UNIVERSITY OF DHAKA

BANGLADESH

COURSE CURRICULUM

FOR

B. Sc. IN LEATHER ENGINEERING

(FOUR YEAR COURSE)

Institute of Leather Engineering and Technology

University of Dhaka, 44-50, Hazaribagh, Dhaka-1209

RULES AND REGULATIONS APPLICABLE FOR
INSTITUTE OF LEATHER ENGINEERING AND TECHNOLOGY
DEPARTMENT: LEATHER ENGINEERING

A. ACADEMIC RULES

1. The Institute of Leather Engineering and Technology (ILET), Hazaribagh, Dhaka shall be deemed to be an institute of the University of Dhaka.
2. The degree to be awarded by the University of Dhaka shall be designated as B. Sc. in Leather Engineering.
3. The Courses for the B. Sc. in Leather Engineering shall extend over four academic years.
4. The medium of instruction and examination shall be in English.
5. Every year there will be an admission test for new intakes. The rules and regulations and other necessary works for the admission purpose will be performed by the central admission committee of the University.
6. Candidates for admission to the first year B. Sc. in Leather Engineering shall be required to have passed the Higher Secondary Certificate in Science with Physics, Chemistry and Mathematics or its equivalent from a recognized Board or Institution. Foreign students with requisite qualification may be admitted with the approval of the Central Admission committee.
7. Admission to the first year B. Sc. in Leather Engineering programme shall be based on the results of S.S.C. and H.S.C. or its equivalent examinations and the admission test to be conducted based on current rules by the Central Admission Committee.
8. The detail syllabus for degree of Leather Engineering shall be approved by Academic Council of the University of Dhaka.
9. An Examination Committee for each year consisting of 4 (four) members of which 3 (three) shall be internal and 1 (one) from other departments of the Institute or the university or research organization shall be constituted by the departmental academic committee.
10. There shall be a Departmental Academic Committee consisting of all the full-time teaching staff to help academic matters.
11. Every year before the commencement of Academic session the list of part time teachers (if required) shall be prepared course wise and must be approved by the authority.
12. The question paper setters and the examiners will be selected by the Examination Committee from the panel approved by the Academic council.
13. The question papers shall be moderated by the Examination Committee.

14. No candidate shall be eligible for degree of B.Sc. in Leather Engineering unless he or she has undergone the approved courses of study for a minimum period of four academic years and maximum of six academic years.
15. There shall be 15 hour lectures for 1 credit of theory classes. There shall be 30 hour lectures for 1 credit of Practical classes. Each of the class duration is 50 minutes.
16. No student shall be allowed to study any other degree programme during his/her study in Institute of Leather Engineering and Technology.

B. CURRICULUM AND EXAMINATION RULES

17. The subjects to be studied and the scheme of examinations for B. Sc. in Leather Engineering courses are given in Annexure-A.
18. There shall be a final examination at the end of each academic year to be conducted by the University of Dhaka.
19. Two examiners of whom one will be the course teacher and the other shall be from other departments of the Institute or University or research organization. The average of two will be taken as final. In case of the difference of more than 20% marks between the two examiners, the script/scripts will be evaluated by a third examiner appointed by the Examination Committee from the approved panel and the average of nearest two marks will be taken as final. In the case of equal difference between the marks of three examiners the middle marks will be taken as final.
21. Final practical examinations will be conducted jointly by Four examiners, 3 (three) internal and 1 (one) external appointed by the examination committee.

    Grades and grade points will be awarded on the basis of marks obtained in the written, oral or practical examinations and/or laboratory performance according to the following scheme:

Marks Obtained (%)	Grade	Grade Point
80-100	A^+	4.0
75-79	A	3.75
70-74	A^-	3.50
65-69	B^+	3.25
60-64	B	3.00
55-59	B^-	2.75
50-54	C^+	2.50

45-49	C	2.25
40-44	D	2.00
<40	F	0.00
	I	Incomplete
	W	Withdrawn

A student obtaining 'D' or higher grade will be counted as credits earned by him/her. A student obtaining 'F' grade will not be counted towards his earned credits.

The GPA (grade point average) will be calculated according to the following formula:

$$GPA = \frac{\sum (\text{Grade points in a course} \times \text{Credits for the course})}{\text{Total credits taken}}$$

CGPA = Cumulative GPA for different years.

22. The total performance of a student in a given course is based on continuous assessment and course final examinations.

(i) For theory courses the assessment is made through in-course assessment, and final examinations;

(ii) The assessment of laboratory and / or field courses will be made through observation of the student at work, viva-voce, assignments and evaluation of practical reports.

An examination committee for each year shall be constituted at the beginning of the session. The distribution of marks for a course will be as follows:

(a) Theory courses:

(i) In-course assessment: 30% of total marks shall be taken as in-course assessment. 5% marks will be awarded on the basis of attendance as follows:

90% and above	5%
85% to less than 90%	4%
80% to less than 85%	3%
75% to less than 80%	2%
60% to less than 75%	1%
Less than 60%	0 (Zero)

(ii) Course final examination 70% of total marks

(iii) Continuous assessment 40% of total marks for practical courses

(iv) Practical Final Examination 60% of total marks

(b) In-course assessment for theory courses: In-course assessment will be done by taking class tests.

(i) Maximum duration of in-course tests will be one class hour.

(ii) Questions for in-course tests may preferably be of multiple choice (MCQ) type. Students may also be evaluated using short questions as decided by the course teacher.

(iii) At least one test for 2 credits hour courses and two tests for 3 or 4 credit hour courses will be taken.

(iv) Course teachers must announce results within 4 weeks of holding the examination.

(v) The course teacher will show the assessed in-course scripts to the students.

(vi) Marks for in-course assessment must be submitted by the course teacher to the Chairman of the Examination Committee and Controller of Examinations before holding the final examination.

(c) Continuous assessment for Practical courses: Continuous assessment will be done on the basis of class performance, report writing and class attendance.

(d) Year-final examination (Theory and Practical courses):

(i) Student having attendance 75% or more (Collegiate) are eligible to appear in the final examination.

(ii) Students having attendance 60-74% are eligible for sitting in the final examination on payment of fees as decided by the University.

(iii) Student having attendance less than 60% are not allowed to sit in the final examination.

(iv) The year final examination will be conducted centrally by Controller of examinations as existing system.

(v) The duration of theoretical examinations will be follows:

Credit	**Duration of theory examinations**
4 credit theory course	4 hours
3 credit theory course	3 hours
2 credit theory course	2.5 hours

(vi) Duration of practical examinations will be from 4-6 hours irrespective of credit hours.

(vii) For final examinations, there will be two examiners: first examiner will be one of the course teachers and the second examiner will be from other departments of the Institute or University or Research organization. Evaluation will be made under the existing rule.

(viii) Marks for final examination will be evaluated by broad and short answer questions. Practice of giving options should be avoided as far as possible.

23. A student has to take the required courses for a particular year, appear at the annual examination and score a minimum specified GPA/CGPA to be promoted to the next year.

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

1st year to 2nd year:	GPA	2.00	(D)
2nd year to 3rd year:	CGPA	2.25	(C)
3rd year to 4th year:	CGPA	2.25	(C)

24. The requirements for the award of the Bachelor of Engineering degree are as follows of the Department:

(i) Completion of the courses for the minimum required credits in a maximum period of six academic years;

(ii) Appearing at the final examination in all the required courses;

(iii) Scoring a CGPA of 2.5, after considering the grades of improvement Examinations.

25. A student must complete his/her studies for a Bachelor's Degree within a maximum period of six academic years.

26. Improvement/retake will be followed by:

(i) If students obtain a grade C+ or lower in a course in any year, he/she will be allowed to repeat the term-final examination only once with the following batch for the purpose of grade improvement, but he/she will not be eligible to get a grade better than 'B^{+}' in such a course. A student failing to improve his/her grade in a course can retain the earlier grade.

(ii) Grade improvement will not be allowed in those courses in which a student obtains grade better than 'C^{+}.

(iii) A student will be allowed to repeat a maximum of 20.0 credits in four years B.Sc. Program for grade improvement purpose.

(iv) Improvement Examination will be taken only for term-final test. No improvement examination will be taken for in-course, practical course, field work, assignment and oral presentation.

27. (i) A course in which a student has obtained ‘D’ or a higher grade will be counted as credits earned by him/her. Any course in which a student has obtained ‘F’ grade will not be counted towards his earned credits.

(ii) A student who obtains ‘F’ grade in a course will be allowed to improve the grade two times with any following batches with a condition that he/she has to complete the Bachelor of Engineering Program within period of 6 (six) academic years from the date of first admission.

(iii) `F’ grade will not be counted for GPA calculation. But will stay permanently on grade sheet and Transcript. When a student will repeat a course in which he/she previously obtained ‘F’ grade, he/she will not be eligible to get grade better than ‘B+’ (grade point 3.25) in such a course.

28. Readmission will be followed by:

(i) A student may seek re-admission provided he/she has at least 30% attendance in the present year and may continue studies as a regular student.

(ii) On re-admission grade earned earlier by a student in the class of re-admission shall in general cease to exist and the student has to retake all courses and examination but in case if they do not get the opportunity to repeat the courses due to late admission, marks of in-course assessment and laboratory performance assessment in the previous year may be retained by the students.

29. Drop out will be followed by**:**

A student failing to earn the yearly GPA for promotion from one year to next year after taking improvement / readmission in any year shall be dropped out of the program.

30**.** Dean’s Award will be followed by**:**

As a recognition of excellent performance, the names of students obtaining an average CGPA of 3.75 or above in an academic year without appearing any improvement examination may be Published in the list of Dean’s award of the Faculty.

31. The failed candidates may seek readmission into the concerned classes on payment of usual fees except university registration fee or may appear in the concerned examination irregular candidates provided they have passed in all practical subjects on payment of examination and center fees as fixed by the University. The marks obtained by the irregular candidates in the

practical examinations; in-course assessment and the project work (if applicable) in the earlier session shall be counted in deciding the results of their examinations.

32. The University may from time to time revise, amend or change rules and regulations and scheme of examinations and syllabus. In the case of students already undergoing the course, the changes will take effect from the beginning of the following academic year after the changes are introduced and shall cover the part of the courses that remain to be completed.

33. In the case of any dispute in interpretation of the rules and regulations regarding the degree programme of B.Sc. in Leather Engineering, the decision of Academic Council of the University shall be final.

FIRST YEAR

Sl. No.	Course NO	Course NAME	Credit		Marks Distribution					Total Marks
					Theory			Practical		
			Theory	Practical	A* 70%	B* 25%	C* 5%	A* 60%	B** 40%	
						30%				
01.	LE-101	Manufacturing Technology of Leather-I	3	-	70	25	5	-	-	100
02.	LE-102	Manufacturing Technology of Leather-I Practical	-	4	-	-	-	60	40	100
03.	LE-103	Physical Chemistry	3	-	70	25	5	-	-	100
04.	LE-105	Inorganic Chemistry	3	-	70	25	5	-	-	100
05.	LE-107	Organic Chemistry	3	-	70	25	5	-	-	100
06.	LE-108	Chemistry Practical	-	4	-	-	-	60	40	100
07.	LE-109	Physics	3	-	70	25	5	-	-	100
08.	LE-110	Physics Practical	-	2	-	-	-	60	40	100
09.	LE-112	Engineering Drawing	-	2	-	-	-	60	40	100
10.	LE-113	Computer and Information Engineering	3	-	70	25	5	-	-	100
11.	LE-114	Computer and Information Engineering Practical	-	2	-	-	-	60	40	100
12.	LE-115	Mathematics-I	3	-	70	25	5	-	-	100
13.	LE-117	Business and Communicative English for Engineers	3	-	70	25	5	-	-	100
Total			**24**	**14**	**560**	**200**	**40**	**300**	**200**	**1300**

A* = Course final examination; B*= In-course assessment ; C*= Attendance; B** =Continuous assessment

For Theoretical courses 1 Credit = 15 class

For Practical courses 1 Credit = 30 class

SECOND YEAR

Sl. No.	Course No.	Course Name	Credit		Marks Distribution					Total Marks
					Theory			Practical		
			Theory	Practical	A* 70%	B* 25%	C* 5%	A* 60 %	B** 40 %	
						30%				
01.	LE-201	Manufacturing Technology of Leather-II	3	-	70	25	5	-	-	100
02.	LE-202	Manufacturing Technology of Leather-II Practical	-	4	-	-	-	60	40	100
03.	LE-203	Applied Chemistry and Chemical Engineering	3	-	70	25	5	-	-	100
04.	LE-204	Applied Chemistry and Chemical Engineering Practical	-	4	-	-	-	60	40	100
05.	LE-205	Materials Science and Technology	3	-	70	25	5	-	-	100
06.	LE-207	Mathematics-II	3	-	70	25	5	-	-	100
07.	LE-209	Statistics	3		70	25	5			100
08.	LE-211	Mechanical Engineering for Leather Manufacture	3	-	70	25	5	-	-	100
09.	LE-212	Mechanical Engineering for Leather Manufacture Practical	-	2	-	-	-	60	40	100
10.	LE-213	Electrical and Electronic Engineering	3	-	70	25	5	-	-	100
11.	LE-214	Electrical and Electronic Engineering Practical	-	2	-	-	-	60	40	100
12.	LE-215	Industrial Management for Leather Manufacturing	3	-	70	25	5	-	-	100
13.	LE-216	Computer Graphics Design	-	2	-	-	-	60	40	100
Total			**24**	**14**	**560**	**200**	**40**	**300**	**200**	**1300**

A* = Course final examination; B*= In-course assessment ; C*= Attendance, B** =Continuous assessment

For Theoretical courses 1 Credit = 15 class

For Practical courses 1 Credit = 30 class

THIRD YEAR

Sl. No.	Course No.	Course Name	Credit		Marks Distribution					Total Marks
					Theory			Practical		
			Theory	Practical	A* 70%	B* 25%	C* 5%	A* 60%	B** 40%	
						30 %				
01.	LE-301	Manufacturing Technology of Leather-III	3	-	70	25	5	-	-	100
02.	LE-302	Manufacturing Technology of Leather-III Practical	-	4	-	-	-	60	40	100
03.	LE-303	Analytical Chemistry for Leather Manufacture-I	3	-	70	25	5	-	-	100
04.	LE-304	Analytical Chemistry for Leather Manufacture-I Practical	-	2	-	-	-	60	40	100
05.	LE-305	Dyeing and Finishing -I	3	-	70	25	5	-	-	100
06.	LE-306	Dyeing and Finishing Practical	-	2	-	-	-	60	40	100
07.	LE-307	Testing of Leather and Allied Materials	3	-	70	25	5	-	-	100
08.	LE-308	Testing of Leather and Allied Materials Practical	-	2	-	-	-	60	40	100
09.	LE-309	Microbiology and Biotechnology in Leather Manufacture	3	-	70	25	5	-	-	100
10.	LE-310	Microbiology and Biotechnology in Leather Manufacture Practical	-	2	-	-	-	60	40	100
11.	LE-311	Footwear Technology	3	-	70	25	5	-	-	100
12.	LE-312	Footwear Technology Practical	-	4	-	-	-	60	40	100
13.	LE-313	Industrial and Production Engineering for Leather Manufacture	3	-	70	25	5	-	-	100
14.	LE-315	Managerial Economics	3	-	70	25	5	-	-	100
Total			**24**	**16**	**560**	**200**	**40**	**360**	**240**	**1400**

A* = Course final examination; B*= In-course assessment ; C*= Attendance; B** =Continuous assessment

For Theoretical courses 1 Credit = 15 class

For Practical courses 1 Credit = 30 class

FOURTH YEAR

Sl. No.	Course No.	Course Name	Credit		Marks Distribution					Total Marks
					Theory			Practical		
			Theory	Practical	A* 70%	B* 25%	C* 5%	A* 60%	B** 40%	
						30%				
01.	LE-401	Manufacturing Technology of Leather-IV	3	-	70	25	5	-	-	100
02.	LE-402	Manufacturing Technology of Leather-IV Practical	-	4	-	-	-	60	40	100
03.	LE-403	Analytical Chemistry for Leather Manufacture-II	3	-	70	25	5	-	-	100
04.	LE-404	Analytical Chemistry for Leather Manufacture-II Practical	-	2	-	-	-	60	40	100
05.	LE-405	Dyeing and Finishing-II	3	-	70	25	5	-	-	100
06.	LE-407	Polymer Science and Engineering	3	-	70	25	5	-	-	100
07.	LE-408	Polymer Science and Engineering Practical	-	2	-	-	-	60	40	100
08.	LE-409	Environmental Science and Pollution Control	3	-	70	25	5	-	-	100
09.	LE-410	Environmental Science and Pollution Control Practical	-	2	-	-	-	60	40	100
10.	LE-411	Leather-Products Technology	3	-	70	25	5	-	-	100
11.	LE-412	Leather-Products Technology Practical	-	4	-	-	-	60	40	100
12.	LE-413	Production Planning and Quality Control	3	-	70	25	5	-	-	100
13.	LE-415	Entrepreneurship and Business Development	3	-	70	25	5	-	-	100
14	LE-416	Project Work and seminar	-	2	-	-	-	75+ 25	-	100
15.	LE-418	Industrial Training [2 Months]	-	2	-	-	-	50	-	50
16.	LE-420	Course Viva	-	2	-	-		50	-	50
Total			**24**	**20**	**560**	**200**	**40**	**500**	**200**	**1500**

A* = Course final examination; B*= In-course assessment ; C*= Attendance; B** =Continuous assessment

For Theoretical courses 1 Credit = 15 class

For Practical courses 1 Credit = 30 class

LE-101: MANUFACTURING TECHNOLOGY OF LEATHER-I

Class per week	Credit	Marks
2	3	Course final Exam: 70, In-course assessment: 25, Class Attendance: 5 Total Class: 45

Introduction to the course: This course covers the knowledge, skills and attitudes required to identify and interpret histological structure and chemical composition of hides and skins, process of slaughtering and procurement of hides and skins, preservation / curing of hides and skins, defects of hides and skins, sorting and gradation of raw hides and skins, different process of leather making like soaking, liming, deliming, bating, pickling and degreasing.

Course Objectives:

The objective of this course is to provide the best interpretation of modern leather manufacturing based on current scientific knowledge. The learning objectives of this course are:

- To provide basic knowledge about the structure of raw hides and skins- their composition and histo-chemical properties, classification and structural organization of proteins, structure and chemical features of collagen, different types of amino acids associated with raw hides and skins and their chemistry.
- To acquire knowledge about slaughtering and flaying of animals, objectives and principles of preservation or curing.
- To introduce different types of pre-mortem and post-mortem defects of hide and skin and their effect on leather.
- To obtain a comprehensive knowledge in sorting and grading of hides and skins, soaking, liming, deliming, bating, pickling and degreasing.

Course Contents:

Histological structure and chemical composition of hides and skins: Structure of raw hides and skins-the epidermis with especial reference to hairs, basal layer, dermis and hypo-dermis layers-their histo-chemical properties, structural difference between hides and skins of different origin, chemical composition of hides and skins, hair follicles and grain pattern of hides and skins, influence of climate, management, sex, age and food on the quality of hides and skins.

Protein and collagen chemistry: Classification of protein, Reactions of protein with acids, bases and salts, Structural organization of proteins. Structure and chemical features of collagen,

Reactive groups, cross linking, Denaturation of protein. Different types of amino acids associated with raw hides and skins and their chemistry in protein, primary, secondary and tertiary structure of collagen, acid-base behavior of collagen.

Slaughtering and procurement of hides and skins: 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, handling and storage of raw hides and skins, collection practice in Bangladesh.

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. **Curing and preservation:** Definition, necessity, principles and different state of cured hides and skins, different methods of preservation. **Curing agents:** Different curing agents, their manufacturing methods and use in curing.

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.

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, grading specification and practice in Bangladesh.

Soaking: Physico-chemical explanation of wetting, objectives and different controls in soaking operation. Different methods of soaking. Theory of wetting and its application to soaking agents, chemistry, and classification of soaking agents, action of different types of soaking agents on a polar substrate like collagen, methods of preparation of different soaking agents and uses, function and uses of preservatives in soaking. Environment friendly soaking agent.

Liming: Chemistry of unhairing, unhairing by different methods, objectives of liming, effects of liming of collagen, thermal unhairing, enzymatic controls in liming operation to achieve different physical properties of leather. **Lime:** Classification of lime, chemical composition of lime and their sustain abilities. **Depilants:** Manufacture and properties of sodium sulphide, unhairing mechanism of sodium sulphide, other unhairing agent-sodium sulfydrate, arsenic sulphides, cyanides.

Organic depilating agents: Their unhairing chemistry, enzyme depilants, oxidative depilants. Environment friendly liming agent.

Deliming: Objectives, principles and controls of deliming. **Deliming agents:** Boric acid, ammonium salts, sodium bisulfite, organic deliming agents, merits of different deliming chemicals. Environment friendly deliming agent.

Bating: Chemistry of proteolytic enzymes used for bating, necessity of bating, Its preparation and controls for desired properties of leather. **Bating agents**: Manufacture, properties and uses of bating agents, functions of different component in synthetic bates in bating operation, acid bates vs alkali bates.

Pickling: Acid binding capacity of collagen, use of organic acids or salts in pickling, its necessity and controls, concept of, depickling. **Pickling agents:** Pickling liquor materials and composition, effect of different pickle acids and salts on leather quality, use of acid syntans in pickling, their difference with organic acid as pickling agent. pickling without salt.

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

Degreasing agents- Chemistry of different degreasing agents-solvent degreasing agents, aqueous degreasing agents, ultrasonic degreasing agents, enzymatic degreasing agents, carbon di-oxide degreasing agents, merits and demerits of different degreasing agents.

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

- Identify and interpret histological structure and chemical composition of hides and skins.
- Interpret the process of slaughtering and procurement of hides and skins.
- Interpret classification and structural organization of proteins, structure and chemical features of collagen.
- Interpret different types of amino acids associated with raw hides and skins and their chemistry.
- Interpret preservation/curing of hides and skins.
- Identify defects of hides and skins.
- Perform sorting and gradation of raw hides and skins.
- Demonstrate different process of leather making like soaking, liming, deliming, bating, pickling and degreasing.

References:

1. Anthony D. Kovington-Tanning Chemistry The Science of Leather
2. Dutta S.S.-An introduction to the principles of leather manufacture.
3. Krystof Bienkieuicz - 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.
11. Mclaughlin.George D. - The Chemistry of Leather Manufacture.
12. Gustavson K.H.- The Chemistry of Tanning Processes.
13. John Gerhard - Possible defects in Leather Production.
14. Dey Jyotirmay - Practical Aspect of the Manufacture of Upper Leather.
15. Thorstensen Thomas C. - Practical Leather Technology.
16. Wilson John Arthur-Modern Practice in Leather Manufacture
17. Wilson John Arthur-The chemistry of leather manufacture
18. Journal of the American Leather Chemists Association.
19. Journal of the Society of Leather Technologist and Chemists.
20. World Leather.

LE-102: MANUFACTURING TECHNOLOGY OF LEATHER-I PRACTICAL

Class per week	Credit	Marks
2	4	Continuous assessment : 40, Course final examination 60

Introduction to the course: This course covers the knowledge, skills and attitudes required to identify and interpret histological structure and chemical composition of hides and skins, process of slaughtering and procurement of hides and skins, preservation / curing of hides and skins, defects of hides and skins, sorting and gradation of raw hides and skins, different process of leather making like soaking, liming, deliming, bating, pickling and degreasing.

Course Objectives: The learning objectives of this course are

- To provide basic Practical knowledge in slaughtering and flaying of animals, and preservation or curing of raw hides/skins.
- To introduce different types of pre-mortem and post-mortem defects of hide and skin and their effect on leather.

- To obtain a comprehensive knowledge in sorting and grading of hides and skins, soaking, liming, deliming, bating, pickling and degreasing.

Course Contents:

1. Rate of deterioration of freshly flayed hides and skins on aging.
2. Curing of freshly flayed cow hide and goat skin with sodium chloride (Common salt) and its effect on water content at different time interval.
3. Effect of bactericides and antibiotic on preservation of cow hides and goat skins.
4. Determination of rate of water uptake and degree of swelling of cow hides and goat skins during soaking.
5. Effects of wetting agents and enzymes on soaking of dry-salted cow hides and goat skins.
6. Enzyme soaking of cow hides and goat skins.
7. Paint unhairing of wet salted goat skins and sheep skins.
8. Liming with slaked lime and sodium sulphide with and without enzyme.
9. Deliming of cow hide with boric acid, lactic acid, ammonium and ammonium sulphate.
10. Bating of goat skins with pancreatic bate.
11. Determination of the rate of acid uptake by cow hides during the pickling.
12. Effect of sodium chloride on pickling.
13. Pickling for preservation of cow hides and sheep skins.
14. Degreasing of sheep skins with kerosene and non-ionic detergent.
15. Production of chrome- tanned leather.

