation slides and presenting the business plan.

**Learning Outcomes:**

- Will be able to develop key strategies and expressions for communicating with professionals and non-specialists.
- Will be able to improve the skills of writing, for example, business plan.
- Will be able to improve the presentation skills
- Will be able to gain insight on how to deliver good presentation

**Reference Books:**

- Joseph A. Covello And Brian J. Hazelgren, The Complete Book of Business Plan- Secrets to Writing Powerful Business Plans.

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 in Leather Products Industry:** Prevention, reduction, reuse, recycling, energy recovery and disposal.

**Learning Outcomes:**

- Understand the role of each unit process within typical treatment process trains, their interaction and the context of when they are applied.
- Appreciate the advantages, disadvantages and limitations of the technologies and new developments.

**Reference Books:**

1. Arceivala S.J. "Waste water treatment and disposal" Marcel Dekkar Inc., New York, 1981.
2. 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.
3. Bessellie, B.E. and Schwartz, M. "The Treatment of Industrial wastes", 2nd edn., McGraw Hill.
4. McCarty, P., Parkin, G.F. and Sawyer, C.N., "Chemistry for Environmental Engineering 4th Edition", McGraw Hill, 1994.
5. Metcalf and Eddy, Wastewater Engineering, Treatment and Reuse, Tata McGraw Hill, New Delhi, 2003.
6. Gilbert M. Masters, 'Introduction to Environmental Engineering and Science', 2nd edition, Pearson Education (2004).
7. Infogate, GTZ, Treatment of Tannery Waste Water, GmbH, Frankfurt, Germany, 2002.

**LPE-410: Wastewater and Solid Waste Management Lab**

Credit	Class/week (h)	Total Class (h)
1.5	3.0/Group	45.0/Group

Lab based of the content of LPE-409.

**BUS-401: Total Quality Management (TQM) for Leather and Leather Products**

Credit	Class/week (h)	Total Class (h)
3.0	3.0	45.0

**Learning Objectives:**

- To provide comprehensive knowledge about the principles, practices, tools and techniques of Total quality management.
- To understand the need for quality, its evolution, basic concepts, contribution of quality
- TQM framework, Barriers and Benefits of TQM.

- To understand the TQM Principles.
- To learn and apply the various tools and techniques of TQM.
- To understand and apply QMS and EMS in any 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 interpretation, 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 & Techniques I:** The seven traditional tools of quality, New management tools, Six-sigma: Concepts, methodology, applications to spinning, weaving, chemical processing and garment industries, Bench marking, Reason to bench mark, Bench marking process, FMEA, Stages, Types.

**TQM Tools & 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 industry, 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

**Learning Outcomes:**

- Ability to apply TQM concepts in a selected enterprise.
- Ability to apply TQM principles in a selected enterprise.
- Ability to apply the various tools and techniques of TQM.
- Ability to apply QMS and EMS in any organization.

**Reference Books:**

1. Dale H. Besterfield, et al., "Total Quality Management", Pearson Education Asia, Third Edition, Indian Reprint, 2006.
2. Suganthi, L and Anand Samuel, "Total Quality Management", Prentice Hall (India) Pvt. Ltd., 2006 .

3. James R. Evans and William M. Lindsay, “The Management and Control of Quality”, (6<sup>th</sup> Edition), South-Western (Thomson Learning), 2005.
4. Oakland, J.S. “TQM-Text with Cases”, Butterworth, Heinemann Ltd., Oxford, Third Edition, 2003.
5. Janakiraman, B and Gopal, R.K, “Total Quality Management-Text and Cases”, Prentice Hall (India) Pvt. Ltd., 2006.
6. Quality management in Clothing & Leather/Footwear/Leather Product Industry, Chuter, A.J

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**BUS-402: Cost and Management Accounting**

Credit	Class/week (h)	Total Class (h)
3.0	3.0	45.0

**Learning Objectives:**

- To know about cost accounting for leather products industry
- To know about Cost Behaviour and Terminology
- To know about Cost Elements
- To know about Cost Accounting system
- To know about Costing Techniques
- To know about Management Accounting

**Course Contents:**

**Cost Accounting:**

**Introduction:** meaning, scope, objective, advantages Financial Accounting vs Cost Accounting, Factors influencing the design of a cost, limitation, 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 Behaviour 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:** Costing for materials, Costing for labour, and costing for Overheads.

**Cost Accounting system:** Job order costing, Contract Costing and Process Costing.

**Costing Techniques:** Standard Costing, Costing of by products and joint products, Direct Costing. Costing of leather and 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 tanneries and leather products industry

**Management Accounting:**

**Introduction-**Definition, Difference from Financial Accounting & 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-run decision: BEP Analysis, Cost for decision making, Differential cost analysis.

**Evaluation Performance:** Variance analysis, financial statement, analysis & Interpretation.

**Business Economic:**

**The role 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.

**Learning Outcomes:** Upon completion of this course students will be able-

- To know about cost accounting for leather products industry
- To know about Cost Behaviour and Terminology
- To know about Cost Elements
- To know about Cost Accounting system
- To know about Costing Techniques
- To know about Management Accounting

**Reference Book:**

1. Accounting Principles, Kieso and Kimmel.

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**LPE-411: Project**

Credit	Class/week (h)	Total Class (h)
3.0		

**Project and Seminar:**

Each student is required to submit a report on the project assigned to him/her by the institute. Prior to the submission of the project report, each student should present a seminar based on the work done.

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**LPE-412: Comprehensive Viva**

Credit	Class/week (h)	Total Class (h)
2.0	-	-

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**LPE-413: Internship**

Credit	Class/week (h)	Total Class (h)
3.0	-	-

Each student will have 2 months intensive training in the industry relevant to their study.