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

- Identify rate of deterioration of freshly flayed hides and skins on aging.
- Perform curing of freshly flayed cow hide and goat skin with sodium chloride (common salt) and its effect on water content at different time interval.
- Determine effect of bactericides and antibiotic on preservation of cow hides and goat skins.
- Determine the rate of water uptake and degree of swelling of cow hides and goat skins during soaking.
- Demonstrate the effects of wetting agents and enzymes on soaking of dry-salted cow hides and goat skins.
- Perform enzyme soaking of cow hides and goat skins.
- Demonstrate paint unhairing of wet salted goat skins and sheep skins.

- Demonstrate liming with slaked lime and sodium sulphide with and without enzyme.
- Demonstrate deliming of cow hide with boric acid, lactic acid, ammonium and ammonium sulphate.
- Demonstrate bating of goat skins with pancreatic bate.
- Determine the rate of acid uptake by cow hides during the pickling.
- Determine effect of sodium chloride on pickling.
- Perform pickling for preservation of cow hides and sheep skins.
- Perform degreasing of sheep skins with kerosene and non-ionic detergent.
- Perform production of chrome- tanned leather.

References:

1. Anthony D. Kovington-Tanning Chemistry The Science of Leather
2. Dutta S.S.-An introduction to the principles of leather manufacture.
3. Krystof Bienkieuicz - 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.
11. Mclaughlin.George D. - The Chemistry of Leather Manufacture.
12. Gustavson K.H.- The Chemistry of Tanning Processes.
13. John Gerhard - Possible defects in Leather Production.
14. Dey Jyotirmay - Practical Aspect of the Manufacture of Upper Leather.
15. Thorstensen Thomas C. - Practical Leather Technology.
16. Wilson John Arthur-Modern Practice in Leather Manufacture
17. Wilson John Arthur-The chemistry of leather manufacture
18. Journal of the American Leather Chemists Association.
19. Journal of the Society of Leather Technologist and Chemists.
20. World Leather.

LE-103: PHYSICAL CHEMISTRY

Class per week	Credit	Marks
2	3	Course final Exam: 70, In-course assessment: 25, Class Attendance: 5 Total Class: 45

Introduction to the course: This is a course in basic Physical Chemistry for undergraduate student. With the development of a variety of exciting new areas of research involving computational chemistry, nano- and smart materials, and applications of the recently discovered graphene, there can be no doubt that physical chemistry is a vitally important field. It is also perceived as the most daunting branch of chemistry, being necessarily grounded in physics and mathematics as well as kinetics, surface chemistry, thermodynamics and photo chemistry.

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

- Converting raw hides and skins into finished leather many chemical reactions are occurred in different steps in industrial process.
- Understanding chemical reactions, physical and chemical change of hides and skins during process.

Course Contents:

Dilute solution: Colligative properties- lowering of vapor pressure, elevation of boiling point, depression of freezing point, osmotic pressure and osmosis, deduction of their chemical formula and molecular weight from Raoult's Law, their experimental determination.

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, 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, free energy and work function, Gibbs-Helmholtz's equation.

Photochemistry: Laws of photochemistry, quantum yield, decomposition of hydrogen halide, photosensitized reaction, fluorescence and phosphorescence, luminescence, chemiluminescence.

Surface chemistry: Adsorption, de-sorption and absorption, physical and chemical adsorption, types of adsorption isotherms, adsorption of gas by solid, adsorption of solid from solution, application adsorption.

Colloid: Classification, 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.

Chemical kinetics: Rate of reactions, order and molecularity, determination of order of reactions, temperature dependence of reaction rate, simple theories of reaction rate, energy of activation, collision theory of reaction rates, complex reactions: (i) reversible or opposing reactions, (ii) side reactions or parallel reactions, (iii) consecutive reactions.

pH and its determination : pH and buffer solutions, standard buffers, methods of determining the pH, accuracy of pH measurements, colourimetric determination of pH, universal indicators, potentiometric determination of pH, hydrogen electrode as pH indicating electrode, advantages and disadvantages of hydrogen electrode, glass electrode as pH indicating electrode, factors affecting pH measurements with the glass electrode, advantages and disadvantages of glass electrode, pH meters- potentiometric, portable pH meters.

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

- Colligative properties, Raoult's law and related problems
- Thermodynamic laws, solve problems on enthalpy changes, heat of reactions, Carnot cyle, entropy, etc.
- Laws of Photochemistry, Photoluminescence and Chemiluminescence, Quantum Yield, Photosensitized reactions.
- Adsorption processes with reference to Langmuir Freundlich and other isotherms and their application.
- Detail mechanism, preparation and properties of colloid formation, Implication of HLB values of surfactants and selection of surfactants.
- Rate equation of chemical reactions with graphical plots and significance, half-life of chemical reactions, activation energy and its significance, role of catalysts in chemical reactions, related problems.
- pH and its implications, determination of pH applying potentiometric method, different type of electrodes and their uses.

References:

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. Robert A. Alberty- Physical Chemistry.
8. Taylor and Taylor- Elementary Physical Chemistry.
9. Moron and Lando- Fundamentals of Physical Chemistry.
10. Donald H. Andrews- Introductory Physical Chemistry.
11. Ira N. Levine- Physical Chemistry.
12. J. Bruce Brackenridge and Robert M. Rosenberg- The Principle of Physical Chemistry.
13. Palit- Elementary Physical Chemistry.
14. B. D. Khosla- Physical Chemistry.
15. N. Kundu and S. K. Jain- Physical Chemistry.
16. Samuel H. Maron and Carl F. Prutton- Principle of Physical Chemistry.
17. Joseph H. Noggle- Physical Chemistry.
18. M. Mahbubul Haque and M. Ali Nawab- Principle of Physical Chemistry.

LE-105: INORGANIC CHEMISTRY

Class per week	Credit	Marks
2	3	Course final Exam: 70, In-course assessment: 25, Class Attendance: 5 Total Class: 45

Introduction to the course: This course is designed for first year B.S. students of Leather Engineering. The first part of the course includes mastery of topics in periodic classification of elements and their relevant properties, different types of chemical reaction like acid-base reactions, redox reactions etc. The remainder of this course includes a survey of different types of chemical bonds and their formation mechanism. Another interesting part of this course is study of transition metal and different theories of coordination chemistry which are related to these metals. Transition metal containing materials are the oldest materials of the earth and are indispensable to our daily life. The spectacular uses of the transition metals in leather tanning justify the importance of these topics in this course. This course will help the student to develop an understanding of chemical principles and the applications of such principles in practical fields. This course will also enable the students to use critical thinking and logic in problem

solving, apply chemical principles in the laboratory setting and develop independent and cooperative learning skills.

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

- In the present text the descriptive materials have been reduced to the minimum and emphasis will be given to conceptual approach of inorganic chemistry.
- 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.
- It explores the unknown world of atoms and molecules and different types of bond exist among them.
- The course will provide a foundation for further education in chemistry directed towards materials, energy technology and process chemistry.

Course Contents:

Periodic classification: Periodic classification of the elements, general survey of the elements including transition and rare earth elements, periodic nature as related to atomic structure, group properties, periodic nature of some important properties.

Oxidation and reduction reaction: Classification of chemical reactions with special reference to oxidation and reductions, oxidation number and oxidation state, difference between oxidation number and valance, oxidizing agent and reducing agent, equations involving oxidation-reduction reactions.

Acid-Base concept: Early concepts, Arrhenius concept, Bronsted-Lowry concept of acid and bases, Lewis acids and bases, acid and base strength, pH and pH scale, buffer solution and its mechanism, hard and soft acids and bases, acid base indicator.

Transition metal: General chemistry of transition elements with reference to Chromium, Titanium, Zinc, Iron, Cadmium, Nickel, Cobalt, chemical natures and application with special reference to leather production.

Co-ordination chemistry: Coordination or complex compounds, ligands or co-ordinating groups, coordination number, 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 (CFT), application of crystal field theory color of transition metal complexes.

Chemical Bond: Introduction, octet rule or rule of eight, ionic or electrovalent bond, covalent bond dipole moment, polarization of ions, Fajan's rule, co-ordinate bond, metallic bond, hydrogen bond, van der Waal's forcers.

Inorganic Salts used for Tannings: Chromium salts, its behavior in solution, oxidation rate, complex form of trivalent Ti.

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

- Colligative properties, Raoult's law and related problems
- Thermodynamic laws, solve problems on enthalpy changes, heat of reactions, Carnot cyle, entropy etc.
- Laws of Photochemistry, Photoluminescence and Chemiluminescence, Quantum Yield, Photosensitized reactions.
- Adsorption processes with reference to Langmuir Freundlich and other isotherms and their application.
- Detail mechanism, preparation and properties of colloid formation, Implication of HLB values of surfactants and selection of surfactants.
- Rate equation of chemical reactions with graphical plots and significance, half-life of chemical reactions, activation energy and its significance, role of catalysts in chemical reactions, related problems.
- pH and its implications, determination of pH applying potentiometric method, different type of electrodes and their uses.

References:

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. Manas Chanda- Atomic Structure and Chemical Bond.
9. K. N. Upadhyaya- A Text Book of Inorganic Chemistry.

10. R.D. Madan, Tuli, Basu, Sharma- Advanced Inorganic Chemistry.

LE-107: ORGANIC CHEMISTRY

Class per week	Credit	Marks
2	3	Course final Exam: 70, In-course assessment: 25, Class Attendance: 5 Total Class: 45

Introduction to the course: Organic chemistry is the study of "living" things-not in the same way that biology is the study of life. Rather, organic chemistry takes a look at what composes the living things, and how they're structured. Organic chemistry breaks down living things not only into organs seen in organisms, but goes a step further to break down those organs into atoms and molecules. It focuses mainly on carbon, which is highly essential to maintaining life, and particularly zeroes in on the hydrocarbon, which is a molecule composed of hydrogen and carbon. Hydrocarbons not only compose what we're made of, but also what we consume, including carbohydrates, proteins, steroids, fats, and more. As a matter of fact, it may be surprised to know that everyday things, such as leather, paint, dye, adhesive and plastic are all composed of hydrocarbons.

Course Objectives:

- The course will provide the important topics in Organic chemistry characteristic reactions, isomerism, functional groups including aromatic compounds, phenols, carboxylic acids and its derivatives, aldehydes and ketones, amines, and ester synthesis.
- This helps students to gain experience to predict the functional group transformations, simple reaction mechanisms, and the synthesis of organic molecules by multi-step synthesis strategies.
- In addition of that, the course will also help students to understand the leather based reaction.

Course Contents:

Characteristic reactions and reaction mechanism of organic compounds: Types of organic reactions, fundamentals of organic reaction mechanism (Fission of bond, carbonium ion, carbanion), factors affecting organic reaction, attacking reagents and its role (electrophile and nucleophile), broad concept of the mechanism of substitution, elimination and addition

reactions, reaction kinetics, energy requirements of organic reaction, mechanism of different reactions, nucleophilic substitution: S_N1 and S_N2 reactions, electrophilic substitution reaction, free radical substitution reaction, addition reaction:- nucleophilic, electrophilic and free radical addition reaction, elimination reaction:- E1 and E2 reactions.

Isomerism: Classification of isomerism, classification of stereoisomerisms, optical isomerism:- plane polarized light, specific rotations, isomerism of substance containing one and two asymmetric carbon atoms, D.L. and R.S. configuration. Geometric isomerism- condition for geometric isomerism, determination of configuration of cis-trans isomerism.

Functional groups: Different functional groups of organic compounds, reactivity of functional groups, activation and de-activation of functional groups, positioning of functional groups and its importance on chemical and physical nature of organic compounds.

Monocyclic aromatic hydrocarbon: Benzene, structure of benzene, Kekule structure, nomenclature, stability of benzene ring, resonance energy, delocalization, aromaticity-conditions and theories, substitution of benzene ring, mechanism of aromatic substitution.

A. A thorough study of the following benzene derivatives: Structure, preparation, reactivity and uses of

i) Halogen compounds- fluoro and chloro- chemicals.
ii) Hydroxy compounds- phenol, β-naphthol, cresol, anthrasol.
iii) Nitro compounds-nitro benzene and its derivatives.

B. A through study of the following class of compounds-

i) Aldehydes and Ketones (Formaldehyde, acetaldehyde, glutaraldehyde, acetone).
ii) Aliphatic mono and di-carboxylic acids (Formic acid, acetic acid, acrylic acid, oxalic acid and succinic acid) and their important derivatives (Amide, ester, etc.).

Atmospheric Pollutants: Organic solvent vapours, isocyanate vapours, rubber fume.

Renewable Resources and green footwear: Upper and lining materials, sole units, insole boards, sewing threads and adhesives, packaging.

Safety audit checking: walking or working areas, storage lofts, second floor, etc, stairs and ladders, egress, occupational health and environmental control. Occupational noise exposure, hazardous materials, general environmental controls.

Management of emergency situations: basic first aid, spillage of chemicals, fires, machinery safety.

Learning Outcomes: Students will gain an understanding of

- The hybridization and geometry of atoms and the three-dimensional structure of organic molecules the fundamental properties.
- Reactivity and stability of an organic molecule based on structure, including conformation and stereochemistry an understanding of nucleophiles, electrophiles, electronegativity, and resonance the prediction of mechanisms for organic reactions.
- How to use their understanding of organic mechanisms to predict the outcome of reactions?
- Basic understanding on stereochemistry of organic molecules
- How to design syntheses of organic molecules?
- The atmospheric pollutants, renewable resources, green footwear, safety audit checking and management of emergency situation in the leather products industries.

References:

1. Morrison and Boyd- Organic Chemistry.
2. B. S. Bahl and Arun Bahl- Organic Chemistry.
3. I. L. Finar- Organic Chemistry.
4. Andrew Streitwieser, Clayton H. Heathcock, Edward M. Kosower- Introduction to Organic Chemistry.
5. Philip Mathews- Advanced Chemistry.
6. Amend, Mundy, Armold- General Organic and Biological Chemistry.
7. Solomons- Organic Chemistry.
8. Stanley H. Pine- Organic Chemistry.
9. Michael B. Smith- Organic Chemistry.
10. P. S. Kalsi- Organic Reactions and Their Mechanism.

LE-108: CHEMISTRY PRACTICAL

Class per week	Credit	Marks
2	4	Continuous assessment : 40, Course final examination: 60

Introduction to the course: The aim of this course is to analyze inorganic salts, organic compounds and preparation of some inorganic compounds and quantitative analysis by titration.

The qualitative analysis of single salt consists of preliminary research and analysis of cation and anion separately. The analysis and identification of unknown organic compounds constitutes a very important aspect of experimental organic chemistry.

Course Objectives: The general concept of the practical part of this course is

- Train students the fundamental laboratory skills.
- This includes the practical work of qualitative and quantitative analysis techniques with some simple inorganic preparations which are required for experimental chemistry.
- The students will acquire skills to observe and record scientific experiments.
- They will familiarize themselves with the laboratory equipment, various chemicals, and set up various instruments to ensure safe.

Course Contents:

Inorganic:

1. Qualitative analysis of inorganic mixtures containing not less than four radicals including the interfering and insoluble radicals by classical or semi-micro methods; Preliminary and Confirmation tests for the following ions: -

a) Anions: Chloride, bromide, iodide, sulphide, sulphite, sulphate, carbonate, nitrate, nitrite, formates, oxalates, acetates.

b) Cations: Lead, copper, zinc, cobalt, calcium, sodium, barium, magnesium, nickel, aluminium, chromium, manganese, iron, tin, arsenic, bismuth, potassium, ammonium, silver, mercury, cadmium, zirconium, titanium.

2. Volumetric analysis:

(A) Acidimetry-Alkalimety:

i) Preparation of standard solutions of sodium thio-sulphate, sodium carbonate, oxalic acid.

ii) Standardization of hydrochloric acid with standard sodium carbonate solution

iii) Determination of degree of alkalinity.

(B) Oxidation -Reduction Titration:

i) Preparation and standardization of $KMnO_4$ using standard oxalic acid or sodium oxalate.

ii) Determination of ferrous (II) ion using $K_2Cr_2O_7$ solution as primary standard titrant.

(C) Iodometric Titration:

i) Standardizing sodium thiosulphate solution using dichromate solution.

3. Organic Practical:

Qualitative analysis: Identification of organic compounds containing one functional group out of the following compounds: ethyl alcohol, isopropyl alcohol, phenol, acetone, acetaldehyde, formaldehyde, formic acid, acetic acid, oxalic acid, benzoic acid, aniline and nitrobenzene.

Analysis should include the following:

i) Physical examination

ii) Melting point and boiling point

iii) Detection of sulphur, nitrogen and halogen in an organic compound

iv) Solubility in the following solvents only-

a) Water

b) 5% solution on $NaHCO_3$/NaOH and HCl acid

c) Conc. H_2SO_4

d) Acetone

e) Isopropyl alcohol

f) Detection of different functional groups: -OH, >C=O, -CHO, $-NH_2$, $-NO_2$, -COOH.

v) Detection of different functional groups:-OH, >C=O, -C=O, -CHO, $-NH_2$, -COOH

4. Inorganic crystal Preparation Practical:

Inorganic Preparation: Alum, ferrous ammonium sulfate, potassium carbonate, basic chromium sulphate, potassium permanganate, chrome yellow.

Learning Outcomes: Students will gain an understanding of

- The use of an analytical balance graduated cylinders, graduated pipettes, and volumetric pipettes, thermometers and temperature probes, pH meters.
- How to do quantitative and qualitative analysis of Inorganic salts and organic compounds and prepare some inorganic compounds.

References:

1. A. I. Vogel -Elementary Practical Organic Chemistry, Part -1: Small Scale Preparation.
2. A. I. Vogel-Elementary Practical Organic Chemistry, Part-2: Qualitative Organic Analysis.
3. A. I. Vogel-Elementary Practical Organic Chemistry, Part-3: Quantitative Organic Analysis

4. A. I. Vogel- A Text Book of Practical Organic Chemistry, ELBS 6th Edition.
5. A. Jabbar Mian and M. Mahbubul Haque-Practical Chemistry.
6. N. Haque and M. Uddin -Practical Chemistry Introduction.
6. H. Dupont Durst, George W. Gokel-Experimental Organic Chemistry.
7. M. Latimer, E. Powell -A Laboratory Course of General Chemistry.
8. Alan Sherman, J. Sherman, Russikoff-Laboratory Experiment of Basic Chemistry.
9. J. B. Yadav-Advanced Practical Physical Chemistry.
10. Gert G. Schlessinger -Inorganic Laboratory Preparations.
11. A. Khalique- A Text Book of Practical Chemistry.
12. A. Faraday -Practical Physical Chemistry.
13. G. Svehla- Vogel's Qualitative Inorganic Analysis.
14. N. K. Vishnoi -Advanced Practical Organic Chemistry.
15. Hein, Best, Miner-Foundation of Chemistry in the Laboratory.

LE-109: PHYSICS

Class per week	Credit	Marks
2	3	Course final Exam: 70, In-course assessment: 25, Class Attendance: 5 Total Class: 45

Introduction to the course: Physics is one of the most fundamental branches of all sciences which is the basis of our scientific knowledge of the physical world. Physics course is offered to all the undergraduate students of the Institute of Leather Engineering and Technology. This course is designed to cover most of the core scientific fundamentals of physics, basic electrical and mechanical engineering principles. Main contents of this course are elasticity, surface tension, heat and thermodynamics, optics, static and current electricity, and modern physics. This course will help the students to identify, formulate and solve problems related to their core subjects.

Course Objectives: Objectives of this course are 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, elastic limit and elastic fatigue, 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.

Optics: Light and light sources, electromagnetic spectrum, prism and dispersion of light, power of a lens, defects of images, spherical aberration, astigmatism, coma, curvature and distortion., chromatic aberration, optical instruments: compound microscope, polarizing microscope, camera and photographic techniques, spectrophotometer, Interference of light, Fresnel's bi-prism, Newton's rings, diffraction of light: Fresnel and Fraunhoffer diffraction, diffraction gratings, resolving power of a grating, polarization, polarized and unpolarized light, polarization by reflection and refraction, Brewster's law, double refraction, nicol prism, polarization by scattering, scattering of light, optical rotation, polarimeter.

Transmission of heat: Conduction, convection and radiation, thermal conductivity of solids and liquids, coefficient of thermal conductivity, good and bad conductor of heat, determination of thermal conductivities of bad conductors- Lee's method.

Radiation: Electromagnetic theory of radiation, black body radiation, emissive power and absorptive power, Kirchoff's law of radiation and its experimental verification, displacement law, Stefan Boltzmann law, quantum theory of radiation, Plank's law, Raleish-Jeans's law, Planck's radiation pyrometers, temperature of the sun, solar constant.

Static electricity: Electric charge, Coulomb's law, electric field- calculation of the electric field strength due to a point charge, intensity of electric fields, electric dipole, electric flux and Gauss's law, potential and field strength, equipotential surface, potential due to a point charge, capacitor and dielectrics, combination of capacitors in series and parallel, dielectrics and Gausses law, three electric vectors, energy storage in an electric field.

Current electricity: Electromotive force, electric current and current density, electric circuits, resistance, resistivity and conductivity, Ohm's law, energy transfer in an electric circuit- Joules law. Combination of resistances, Kirchhoff's laws, Wheatstone bridge, varying current, growth and decay of currents in LR, CR and LCR circuits, magnetic field due to a current, Ampere's

law, magnetic induction for a solenoid, magnetic induction near a long wire, Ampere's circuital law, electromagnetic induction-Faraday's laws, Lenz's law, Leus's law and the law of conservation of energy, Fleming's right hand rule, eddy current, self and mutual induction, unit of inductance. Alternating currents- concept of r.m.s. and average values of alternating current and voltage, A-C circuits containing LR, CR and LCR in series, calculation of expression for current and power, power factor, resonance.

Modern physics: The atomic structures, atom models, orbital energy, radioactivity, laws of radioactive disintegration, half life and mean life, laws of successive disintegration, alpha, beta, gamma and X-ray and their applications, photoelectric effect, Compton effect, Plank's radiation formula, Einstein's photon theory.

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.
- Skills for a successful career as well as to collaborate with other to solve problems with critical thinking and effective communication.
- Entrance to entry level research and development 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.

References:

1. C. L. Arora -B.Sc. Physics, Vol-I and II.
2. Charles Kittel/Herbert Kroemer -Thermal Physics.
3. Resnick/Halliday/Krane-Physics, Vol I and II.
4. Alvin Hudson/Rex Nelson-University Physics.
5. Arther Beiser-Concepts of Modern Physics.
6. David Halliday/Robert Resnick/Jearl Walker-Fundamentals of Physics.
7. Harvey E.White/Francis A. Jenkins-Fundamentals of Optics.
8. D.W.Tenquist/R. M. Whittle/J. Yarwood-University Optics.

9. S.C.Arrora/S. Domkundwar-A Course in Heat and Mass Transfer.
10. Marcelo Alonso/Edward J. Finn-Physics

LE-110: PHYSICS PRACTICAL

Class per week	Credit	Marks
1	2	Continuous assessment : 40, Course final examination: 60

Introduction to the course: Physics is one of the most fundamental branches of all sciences which is the basis of our scientific knowledge of the physical world. Physics practical course is offered to all the undergraduate students of the Institute of Leather Engineering and Technology. This course is designed to cover experiments and laboratory apparatus related to some of the core scientific fundamentals of physics and basic electrical engineering principles. For instance, modulus of rigidity, Young's modulus, acceleration due to gravity, thermal conductivity, specific heat, electrochemical equivalent, mechanical equivalent of heat, post office box, galvanometer, ammeter, voltmeter, Ohm's law, refractive index, diffraction grating, wavelength of light, magnetometer, velocity of sound. It will help the students to be able to design and conduct experiments, as well as to analyze and interpret data. It will also help the students to identify, formulate, and solve problems related to their core subjects.

Course Objectives: Objectives of this course are to

- Provide a broad training in physics with laboratory experiments 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 measurements and dimensioning, critical thinking and data 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:

1. Determination of the radius of curvature of a lens by Newton's ring method (wavelength of light to be given).
2. Determination of the refractive index of a material of a given prism by a spectrometer.

3. Determination of the grating constant of a plane diffraction grating.
4. Determination of the specific sugar solution (at six different concentrations) with the help of a polarimeter.
5. Determination of the value of M and H by magnetometer.
6. Verification of the laws of combination resistance by P.O. Box (at least three different resistance, are to be used).
7. Determination of the resistance of a galvanometer by half deflection method.
8. Determination of the figure of merit (current sensitivity) of a galvanometer.
9. Measurement of low resistance by ammeter and voltmeter.
10. Verification of Ohm's law.
11. Determination of the value of low resistance by the method of fall of potential.
12. Determination of the electrochemical equivalent (ECE) of copper-by copper voltameter.
13. Determination of the J (mechanical equivalent of heat) by electrical method.
14. Determination of the temperature coefficient of resistance of a coil.
15. Graphical representation of the variation of the elongation of the given wire with load and determination of the Young's modulus of the material of the wire by Searle's apparatus.
16. Determination of the modulus of rigidity of a cylindrical wire by dynamic method.
17. Determination of the value of "g" by Kater's reversible pendulum.
18. Determination of the thermal conductivity of rubber.
19. Determination of the thermal conductivity of bad conductor by Lee's method.
20. Determination of the specific heat of a liquid by the method of cooling.
21. Determination of the velocity of sound at N.T.P by resonance column.
22. Determination of the frequency of a tuning fork by Meld's experiment (use either transverse or longitudinal arrangement).

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.
- Ability to design and conduct experiments, as well as to analyze and interpret data.
- Entrance to entry level research and development 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.

References:

1. C. L. Arora -B.Sc. Physics, Vol-I and II.
2. Charles Kittel/Herbert Kroemer -Thermal Physics.
3. Resnick/Halliday/Krane-Physics, Vol I and II.
4. Alvin Hudson/Rex Nelson-University Physics.
5. Arther Beiser-Concepts of Modern Physics.
6. David Halliday/Robert Resnick/Jearl Walker-Fundamentals of Physics.
7. Harvey E.White/Francis A. Jenkins-Fundamentals of Optics.
8. D.W.Tenquist/R. M. Whittle/J. Yarwood-University Optics.
9. S.C.Arrora/S. Domkundwar-A Course in Heat and Mass Transfer.
10. Marcelo Alonso/Edward J. Finn-Physics

LE-112: ENGINEERING DRAWING

Class per week	Credit	Marks
1	2	Continuous assessment : 40, Course final examination: 60

Introduction to the course: Engineering Drawing is a performance based practical course. It makes in students the idea of planning of productions, precision of measurement and dimension, difference in 2D and 3D drawing etc.

Course Objectives:

- To draw orthographic views (2D) from isometric view (3D) with precision;
- To perform Development Drawing;
- To perform the product design and layout drawing

Course Contents:

Introduction, Drawing equipment and the use of instruments; Basic drafting techniques and standards; Geometrical curves including plane curves; Cycloid, Hypocycloid, and the Involutes. Intersections at various positions of geometrical bodies such as prisms, pyramids, cylinders and cones. Development of surfaces of prisms. Pyramids, cylinders, cones, drum, gear-box guard, knife-guard, coating machine, hand spray, spray coater, roller coater, etc. Freehand sketching of machine and engine components; Locking arrangements; Foundation bolts; Stuffing box; Shaft couplings; Foot-step bearing; Pulleys; Engine connecting rod. Concept of working drawing of component parts of machines and engines; Size, description, dimensions, and specifications; limit dimensioning and geometric tolerance; limits; Fits and tolerances, conventional symbols. Sectioning of machine and engine components; Orthographic projections and standard practices Isometric views with particular reference to piping and ducting; Layout drawing of a modern tannery.

Learning Outcomes: From the practice of the course a student can perform to

- Draw orthographic views (2D) from isometric view (3D) with precision;
- Perform Development Drawing;
- Perform the product design and layout drawing of a modern Footwear Industry.

References:

1. Spencer and Hill-Technical Drawing
2. Mandal., Dr. Amalesh Chandra and Islam., Dr. Md. Quamrul-Mechanical Engineering Drawing
3. Giesecke, F.E. and et al, “Technical Drawing”, 7th Edition, 1985, McMillan Publishing Co., Inc., New York.
4. French, T.E., Vierck, C.J. and Foster, R.J., “Engineering Drawing and Graphic Technology”, 14th Edition, 1993, McGraw Hill International Edition, U.S.A.
5. Dhawan.,R.K.; “Engineering Drawing”
6. Parkinson.,A.C.; “A First Year Engineering Drawing”
7. Verma.,C.L.; “Engineering Drawing”
8. Gupta.,R.B.; “A Text Book of Engineering Drawing”

LE-113: COMPUTER AND INFORMATION ENGINEERING

Class per week	Credit	Marks
2	3	Course final Exam: 70, In-course assessment: 25, Class Attendance: 5. Total Class: 45

Introduction to the course: This course discusses the fundamental knowledge of computer and Information Technologies. It covers computer hardware as well as with computer software with the internal mechanism of hardware and the development process of a software system and its classifications. Additionally, it also discusses the basic of a computer network with its classification and the peripheral devices used in networking. It also describes the Internet and the basic of mobile and wireless communication technology.

Course Objectives: The course is designed to aim at imparting basic level computer knowledge for the students. After completing the course the incumbent is able to understand how a computer operates,

- How does everything work on the computer?
- How does a computer process and store data?
- Moreover, students will learn the basic knowledge on a computer network and other associated things related computers.
- The computer for basic purposes of preparing his personal/business letters, viewing information on Internet (the web), sending emails, using internet banking services etc.

Course Contents:

Introduction to computer: History and development of computer, types of computers, Scope of computer, impact of computers on society and technology, working principle of a computer system, single and multi-user systems.

Hardware: Organization and architecture, motherboards and microprocessors, memory units: primary memory, secondary memory, Input/Output device, other peripheral devices like pointing devices, display devices, printing devices etc

System software: Operating system concepts, importance, components and basic functions of DOS, Windows and LINUX operating systems.

Application software: Desktop publishing: Desktop publishing includes effective page layout techniques, ways to add graphics, manipulating text and print. Word processing: Word processing software includes creating documents, printing documents, changing the appearance

of text or lines of text, changing page formats and other writing tools. Spreadsheets: Spreadsheets software includes basic concepts of spreadsheets, making basic worksheets entries, entering formulas to perform calculations, altering column options, working with ranges versus all of the worksheets, basic print options, file commands and basic graphing. Database: Database management system, database concepts, creating a database file structure, entering and editing data, displaying, organizing and printing data, modifying the data structure, creating queries and building and printing custom reports or forms.

Maintenance: Power supply stability, grounding, effects of surge, sag current and its protection, classification of stabilizer and UPS, effect of static charge on computer devices, handling of computers cards and chips, computer viruses and protections, operating system setting, disk-partitioning, software troubleshooting and maintenance.

Computer networks: Concepts of network, different types of network, study of LAN concepts and operation, hardware and software for networks, data transmission, network architectures, protocols and standards are examined, as well as install and uninstall network components and peripheral devices, study of connectivity between LAN and wide area networks.

Internet: Worldwide web including navigating the internet, task-oriented skill sessions on logging on, Internet services: Telnet, FTP, e-mail, www, internet, Intranet etc.

Mobile and wireless Communication: 1G, 2G, 2.5G and 3G mobile, GSM and CDMA, bluetooth, WiFi Max etc.

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.
- Describes the software development process and networking.

References:

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

LE-114: COMPUTER AND INFORMATION ENGINEERING PRACTICAL

Class per week	Credit	Marks
1	2	Continuous assessment : 40, Course final examination: 60

Introduction to the course: This course reifies the fundamental knowledge of computer and information Technologies to the students. It teaches Office Word, Excel and PowerPoint to the students. After completing the course, students can able to write reports in a more better and organized way, can make power point presentation, and finally become capable of performing excel operations for their different purposes. It also teaches students how to use the internet in a better way and how to be safe while using social networking and browsing the internet.

Course Objectives: After completion the course the incumbent is able to operate and interpret the following

- Office Word, Excel and Power Point.
- Describes the basic of preparing his personnel/business letters, viewing information on Internet (the web), sending emails, using internet banking services etc.

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 processor: students will learn to use a popular word processor to create a camera-ready test file complete with figures, columns and tables. Spread sheet: students will learn how to use a popular spread sheet to maintain a minor book keeping, statistical and graphical analysis off data. Database: students will learn how to design a database structure/table. Computers assemble: students will assemble a computer. Internet: e-mail access, browsing, downloading.

Learning Outcomes:

- Students learn how to operate a computer in two basic environments- dos and windows and to install DOS, Windows operating system.
- Students learn to use a popular word processor to create a camera-ready test file complete with figures, columns, and tables.
- Students learn how to use a popular spreadsheet to maintain a minor book keeping, statistical and graphical analysis of data.

- Students learn how to design a database structure/table.
- Students assemble a computer. Internet: e-mail access, browsing, downloading.

References:

1. S. Frence- Computer Science.
2. Warford- Computer Science.
3. Peter Norton – An Introduction to Computer Science
4. L. Rosch- Hardware Bible, Brady Publishing, Indianapolis.
5. Clive Finkelstein – An Introduction to Information Engineering
6. Ian Macdonald - Information Engineering
7. James Martin - Information Engineering: Introduction

LE-115: MATHEMATICS-I

Class per week	Credit	Marks
2	3	Course final Exam: 70, In-course assessment: 25, Class Attendance: 5. Total Class: 45

Introduction to the course: Mathematics-I course is primarily concerned with developing the students' understanding of the concepts of matrix and calculus that providing experience with its methods and applications. The course emphasizes a multi-representational approach to calculus and system of linear equations, with concepts, results, and problems being expressed geometrically, numerically, analytically, and verbally. The connections among these representations also are important. Broad concepts and widely applicable methods are emphasized.

Technology should be used regularly to reinforce the relationships among the multiple representations of functions, to confirm written work, to implement experimentation, and to assist in interpreting results. Through the use of the unifying themes of derivatives, integrals, limits, approximation, and applications and modeling, the course becomes a cohesive whole rather than a collection of unrelated topics. These themes are developed using all the functions listed in the prerequisites.

Course Objectives:

- Learn to find the determinant of a matrix, inverse matrix, and use them to solve the system of linear Equations.
- Learn to find the vectors properties and use them in applications.
- Learn to find and use limits of functions, continuity and derivatives of functions.
- Learn to find the derivatives of elementary algebraic functions and trigonometric functions.
- Learn to use derivatives for graphing algebraic and trigonometric functions and to solve optimization
- Problems.
- Learn to evaluate definite and indefinite integrals and use them in applications.

Course Contents:

Algebra: Determinant, matrix, inequalities.

Vector algebra and vector calculus: Introduction, scalar and vector products, solutions of vector equations, applications of vectors in geometry, vector calculus: vector function of scalar variables, differentiation of vector functions: grad, div and curl of functions, line, surface and volume integrals: green, gauss and stokes theorems-verification and applications.

Differential calculus: Functions of real variable and their graphs, limit, continuity and derivative, physical meaning of derivative of a function, evaluation of indeterminate forms of limit, L' Hospitals theorem, 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, functions of two and three variables, partial and total derivatives, Euler's theorem, concavity and convexity of a function.

Integral calculus: Definition of integration, integration by the method of substitution, integration by parts, standard integrals, method of successive reduction, definite integral, its properties and use in summing series, Wallis's formulae, improper integral, beta function and gamma function, area under a plane curve in Cartesian and polar coordinates, area of the region enclosed by two curves in Cartesian and polar coordinates, Trapezoidal rule, Simpson's rule, area, lengths of curves in Cartesian and polar coordinates, parametric and pedal equation, intrinsic equation, volumes of solids of revolution, volume of hollow solids of revolution by shell method, area of surface of revolution.

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

- Use computational techniques and algebraic skills essential for the study of systems of linear equations, matrix algebra, vector spaces, eigenvalues and eigenvectors, orthogonality and diagonalization. (Computational and Algebraic Skills).
- Critically analyze and construct mathematical arguments that relate to the study of introductory linear algebra. (Proof and Reasoning).
- Use technology, where appropriate, to enhance and facilitate mathematical understanding, as well as an aid in solving problems and presenting solutions (Technological Skills).
- Communicate and understand mathematical statements, ideas and results, both verbally and in writing, with the correct use of mathematical definitions, terminology and symbolism (Communication Skills).
- Work collaboratively with peers and instructors to acquire mathematical understanding and to formulate and solve problems and present solutions (Collaborative Skills).
- Interpret a function from an algebraic, numerical, graphical and verbal Perspective and extract information relevant to the phenomenon modeled by the function.
- Verify the value of the limit of a function at a point using the definition of the limit
- Calculate the limit of a function at a point numerically and algebraically using appropriate techniques including L'Hospital's rule.
- Find points of discontinuity for functions and classify them.
- Interpret the derivative of a function at a point the as the instantaneous rate of change in the quantity modeled and state its units.
- Interpret the derivative of a function at a point as the slope of the tangent line and estimate its value from the graph of a function
- Sketch the graph of the derivative from the given graph of a function
- Compute the value of the derivative at a point algebraically using the (limit) definition
- Interpret the tangent line geometrically as the local linearization of a function
- Compute the expression for the derivative of a composite function using the chain rule of differentiation.
- Differentiate a relation implicitly and compute the line tangent to its graph at a point

- Differentiate exponential, logarithmic, and trigonometric and inverse trigonometric functions.
- Obtain expressions for higher order derivatives of a function using the rules of differentiation
- Interpret the value of the first and second derivative as measures of increase and concavity of a functions.
- Identify the extrema of a function on an interval and classify them as minima, maxima or saddles using the first derivative test.
- Understand the consequences of Rolle's Theorem and the Mean Value theorem for differentiable functions.
- Interpret the definite integral geometrically as the area under a curve
- Interpret differentiation and anti-differentiation as inverse operations (Fundamental Theorem of Calculus, part 1)
- Use substitution to find the anti-derivative of a composite function and apply basic optimization techniques to selected problems arising in various fields such as physical modeling, economics and population dynamics and engineering.

References:

1. Bali N. P. Ashok Saxena and Sriman Narayana - A Text Book on Engineering Mathematics.
2. P. Kandasamy, K. Thilagavathi and K.Gunavathi - Engineering Mathematics,Vols. I and II.
3. S. Narayanan, T. K. Manicavachagam Pillay and G. Ramanaiah - Advanced Mathematics for Engineering Students, Vols. I and II.
4. E. Kreyszig- Advanced Engineering Mathematics.
5. R. V. Churchill and J. W. Brown -Complex Variables and Applications.
6. S. S. Sastry -Inductory Methods of Numerical Analysis.
7. Finney and Thomas-Calculus and Analytical Geometry.
8. Mohammad and Bhattacharjee-Differential Calculus.
9. M. R. Spiezel- Advanced Calculus.
10. R. A. Sardar -Differential Calculus.
11. H. T. H. Piaggio -Differential Equations.

LE-117: BUSINESS AND COMMUNICATIVE ENGLISH FOR ENGINEERS

Class per week	Credit	Marks
2	3	Course final Exam: 70, In-course assessment: 25, Class Attendance: 5. Total Class: 45

Introduction to the Course: What sounds true about the incalculable potency of language is that it can hold the whole gamut of human culture. Likewise, what is creditably measurable by the linguistic phenomena is attributable to the fact that there appeared a form of English that can retain a myriad of components from science, technology, economy and business. The people's insight in a context of technologically-affluent society is inextricably tied up with Business English. Apart from understanding the functioning of the linguistic phenomena, it goes impossible to inherit, analyze and assess the up-to-date trends in modernist culture.

Course Objectives: The course is identical with certain objectives herein after following

- Generating awareness among the learners about the art of Business English; and
- Enabling them to adopt the communicative English skillfully and purposively as an effective means of expression.

Course Contents:

Introduction to English grammar and its usage: Basic English Grammar and its standard usage.

English language: Its function as a primary means of communication to the technologists in writing, speaking, listening and reading.

Writing: Planning- technique, style and form, paragraph headings context, vocabularies writing for specific purposes.

Technical writing: Technical and industrial report including various types of technical reports with emphasis on preparation, data collection and research, organization style format graphics technical descriptions and report writing. Proposal for new equipment increasing production, description of visits

Business / commercial writing: Job application, Business Letters

Speaking and Listening: Effective communication between speaker and listener through presentation, use of visual aids.

Reading and Understanding: Technical and scientific books and journals.

Style of Letters: Full blocked, Semi-blocked, Blocked

Parts of Writing Official Letters: Techniques of writing (Heading, Reference, date, inside address, topic, greetings, complementary closing, Signature, Supplements.

Types of Format Documentation (In English)

Application with Curriculum Vitae (C.V)

Appointment letter

Joining Report

Letter of enquiry, orders, cancellation

Letter of compensation and complaint

Letter to the print and Electronic media

Application for opening a Bank Account

Application for Bank Solvency Certificate

Application for Bank Loan

Office note

Memorandum

Notice Writing

Listening: Phonetics and phonology, sound practice.

Learning Outcomes: The expected outcome is that the students after a perusal of the course will be able to:

- Research and writing, in different forms and resources—archives, libraries, collections, criticisms, histories, databases, and more.
- Provide students with a field for exercising skills of disciplined and independent inquiry that transfer to all walks of life.
- Provide students with a uniquely practical and creative grasp of the English language.
- Pursue the creative writing option produce independent verbal and artistic works and assemble them.

References:

1. Orient Longman- English for Engineers' and Technologist, Vol. 1 and Vol. 2.

LE-201: **MANUFACTURING TECHNOLOGY OF LEATHER-II**

Class per week	Credit	Marks
2	3	Course final Exam: 70, In-course assessment: 25, Class Attendance: 5. Total Class: 45

Introduction to the Course: This course can be considered as the heart of all courses related to B.Sc. in Leather Engineering degree. In accordance with the criteria illustrated by University of Dhaka each student can acquire basic to developed knowledge on different types of tanning process such as; chrome tanning, vegetable tanning, oil tanning, aluminum tanning, titanium tanning, resin tanning and so on. Not only tanning process but also process of imparting strength properties, dyeing and fat liquoring etc. can be learnt through this course. So, it can be named as the mother subject of all courses taught in this curriculum.

Course Objectives: The learning objectives of this course are

- To know about different types of tanning processes.
- To learn various theories of chrome tanning, vegetable tanning, aluminum tanning, aldehyde tanning and so on.
- To know about strength properties of leather, action of dyes on leather, neutralization and fat liquoring process.
- To acquire knowledge on different chemicals used in leather manufacturing.
- To gather knowledge on how to prepare raw hides and skins for further chemical operations.

Course Contents:

Tanning: Basic principle of tanning, tanning potentials of various metals, non-metals, natural and synthetic materials, tanning characteristics, hydrothermal stability and shrinkage temperatures of various tanning materials, stability of enzymatic degradation, tanning and collagen reactivity, stability of tannage, environmental friendly tanning materials.

Chrome tanning: Historical development, chromium complexes, theories of chrome tanning, factors affecting chrome tanning, basicity and its effect on chrome leather production, masked and self-basified chrome tanning and their advantages and disadvantages, principles of single and double bath chrome tanning processes, chrome tanning and its impact on environment, recycling, reduce and reuse of chrome liquors, defects of chrome tanning and their remedies, control in chrome tanning. Preservation and hydrothermal stability of chrome tanned leather.

Aluminum and titanium tanning: Theory and methods of aluminum and titanium tanning, parameters of tanning, advantages and limitation of aluminum and titanium tanning.

Vegetable tanning: Sources and supply of vegetable tannins and their classifications, vegetable tanning materials available in Bangladesh, mechanism of vegetable tanning, improvement of water resistance of vegetable tanned leathers, degree of tannage, factors affecting vegetable tanning process, bleaching and finishing of vegetable tanned leather, manufacturing techniques of different vegetable tanned leathers, controls of vegetable tanning, use of vegetable tanning materials as a retanning agent.

Synthetic tanning: Introduction, classification, method of application, collagen-syntan interaction, hydrothermal stability and mechanism, factors affecting the tanning effect of syntan, syntan as dyeing and retanning auxiliaries, advantages and limitation of the use of synthetic tanning agents, auxiliary syntan, replacement syntan, combination syntan.

Aldehyde tanning: Basic concept of aldehyde tanning, tanning action of formaldehyde, glutaraldehyde, glyoxal and cellulose aldehydes, mechanism of aldehyde tanning, factors effecting aldehyde tanning, quality of aldehyde tanned leather, uses of aldehyde tanning materials.

Oil tanning: Objectives, selection of oil for tanning, theory of oil tanning, application of oil tanning for the production of chamois leather, essential conditions for oil tanning.

Resin and polymeric tanning: Introduction, objects, types of resin and polymeric tanning agents, theory and application of acrylics, methacrylics, polyurethane, methylol ureas, melamine, dicyandiamide, styrene-maleic anhydride co-polymers, etc, advantages and disadvantages of resin tanning.

Preparation for post tanning: Selection of wet blue: Objects, procedure, selection based on size, defects, origin, selection of wet blue for specific types of leather production. Preservation of wet-blue prior to post tanning operation. **Wet-back 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, chemistry and mechanism of re-tanning, combination tannage, advantages and disadvantages of retanning and combination tannage, factors effecting retanning and combination tannage, influence of retanning materials on physical and dyeing properties of leather, mode of application of retanning materials, quality control during retanning and combination tannage, lubricating retanning agents.

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 fat liquors, theory and mechanism of fat liquors, theory and behavior of emulsions, emulsifiers, stability of emulsion, application of fat liquors, factors effecting fat liquoring, distribution of fat and oils in leather, controls of fat liquoring, effects of fat liquors on physical properties, fat liquors used in water repellent leather, modern trends in fat liquoring, curing and stuffing using fats and oils.

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

- Know different types of tanning processes and their objectives.
- Realize the functions of different chemicals used in tanning process.
- Get chance to experience creative experiments on leather making.
- Understand the merits and demerits of using chemicals on leather.
- Gather overall theoretical knowledge of leather manufacturing process.

References:

1. Anthony D. Kovington- Tanning Chemistry The Science of Leather
2. Dutta S.S.-An introduction to the principles of leather manufacture.
3. Krystof Bienkieuicz - 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.
11. Mclaughlin.George D. - The Chemistry of Leather Manufacture.
12. Gustavson K.H.- The Chemistry of Tanning Processes.

13. John Gerhard - Possible defects in Leather Production.
14. Dey Jyotirmay - Practical Aspect of the Manufacture of Upper Leather.
15. Thorstensen Thomas C. - Practical Leather Technology.
16. Wilson John Arthur-Modern Practice in Leather Manufacture
17. Wilson John Arthur-The chemistry of leather manufacture
18. Journal of the American Leather Chemists Association.
19. Journal of the Society of Leather Technologist and Chemists.
20. World Leather.

LE-202: MANUFACTURING TECHNOLOGY OF LEATHER-II PRACTICAL

Class per week	Credit	Marks
2	4	Continuous assessment : 40 Course final examination 60

Introduction to the Course: The purpose of the course is to provide the students practical knowledge and improved the skilled in leather manufacturing.

Course Objectives: The objective of this course is

- To gather knowledge about specific leather productions
- To able to predict the problems and defects that might occur in specific leather processes
- To be able to compare old and recent techniques in specific leather production
- To gain knowledge to students about the production of vegetable tanned leather, effect of basification with different basifying agent, effect of masking with different masking agent.
- To perform different processes for manufacturing of chrome- tanned leather, semi chrome leather, wet- white leather.
- To understand the impact of pH, temperature, low float, pH, time, temperature and mechanical agitation, syntan and other polymeric agent in leather processing.

Course Contents:

1. Manufacture of vegetable tanned leather.
2. Effect of basification with different basifying agent.
3. Effect of masking with different masking agent.
4. Manufacture of semi chrome leather.

5. Manufacture of wet- white leather.
6. Effect of pH, temperature
7. Manufacture of chrome- tanned leather.
8. Manufacture and mechanical agitation during tanning.
9. Effect of chromium absorption due to low float, pH, time, temperature and mechanical agitation.
10. Effect of syntan and other polymeric agent in tanned leather.
11. Effect of different neutralizing agent in post tanning operation.
12. Effect of rate of dye absorption due to pH, time, temperature
13. Effect of different fat liquoring agent on chemical softening of leather in post tanning operation.
14. Compare the filling properties of different types of syntans during retanning
15. Effect of glutaraldehyde during the processing of softy shoe upper/garments leather.

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

- Perform manufacturing of vegetable tanned leather.
- Demonstrate manufacturing of semi chrome leather**.**
- Perform manufacturing of wet- white leather.
- Perform manufacturing of chrome- tanned leather.

References:

1. Anthony D. Kovington- Tanning Chemistry The Science of Leather
2. Dutta S.S.-An introduction to the principles of leather manufacture.
3. Krystof Bienkieuicz - 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.
11. Mclaughlin.George D. - The Chemistry of Leather Manufacture.
12. Gustavson K.H.- The Chemistry of Tanning Processes.
13. John Gerhard - Possible defects in Leather Production.

14. Dey Jyotirmay - Practical Aspect of the Manufacture of Upper Leather.
15. Thorstensen Thomas C. - Practical Leather Technology.
16. Wilson John Arthur-Modern Practice in Leather Manufacture
17. Wilson John Arthur-The chemistry of leather manufacture
18. Journal of the American Leather Chemists Association.
19. Journal of the Society of Leather Technologist and Chemists.
20. World Leather.

LE-203: APPLIED CHEMISTRY AND CHEMICAL ENGINEERING

Class per week	Credit	Marks
2	3	Course final Exam: 70, In-course assessment: 25, Class Attendance: 5 Total Class: 45

Introduction to the Course: This course is designed to provide the basic concept**s** of fatty oils and fats, waxes and understanding related to extraction and refining method of vegetable oils, mechanism of soap and detergent and their manufacturing process. It also covers glue and gelatin, adhesives and different cosmetics. Moreover, fundamental of material balance, principles of energy conversion and conservation**,** fluid mechanics are also discussed.

Specific Objectives : The learning objectives of this course are

- To understand basic concept and mechanism of fat, oil and waxes.
- To know the extraction and refining method of vegetable oils.
- To introduce the cleansing mechanism of soap, raw materials of soap manufacturing.
- To learn about different types of manufacturing process of different cosmetics.
- To understand the fundamental of material balance, energy balance**,** fluid mechanics etc.

Course Contents:

Oils, Fats and waxes: Oils and its classification, animal fats, characteristics and uses of fatty oils and fats, waxes and its classification, saponification value, acid value, iodine value of oils, fats and waxes, extraction and refining method of vegetable oils, rancidity of oils, hydrogenation of vegetable oils.

Soaps and Detergents: Cleansing mechanism of soap, raw materials of soap manufacturing, Batch-kettle process and modern process of soap manufacture, detergent and its classification, manufacture of ABS detergent, glycerine and its manufacture.

Glue, Gelatin and Adhesives: Introduction, characteristics and uses of glue and gelatin, adhesives and its uses, gelatin manufacture and by products, animal glue.

Cosmetics: Introduction, types of cosmetics, hair products (shampoo, hair straightener), face powder, cleansing cream and lotion, lipstick, eye makeup, preshave, shaving and aftershave preparation.

Material balance: Fundamental of material balance: Types of balances, steady state and unsteady state operations, principle and procedure of material balance, material balance calculations of problems without chemical reactions.

Material balance on reactive system: Stoichiometry, stoichiometric equation, stoichiometric coefficient, stoichiometric ratio, stoichiometric proportion, limiting and excess reactant, recycle, purge and by-pass, mass balance involving chemical reactions.

Energy balance: Principles of energy conversion and conservation, form of energy, total energy balance, heat of reaction, heat of combustion, heat of formation, theoretical and excess air of combustion, energy balance calculation without and with chemical processes.

Absorption: Principle of absorption, operational and constructional features of packed absorption tower, mass balance equation of packed absorption tower, tower packings and their characteristics.

Refrigeration: Introduction, vapor-compression refrigeration cycle, absorption refrigeration cycle, refrigerants, refrigerants classification, refrigerants properties and uses.

Fluid mechanics: Introduction, fluid flow and its measurement, laminar flow, turbulent flow, Reynold's number, Euler's differential equation of hydrostatic pressure, basic equation of hydrostatic equilibrium and its application, fluid machinery- pumps.

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

- Understand the basic concept and sources of raw materials of fat, oil and waxes.
- Differentiate between fat, oil and waxes. Characterization and properties of fat, oil and waxes.
- Know the extraction and refining method of vegetable oils.
- Interpret the cleansing mechanism of soap, raw materials of soap manufacturing.
- Learn about different types of manufacturing process of different cosmetics.
- Identify different faults in manufacturing process.

References:

1. W. J. Moore- Physical Chemistry.

2. Bahl and Tuli- Essentials Physical Chemistry.
3. Sharma and Sharma- A Text Book of Physical Chemistry.
4. S. Glasstone-Text Book of Physical Chemistry.
5. P. W. Atkins- Physical Chemistry.
6. M. Mahbubul Haque and M. Ali Nawab- Principle of Physical Chemistry.
7. McCabe and Smith- Introduction to unit operation
8. Perry- Handbook of chemical engineering.
9. Fogler- Element of chemical reaction engineering
10. A text book of engineering Chemistry –M.M. Uppal.

LE-204: APPLIED CHEMISTRY AND CHEMICAL ENGINEERING PRACTICAL

Class per week	Credit	Marks
2	4	Continuous assessment : 40 Course final examination 60

Introduction to the Course: This course is designed to develop and improve the practical skill of students. The students have the opportunity to prepare several industrially important raw materials and products. This course will assist students to know the characteristics and properties of oils and fats, waxes and understanding related to extraction and refining method of vegetable oils, mechanism of soap and detergent and their manufacturing process. In addition, various analytical techniques are specially focused in this course.

Specific Objectives :

The learning objectives of this course are :

- To improve the practical knowledge and analytical skills in applied chemistry.
- To introduce learners with analysis of Industrial raw materials.
- To help them understand the importance of some specific chemical reactions.
- To familiarize with different analyzing techniques of industrial products.
- To understand specific instrumental analysis for analytical purposes.

Course Contents:

Lab I: Analysis of Industrial Raw materials:

1. Water 2. Sulphur 3. Oil seeds 4. Cellulose raw materials 5. Raw hides and skins
6. Different types of Leather 7. Effluent of raw hides and skins 8. Sea salt 9. Chrome powder

Lab II: Analysis of Industrial Products:

1. Soap, 2. Acids and alkaline, 3. Fish oils, 4. Hydrogenated fats, 5. Animal fats and oils, 6. Wet-blue hides and skins, 7. Crust leather 8. different type of finished leather

Lab III: Instrumental analysis

1. study of kinetics of chemical reactions using:

a) Polarimeter b) Conductance bridge c) Spectrophotometer and d) Chemical analysis

2. Electrochemical measurements: pH measurements
3. Spectrophotometric analysis
4. Chromatographic analysis

Learning Outcomes:

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

- Understand the fundamentals of raw materials of fat, oil and waxes.
- To be able to analysis of industrial raw materials such as water, Sulphur, oil seeds, cellulose raw materials, raw hides and skins, different types of leather, effluent of raw hides and skins, sea salt, chrome powder, etc.
- To be able to analysis of industrial products such as soap, acids and alkaline, fish oils, hydrogenated fats, animal fats and oils, wet-blue hides and skins, crust leather, different type of finished leather, etc.
- Interpret the mechanism of soap manufacturing.
- Know the extraction and refining method of vegetable oils.
- Utilize various analytical techniques.
- Identify different faults in manufacturing process.

LE-205: MATERIALS SCIENCE AND TECHNOLOGY

Class per week	Credit	Marks
2	3	Course final Exam: 70, In-course assessment: 25, Class Attendance: 5. Total Class: 45

Introduction to the Course: The curriculum for undergraduate program in Materials Science and Technology leading to the award of B.Sc. in Leather Engineering degree so that each student can gather basic to advanced knowledge on manufacturing requirements, properties and

application of different polymeric materials, polymer modification techniques, and their applications, mineral tanning materials, vegetable tannins, synthetic tanning agents, resin and other polymeric tanning agents in leather manufacturing.

Course Objectives:

- To provide an overview of materials science and technology related with leather manufacture.
- To understand the polymeric materials and their properties and applications in leather manufacturing.
- To know how the polymer modification techniques help to modify the properties of polymer.
- To learn about the properties, applications of vegetable tanning, synthetic tanning agents, resin and other polymeric tanning agents and their types and properties.
- To Introduce chemistry and tanning action of formaldehyde, glutaraldehyde, mono- and di-isocyanate, epoxide, aliphatic sulfochlorides and oil tanning agents.
- To garner the properties, applications and manufacturing requirements of finishing materials and their characteristics used in leather manufacturing.
- To understand about the properties, applications and manufacturing requirements of different types of artificial leather/synthetic materials used in leather goods and footwear manufacturing.
- To learn the properties, applications and manufacturing requirements of several footwear materials like sole, insole, heel, last, shank, toe puffs and stiffeners.
- To know the properties, applications and manufacturing requirements of dressing materials, polishes, and accessories used in leather goods manufacturing.

Course Contents:

Polymeric materials:

Definition and classification of polymers, chemistry and mechanism involved in different polymerization process such as stepwise, addition, ring opening, free radical polymerization, properties and applications of different materials such as natural and synthetic rubber, PVC, polystyrene, PU, LDPE and HDPE polypropylene, EVA, ABS, acrylics, fiber reinforced plastics, poromerics/ PVC or PU coated fabrics and their quality, materials for quality assurance.

Mineral tanning agents:

Introduction, tanning action of metal salts, Chrome tanning agent, Structure of chromium complex, chromium complexes participating in tanning process, safety handling of chromium compounds. Aluminum, zirconium, titanium and iron tanning

Organic tanning agents:

Vegetable tannins, synthetic tanning agents, resin and other polymeric tanning agents and their types and properties.

Miscellaneous tanning agents:

Introduction, chemistry and tanning action of formaldehyde, glutaraldehyde, mono- and di-isocyanate, epoxide, aliphatic sulfochlorides and oil tanning agents.

Dyeing and fat liquoring agents:

Different types of dyes and their characteristics, different types of fat liquoring agents and their characteristics

Finishing materials:

Different types of finishing materials and their characteristics.

Materials for leather products and footwear:

Leather as upper and lining materials: Major types of leather and their characteristics, classification of leather according to their use, finishing materials, finishing techniques and finishing effects. Exotic leathers, calf leather, side leather, full grain leather, corrected grain leather, patent leather, printed side leather, suede leather, nubuck leather, split leather, etc. and their properties.

Fabrics:

Introduction, woven, nonwoven and knitted fabrics and their uses, Manufacturing techniques of fabrics and different types of materials used for fabrics manufacture.

Coated Fabrics : Introduction, types of coated fabrics, backers and coating materials used in coated fabrics, direct coating and transfer coating, poromerics, PVC coated fabrics, PU coated fabrics, rubber coated fabrics and their properties and 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: Drill cloth, sugar coated fabric, cow, goat, buffalo softy leather, split suede leather.

Accessories: Introduction, Types of accessories, fittings-locks, frames, strap fittings, buckles, handles, hooks, hinges, clips, fasteners- rivets, rivets buttons, eyelets, press button, zippers, Velcro, fusing materials, fastening materials, elastic materials, textiles materials

Reinforcement: Introduction, types of reinforcement, leather, leather board, fiberboard, mill board, cellulose board, impregnated non-woven, plastics, fusing, reinforcement tape, EVA sheet, foam, celluloid, toe puffs and stiffener, etc.

Threads and needles: Different types of threads and their sizing system, materials of threads, Nylon thread (Nylon 6, Nylon 66), cotton thread, polyester thread, rayon thread, etc. Needle system, needle size and needle points, relation among needle, thread and materials.

Adhesives: Introduction on adhesive formulations, different adhesive formulations, mechanism of adhesion, kinetics of adhesives, thermal, chemical, mechanical, electrical, rheological characteristics of adhesives. Factors affecting of adhesion, surface preparation for optimum adhesion, methods of application of adhesives, curing of hot melt adhesives, curing of liquid adhesives, function of primer and hardener in adhesion, Links of adhesion and their bonding, faults, their cause and remedy of adhesion.

Sole: Raw materials, kinds of sole, ideal qualities of sole, leather, PVC, PU, TPR, Micro cellular rubber (MCR), crepe rubber, EVA, polystyrene, nylon, polyethylene, etc. as soling materials. Welts and runners used for soles.

Insoles: raw materials, kind of insoles, ideal qualities for insoles, different types of shanks used in insoles.

Heels: definition, different materials for heels, wooden heels, plastic heels, ABS, EPDM, injection moulded heels.

Shoe finishing materials:

Polishes, waxes, solvents, petroleum and aromatic hydrocarbons, special solvents, addition of metallic soaps to solvents, alkali raw materials and emulsifying agents, cleaners, fillers, repairing crayons, repairing pastes, informers, renovators, creams, liquid dressing.

Learning Outcomes: Students will be able to

- Understand the identification characteristics and applications of various polymeric materials.
- Interpret the polymer modification techniques.
- Know the properties, applications and manufacturing requirements of various lining and adhesive materials for leather goods manufacturing.
- Assess the properties, applications and manufacturing requirements of different types of soling materials (sole, insole, heel, last, shank, toe puffs, stiffeners, bottom filler etc.) used in footwear manufacturing.

- Interpret the properties, applications and manufacturing requirements of different types of dressing materials and polishes used in leather products manufacturing.

References:

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

LE-207: MATHEMATICS-II

Class per week	Credit	Marks
2	3	Course final Exam: 70, In-course assessment: 25, Class Attendance: 5. Total Class: 45

Introduction to the Course: Mathematics-II combines different interesting and cardinal branches of Mathematics. Coordinate geometry is one of the central part of mathematics and it provides a foundation to understand different phenomenon by plotting them and deriving their properties. This will shape to create a foundation for advance trigonometry also. Laplace and Fourier transformation will be used to transform derivatives, integrals, periodic functions etc. In addition, Fourier series will be conducive to understand some intricate phenomenon like harmonic analysis. Methods of Ordinary and Partial differential equations are most useful mathematical techniques for developing mathematical models of real life problems like bacterial growth with the change of time, predator-prey model etc.

Course Objectives:

- To provide students a comprehensive idea on solving problems involving science and engineering.

- To develop conceptual ideas of two and three dimensional geometry.
- To understand the techniques of Laplace and Fourier transformations and Fourier series which are necessary tools for solving real life problems.
- To enhance knowledge on advance trigonometry.
- To garner knowledge of the methods of ordinary and partial differential equations that will provide ideas for developing real life models involving one or more dependent variables with respect to one or more independent variables as well as their solution procedures.

Course Contents:

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

Trigonometry: Complex numbers and functions: De Moivre's theorem and application, summation of finite trigonometric series, hyperbolic function.

Laplace transforms: Transforms of simple functions, basic operational properties, transforms of derivatives and integrals, periodic functions, convolution theorem, inverse transforms, initial and final value theorem, applications of Lap lace transforms to linear differential equations.

Fourier series: Dirichlet's conditions, general Fourier series, half range sine and cosine series, Parseval's identity, harmonic analysis.

Fourier transforms: Fourier integral representation, Fourier transform pairs, properties, Fourier sine and cosine transforms, transforms of simple functions, transform of derivatives, the convolution integrals of Fourier, application to one dimensional wave and diffusion equation.

Differential equation: Ordinary differential equation: formation of differential equation, 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.

Partial differential equations: Formation, 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.

Learning Outcomes:

- At the end of Two-dimensional geometry students will be able to do transformations of axes. They will also be able to determine different properties of straight lines, circles and conics with identification of curves.
- At the end of Three-Dimensional geometry students will be able to determine directional cosines and directional ratios of straight lines manually with geometric interpretations, and different properties of conics and straight lines in three dimensions.
- At the end of Trigonometry they will be adroit to apply the idea of De Moivre's theorem, and also to determine sum of infinite trigonometric series.
- At the end of the Laplace and Fourier transformation and Fourier series students will learn about transformations of integrals, derivatives, periodic functions, half range sine and cosine series, harmonic analysis.

References:

1. Bali N. P. Ashok Saxena and Sriman Narayana- A Text Book on Engineering Mathematics.
2. P. Kandasamy, K. Thilagavathi and K. Gunavathi- Engineering Mathematics, Vols. I and II.
3. S. Narayanan T. K. Manicavachagam Pillay and G. Ramanaiah- Advanced Mathematics for Engineering Students, Vols. I and II.
4. E. Kreyszig - Advanced Engineering Mathematics.
5. R. V. Churchill and J. W. Brown -Complex Variables and Applications.
6. S. S. Sastry -Introductory Methods of Numerical Analysis.
7. Finney and Thomas-Calculus and Analytical Geometry.
8. Mohammad and Bhattacharjee-Differential Calculus.
9. M. R. Spiezel- Advanced Calculus.
10. R. A. Sardar -Differential Calculus.

LE-209: STATISTICS

Class per week	Credit	Marks
2	3	Course final Exam: 70, In-course assessment: 25, Class Attendance: 5. Total Class: 45

Introduction to the Course:

Statistics play an important role in many aspects of engineering including forecasting, optimization of industrial processes, quality assurance and design of reliable systems. This course provides an introduction to the theory and practice of probability and statistics in the context of engineering. Topics covered are: review of descriptive statistics and basic probability, random variables, commonly used discrete and continuous distributions including Bernoulli, binomial, Poisson, and normal probability distribution, central limit theorem, hypothesis tests, single sample, two independent samples, paired samples, inference for proportions; acceptance sampling, general control charts, regression and correlation, simple linear regression, least squares estimation, prediction and estimation, index number and z-transformation.

Course Objectives:

- Students will be taught on how to use and incorporate statistical tools for solving engineering statistics problem. This course covers the role of statistics in engineering.

Course Contents:

Introduction: Historical development of the subject, its nature and scope, nature of statistical data, attributes and variables, population and sample, collection and condensation of data. Frequency distribution, graphical representation of data.

Measures of location: Arithmetic mean, median and mode, geometric mean, harmonic mean. quadratic mean, deciles and percentiles.

Measures of dispersion: Range, mean deviation, standard deviation, variance, quartile deviation. Coefficient of variation, moments and cumulates of a distribution, skew ness and kurtosis.

Regression and correlation: Bivariate data, relationship between the varieties, method of least squares, regression line, correlation and regression coefficients, rank correlation.

Probability: Definition of probability and related concepts, laws of probability, discrete and continuous random variables, mathematical expectation, conditional probability, Binomials, Poisson and normal distribution and their properties.

Sampling: Population and sample, census and sampling, methods of sampling, random sampling, stratified sampling, systematic sampling, two stage sampling errors and non sampling errors, population projection.

Statistics for industry: Introduction, level of significance, hypothesis, important steps in a test of significance, testing the difference between two-sample mean and population mean. Acceptance sampling procedure, introduction, acceptance sampling by attributes, consumer's and producer's acceptance sampling by variables, continuous sampling plan, sequential sampling. Control charts natural tolerance limits and specification limit.

Index number: The concept of an index number, problems in construction of index number. Construction of price, quantity, value and cost of living indices, their uses. Laspeyres, Paasche and Fisher's ideal indices, test of index number, cost of living index number, national income and wealth.

Educational statistics: Introduction, education and psychology, scaling measurement of different scores, IQ, planning, reliability and validity of tests.

Difference Equations and Z-Transform: Linear difference with constant coefficients, elementary properties of z transform, applications of z transform, application of z transform to difference equations.

Learning Outcomes: After successfully completing the course, students should be able to do the following

- Compute and interpret descriptive statistics using numerical and graphical techniques for both categorical and continuous data.
- Understand the basic concepts of probability, random variables, probability distribution, and joint probability distribution.
- Know and apply the concepts of expected value and variance for discrete and continuous variables.
- Know and apply the Central Limit Theorem, which is crucial for inference.
- Understand confidence intervals and hypothesis tests.
- Carry out and interpret one-sample and two-sample analyses for means and proportions.
- Carry out and interpret statistical modeling using linear regression analysis.
- Know and apply basic quality control procedures.
- Understand and use process monitoring charts.
- Understand and apply index number.

References:

1. Barlow R. J. - Statistics.

2. Meyer A. - Probability and Statistics.
3. Mosteler, Rourke and Thomas - Probability with Statistical Applications.
4. Ross S.M. - A First Course in Probability.
5. Toha H.A. - Introduction to Operation Research.
6. Hoel P. - Introductory Statistics.
7. Mostafa M. G. - Methods of Statistics.
8. Weatherburn- First course in Mathematical Statistics.
9. Yule and Kendal- An Introductory to the Theory of Statistics.
10. Duncan A. J. - Quality Control and Industrial Statistics.
11. Grant- Statistical Quality Control.
12. Guilford J. P. - Educational Statistics and Psychometric Methods.

LE-211: MECHANICAL ENGINEERING FOR LEATHER MANUFACTURE

Class per week	Credit	Marks
2	3	Course final Exam: 70, In-course assessment: 25, Class Attendance: 5 Total Class: 45

Introduction to the course: Mechanical Engineering is an applied science theory and performance based practical course. It makes in students the idea of implementation of force, use of heat and mass transfer, safe heat and mass transfer, use of fluid energy, protection against corrosion and use of Engineering Materials, Refrigeration and Air-conditioning etc.

Course Objectives:

- Students have to try to understand Engineering materials, Corrosion, Engineering Mechanics, Fluid mechanics, Heat and mass transfer, Refrigeration and Air-conditioning, welding etc.

Course Contents:

Engineering materials: Introduction, properties of engineering materials, characteristics and specification of brick, composition and uses of sand, constituents of cement, cement concrete (C.C), reinforce cement concrete (R.C.C.), abrasives; types of abrasives, abrasive wheels, use of abrasives in leather-goods, normal abrasive, artificial abrasive, paints and their constituents,

fuels and lubricants, types of iron and steels, reason for alloying, iron-carbon equilibrium diagram.

Corrosion: Definition of corrosion, behavior of iron and steel in atmosphere, types of corrosion atmospheric, soil, high temperatures, stray current, protection from corrosion and its types, inorganic coatings, metallic coatings, non-metallic inorganic enamel and cathodic coatings.

Welding: Idea of shop safety practice, acquaintance with arc and gas welding tools, machines, electrodes, gas cylinders and their identification, types of gas flames, safety and precaution for welding. Mechanism of gas and arc welding and gas cutting on mild steel sheets and plates, non-ferrous metal working, cast-iron welding, soldering and brazing, study of welding defects.

Engineering mechanics: Introduction, force, moments and their applications; lever, center of gravity, moment of inertia, work, power and energy, friction on inclined surfaces; wedge, simple stress and strain, pressure vessel, torsion of circular shafts.

Fluid mechanics: Introduction, fluid flow and its measurement, boundary layer equations, laminar flow, turbulent flow, compressible flow, fluid machinery; pumps, lifting machines, etc. compressors; type of compressors, pneumatic compressor; preparation of compressed air, use of compressed air in leather-products machinery, blowers, **hydraulics**; the pressurization, hydraulic clicking press operation, hydraulic devices.

Heat and mass transfer: Introduction, different modes of heat transfer, heat transfer through plane wall, composite wall and cylindrical wall, overall heat transfer co-efficient, critical thickness of insulation, solution of energy balance equations, heat exchangers.

Refrigeration and air-conditioning: Introduction, vapor-compression refrigeration cycle, refrigerants, fundamentals of air-conditioning, summer air-conditioning system.

Learning Outcomes: From learning and practice of the course a student can be able to

- Understand Engineering materials, Corrosion, Engineering Mechanics, Fluid mechanics, Heat and mass transfer, Refrigeration and Air-conditioning, welding etc.

Reference:

1. Virgil Moring Faires- Analytic Mechanics.
2. R.S. Khurmi-A Text Book of Mechanical Technology.
3. Mark's Standared Handbook for Mechanical Engineers.
4. Ferdinand P. Beer, E. Russel Johnston, Jr.- Vector Mechanics for Engineers.
5. R.S. Khurmi, J.K. Gupta- Theory of Mechanics.
6. G.J. Kulkarni- Engineering Materials

7. Dr. M.A. Aziz- Engineering Materials
8. J.P. Holman-Heat Transfer.
9. Rogers and Mathew- Engineering Thermodynamics.
10. R.S. Khurmi- A Text of Engineering Mechanics.
11. 11.K.L. Kumar-Engineering Fluid Mechanics.
12. Stocker/Jones- Refregeration and air conditioning.
13. G.C. Mostley- Leather Goods Manufacture.
14. W.A. Attwater- Leathercraft.
15. Hamlyn- Leatherwork- A step by step guide.
16. Sylvia Grainger- Leatherwork.
17. R.S. Khurmi-Applied Mechanics and Strength of Materials

LE-212: MECHANICAL ENGINEERING FOR LEATHER MANUFACTURE PRACTICAL

Class per week	Credit	Marks
1	2	Continuous assessment : 40 Course final examination 60

Introduction to the course: Mechanical Engineering is an applied science theory and performance based practical course. It makes the student practice on different mechanical machines, welding practice and machine elements and their maintenance.

Course Objectives:

- To perform fitting works;
- To perform machining on lathe, shaper, milling, drilling and grinding machine;
- To perform DC/AC arc welding and gas welding

Course Contents:

Mechanical Machines: Introduction, hand tools and accessories, measuring tools, machine tools, uses of steel vice, working bench, lapping machine, lathe, shaper, milling, drilling and grinding machine, air compressor, knife bending machine, knife cutting machine and leather crushing machine etc.

Welding: Shop safety practice, acquaintance with arc and gas welding tools, machines, electrodes, gas cylinders and their identification, types of gas flames, safety and precaution for

welding. Practice on gas, arc welding and gas cutting on ms sheets and plates, non-ferrous metal working, cast-iron welding, soldering and brazing, study of welding defects.

Machine elements and their maintenance: Introduction, power transmission system, gear, pulley and chain, bearing, wood and machine screws, simple lifting machine; efficiency of machine, steam boiler and their accessories and mountings, pre-heater, heater, super-heater and economizers, planning and scheduling of preventive maintenance, break-down maintenance and trouble shooting, computerized machine maintenance systems.

Learning Outcomes: From the practice of the course a student can be able to

- Work on different machines and their maintenance, fitting work, welding, etc.

Reference:

1. Khurmi., R.S.; "A Text Book of Mechanical Technology".
2. Mark's Standared Handbook for Mechanical Engineers.
3. Khurmi., R.S. ;"Workshop Technology", Volume-1
4. Chapman.,W.A.J.; "Workshop Technology(4th Edition"), Part-1
5. Khurmi., R.S.; and Gupta., J.K.; " Theory of Mechanics"
6. Choudhury., S.K. Hazra. and Bhattacharya., Dr. S.C.; "Elements of Workshop Technology" (4th Edition),Volume-1.

LE-213: ELECTRICAL AND ELECTRONIC ENGINEERING

Class per week	Credit	Marks
2	3	Course final Exam: 70, In-course assessment: 25, Class Attendance: 5 Total Class: 45

Introduction to the Course: Electrical and Electronic Engineering (EEE) is one of the dynamic and time demanding branches in engineering sector. EEE course is offered to all the undergraduate students of the Institute of Leather Engineering and Technology. This course is designed to cover most of the core scientific fundamentals related to basic electrical and mechanical engineering principles. Main contents of this course include different types of symbols used in electrical circuits, circuit laws, network transformation, network-analysis,

network theorems, magnetic circuits, magnetic properties of matter, basic construction, principle, and operation of DC and A.C. machines.

Course Objectives: The specific objectives of this course are to expertise the students for the following skills

- Have the skills for a successful career as well as the ability to collaborate with others to solve problems with creative thinking and effective communication.
- Function effectively in laboratory environment and pursue independent research towards the development of new devices and products using sophisticated EEE concepts.
- Work efficiently in leather, leather products, and footwear industries where proper application of engineering knowledge requires the basics of electronics, communication systems, signal processing, control systems, and computer-based systems

Course Contents:

Electrical: Different types of symbol used in electrical circuits, types of wires and cables and their uses, domestic and factory wiring, Delta-wye transformation, network-analysis methods of branch and loop currents, method of node-pair voltages, Thevenin's and Norton's theorems, magnetic field, right-hand rule, magnetic flux density, Biot-savart law, magnetic properties of matter, poles and dipoles, Gauss's law for magnetism, para magnetism, diamagnetism and ferromagnetism, nuclear magnetism, magneto motive force, magnetic field intensity, permeability, susceptibility, energy in a magnetic field, magnetization curves, Hysteresis, magnetic field intensity, measurement of magnetic flux, energy of magnetic field, theory of ferromagnetism. Electrical machines: Introduction to magnetic circuit, eddy current loss, core loss, elementary A.C. generator, Transformer: single-phase transformer-equivalent circuit, laboratory testing, introduction to three-phase transformer, D.C. generator: principles, types, performances and characteristics, D.C. motor: principles, types, performances, speed control, Ward Leonard system, starters and characteristics. A.C. machines: three phase induction motor principles, equivalent circuit, introduction to synchronous machines and fractional horse power motors, choice of motor and generator for specific load, armatures and their types, winding and rewinding of armature, manual and automatic star-delta starters, Driver Servo-motors: basic theory and application. Measuring instruments and their classification, working principles and uses (Ammeter, voltmeter, wattmeter, energy meter, AVO-meter, frequency-meter, earth-tester, clamp-tester and A.C. maggers, etc.)

Electronics: Different types of symbol used in electronic circuits, color code of resistors and capacitors, concept of conductor, semiconductor and insulator, emission of electron, thermo ionic valves, principles of operation and applications of semiconductor diode, zener diode, LED, LCD, LDR, Photo diode. Transistors: (bipolar and FETs), silicon controlled rectifier (SCR), DIAC, TRIAC Characteristics and application of CB, CE and CC and class (ABC) amplifiers, feedback in amplifiers, oscillators, inverters, clipping and clamping ckts, timer, voltage regulators. . OP-amp, digital logic gates (combination and sequential) and its truth table, basic idea about microprocessors, different types of sensors and transducer, strain, pressure, temperature, speed and torque measurement, Microcomputer based systems and Industrial robots.

Learning Outcomes:

- Understand the mathematical and physical foundations of electrical engineering and how these are used in electronic devices and systems.
- Apply knowledge of mathematics, science, and engineering to identify, formulate, and solve engineering problems.
- Employ as a practicing engineer in fields such as design, research, development, testing, manufacturing, operations and service systems.
- Design and conduct experiments as well as to analyze and interpret data.
- Communicate effectively to function on multidisciplinary teams.
- Use the techniques, skills, and modern engineering tools necessary for engineering practice.

References:

1. V.K.Metha - Principles of Electronics.
2. Paul D. Malvino - Electronic principles.
3. Chut and Chut - Electronics in Industry.
4. B.L. Therera and A.K. Therera - Solid State Electronics
5. B. L. Therja, A. K. Theraja- A Textbook of Electrical Technology.
6. V. K. Mehta- Principles of Electrical Engineering and Electronics.
7. Kurt S. Lion- Elements of Electrical and Electronic Instrumentation.
8. A. K. Sawhney- A course in Electrical and Electronics Measurement and Instrumentation.
9. Robert P. Ward- Introduction to Electrical Engineering.
10. George J. Angerbauer- Principles of DC and AC circuits.

LE-214: ELECTRICAL AND ELECTRONIC ENGINEERING PRACTICAL

Class per week	Credit	Marks
1	2	Continuous assessment : 40 Course final examination 60

Introduction to the course: Electrical and Electronic Engineering (EEE) is one of the dynamic and time demanding branches in engineering sector. EEE practical course is offered to all the undergraduate students of the Institute of Leather Engineering and Technology. This course provides a broad training on electrical engineering, analogue, digital, and power electronics, and electrical AC and DC machines with laboratory experiments in order to develop their skills in basic engineering. 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 engineering concepts.

Course Objectives: The specific objectives of this course are to expertise the students for the following skills

- Understand the machines and their functions related to electrical and electronic engineering in practical classes.
- Provide necessary knowledge to adapt in a world of constantly evolving and innovative technology.
- Function effectively in laboratory environment and pursue independent research towards the development of new devices and products using sophisticated EEE concepts.

Work efficiently in leather, leather products, and footwear industries where proper application of engineering knowledge requires the basics of electronics, communication systems, signal processing, control systems, and computer.

1. Measurement of high resistance by magger and bridge magger.
2. Calibration of voltmeter, ammeter and watt hour meter.
3. Measurement of voltage, current and power by voltmeter and wattmeter.
4. Measurement of internal resistance of a storage cell.
5. Measurement of resistance of a bulb in (i) cold and (ii) hot condition.
6. Star and delta connection of three phase circuit.
7. Connection of a three phase transformer in an AC circuit.
8. Connection of one lamp controlled by single way switch and by two-way switch.
9. Connection of two lamps with the main to work as series with no switch and parallel with switch.
10. Connection of a fluorescent lamp controlled by a switch.

11. Connection of an electric bell controlled from two points with lamp indication.
12. Changing of storage battery from DC mains.
13. Detection of defects of DC and AC.
14. Study of AC and DC starters.
15. Load test of a DC motor.
16. Speed control of a three phases induction motor.
17. Measurement of self-inductance by Raleigh's method.
18. Study the characteristic of a general purpose and Zener diode.
19. Study the characteristic of a transistor in CB configuration.
20. Study the characteristic of a transistor in CE configuration.
21. Study the characteristic of a single stage amplifier.
22. Study the basic characteristic of logic gates.
23 Study the basic characteristic of SCR, LDR and TRIAC,
24. Study the basic operation of Microprocessors.
25. Study the basic operation of different sensors and Transducers.

Learning Outcomes:

- Understand the mathematical and physical foundations of electrical engineering and how these are used in electronic devices and systems.
- Design and conduct experiments, as well as to analyze and interpret data.
- Employed as a practicing engineer in fields such as design, research, development, testing, manufacturing, operations, and service systems.
- Use the techniques, skills, and modern engineering tools necessary for engineering practice.
- Use the fundamental aspects of electrical and electronic engineering in careers in industry.
- Continue to learn through advance study or engagement in professional development activities within physics, electrical engineering or other technically related fields.

LE- 215: INDUSTRIAL MANAGEMENT FOR LEATHER MANUFACTURE

Class per week	Credit	Marks
2	3	Course final Exam: 70, In-course assessment: 25, Class Attendance: 5. Total Class: 45

Introduction to the course: This course aims to facilitate student understanding of management scope, importance, functions, principles, social responsibilities, management process, skills, roles, effectiveness and efficiency. It offers an overview of management theories and applications including planning, organizing, leading, controlling and global management. Moreover, industrial policies of Bangladesh are also introduced in this course.

Course Objectives: The specific objectives of this course are to expertise the students for the following skills

- To familiarize students with different management principles.
- To help students develop an understanding of managerial functions, types, skills and roles.
- To familiarize students with different concepts including planning, organizing, leading, controlling and global management.
- To introduce different industrial policies, nationalization, privatization, foreign investment, role of Government.
- To prepare students to practice professionally in the fields of industrial management and product manufacturing.

Course Contents:

Introduction: Definition of Management- scope, importance, functions, principles, objectives and their attainments- social responsibilities, historical evolution, management process, skills, roles, effectiveness and efficiency.

Planning: Nature and meaning, importance, types, steps, process, tool and techniques, limitation.

Organizing: Definition, principles, importance, types of structures, delegation and decentralization, authority, span of supervision.

Leading: Definition of directing, importance, principles, consultative direction, coordination need, aids, means, motivation, theories, types of needs, means, motivation level in Bangladesh, definition of leadership, theories, and styles.

Controlling: Meaning, types, methods, process, requirements, budgetary control.

Environment: Internal and external, components, merits and demerits.

Global management: Nature and characteristics, management of multinational corporations (MNCS), role of recipient countries, demerits, problems for developing countries like Bangladesh.

Industrial policy of Bangladesh: Nationalization, privatization, foreign investment, role of MNCS, export processing zone, problems of industrialization in Bangladesh, ways to overcome, Government role.

Technology transfer: Definition of technology, types, appropriate technology-technology policy and base, lessons from Japan, Malaysia, Korea, Pakistan, India. Drawbacks of technology transfer.

Management structure in Bangladesh: Features of financial and industrial management, patterns, problems, measures, prospects.

Learning Outcomes:

- Understand the and basic principles of management.
- Describe the most well-known theories and perspectives on management employed as a practicing engineer in fields such as design, research, development, testing, manufacturing, operations, and service systems.
- Work professionally in the fields of industrial and systems engineering in either manufacturing or service sectors, and able to work in a wide range of areas such as systems engineering, sustainability, quality engineering, and advanced manufacturing.
- Able to work with multidisciplinary teams.
- Identify, formulate, and solve engineering problems.
- Use the fundamental aspects of professional and ethical responsibility.
- Capable of applying different principles to solve relevant Industrial problems.

References:

1. Khan M. Y. and Jain P. K. - Financial Management.
2. Van Horne J. C. - Financial Management and Policy.
3. Pandey I. M. - Financial Management.
4. Woodward-Industrial Organisation.
5. Moore-Manufacturing Management
6. Gitman L. J. and Moses E. A. - Financial Management Cases
7. Kuchhal S. C. - Financial Management- An Analytical and conceptual approach.

8. Weston J. F. and Brigham E. F - Managerial Finance.
9. Ashraf Ali A. F. M. - Arthikh Babosthapona.
10. Block S. B. and Hirt G. A - Foundation of Financial Management.
11. Johnson R. W. - Financial Management.

LE- 216: COMPUTER GRAPHICS DESIGN

Class per week	Credit	Marks
1	2	Continuous assessment : 40 Course final examination 60

Introduction to the course: This is an introductory practical course which focuses on basic photo corrections, selecting with the magic wand tool, cropping an image, rearranging layers. The Computer Graphics Design helps student in creating, editing a quick mask and saving a selection as a mask. This course will improve the skill about retouching, repairing, painting, editing etc. Furthermore this course also provides the current practices in 3D Studio Max and Auto CAD.

Course Objectives: The learning objectives of this course are

- To understand basic concept and mechanism basic photo corrections, selecting with the magic wand tool, cropping an image, rearranging layers.
- To introduce the essential facts and development method in creating, editing a quick mask and saving a selection as a mask.
- To acquaint students with the current practices in 3D Studio Max Auto CAD.

Course Contents:

Adobe Photoshop:

Work area: using tools, viewing images, working with palettes.

Basic photo corrections: Resolution and image size, straightening and cropping an image, adjusting the tonal range, removing a color cast, replacing colors in an image, adjusting lightness with the dodge tool, adjusting saturation with the sponge tool.

Selections: making selections, moving selection contents, selecting with the magic wand tool, selecting with the lasso tool, transforming a selection, selecting with the magnetic lasso, cropping an image and erasing within a selection.

Layer basics: Layers, rearranging layers, editing text, flattening and saving files, creating a layer set and adding a layer.

Masks and Channels: Creating a quick mask, editing a quick mask, saving a selection as a mask, editing a mask, loading a mask as a selection and applying an adjustment, extracting an image, applying a filter effect to a masked selection, creating a gradient mask.

Retouching and repairing: repairing areas with the clone stamp tool, pattern stamp tool, healing brush and patch tools, retouching on a separate layer.

Painting and editing: custom workspace, blending an image with the background,
Changing image with the history tool, brush tool.

Basic pen tool techniques: paths and pen tool, drawing straight paths, drawing curved paths, combining straight and curved path segments, editing anchor points, using paths with artwork, adding layers to complete the effect.

Creating special effects: automating a multi-step task.

3D Studio Max:

Introduction: MAX interface, customizing MAX interface

Objects: Referencing External objects, Importing and Exporting, cloning objects and using arrays, selecting and grouping objects, modifying objects.

Modeling: creating primitive objects, working with spline shapes, meshes, creating patches, creating loft objects, building compound objects.

Materials and Maps: material editor, material maps.

Lights and Cameras: Controlling lights, lighting special effects, controlling cameras, camera matching and tracking.

Particle systems and space wraps: creating and controlling particle systems, space wraps, particle system special effects.

Model systems: Building linked hierarchies, schematic view, creating an inverse kinematics system.

Animation: Animation basics, track view, animating with controllers, expressions, dynamic simulation.

Rendering and post production: Backgrounds, environments and atmospheric effects, setting rendering parameters, render effects.

AutoCAD

Getting familiar with AutoCAD, understanding the drafting tools, drawing 2D objects, editing AutoCAD objects, editing with the modify panel tools, Drawing fundamentals:
Use of line, circle, square, rectangle, triangle, ellipse, polygon.

Creating 3D drawings, getting organized with layers, using blocks, groups, design center, creating text, using dimensions, gathering information, laying out and painting drawing.

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

- Possess the skills in photo corrections, selecting with the magic wand tool, cropping an image, rearranging layers.
- Describe the essential facts and development method in creating, editing a quick mask and saving a selection as a mask.
- Understand the drafting tools, drawing 2D objects, editing Auto CAD objects, editing with the modify panel tools.
- Learn to use the line, circle, square, rectangle, triangle, ellipse, polygon.
- Acquire extensive knowledge and use of computer aided drafting software.
- Understand the current practices in 3D Studio Max Auto CAD.

References:

1. Adobe Creative Team – Adobe Photoshop 7.0 Classroom in a book
2. George Omura – Mastering AutoCAD 2009.
3. Jon A. Bell – 3D Studio MAx R 2.5 f/x
4. Kelly L. Murdock – 3D Studio Max R3 Bible
5. Alf Yarwood - Introduction to AutoCAD 2009
6. Frede Uhrskov - AutoCAD Tutorials
7. George Omura – Mastering AutoCAD 2009.

LE: 301: MANUFACTURING TECHNOLOGY OF LEATHER-III

Class per week	Credit	Marks
2	3	Course final Exam: 70, In-course assessment: 25, Class Attendance: 5. Total Class: 45

Introduction to the Course: The purpose of the course is to provide the students with the subjects that to sequential finishing process of the leather, to main and supplementary machine/instrument used in the leather finishing, to recognize absolute chemical and machine for the best manufacturing, to tell cost-effective and eco-friendly used in the leather finishing, to

learn reaction mechanism and machine working-mechanism used in the leather finishing process techniques.

Specific Objective: The objective of this course is

- To give information about the finishing materials structures, mechanism, interaction with fibre, physical and chemical properties etc.
- To make the students and gain knowledge about the recent advanced technologies used in leather production from tanning to drying process.

Course Contents:

Drying of leather: Definition of leather drying, Course of drying, Water content in leather, Theory of drying of solids, The equilibrium and non equilibrium state of leather with the air, the view point of drying energy-Heat energy consumption, the principles of dryer construction, the limitation of air drying, Drying Methods-Hang drying, Vacuum drying, Frame drying, Drying by radiation, the influence of humidity of the air on leather shrinkage during drying, the influence of temperature on the leather at drying and defects of drying.

Pre-Finishing Operation: Mechanical processes- conditioning, staking, milling, stretching, trimming of edge zones, dry splitting or dry shaving, buffing, dedusting, polishing, rolling.

Finishing: Definition of leather finishing, structure of finishes, classification of finishes-Classification according to finishing technique, classification according to finishing effect, classification according to finishing material used.

Basic products for finishing application: Leather Coating materials (pigment preparations), organic dyes for finishing preparation, Thermoplastic and cross-linking binders, Non-thermoplastic binders, Grain impregnation agents, Base coating agents, Top coating agents, Plasticizers, Finishing auxiliaries. General Composition of finishing floats.

Application of finishes: Padding, Brushing, Sponging, Spraying, Curtain coating, Padding, Printing, Laminating, Coating.

Mechanical Finishing methods: Grain-Forming operations: Plating, Graining, Glazing, Boarding, Rubbing off polishing.

Finishing defects: Defects of the finishing products, Defects of the finishing floats,
Defects of application, Finishing defects on the leather.

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

- Recognize the suitable drying method of the leather.

- Understand suitable finishing materials used in the leather manufacturing.
- Identify finishing fault and find out the remedy.
- Corelate finishing with leather.
- Explain finishing mechanism and techniques.
- Develop best leather production techniques for modern leather articles.

References:

1. Dutta S.S.-An introduction to the principles of leather manufacture.
2. Krystof Bienkieuicz - Physical chemistry of leather making.
3. Flaharty , Roddy , Lollar-The chemistry and technology of leather (vol-2and3)
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.
12. John Gerhard - Possible defects in Leather Production.
13. Dey Jyotirmay - Practical Aspect of the Manufacture of Upper Leather.
14. Thorstensen Thomas C. - Practical Leather Technology.
15. Wilson John Arthur-Modern Practice in Leather Manufacture
16. Wilson John Arthur-The chemistry of leather manufacture
17. Journal of the American Leather Chemists Association.
18. Journal of the Society of Leather Technologist and Chemists.
19. World Leather.

LE-302: MANUFACTURING TECHNOLOGY OF LEATHER-III PRACTICAL

Class per week	Credit	Marks
2	4	Continuous assessment : 40, Course final examination 60

Introduction to the Course: The purpose of the course is to provide the students practical knowledge and improved the skilled in leather manufacturing.

Course Objectives: The purpose of this course is to gain knowledge to students about the production methods and techniques of specific leather types having different fields of final use.

Course Contents:

1. Manufacture of full chrome white natural crust leather.
2. Manufacture of semi-chrome crust leather from goat skin/cow hides/sheep skin.
3. Manufacture of full vegetable natural crust leather from goat skin/cow hides/sheep skin.
4. Manufacture of full dyed crust leather from goat skin/cow hides/sheep skin.
5. Manufacture of chrome free vegetable free crust leather from goat skin/cow hides/sheep skin.
6. Manufacture of garment lining crust leather from goat skin/cow hides/sheep skin.
7. Manufacture of shrunken grain leather from goat skin/cow hides/sheep skin.
8. Manufacture of chamois leather from goat skin/cow hides/sheep skin.
9. Manufacture of fur skin.
10. Manufacture of shrunken upholstery leather.
11. Manufacture of book binding leather from goat skin/cow hides/sheep skin.
12. Manufacture of softy insole leather from goat skin/cow hides/sheep skin.

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

- Understand different types of leather productions and their objectives.
- Develop full chrome white natural crust leather.
- Manufacture semi-chrome crust leather from goat skin/cow hides/sheep skin.
- Poses experience in creative experiments of full vegetable natural crust leather from goat skin/cow hides/sheep skin.
- Develop chrome free vegetable free crust leather from goat skin/cow hides/sheep skin.
- Manufacture of garment lining crust leather from goat skin/cow hides/sheep skin.
- Gather overall practical knowledge of shoe upper leather, shrunken grain chamois leather, shrunken upholstery leather, book binding leather, and softy insole leather manufacturing from goat skin/cow hides/sheep skin.

LE-303: ANALYTICAL CHEMISTRY FOR LEATHER MANUFACTURE-I

Class per week	Credit	Marks
2	3	Course final Exam: 70, In-course assessment: 25, Class Attendance: 5. Total Class: 45

Introduction to the course: Analytical chemistry is too broad and too active a discipline for us to define completely. In this course we will try to say a little about different methods and techniques of analysis. Analytical chemistry is often described as the area of chemistry responsible for characterizing the composition of matter, both qualitatively and quantitatively.

Course Objectives: Throughout this course, we will focus on the following learning objectives

- Errors and statistics, gravimetric and volumetric methods chromatographic technics analytical spectrometry, thermal technics, 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, accuracy and precision, 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, Acid-Base titration, complexometric titration, precipitation titration, oxidation-reduction titration. Determination of end point.

Chromatographic techniques: Introduction, principles, classification of chromatographic methods, instrumentation and application of paper, thin layer chromatography (TLC) and high performance liquid chromatography (HPLC). Application in leather science.

Analytical spectrometry: Ultraviolet /Visible spectroscopy- Introduction, absorption laws, deviation from Beer's Law, instrumentation, principles, applications, molar extinction coefficient, measuring unknown concentration, absorbing species, absorption spectrum and λ_{MAX}, application of transmission spectrophotometry to dyes. Reflectance spectrophotometry-

Introduction, principles, Kubelka-Munk equation, reflectance measurement, instrumentation, determination of surface colour of solid substrates, application of reflectance spectrophotometry for the surface colour determination of leather.

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

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

Analysis of leather- vegetable tanned leathers: moisture, oils and fats, water solubles, insoluble ash, nitrogen and hide substance, degree of tannage, pH of water solubles, oxidized fat, combined fat, differential number, glucose, total ash, epsom salt, analysis of chrome tanned leather; Leather auxiliaries: casein, shellac, oils, fats, and waxes: moisture, acid value, saponification value, iodine value, unsaponifiable matter; determination of sulphide in alkaline liquors, determination of chlorides in alkaline liquors, determination of total available strong alkali.

Environmental analysis: Sampling procedures of waste water for analysis. Analysis of tannery wastewater sample: pH, alkalinity, acidity, total solids, dissolved solids, suspended solids, sulphate, sulphide, chromium, settleable solid.

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 thorough 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.

References:

1. Gary D. Christian- Analytical Chemistry
2. John Kenkel- Analytical Chemistry for Technicians
3. Skoog, Holler and Nieman- Principles of Instrumental Analysis
4. Sharma B. K. - Instrumental Methods of Chemical Analysis
5. Skoog, West and Holler- Fundamental of Analytical Chemistry
6. Browning D. R. - Chromatography
7. Hatakeyama T. and Quinn F.X. - Thermal analysis.
8. Vogel A. I. - Text Book of Quantitative Chemical Analysis
9. Roderick McDonald-Colour Physics for Industry.
10. P.K. Sarker - Analytical Chemistry for Leather Manufacture.
11. Williams D. H. and Ian Fleming- Spectroscopic methods in Organic chemistry.
12. Kalsi P.S. - Spectroscopy of organic compounds.
13. Venkatachalam P.S. - Lecture Notes on Leather.
14. John A. Dean. -Analytical Chemistry Handbook.
15. Dr. Sethi P.D. - High Performance Liquid Chromatography.
16. Banwel l C. N. -Fundamentals of Molecular Spectroscopy.
17. Hamilton, Hamiltoan-Thin Layer Chromatography.
18. Fifield and Haines-Environmental Analytical Chemistry.
19. UNIDO- Tannery and Environment.
20. Chhatwal G .R. - Encyclopedia of Environmental Analysis (vol.1, 2 and3)

LE-304: ANALYTICAL CHEMISTRY FOR LEATHER MANUFACTURE-I PRACTICAL

Class per week	Credit	Marks
1	2	Continuous assessment : 40, Course final examination 60

Introduction to the courses: This course is designed for the students of 3rd year B.Sc. in Leather Engineering aiming to introduce analytical chemistry practical utilizing their previous knowledge on basic chemistry. This course deals with the methodologies for the estimation of heavy metals, anions, pH, dye, ash, moisture, fat in the leather products and liquors using

volumetric, spectroscopic, chromatographic, thermal, and gravimetric analyses to ensure the quality of leather products and the validity of used methods**.**

Course Objectives: The objectives of this course are to

- Familiarize the students with the practical knowledge on analytical chemistry for the analysis of leather products, liquor and extracts from different tanning materials for the estimation of chromium, fat, moisture, pH, acid value, iodine value, dissolved substances and so on.

Course Contents:

1. Determination of fats, oils and other solubles.
2. Determination of water-soluble matter, water -soluble inorganic matter and water-soluble organic matter.
3. Determination of sulphated total ash and sulphated water-insoluble ash.
4. Determination of nitrogen and hides substance from different types of leather.
5. Determination of chromium content from different types of leather.
6. Determination of chromium content from different commercial chrome tanning agents.
7. Determination of sulphide from sodium sulphide.
8. Test for the identification of vegetable tanning materials.
9. Determination of moisture/total solids/ total solubles/non-tannin constituents/ insolubles/ colour/ pH from vegetable tanning materials.
10. Determination of moisture/ soluble matter/ ash/ alkalinity of ash/ pH/non-tannin of hide powder.
11. Determination of sulphur dioxide in bleaching extracts.
12. Determination of iron and copper in vegetable tanning extracts.
13. Determination of strong alkali in solution.
14. Determination total available strong alkali.
15. Determination of acid /iodine value of oil/fat.
16. Determination of unsaponifiable matter.
17. Determination of chloride content from alkaline liquor.
18. Determination of unknown concentration of dye solution.
19. Determination of thermal response of raw hide/limed pelt/pickled pelt/tanned/Crust leather/ finished leather.
20. Determination of dissolved solid/ suspended solid/total solids from wastewater sample.

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

- Handle with the equipment and apparatus safely and properly
- Familiarize with techniques for the treatment of leather products
- Know the principle and use of machines such as spectrophotometer
- Gain knowledge about chromatographic processes
- Prepare samples for characterizing leather and liquor from different tanning processes
- Investigate heavy metals by various techniques
- Know the process how to analyze iodine value and saponification value
- Investigate chloride, sulphated total ash and so on
- Perform and use pH meter for the estimation of pH
- Determine solubles and insolubles materials from liquor and tanning materials

References:

1. Gary D. Christian- Analytical Chemistry
2. John Kenkel- Analytical Chemistry for Technicians
3. Skoog, Holler and Nieman- Principles of Instrumental Analysis
4. Sharma B. K. - Instrumental Methods of Chemical Analysis
5. Skoog, West and Holler- Fundamental of Analytical Chemistry
6. Browning D. R. - Chromatography
7. Hatakeyama T. and Quinn F.X. - Thermal analysis.
8. Vogel A. I. - Text Book of Quantitative Chemical Analysis
9. Roderick McDonald-Colour Physics for Industry.
10. P.K. Sarker - Analytical Chemistry for Leather Manufacture.
11. Williams D. H. and Ian Fleming- Spectroscopic methods in Organic chemistry.
12. Kalsi P.S. - Spectroscopy of organic compounds.
13. Venkatachalam P.S. - Lecture Notes on Leather.
14. John A. Dean. -Analytical Chemistry Handbook.
15. Dr. Sethi P.D. - High Performance Liquid Chromatography.
16. Banwel l C. N. -Fundamentals of Molecular Spectroscopy.
17. Hamilton, Hamiltoan-Thin Layer Chromatography.
18. Fifield and Haines-Environmental Analytical Chemistry.
19. UNIDO- Tannery and Environment.

20. Chhatwal G .R. - Encyclopedia of Environmental Analysis (vol.1, 2 and3)

LE 305- DYEING AND FINISHING -I

Class per week	Credit	Marks
2	3	Course final Exam: 70, In-course assessment: 25, Class Attendance: 5. Total Class: 45

Introduction to the course: After tanning, most leather is first dyed through completely. This is done in dye stuff (liquid dye like ink for colouration of textiles). For this purpose, the leather is immersed in a dye bath in rotating barrels. The dye has to be fixed and excess colour has to be rinsed out to prevent dye transfer from leather. Aniline dye is a transparent liquid which is absorbed by the leather without forming a coating layer. All absorbent leather types (suede, nubuck and aniline leather) are dyed this way. Top-grained absorbent porous leather is called aniline. But also, most pigmented (with coating layer) leather is first dyed through. Since these dyes are transparent, they can only be used to dye a darker shade. Aniline dye is usually referred to as "aniline colour". Previously, azo dyes were used as aniline paints. However, use of azo dyestuff (coal tar dyestuffs) is no longer allowed as it is harmful to health.
Finishing is a series of processing operations applied to a leather to improve its appearance, handle and functional properties.

Course Objectives: The objectives of this course are

- To eliminate the random element which occurs in dyeing, by applying and understanding of the mechanism of dye fixation, in order to advance dye house process control specified in the 'Recipe'.
- To predict consistent results: in leather dying.
- To match color within agreed tolerances.
- To achieve fastness properties.
- To minimize waste, avoiding re-dyeing, correction dyeing's and multiple shading additions.
- To enhance the suitability of the leather for end use.
- To improve appearance and sale appeal for comport and utility.
- To improve the feel of the leather.

- To cover faults in the original leather.
- To improve using qualities of leather by making it shrinks or crease resistant.
- To import special properties to the leather for special end uses such as waterproofing, flame-proofing etc.
- To learn finishing techniques of different types of leather (shoe upper leather, aniline and semi-aniline leather, finishing of corrected grain leather, upholstery leather, box- side leather, bag leather, bookbinding leather, nubuck leather, patent leather, lining leather, glace kid leather e.t.c).

Course Contents:

Colour and constitution: History, definition and classification of colour and colourants, basic concepts of colour, relation between light and colour. Theory of colour production, colour of inorganic and organic compounds, fluorescence and phosphorescence, chemiluscence.

Primaries and intermediates: Basic chemicals, primaries and intermediates, manufacture of different intermediates from primaries, unit process for primaries and intermediate manufacture.

Dyes: History and development of dyes, nomenclature and classification of dyes, structure of natural and synthetic dyes. Azo dyes**:** Preparation, azo coupling and diazotization, classification, stereoisomerism and tautomerism of azo dyes, reaction mechanism between azo dyes and protein fibre, banned amines in azo dyes, commercial azo dyes and their application. Metal complex dyes-their chemistry, mechanism, toxicity and application. Reactive dye- their chemistry and application. Sulfur and other dyes- their chemistry and application Dyes for the coloration of leather-: purpose, types of dyes used for the coloration of leather, selection of leather dyes, properties of leather dyes, fastness properties of leather dyes, leather dyes in Colour Index

Leather dyeing: Introduction, preparation of chrome and vegetable tanned leather for dyeing, Dyeing of full chrome leather, semi- chrome leather, shoe-upper leather, aniline and semi-aniline leather, clothing leather, gloving leather, garments leather, lining leather, suede leather, chamois leather, full-vegetable shoe upper leather. Factors influencing leather dyeing, levelness, production of deep shade on re-tanned leather, fixation of leather dyes, quality assurance of leather dyeing, dyeing defects and their controls, dyeing auxiliaries, classification- anionic, non-ionic and cationic dyeing auxiliaries, effects of dyeing auxiliaries, limitation of this application.

Leather finishing: Introduction, history of finishing, aim and purpose, classification of leather finishing, requirements of leather finishes, dimensions of the finish as a protecting layer and characteristics of the finish film, formulation of leather finishes, different layers in finish coat.

Leather finishing materials: Introduction, aqueous and non-aqueous finishing materials, different types of finishing materials- Protein, shellac, resin binder, liquid dyestuffs, pigment, plasticizer, preservatives, wetting agents, dispersing agents, defoamers, plate release agents, penetrators, optical brighteners, polishing agents, flow improver, cross-linking agents and hardeners, leveling agents, filling agents, thickeners, matting agents, fluorescent agents, pearlisers, crackle lacquers, silicones, modifiers, slip agents, fixing agents etc.

Theory of leather finishing: Basic concept of coating, preparation of leather surface for finishing, coating of leather, theory of adhesion, theory and mechanism of film formation, gloss and gloss retention, Plasticization of finish film, techniques of leather coating, ironing and embossing during coating, evaluation and control of leather finishing.

Pigments: Definition, objects of pigmentation, properties of pigments, classification, organic and inorganic pigments, different forms of pigments powder and pastes. Evaluation and control of their brilliance, opacity, particle size, resistance to solvent, heat and light and colour matching, application of colour circle for colour matching, pigment dyeing - their advantages and limitation.

Finishing techniques: Finishing of shoe upper leather, aniline and semi-aniline leather, finishing of corrected grain leather, upholstery leather, box- side leather, bag leather, bookbinding leather, nubuck leather, patent leather, lining leather, glace kid leather, hunting leather, shrunken grain leather, water proof leather, novelty and other commercial leather etc. Antique finish, oil pull-up, waxy polishable, two-tone effect finish, burnish finish, grain seeded, screen-printing, roller printing, tie and dye finishing, easy care and patent finishing. Up-gradation of split by finishing.

Learning Outcomes:

The course aims to develop artistic ability within dyeing and finishing through application and experimental examination of the expressive and functional opportunities offered by various technologies. After completing and passing the course, students should be able to:

- Explain the effect of dyes and chemicals on the properties of leather, in both aesthetic and functional terms
- Independently carry out different types of dyeing and processing of leather
- Describe and analyze the effects of dyes on processes and on the environment.
- Apply adequate technologies and materials in relation to production concept.
- Document and reflect on technology in relation to the latest green process.

- Learn finishing techniques of different types of leather (shoe upper leather, aniline and semi-aniline leather, finishing of corrected grain leather, upholstery leather, box- side leather, bag leather, bookbinding leather, nubuck leather, patent leather, lining leather, glace kid leather e.t.c).

References:

1. Charles Hugh Giles-A Laboratory Course in Dyeing.
2. Gohl E.P.G. -Textile Science.
3. Paterson D. -Textile Colour Mixing.
4. Lubs H. A. - The Chemistry of Synthetic Dyes and Pigments.
5. Finer I. L. - Organic Chemistry (vol-1).
6. Kurt Nassau-The Physics and Chemistry of Colour.
7. Venkata Raman K. - The Chemistry of synthetics Dyes. (Vol.1-7)
8. Colour Index (Vol. 1-7).
9. Shenai V. A. - An Introduction to the Chemistry of dyestuffs.
10. Koteswara Rao and Olivannan- Dyeing and Finishing of Leather.
11. Sarkar K.T. - Theory and Practice of Leather Manufacture.
12. Roderick McDonald-Colour Physics for Industry.
13. O'Flaherty, Roddy and Lollar-The Chemistry and Technology of Leather.
14. Allen R.L.M. - Colour Chemistry.
15. Publio Puene, Jose' Valldegeras Jose' Cegera- The Dyeing of Textile Materials.
16. Jone Shone-Cellulosics Dyeing.
17. Shenai V.A. -Technology of Dyeing.
18. Mac Adam D.L. -Colour Measurement.

L.E 306: DYEING AND FINISHING PRACTICAL

Class per week	Credit	Marks
1	2	Continuous assessment : 40, Course final examination 60

Introduction to the course: This course is designed to provide the practical knowledge of leather dying. The course also demonstrates and conducts different tests to identify fastness

properties of dye solution and dyed leather. Moreover various standard operating procedures are practiced to assess the quality of finishing materials and finished leather.

Course Objectives: The objectives of this course are

- To determine dye class from supplied dye sample.
- To predict purity of dye and solid content in commercial leather dyes.
- To test homogeneity and compatibility of leather dyes.
- To perform different fastness properties of dye and dyed leather.
- To enhance the suitability of the leather for end use.
- To cover faults in the original leather.
- To increase the usability of leather by coating or laminating.

Course Objectives:

The learning objectives of this course are

- To understand core concept of thumb tests and laboratory tests for upper, lining, garments and sole leather.
- To introduce the essential knowledge and skill of different tests to assess the quality of different leather and allied materials.
- To familiarize students with different international standard operating procedures.
- To acquaint students with international standard quality parameters
- To make the students competent in the field of quality assessment and leather testing.

Course Contents:

1. Determination of dye class from supplied dye sample.
2. Determination of purity of dye and solid diluent content in commercial leather dyes.
3. Testing of homogeneity of supplied leather dyes.
4. Determination of compatibility of leather dyes.
5. Solubility of Acid/Direct/Basic dyes use for leather coloration at room temperature / 45°C/ 60°C using IUF 201 method.
6. Determination of extinction co-efficient of Acid/Direct/Basic/Metal complex/Sulphur dyes used for leather dyeing.
7. Determination of colour fastness of dye solutions to acids using IUF 202 method.
8. Determination of colour fastness of dye solutions to formaldehyde using IUF 224 method.

9. Determination of stability dye solutions to acids using IUF 203 method.
10. Determination of stability dye solutions to hard water using IUF 205 method.
11. Determination of colour fastness of leather to day light using IUF 401 method.
12. Determination of colour fastness of leather to artificial light (Xenon lamp) using IUF 402 method.
13. Determination of colour fastness of leather to water spotting using IUF 420 method.
14. Determination of wash fastness of dyed crust leather/finished leather.
15. Determination of dry cleaning fastness of clothing leather.
16. Determination of perspiration fastness of garment /clothing leather.
17. Determination of rate of leather dyeing using commercial Acid/Direct/Sulphur dyes.
18. Determination of colour fastness of crocking of dyed/finished leather.
19. Determination of colour fastness of leather to hot ironing.
20. Determination of colour fastness to diffusion into crude rubber crepe using IUF 441.
21. Determination of colour fastness to diffusion into plasticized polyvinyl chloride using IUF 442 method.
22. Determination of fastness to buffing of dyed leather using IUF 454 method.
23. Determination of dry and wet adhesion of a finish coat of the leather using IUF 470 method.

Learning Outcomes:

After completing and passing the course, students should be able to:

- Determine dye class from supplied dye sample.
- Carry out different types of dyeing and processing of leather.
- Describe and analyze the effects of dyes,
- Perform purity of dye and solid content in commercial leather dyes.
- Apply adequate technologies and materials in relation to homogeneity and compatibility of leather dyes.
- Perform different tests for fastness properties of dye and dyed leather.
- Find out the remedy of faults in the original leather.

References:

1. Charles Hugh Giles-A Laboratory Course in Dyeing.
2. Gohl E.P.G. -Textile Science.
3. Paterson D. -Textile Colour Mixing.

4. Lubs H. A. - The Chemistry of Synthetic Dyes and Pigments.
5. Finer I. L. - Organic Chemistry (vol-1).
6. Kurt Nassau-The Physics and Chemistry of Colour.
7. Venkata Raman K. - The Chemistry of synthetics Dyes. (Vol.1-7)
8. Colour Index (Vol. 1-7).
9. Shenai V. A. - An Introduction to the Chemistry of dyestuffs.
10. Koteswara Rao and Olivannan- Dyeing and Finishing of Leather.
11. Sarkar K.T. - Theory and Practice of Leather Manufacture.
12. Roderick McDonald-Colour Physics for Industry.
13. O'Flaherty, Roddy and Lollar-The Chemistry and Technology of Leather.
14. Allen R.L.M. - Colour Chemistry.
15. Publio Puene, Jose' Valldegeras Jose' Cegera- The Dyeing of Textile Materials.
16. Jone Shone-Cellulosics Dyeing.
17. Shenai V.A. -Technology of Dyeing.
18. Mac Adam D.L. -Colour Measurement.

L.E-307: TESTING OF LEATHER AND ALLIED MATERIALS

Class per week	Credit	Marks
2	3	Course final Exam: 70, In-course assessment: 25, Class Attendance: 5. Total Class: 45

Introduction to the course:

This course is designed to provide the basic concept**s** of thumb tests and laboratory tests for upper, lining, garments and sole leather. It also covers the knowledge and skills to assess different properties (strength, comfort and aesthetic appeal) for upper and lining leather, sole, insole and other allied materials. Moreover, different international standard operating procedures are practiced to assess the quality of different shoe upper materials and for complete shoe and safety shoe.

Course Objectives:

The learning objectives of this course are:

- To understand core concept of thumb tests and laboratory tests for upper, lining, garments and sole leather.

- To introduce the essential knowledge and skill of different tests to assess the quality of different leather and allied materials.
- To familiarize students with different international standard operating procedures.
- To acquaint students with international standard quality parameters
- To make the students competent in the field of quality assessment and leather testing.

Course Contents:

Introduction: Object of carrying out physical testing of leather, few popular thumb tests, disadvantages of thumb tests, physical testing methods.

Sampling: Introduction, statistical aspects of the sampling problem, determination of sample size selection of a sampling location, hide to hide variability for various tests, acceptance sampling, collection of sample section of raw hides and skins and leather, sampling positions for full hide and skins, bends or butts, shoulder, belly.

Strength and stretch of leather: Tensile strength and percentage of elongation at break, stitch tearing strength, tearing strength, tongue tearing strength, buckle tear strength, split tear strength, distension and strength of grain by the ball burst test, relationship between different strength, puncture resistance, effect of splitting on strength, area stability, effect of relative humidity, effect of oil content, effect of kind of tannage and method of finishing, measurement of the initial strain energy of leather, temper of leather, resilience properties of leather.

Physical tests: Physical tests essential for leather, footwear and leather products manufacture, principles of different physical tests such as flexing endurance test, vamp flexing, water vapor permeability test, air permeability of leather, dynamic water proof ness test, apparent and real densities, scuffing and abrasive resistance, absorption of water, water penetration, resistance to cracking of grain and crack index, perspiration resistance of leather, leather softness, fogging tendency of leather.

Important physical characteristics of specific types of leather: Upper leather, lining leather, sole leather, clothing leather, upholstery leather, belting leather, hydraulic leather, chamois leather, football leather, book binding leather, glace kid leather, glove leather, Varnished leather, oil-pull up leather, aniline, semi aniline and pigment finished leather, etc.

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 Soling Materials: Apparent and real densities, abrasive resistance, absorption of water by kubelka method, dynamic water proofness test of sole leather, resistance to cracking of grain crack index, why sole leather cracks and how to pervert it, perspiration resistance of leather, how to improve perspiration resistance of leather, Relative porosity. Hydrolysis test, Flexing test (SATRA BATA Ross flex, Bennewart flex) compression set test, adhesion test oil swelling resistance test.

Test for Insole and other accessories: Insole- Flexing Index, Tensile strength and extension at break, scuff resistance, peel strength, Laminar strength, Water uptake, water absorption and desorption. Laces: Breaking strength and elongation at break, Bodkin attachment strength, abrasion resistance, lace to eyelet abrasion test. Velcro: Peel test, shear resistance. Hook, Eyelet's, D-Rings: Attachment in leather, corrosion test, Breaking strength. Buckles: Corrosion test, Tensile strength, strength buckle and strap attachment. Top piece : Top piece attachment strength. Stiffener and Toe puffs : Tear strength, Adhesion strength,

Tests for safety Footwear: Impact resistance of toecap, compression resistance, electrical resistance. Penetration resistance of metal insole. Upper/outsole and sole interlayer bond strength, insulation against heat, insulation against cold, resistance to fuel oil, corrosion resistance of metallic part.

Learning Outcomes:

After completion of this unit the students will able to:

- Understand the basic concept of thumb tests and laboratory tests for shoe upper, bag upper, lining, garments and sole leather.
- Obtain feasible knowledge and skill for different tests of upper leather and other accessories.
- Evaluate different quality parameter of shoe upper, bag upper, lining, garments and sole leather.
- Critically analyze to maintain the world class quality of complete shoe.
- Acquire a comprehensive knowledge in quality testing using international standard operating procedures.

References:

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

LE-308: TESTING OF LEATHER AND ALLIED MATERIALS PRACTICAL

Class per week	Credit	Marks
1	2	Continuous assessment : 40, Course final examination 60

Introduction to the course:

This course is designed to provide the practical knowledge of thumb tests and laboratory tests for upper, lining, garments and sole leather. The course also demonstrate and conducts different tests to assess different properties(strength, comfort and aesthetic appeal) for upper and lining leather, sole, insole and other allied materials. In addition various standard operating procedures are practiced to assess the quality of different shoe upper materials, complete shoe and safety shoe.

Course Objectives:

The learning objectives of this course are :

- To understand basic concept and conduct thumb tests and laboratory tests for upper, lining, garments and sole leather.
- To introduce the essential experimental knowledge and skill of different tests to assess the quality of different leather and allied materials.
- To familiarize students with different practicable international standard operating procedures.
- To acquaint students with realistic international standard quality parameters of shoe upper and lining leather, sole, insole, adhesive and other allied materials.

Course Contents:

1. Determination of Tensile strength and % Elongation at break.
2. Determination of Tear strength/Stitch tear strength/ Tongue tear strength/ Split tear strength.
3. Determination of Distension and strength of grain.
4. Determination of Flexing Endurance (Vamp flexing/ Fibreboard flexing/ Stretching and flexing/ Bally flexing).
5. Determination of Water vapour permeability of leather.
6. Determination of Water vapour absorption of leather.
7. Determination of Resistance to water penetration.
8. Determination of % of shrinkage at 100^0C and Shrinkage temperature.
9. Determination of Scuff resistance of leather.
10. Determination of Colour fastness to circular rubbing.
11. Determination of Apparent density of leather.
12. Determination of Abraqsion resistance of sole leather.
13. Determination of Water absorption and % of Swelling.
14. Determination of Resistance to bending.
15. Determination of Adhesion of finish using Deadweight/ Creep method.
16. Determination of Heat resistance of finish film.
17. Determination of Light fastness of finish film.
18. Determination of Break/ Pipiness/ Wrinkle.
19. Determination of Electric conductivity.
20. Determination of Stiffness/ Shape retention/ Seam durability of leather.

Learning Outcomes:

After completion of this unit the students will able to:

- Identify the quality of upper and lining leather, sole, insole, adhesive and other allied materials.
- Conduct different tests according to different International SOP for upper leather, lining leather, sole and insole materials, other allied materials.
- Carry out different colour fastness tests according to different International SOP for different types of upper and lining leather.

- Evaluate different quality parameter of shoe upper, bag upper, lining, garments and sole leather.
- Critically analyse to maintain the world class quality of complete shoe
- Carry out different tests according to different international SOP for casual, safety, sports and ladies shoes.
- Acquire a comprehensive knowledge in quality testing using international standard operating procedures.

References:

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

LE-309: MICROBIOLOGY AND BIOTECHNOLOGY IN LEATHER MANUFACTURE

Class per week	Credit	Marks
2	3	Course final Exam: 70, In-course assessment: 25, Class Attendance: 5. Total Class: 45

Introduction to the course:

This course is designed to provide the basic concepts of histological techniques used for studying the internal structure of hides, skins, and leather. It also covers the knowledge of bacteriology, mycology, biocides, fungicides and insecticides. This course is also containing the enzymology. Moreover, different microbial fermentation methods, control of undesirable microorganisms, different methods of sterilization are incorporate for leather manufacture. Biotechnology is a science that uses the method and process for transformation of natural raw materials into useful

product by the application of living organism in the industrial process. Thus, it is the biology in service to mankind.

Course 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:

Different types of microscopes and their uses.

Histological techniques used for studying the internal structure of hides, skins, and leather: Preparation of specimen for sectioning, free hand sectioning, paraffin embedding method, freezing method, staining techniques - stock solutions for staining, methods for staining, mounting techniques, quick test for defect identification.

Bacteriology: History and development, bacteria and its morphology, functions of bacteria, biological needs of bacteria, nomenclature, classification, structure, nutritional requirements, growth of an organism in a medium., differentiation and classification of bacteria, infection and immunity, dissociation and association of bacteria, staining of bacteria with ordinary staining, different staining, gram staining method, acid fast staining, special staining.

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, bio-degradation of biocides, chemistry of bactericides, bacteriology of the leather manufacturing process, bacteriological diseases and defects on hides, skins and leather and their remedy, application of biocides in leather science. **Fungicides-** Definition, classification chemistry of fungicides, copper, mercury fungicidal action of sulfur. **Insecticides-** Definition, classification, chemistry of insecticides, application of insecticides in leather technology, defects of leather due to insect infection and their remedy.

Control of microorganism: General principles of microbial control, control of undesirable microorganisms by physical means, chemical disinfectants and their use.

Sterilization: Sterilization and its kinds, sterilization by heat, steam sterilization, autoclave, cause of sterilization failure, sterilization by chemicals, sterilization by physical methods, pasteurization, merits and demerits of different methods of sterilization.

Microbial fermentation: Microbial fermentation methods, types of fermentations, fermentation equipments, preparation of media, preparation of inoculums, separation and purification of products.

Enzymology: Introduction, classification of enzymes, factor that influence enzyme action, source and uses of enzymes, enzyme in leather industry. Microbial cells in leather and allied industries. Principle of industrial enzymology, enzyme activity, fermentation -source of

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

References:

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.
11. Roger Y. Stanier [et al] — General Microbiology.
12. I. Edward Alcamo — Fundamentals of Microbiology.
13. A. L. Smith — Principles of Microbiology.
14. M. Frobisher — Fundamentals of Microbiology.
15. G. Virella — Microbiology and Infectious Diseases.
16. 16. G. R. Chhatwal - Text book of Biotechnology.

LE-310: MICROBIOLOGY AND BIOTECHNOLOGY IN LEATHER MANUFACTURE PRACTICAL

Class per week	Credit	Marks
1	2	Continuous assessment : 40, Course final examination 60

Introduction to the course:

This course is designed to provide practical knowledge of histological techniques used for studying the internal structure of hides, skins, and leather. It also covers the knowledge of Microscopic study of leather defects due to moulds/ insect/bacteria/fungi. This course is also containing the counting methods of bacteria in raw hides and skins, tape water, drain water, soak liquor, bate liquor and tannery drain liquor. Moreover, different isolation and identification methods of moulds in pelts, wet-blue, vegetable tanned leather, finished leathers, stored leather, shoe and leather goods are incorporate.

Course 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.

References:

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.
11. Roger Y. Stanier [et al] — General Microbiology.
12. I. Edward Alcamo — Fundamentals of Microbiology.
13. A. L. Smith — Principles of Microbiology.

14. M. Frobisher — Fundamentals of Microbiology.
15. G. Virella — Microbiology and Infectious Diseases.
16. 16. G. R. Chhatwal - Text book of Biotechnology.

LE-311: FOOTWEAR TECHNOLOGY

Class per week	Credit	Marks
2	3	Course final Exam: 70, In-course assessment: 25, Class Attendance: 5. Total Class: 45

Introduction to the course:

Footwear Technology is a vital course for leather engineers as footwear is an important leather product. This course is related to foot anatomy, different types and styles of footwear, last, different methods of manufacturing, sizing systems, sequence of operations for different constructions, special types of footwear making etc.

Course Objectives:

The learning objectives of this course are :

- To learn about the anatomy of human foot and its importance for the body.
- To know the functions of foot and footwear.
- To learn different types and styles of footwear.
- To know about foot problems.
- To learn manufacturing sequences of footwear.
- To know about the machines required for footwear manufacturing.
- To learn most commonly used shoe sizing systems in the world.
- To gather knowledge of different types of upper and lining materials of footwear.
- To get overall idea about foot, last and footwear.

Course Contents:

Foot and Last: Foot, anatomy of human feet, foot comfort, foot care and their relationship to footwear, common defects of foot and their remedy; Last, different types of last, last specification, relationship between foot and last, design, pattern making, concept of design and pattern making, 2D-3D concept, marking.

Cutting: Introduction, qualities required for clicker, materials, characteristics and variations in leather, methods of cutting, leather measurement systems.

Closing: Introduction, preparation, top line and edge treatments, stitch formations, type of seam, finishing off, punching, eyeleting and perforation.

Lasting: Definition, principle of lasting operation, different techniques of lasting, shape retention, sole, heel and top-piece attaching techniques.

Lasting and making: The need of machine lasting, upper preparation for machine lasting, adjustment of machine, machine parts and function and its parameters setting, problems finding in machine lasting and remedies, detail controlling of forepart, seat and side lasting operation for different types footwear, lasting procedure for flat lasted, force lasted, string lasted, veldtschoen, slip lasted, strobel constructed footwear. Operational sequence in lasting line for oxford, derby, Moccasin, Slipper, Mule, boot, sports shoe, court shoe, monk shoe, sandal.

Moulding Technique: Injection Moulding (Direct), Direct Vulcanizing, Casting (Direct) direct moulded footwear construction stitch down, veldtschoen method, turnshoe and little way method, machine welted construction, Californian slip lasted construction.

Specific types of footwear: Safety footwear- purpose of safety footwear, required standards for safety, protective and occupational footwear and application field of safety footwear, construction and operational procedure of safety footwear. Welted footwear- General features of welted footwear, preparation of insole, position of lip in relation to insole edge, preparation of uppers, last for welted footwear, attachment of welt and sole for making welted footwear. Sports footwear- The need of footwear for sports, special features of sports footwear for specific sports, types of sports footwear, fitting of footwear. Orthopedic footwear, Turn shoe.

Shoe room and finishing: The aims and objects of finishing and their utility, the relation between heel pairing and heel scouring, edge trimming and setting, characteristics of bottom finishes, edge and heel finishes, upper leather dressing, cleaning and shoe lacing, heel attaching and top piece attaching by hand and machine, different types of edge trimming, forepart and waist trimming, heel scouring, heel front buffing, bottom finishing, upper leather cleaning and dressing, fitting the sock, shoe lacing, various tools, equipments and machinery employed for finishing, their use and general maintenance, inspection, recognition and elimination of faults.

Learning Outcomes:

After completion of this course students will be able to:

- Learn about the structure of human foot, last and footwear.
- Introduce the necessity and objectives of foot and footwear.

- Classify footwear based on materials, purposes, styles etc.
- Introduce the sequence of operations for different shoe construction.
- Gather knowledge about different footwear materials (both upper and lining).
- Acquire idea about different shoe sizing systems.
- Get overall knowledge about footwear manufacturing.

References:

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. SATRA Bulletin
6. Spencer Crookenden -K Shoes -The first 150 years 1842-1992
7. Ruth Thomson -Making Shoes
8. Swayam Siddha -Product Knowledge
9. Swayam Siddha -The Skill of Seam Reducing
10. Thornton J. H. -Text Book of Footwear Materials
11. D.R. Davidsohn J. and Davidsohn A. - Polishes - Their Raw Materials and Manufacture
12. Martin M. Shoben and Janet P.Ward-Pattern Cutting And Making Up
13. Xenia Ley Parker -Working With Leather
14. Anne and Jane Cope-Leather work
15. Lehrmittel. Nourney -Clothing Technology
16. Swayam Siddha-The Art of Cutting Kid and Goat Skin
17. Roseaman I. P. -Leather Work

LE-312: FOOTWEAR TECHNOLOGY PRACTICAL

Class per week	Credit	Marks
2	4	Continuous assessment : 40, Course final examination 60

Introduction to the courses:

This course is related to identification of different parts of foot from skeleton and model, identification of basic styles of footwear, parts identification for every style of footwear, foot

measurement, tools and machines used in footwear manufacturing, designing and manufacturing of basic styles of footwear etc.

Course Objectives:

The learning objectives of this course are :

- To identify foot composition from skeleton.
- To identify basic styles of footwear.
- To identify different parts for every style of footwear.
- To know the tools and machines used in footwear manufacturing.
- To design and pattern making of a complete set of footwear.
- To manufacture a complete footwear.

Course Contents:

1) Identification of shoes, identification of parts and components of shoes.
2) Foot measurement and foot impression taking techniques.
3) Identification of bones, nerves, muscles from skeleton and model.
4) Handling and introduction of working tools of footwear.
5) Mean forme-making technique, dead forme, standard making.
6) Working pattern making technique
7) Sandal making: Toe peg, toe band, v-strap, instep- band, crossed bands, multi-straps.
8) Attachment of straps of sole.
9) Baby shoe making, slipper making, fancy ladies sandal making
10) Sandal making – Toe peg, Toe band, V-strap, instep-band, Crossed bands, multi-straps.
11) Men's Shoe making- Oxford shoe, Gibson/Derby shoe, Brogue shoe, Monk shoe, Army boot, Riding boot, orthopedic shoe, miner's boot, moccasin, Slippers.
12) Women's Shoe Making- Fancy shoes, Court shoe, Mule, Bar Shoe, Tie Shoe, Ankle Strap, Sling- back.

Learning Outcomes:

The learners will be able:

- Understand about the structure of human foot, last and footwear.
- Know the necessity of foot and footwear.
- Learn to classify footwear based on materials, purposes, styles etc.
- Proficient about the manufacturing sequence.

- Possess the skills to identify different footwear materials (both upper and lining).
- Gather idea about different shoe sizing systems.
- Develop design and pattern making for specific style of footwear.
- Get overall knowledge about footwear manufacturing according to proper size and fit.

LE-313: INDUSTRIAL AND PRODUCTION ENGINEERING FOR LEATHER MANUFACTURE

Class per week	Credit	Marks
2	3	Course final Exam: 70, In-course assessment: 25, Class Attendance: 5. Total Class: 45

Introduction to the course:

This course is a combination of Industrial Engineering and Production Engineering. It is also a Manufacturing course which gives idea on Metal casting, Bulk deformation process, Sheet metal work, Material removal process, Leather Manufacturing machines and their maintenance, Standardization, etc.

Course Objectives: Students have to get the idea on:

- Metal casting, Bulk deformation process, Sheet metal work, Material removal process,
- Leather Manufacturing machines and their maintenance, Standardization, etc.

Course Contents:

Metal casting processes: casting processes for ferrous and non-ferrous metals; sand, die, centrifugal, slush, plaster mold, loam mold, precision investment casting etc. casting defects, design of moulds, riser, gate sprue and core, cost analysis, metals for casting, product design considerations.

Bulk deformation processes in metal working: rolling and other deformation processes related to rolling, forging and other deformation processes related to forging, extrusion and other deformation processes related to extrusion, wire and bar drawing.

Sheet metal working: cutting operations, bending operations, drawing, other sheet metal forming operations, deep drawing, dies and presses for sheet metal processes, sheet metal operation not for performed on presses, bending of tube stock.

Material removal processes: single point cutting tool, chip formation in metal machining, types of chips, various operations performed on turning, milling, drilling, shaping, grinding, broaching etc., cutting tool materials and cutting fluids, tool wear and tool life, economics of machining.

Leather Manufacturing Machines and their Maintenance: Cutting section; Hand-Operated leather cutting machine, hydraulic clicking press, traveling head/sewing arm cutting machine. Leather splitting machine, stamping and numbering machine for lining, strap cutting machine, cutting plotter, drawing plotter, cutting knife production unit, stitch marking machine. Sewing section: skiving machine, liner edge folding machine, use of various types of sewing machine for leather products manufacture, zigzag sewing machine, cylinder bed sewing machine for bag profiling and wallets, flat bed single and double sewing machine, post bed single and double needle sewing machine, ornamental sewing machine, light sewing and heavy duty sewing machine, button stitch machine, seam rubbing and taping machine, thread burner, upper leather perforating machine, eyeleting machine, punching and riveting machine, binding machine. Closing section: binding machine, belt-finishing machine, belt-folding marking machine, embossing machine, trimming machine, edge coloring machine, edge polishing machine, fusing machine, buffing machine, ironing machine, spiral cutting machine, leather and plastic auto-weaving machine, humidifier.

Standardization: Introduction, product simplification and diversification, interchangeability, selective assembly, principles, preparation of standards, application of standards in design and manufacturing, applying for patents, international and national standard organization.

Learning Outcomes:

From learning this course the students can understand the

- Metal casting, Bulk deformation process, Sheet metal work, Material removal process, Leather Manufacturing machines and their maintenance, Standardization, etc.

Reference:

1. Production Technology- R.K. Jain
2. Production Process- Degarmo
3. Production Process- Dole
4. Manufacturing Process-Kalpakjain

LE-315: MANAGERIAL ECONOMICS

Class per week	Credit	Marks
2	3	Course final Exam: 70, In-course assessment: 25, Class Attendance: 5. Total Class: 45

Introduction to the course:

Understanding the economic environment is essential for the successful management of virtually any business activity ranging from placement to production and marketing decisions. Indeed, making decisions is what management is all about. However, making the right decision is the biggest challenge any manager faces. Markets are fickle, and competition can be intense, leaving managers faced with a wide variety of information and choices that need to be acted upon. Managerial Economics can help students with structuring these difficult decisions by giving them the adequate tools. Managerial Economics provides a conceptual framework for understanding the economic forces at work in firms and markets and supplies models and tools for improving managerial decision making.

Course Objectives:

This course aims to make the participant familiar with the language and methods of economic analysis while emphasizing issues of practical relevance in business management. The students will not only learn how supply and demand effect prices, or the fundamentals of differentiation in a firm's strategy, but also will be able to improve their decision-making processes, at a strategic level within the organization.

- List the different goals and constraints that firms face.
- Apply the economic way of thinking to individual decisions and business decisions.
- Use calculus (first and second order derivatives) to solve for an optimum solution.
- Understand how prices get determined in markets, how market participants benefit in the form of consumer surplus and producer surplus, and what are the consequences of government intervention.
- Measure the responsiveness of consumers' demand to changes in the price of a good or service, the price of other goods and services, and income
- Understand the different costs of production and how they affect short and long run decisions.
- Derive the equilibrium conditions for cost minimization and profit maximization.

- Understand economies of scale, diseconomies of scale, economies of scope, and cost complementarities, and how each affects the cost of production.
- Explain the principal-agent problem and why different forms of compensation exist.
- Understand the four basic market models of perfect competition, monopoly, monopolistic competition, and oligopoly, and how price and quantity are determined in each model.
- Understand how game theory can be used to explain several business decisions.
- Explain four different pricing practices such as discrimination, two-part pricing, block pricing, commodity bundling, transfer pricing, and peak load pricing.
- Understand why there is a role for the government to play in market economies.

Course Contents:

Managerial economics: Introduction to macro and micro, nature and scope, theories and constructions, firm goals, firm size, location of firm, fundamental concepts and techniques for business decisions.

Demand and supply analysis: Meanings, laws, exceptions, types, determinants and elasticity of demand and supply, demand forecasting for consumer durable like leather, theory of production and supply.

Determination of Prices and Profits under different market conditions: Perfect competition, monopoly and oligopoly costs of production and distribution, pricing practices with special reference to leather, decision making under risk and uncertainty.

Market economy: Meaning, features, markets and prices, operation, dominance of developed countries, impact on developing countries, impact on the economy and industrialization process of Bangladesh.

Monetary policy: Fiscal policy, inflation, devaluation, budgets of Bangladesh, monetary policy for export oriented industries-specially for leather, footwear, leather products, hand- gloves, leather garments, horns and hooves and other by-products based industries, matching grant funds and other special funds for leather, footwear and leather products industries, incentives and other financial supports for leather, footwear and leather products sectors.

Documentation for international business: Up to date govt. documents: export-import policy, monetary policy, duty on import and export, L/C opening, clearing and forwarding, shipment, value added tax (VAT), tariff and non-tariff barriers etc.

Plant and Production costing: Selection of machines, cost involved in production system, machine depreciation, material costing, costing for individual item, competitiveness, local and

international market price, labor and manpower cost, other overhead cost, cost involved in export/import of goods, gross profit and net profit, break-even point. Merchandising.

Learning Outcomes:

After the completion of the course, students will be able to –

- Understand the roles of managers in firms
- Understand the internal and external decisions to be made by managers
- Analyze the demand and supply conditions and assess the position of a company
- Design competition strategies, including costing, pricing, product differentiation, and market environment according to the natures of products and the structures of the markets.
- Analyze real-world business problems with a systematic theoretical framework.
- Make optimal business decisions by integrating the concepts of economics, mathematics and statistics.

References:

1. Benjamin Higgins-Economic Development.
2. Meir and Boldwen- Economic Development.
3. Dwivedi D.N - Managerial Economics, Vikas publishing, India.
4. Export Quality Management, ISO 9000 Quality Management systems,
5. Hyder R. M. - Managerial Economics, Abdullah and Sons, Dhaka.
6. Hossain A. M., Azad G.M., Sibli S.A - Managerial Economics, Dhaka.
7. Kranse- Economic Development
8. Eilis and Buchanon- Approaches to Economic Development.

LE-401: MANUFACTURING TECHNOLOGY OF LEATHER-IV

Class per week	Credit	Marks
2	3	Course final Exam: 70, In-course assessment: 25, Class Attendance: 5. Total Class: 45

Introduction to the course:

This course covers the knowledge, skills and attitudes required to identify and interpret finishing, finishing auxiliaries, manufacturing and trouble shooting of shoe upper, lining, suede and nappa

leather, army boot upper leather, semi-chrome upper leather, glaze kid, chamois, upholstery leather, grain garments leather, book binding leather, vegetable /chrome tanned belting leather, vegetable tanned firm sole leather, hand glove leather, mesh leather, fur skin, reptile leather, picker band and shrunken grain leather.

Course Objectives:

Specific objectives of this course are:

- To familiarize students with the classification of finishing, finishing components.
- To foster an understanding of different types of film forming materials and their application.
- To know the characteristics of finishing film and different layers in finish coat.
- To describe processing steps involved in leather finishing.
- To acquaint the students with nature of polymeric molecules used as film formers, finishing auxiliaries- anti-sticking agents, foaming agent, defoamers, fixing agents, filling agents, modifiers, matting agents, cross linking agents e.t.c.
- To acquaint the students with different machineries involved in leather finishing.
- To enable the students to apply various techniques in making leather.
- To make the students competent in the field of leather manufacturing process of shoe upper, lining, suede and nappa leather, army boot upper leather, semi-chrome upper leather, glaze kid, chamois, upholstery leather, grain garments leather, book binding leather, vegetable /chrome tanned belting leather, vegetable tanned firm sole leather, hand glove leather, mesh leather, fur skin, reptile leather, picker band and shrunken grain leather.
- To provide comprehensive knowledge about the Organization and management of leather manufacturing

Course Contents:

Finishing: Introduction, definition, purpose, classification of finishing, finishing components, preparation of leather before finishing, absorptive quality of leather, spray dyeing before finishing (staining), impregnation of grain surface of leather, theory of adhesion, theory of film formation, different types of film forming materials and their application, characteristics of finishing film, different layers in finish coat, nature of polymeric molecules used as film formers, factors influencing the intermolecular forces of attraction, thermoplastic and cross linking binders, non thermoplastic binders, plasticization and plasticizers.

Finishing auxiliaries: Anti-sticking agents, foaming agent, defoamers, fixing agents, filling agents, modifiers, matting agents, optical brighteners, penetrators, polishing agents, flow improvers, cross linking agents, hardeners, thickeners, plate releasing agent.

Manufacture of shoe upper, lining, suede and nappa leather: Introduction, physical and chemical requirements, detail classification, principles, methodology, detail processing techniques, optimization of process according to requirement, details of variation in processing techniques, optimization of process, utility.

Manufacture of army boot upper leather: Introduction, properties, physical and chemical requirements, principles, methodology detail processing techniques, variation in process according to requirement, uses, details of variation in processing techniques, optimization of process.

Manufacture of semi-chrome upper leather: Introduction, properties, physical and chemical requirements, detail classification of semi chrome upper leather, principles, methodology, details, processing, techniques, variation in process according to requirement, details of variation in processing techniques, optimization of process, utility of semi-chrome leather.

Manufacture of glaze kid, chamois, upholstery leather: Introduction, physical and chemical requirements, details processing techniques, variation in process according to requirement, optimization of process utility, uses.

Manufacture of grain garments leather: Introduction, properties, physical and chemical requirements, details processing techniques, variation in process according to requirement, optimization of process utility of grain garments leather.

Manufacture of book binding leather: Introduction, properties, Physical and chemical requirements, details processing techniques, variation in process according to requirement, optimization of process utility of book binding leather.

Manufacture of vegetable /chrome tanned belting leather: Introduction, properties, Physical and chemical requirements, details processing techniques, variation in process according to requirement, optimization of process utility of vegetable /chrome tanned belting leather.

Manufacture of vegetable tanned firm sole leather: Introduction, properties, principles involved in sole lather making, types of sole leather, physical and chemical requirements, methodology, detail processing technique, variation in process according to requirement, degree of tannage of sole leather, optimization of process, utility of vegetable tanned firm leather.

Manufacture of hand glove leather: Introduction, properties, physical and chemical requirements, details processing techniques, variation in process according to requirement, optimization of process utility of hand glove leather.

Manufacture of mesh leather: Introduction, properties, physical and chemical requirements, details processing techniques, variation in process according to requirement, optimization of process utility of mesh leather.

Manufacture of Football leather: Introduction, types of Football leather, properties, physical and chemical requirements, details processing techniques, variation in process according to requirement, optimization of process utility of Football leather.

Manufacture of fur skin, reptile leather: Introduction, classification of fur skin, properties, Physical and chemical requirements, details processing techniques, variation in process according to requirement, optimization of process, utility.

Manufacture of picker band, shrunken grain leather: Introduction, classification, properties, physical and chemical requirements, principles, methodology, details processing techniques, variation in process according to requirement, optimization of process, utility.

Trouble Shooting: Troubles arising in different stages of operation in Leather manufacture and their remedies.

Learning Outcomes:

After completion of this unit the students will able to:

- Interpret finishing process and finishing components.
- Identify different types of film forming materials and their application.
- Understand different types of finishing auxiliaries and their use.
- Demonstrate different manufacturing process of leather viz. shoe upper, lining, suede and nappa leather, army boot upper leather, semi-chrome upper leather, glaze kid, chamois, upholstery leather, grain garments leather, book binding leather, vegetable /chrome tanned belting leather, vegetable tanned firm sole leather, hand glove leather, mesh leather, fur skin, reptile leather, picker band and shrunken grain leather.

References:

1. Anthony D. Covington- Tanning Chemistry The Science of Leather
2. Dutta S.S.-An introduction to the principles of leather manufacture.
3. Krystof Bienkieuicz - 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.
11. Mclaughlin.George D. - The Chemistry of Leather Manufacture.
12. Gustavson K.H. - The Chemistry of Tanning Processes.
13. John Gerhard - Possible defects in Leather Production.
14. Dey Jyotirmay - Practical Aspect of the Manufacture of Upper Leather.
15. Thorstensen Thomas C. - Practical Leather Technology.
16. Wilson John Arthur-Modern Practice in Leather Manufacture
17. Wilson John Arthur-The chemistry of leather manufacture
18. Journal of the American Leather Chemists Association.
19. Journal of the Society of Leather Technologist and Chemists.
20. World Leather.

LE-402: MANUFACTURING TECHNOLOGY OF LEATHER-IV PRACTICAL

Class per week	Credit	Marks
2	4	Continuous assessment : 40, Course final examination 60

Introduction to the course:

This course covers the practical knowledge, skills and attitudes required to demonstrate leather finishing and perform manufacturing and trouble shooting of various leather viz. shoe upper, lining, suede and nappa leather, army boot upper leather, semi-chrome upper leather, glaze kid, chamois, upholstery leather, grain garments leather, book binding leather, vegetable /chrome tanned belting leather, vegetable tanned firm sole leather, hand glove leather, mesh leather, fur skin, reptile leather, picker band and shrunken grain leather.

Course Objectives:

Specific objectives of this course are:

- To prepare leather before finishing.
- To identify different types of film forming materials and their application.
- To know the characteristics of finishing film and different layers in finish coat.
- To carry out processing steps involved in leather finishing.

- To acquaint the students with different machineries involved in leather finishing.
- To enable the students to apply various techniques in making leather.
- To make the students competent in the field of leather manufacturing process of shoe upper, lining, suede and nappa leather, army boot upper leather, semi-chrome upper leather, glaze kid, chamois, upholstery leather, grain garments leather, book binding leather, vegetable /chrome tanned belting leather, vegetable tanned firm sole leather, hand glove leather, mesh leather, fur skin, reptile leather, picker band and shrunken grain leather.

Course Contents:

1. Manufacture of full chrome/semi chrome/full veg. shoe upper leather.
2. Manufacture of suede/nubuck/nappa/chamoise leather.
3. Manufacture of picker/picking band/belting leather.
4. Manufacture of sole/ insole leather.
5. Manufacture of shrunken/zug-grain leather.
6. Manufacture of book binding leather.
7. Manufacture of garments/clothing/gloving leather.
8. Manufacture of lining leather.
9. Manufacture of football leather.
10. Manufacture of upholstery leather.
11. Manufacture of fur skin.
12. Manufacture of saddle/harness skin leather.
13. Manufacture of glace kid/ corrected grain/aniline finish leather.
14. Manufacture of army boot leather.
15. Manufacture of screen/block/boutique printed leather.
16. Manufacture of industrial and technical leather.

Learning Outcomes:

After completion of this unit the students will able to:

- Demonstrate manufacturing of full chrome/semi chrome/full veg. shoe upper leather.
- Perform manufacturing of picker/picking band/belting leather
- Perform manufacture of suede/nubuck/nappa/chamoise leather.
- Perform manufacturing of sole/ insole leather.
- Perform manufacturing of book binding leather.

- Perform manufacturing of garments/clothing/gloving leather.
- Perform manufacturing lining leather.
- Demonstrate manufacturing of football leather.
- Demonstrate manufacturing of upholstery leather.
- Demonstrate manufacturing of fur skin.
- Demonstrate manufacturing of saddle/harness skin leather.
- Demonstrate manufacturing of glace kid/ corrected grain/aniline finish leather.
- Perform manufacturing of army boot leather.
- Perform manufacturing of screen/block/boutique printed leather.
- Perform manufacturing of industrial and technical leather.

References:

1. Anthony D. Covington- Tanning Chemistry The Science of Leather
2. Dutta S.S.-An introduction to the principles of leather manufacture.
3. Krystof Bienkieuicz - 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.
11. Mclaughlin.George D. - The Chemistry of Leather Manufacture.
12. Gustavson K.H. - The Chemistry of Tanning Processes.
13. John Gerhard - Possible defects in Leather Production.
14. Dey Jyotirmay - Practical Aspect of the Manufacture of Upper Leather.
15. Thorstensen Thomas C. - Practical Leather Technology.
16. Wilson John Arthur-Modern Practice in Leather Manufacture
17. Wilson John Arthur-The chemistry of leather manufacture
18. Journal of the American Leather Chemists Association.
19. Journal of the Society of Leather Technologist and Chemists.
20. World Leather.

LE - 403: ANALYTICAL CHEMISTRY FOR LEATHER MANUFACTURE-II

Class per week	Credit	Marks
2	3	Course final Exam: 70, In-course assessment: 25, Class Attendance: 5. Total Class: 45

Introduction to the Course:

The course gives an introduction to inorganic and organic analytical chemistry, including basic analytical methods and application in leather products.

Course Objectives:

The objectives of this course is to provide:

- An introduction to analytical chemistry for 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, spectroscopic / 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:

Chromatography:

Ion-exchange methods: Introduction, ion-exchange resins, synthetic organic ion-exchangers, use of ion-exchange resins. Anion and cation exchange resins, properties of ion exchange resin, application of ion-exchange resins, ion-exchange chromatography, ion-exchange columns, application of ion exchange chromatography, ion -chromatography.

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.

Spectrometry:

Infrared spectrometry: Principles, instrumentations and applications.

Nuclear magnetic resonance spectrometry: Principles, instrumentations and applications.

Mass spectrometry: Principles, instrumentations and applications.

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

Surface characterization by spectroscopy and microscopy: Introduction to the study of surfaces, spectroscopic surface methods, scanning electron microscopy, scanning probe microscopes, principles involved in the morphological investigation on leather and polymers, imaging techniques for surface applications, ESCA, Auger spectroscopy.

Particle size measurements: Introduction, working principles, qualitative and quantitative information, applications.

Environmental analysis: Introduction, Banned amines, Identification of carcinogenic amine from a mixture of dyes, identification of benzidine-based dye, ***Air pollution in Tannery***-determination of volatile organic compound (VOC), formaldehyde content in finishing area, Total Organic carbon (TOC) analyzer and its application for determining TOC, determination of COD and BOD of tannery effluent, River water etc.

Chemical analysis of leather and related chemicals: Introduction, *Tanning materials*-routine analysis of synthetic tanning materials, analysis of alum tanning agents; formaldehyde.

Analysis of leather- analysis of alum tanned leather; formaldehyde tanned leather. Leather auxiliaries: analysis of sulphated oils: moisture, acid value, soaps, organically combined SO_3 existing as neutralized sulphuric esters and as neutralized sulphonic esters, sodium sulphate, sodium chloride, unsaponifiable matter, qualitative identification of surface active groups, determination of hydoxyproline in materials containing collagen.

Learning Outcomes:

Upon completion of this course the students will be able to

- Introduce analytical chemistry for 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.
- 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.

References:

1. Gary D. Christian- Analytical Chemistry
2. John Kenkel- Analytical Chemistry for Technicians
3. Skoog, Holler and Nieman- Principles of Instrumental Analysis
4. Sharma B. K. - Instrumental Methods of Chemical Analysis
5. Skoog, West and Holler- Fundamental of Analytical Chemistry
6. Browning D. R. - Chromatography
7. Hatakeyama T. and Quinn F.X. - Thermal analysis.
8. Vogel A. I. - Text Book of Quantitative Chemical Analysis
9. Sarker P.K. - Analytical Chemistry for Leather Manufacture.
10. Williams D. H. and Ian Fleming- Spectroscopic methods in Organic chemistry.
11. Kalsi P.S. - Spectroscopy of Organic Compounds.
12. Venkatachalam P.S. - Lecture Notes on Leather.
13. John A. Dean. -Analytical Chemistry Handbook.
14. Dr. Sethi P.D. - HPTLC (High Performance Thin Layer Chromatography).
15. Banwell C. N. - Fundamentals of Molecular Spectroscopy.
16. Hamilton, Hamiltoan-Thin Layer Chromatography.
17. Fifield and Haines-Environmental Analytical Chemistry.
18. UNIDO- Tannery and Environment.
19. Chhatwal G .R. - Encyclopedia of Environmental Analysis (vol.1, 2 and3)
20. Robert L. Grob- Modern Practice of Gas Chromatography
21. Dyer A., Hudson M.J. and Williams P.A. -Progress in Ion Exchange -Advances and applications.

LE-404: ANALYTICAL CHEMISTRY FOR LEATHER MANUFACTURE-II PRACTICAL

Class per week	Credit	Marks
2	2	Continuous assessment : 40, Course final examination 60

Introduction to the Course:

This course is designed to provide the practical knowledge in analytical chemistry, including basic analytical methods and application in leather manufacturing. The course also demonstrate and conducts different tests to determine moisture content /total solids/ total solubles/non-tannin constituents/insolubles/colour/ pH in synthetic tanning materials,pH/ ash content of sulphated oils, unsaponifiable matter of sulphated oils, organically combined SO_3 existing as neutralized sulphuric esters/ sulphonic acid groups, total fat in sulphated oils e.t.c. In addition various standard operating procedures are practiced to determine Chromium (VI) content, Pentachlorophenol, phenolic components, banned amines using UV-VIS spectrophotometer and HPTLC.

Course 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 /total solids/ total solubles/non-tannin constituents/insolubles/colour/ pH in synthetic tanning materials, pH/ ash content of sulphated oils, unsaponifiable matter of sulphated oils, organically combined SO_3 existing as neutralized sulphuric esters/ sulphonic acid groups, total fat in sulphated oils e.t.c.
- To determine bio-chemical oxygen demand (BOD_5) and chemical oxygen demand (COD) of wastewater sample.
- To determine of silicone/zirconium/phosphorus/ aluminum by atomic absorption spectroscopy.
- To acquaint students about Chromium (VI) and Chromium (III) content determination from spent liquor using UV-VIS spectrophotometer.

- To identify phenolic components from leather using High Performance Liquid Chromatography.
- To identify the banned amines from leather using HPTLC.

Course Contents:

1. Determination of moisture content/total solids/ total solubles/non-tannin constituents/insolubles/colour/ pH in synthetic tanning materials.
2. Determination of pH/ ash content of sulphated oils.
3. Determination of unsaponifiable matter of sulphated oils.
4. Determination of organically combined SO_3 existing as neutralized sulphuric esters/ sulphonic acid groups.
5. Determination of total fat in sulphated oils.
6. Test for the identification of surface active agents.
7. Determination of silicone/zirconium/phosphorus/ aluminum by atomic absorption spectroscopy.
8. Determination of hydroxyproline in materials containing collagen.
9. Determination of sulphide in alkaline liquors.
10. Determination of saponification value of oil/fat.
11. Determination of bio-chemical oxygen demand (BOD_5) of wastewater sample.
12. Determination of chemical oxygen demand (COD) of wastewater sample.
13. Determination of thermal behaviour of sole, insole, crust and finished leather.
14. Determination of refractive index of supplied sample.
15. Determination of particle size and shape of supplied pigments.
16. Determination of Chromium (VI) content from spent liquor using UV-VIS spectrophotometer.
17. Determination of Pentachlorophenol using High Performance Liquid Chromatography.
18. Determination of extractable fat content from leather sample
19. Identification of phenolic components from leather using High Performance Liquid Chromatography.
20. Identification of banned amines from leather using HPTLC.
21. Determination of particle size and shape of supplied pigments.
22. Determination of Total Organic Carbon from wastewater sample.

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 /total solids/ total solubles/non-tannin constituents/insolubles/colour/ pH in synthetic tanning materials,pH/ ash content of sulphated oils, unsaponifiable matter of sulphated oils, organically combined SO_3 existing as neutralized sulphuric esters/ sulphonic acid groups, total fat in sulphated oils e.t.c.
- Learn about risk assessment of chemical experiments, important steps and procedures in analytical chemistry, and evaluation/interpretation of results.
- Determine bio-chemical oxygen demand (BOD_5) and chemical oxygen demand (COD) of wastewater sample.
- Determine silicone/ zirconium/ phosphorus/ aluminum by AAS.
- Acquaint students about Chromium (VI) and Chromium (III) content determination from spent liquor using UV-VIS spectrophotometer.
- Identify phenolic components and banned amines from leather using High Performance Liquid Chromatography.

References:

1. Gary D. Christian- Analytical Chemistry
2. John Kenkel- Analytical Chemistry for Technicians
3. Skoog, Holler and Nieman- Principles of Instrumental Analysis
4. Sharma B. K. - Instrumental Methods of Chemical Analysis
5. Skoog, West and Holler- Fundamental of Analytical Chemistry
6. Browning D. R. - Chromatography
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15. Banwell C. N. - Fundamentals of Molecular Spectroscopy.

16. Hamilton, Hamiltoan-Thin Layer Chromatography.
17. Fifield and Haines-Environmental Analytical Chemistry.
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19. Chhatwal G .R. - Encyclopedia of Environmental Analysis (vol.1, 2 and3)
20. Robert L. Grob- Modern Practice of Gas Chromatography
21. Dyer A., Hudson M.J. and Williams P.A. -Progress in Ion Exchange -Advances and applications.

LE - 405: DYEING AND FINISHING –II

Class per week	Credit	Marks
2	3	Course final Exam: 70, In-course assessment: 25, Class Attendance: 5. Total Class: 45

Introduction to the Course:

This course is designed to provide basic concept of behavior of dyes in solution including Fick's law of diffusion, diffusion in the steady state, diffusion in the non-steady state, and boundary layers in diffusion, diffusion in finite baths, dyeing with ionized dyes on substrate without Sites, activation energies of diffusion, factors effecting diffusion ability of dyes in solution. basic analytical methods and application in leather manufacturing. The course also demonstrate the First law and second law of thermodynamics, activity of a dye, standard affinities of dyes for fibres, adsorption isotherms - Freundlich (or classical) adsorption isotherm, Langmuir adsorption isotherm, rate of dyeing. Moreover, basic principles of additive and subtractive colour mixing, colour-match prediction for pigmented materials and formulation of different leather are also included to this course.

Course Objectives:

The learning objectives of this course are :

- To introduce the basic concept of behavior of dyes in solution.
- To learn the essential knowledge of factors affecting dye spectra.
- To acquaint students about Fick's law of diffusion.
- To learn first law and second law of thermodynamics.
- To introduce the adsorption isotherms - Freundlich adsorption isotherm, Langmuir adsorption isotherm, rate of dyeing e.t.c.

- To know the basic principles of additive and subtractive colour mixing, colour speciation system, and colour matching functions.
- To recognize different product families involved in a leather finishing process.
- To develop critical thinking to formulate objectively any type of finished leather.

Course Contents:

Behavior of dyes in solution: Nature of dye solution, effect of concentration, temperature, pH, presence of electrolytes in dye solution, ionic nature of dye solution, poly dispersity of dye in solution, light absorption and dye solution, light absorption and dye concentration, factors affecting dye spectra - solvent effect, effect of pH, concentration, temperature, heating of solution, interfering ions, ionic strength, irradiation, redox potential, dissolution aid, component interaction, hydrolysis, light fading, turbidity, plating, aggregation of dyes in solution, causes of aggregation of dyes in solution, conditions necessary for the formation of aggregates of dyes in solution-one dimensional aggregates (rods), two-dimensional aggregates (discs), three dimensional aggregates (spheres), determination of aggregation number- Nernst-Husckel equation, schematic representation of dye in solution,

Diffusion of dye in solution: Fick's law of diffusion, diffusion in the steady state, diffusion in the non-steady state, and boundary layers in diffusion, diffusion in finite baths, dyeing with ionized dyes on substrate without Sites, activation energies of diffusion, factors effecting diffusibility of dyes in solution, measurement of co-efficient of diffusion, affinity of dyes in solution, determination of affinity in dyeing system, influence of affinity.

Thermodynamics of Dyeing: First law and second law of thermodynamics, activity of a dye, standard affinities of dyes for fibres, surface adsorption, adsorption at dyebath-fibre interfaces, adsorption isotherms - Freundlich (or classical) adsorption isotherm, Langmuir adsorption isotherm, rate of dyeing , dyeing equilibrium, adsorption equilibria, chemical potential, electrical effect of dyeing, chemical affinity of dyeing, , half-time of dyeing, velocity constant of dyeing, heat of dyeing, equilibria and equilibrium state on affinity, entropy of dyeing, enthalpy of dyeing, heat of dyeing.

Light, light sources and light interaction: Light, colour and electromagnetic spectrum, Planckian radiators and colour temperature, day light and CIE standard illuminants, sources of artificial light, properties of artificial light sources, color matching booth and visual color matching.

Interaction of light with matter, light absorption, reflection and colour, light interaction with atoms and molecules, details of different fastness properties.

Colour and vision: Concept of colour, visible spectrum, selective absorption, sensitivity of the retinal cones, colour vision, colour primaries and colour mixing, colour space, colour atlases and colour order systems and details of theories of colour vision, attributes of color, method of investigating the perception of color, discrimination of color attributes, some color appearance phenomena, individual differences in colour vision, test for defective color vision,

Measurement of color: Tristimulus colourimeter, spectrophotometer-specular and diffuse components, monochromatic and polychromatic illumination and fluorescence, reflectance measurement, spectrophotometer light sources, application of transmission spectrometry to dyes, comparing results from different design of spectrophotometer.

Colourmetry, Colour System, Colour Spaces and Colour differences: Basic principles, additive and subtractive colour mixing, colour speciation system, colour matching functions, different colour system, colour order system and colour spaces- Hunter lab and scofield colour space, colour difference and evaluation, metamerism, Kubelka-Munk equation, CMC method of colour matching.

Colour-match prediction for pigmented materials: Introduction, semitransparent layers, partial reflection at air/ coating interface, database calibration of opaque layers, preparation of calibration panels (Paint), database calibration for semitransparent layers, match prediction of an opaque layer, match prediction of a semitransparent layer.

Formulation of leather finishes: Plain finishes, glazing finish, shellac finish, wax finish, media that can be used for pigment finishes, pigment finish of a simple type, pigment finish from dry powdered pigments, concentrated finishes, colourless lacquers for general use, titanium white, zinc oxide castor oil barkite, concentrated white high flash liquor, false grain finish for flesh side of shearling, side leather finish for corrected leathers, finish for glazed lining leather, semi aniline finish for corrected grain sides, clothing and gloving gloss finish, suede leather finishes, patent and wet look leathers, antique finish, gold finish, silver finish, gold kid, etc.

Rheology of coatings: Introduction, rheology, rheological measurements, rheological processes associated with coatings, low VOC coatings- flow problems and solutions.

Physics of film formation: Introduction, thermoplastic coatings, solutions of crosslinking polymers, solventless crosslinking systems, disperse phase systems.

Performance properties of coatings: Introduction, mechanical performance, ageing processes and the retention properties, chemical exposure.

Coatings polymers: Polymeric materials, polymers in coatings, thermoplastic binders, reactive binders, cross linking chemicals, high solid coatings, powder coatings.

Learning Outcomes:

The course aims to develop artistic ability within pretreatment, dying and finishing through application and experimental examination of the expressive and functional opportunities offered by various technologies. After completing and passing the course, students should be able to:

- Develop the basic concept of behavior of dyes in solution and learn the essential knowledge of factors affecting dye spectra.
- Understand Fick's law of diffusion, first law and second law of thermodynamics.
- Introduce the adsorption isotherms - Freundlich adsorption isotherm, Langmuir adsorption isotherm, rate of dyeing e.t.c.
- Know the basic principles of additive and subtractive colour mixing, colour speciation system, and colour matching functions.
- Recognize different product families involved in a finishing process. Know how to mix these products to obtain a set of properties and characteristics that define the finished leather.
- Explain the effect of dyes and chemicals on the properties of leather materials, in both aesthetic and functional terms.
- Develop critical thinking to formulate objectively any type of finished leather.
- To develop critical thinking to formulate objectively any type of finished leather.

References:

1. Charles Hugh Giles-A Laboratory Course in Dyeing.
2. Gohl E.P.G. -Textile Science.
3. Paterson D. -Textile Colour Mixing.
4. Lubs H. A. - The Chemistry of Synthetic Dyes and Pigments.
5. Finer I. L. - Organic Chemistry (vol-1).
6. Kurt Nassau-The Physics and Chemistry of Colour.
7. Venkata Raman K. - The Chemistry of Synthetics Dyes. (Vol.1-7)
8. Colour Index (Vol. 1-7).
9. Shenai V. A. - An Introduction to the Chemistry of dyestuffs.
10. Koteswara Rao and Olivannan- Dyeing and Finishing of Leather.
11. Sarkar K.T. - Theory and Practice of Leather Manufacture.
12. Roderick McDonald-Colour Physics for Industry.
13. O'Flaherty, Roddy and Lollar-The Chemistry and Technology of Leather.
14. Allen R.L.M - Colour Chemistry.

15. Publio Puene, Jose' Valldegeras Jose' Cegera- The Dyeing of Textile Materials.
16. Jone Shone-Cellulosics Dyeing.
17. Shenai V.A. -Technology of Dyeing.
18. Mac Adam D.L. - Colour Measurement-Themes and Variations.

LE-407- POLYMER SCIENCE AND ENGINEERING

Class per week	Credit	Marks
2	3	Course final Exam: 70, In-course assessment: 25, Class Attendance: 5. Total Class: 45

Introduction to the Course:

From the candy wrapper to the artificial heart, polymers touch our lives as does no other class of materials. This course deals with polymers which find technological use as adhesives, fibres, plastics, rubbers as well as upper and lining materials of leather products. Different modes of synthesis of polymers, factors affecting glass transition temperature of polymer, degradation of polymer, polymer processing techniques are included.

Course Objectives:

The objective of this course is to guide the students:

- To learn polymer and macromolecules and synthesis of different types of polymer.
- To identify the characteristics and application of polymer.
- To understand mode of synthesis of polymer and different polymerization techniques.
- To know the causes of polymer degradation.
- To understand different polymerization processing techniques.

Course Contents:

Polymeric materials: Definition and classification of polymers, chemistry and mechanism involved in different polymerization process such as stepwise, addition, ring opening, free radical polymerization, polymerization techniques-Bulk, solution, suspension and emulsion polymerization. Co-polymerization, anionic and cationic polymerizations. Chemistry and Technology involved in - Natural and synthetic rubber, PVC, polystyrene, PU, LDPE and HDPE

polypropylene, EVA, ABS, acrylics, fibre reinforced plastics, poromerics /PVC or PU coated fabrics. Polymeric materials as adhesives and binders.

Macromolecules: Introduction, classification, structure of macromolecules in solid and solution state.

Structure and properties of polymers: Chemical and geometrical structure of polymer molecules, glass transition temperature and related topics of polymers properties, crystallinity in polymers.

Properties of commercial polymers: Introduction, polyamide and related polymers, phenol-formaldehyde polymers, urea-formaldehyde polymers and melamine-formaldehyde polymers, cellulose and related polymers, silicones, epoxies and biopolymers.

Polymers degradation and environmental issues: Introduction, types of degradation, management of plastics in the environment, polymer recycling, incineration, biodegradation, impact on environment of various types of polymers.

Polymers, additives, blends and composites: Additives, plasticizer, filler and reinforcements, other important additives, polymer blends and interpenetrating networks- polymer blend.

Polymers used in leather, footwear and leather products industry: Introduction, important polymers used in leather industry and application in leather processing.

Polymer processing: Basic processing operations, Plastic technology, Fibre technology, Elastomer technology.

Learning Outcomes:

This course will give the students sufficient grounding to:

- Know the characteristics of materials that not only are commercially important but are a part of the everyday experience.
- Understand different additives and their role on polymer blending.
- Learn to synthesis of different polymers.
- Provide knowledge about polymer degradation and impact of various types of polymers on environment.
- Gather idea of different polymer processing technique.

References:

1. Billmeyer F.W. Jr. - Text Book of Polymer Science.
2. Fried J.R. - Polymer Science and Technology.
3. Gowariker V. R. -Polymer Science.

4. Arora M.G. and 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. and Creamer L.K. - Fibrous Proteins: Scientific, Industrial and Medical aspects.
10. Finar I. L. - Organic Chemistry Volume-II
11. Winding C.C. and Hiatt G.D. - Polymeric Materials.
12. Ghosh P. - Polymer Science and Technology of Plastics and Rubbers.
13. Sandler S. R. and Karo W. - Polymer Synthesis.
14. Gustavson-The chemistry and Reactivity of Collagen

LE-408: POLYMER SCIENCE AND ENGINEERING PRACTICAL

Class per week	Credit	Marks
2	2	Continuous assessment : 40, Course final examination 60

Introduction to the Course:

This course provides the students a practical guide to identify different types of polymeric materials, their characterization, viscosity determination, synthesis of different types of polymer etc.

Course Objectives:

This course will make the students skilled about –

- To synthesis of different types of polymer
- To identify different types of polymeric materials and their characterization.
- To determine the viscosity of polymer.
- To understand the application of polymer in leather 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, fibres, rubbers and plastics
- Synthesis of different types of polymer and their characterization
- Apply knowledge to find out the application of polymer in leather manufacturing.
- Determine the viscosity of polymer which is very essential in leather finishing.

LE-409: ENVIRONMENTAL SCIENCE AND POLLUTION CONTROL

Class per week	Credit	Marks
2	3	Course final Exam: 70, In-course assessment: 25, Class Attendance: 5. Total Class: 45

Introduction to the Course:

The course has been designed to improve the understanding of the students primarily about the leather manufacturing unit operations carried out in tanneries, types of tannery wastes, exposure pathways and evaluate their impacts to environmental quality and human health. It aims to

enable students to understand the necessity of installation of pre-treatment and recycling plant for treating the tannery wastes for their reuse or safe disposal to the environment. The course will also be dealing about the sources of pollution in water, air and soil, control strategies and the skills of application of remediation techniques to combat pollution in these three environmental compartments. In addition, the students will be given the training to develop the particular skills required in pollution related structured research.

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.
- Present up to date information and data with regard to existing tanneries/leather manufacturing units in operation, type of tanning processes and chemicals employed, and storage of raw materials.
- Inform about the volume, types of tannery 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 tannery workers and other individuals.
- Offer the fundamentals of tannery effluent treatment processes, and demonstrate the necessity of installation of a pre-treatment and recycling plant based on processes developed locally and internationally and other aspects of environmental pollution and its control.
- Aware about the health and safety policies developed for the tannery workers to reduce the accidents in the tanneries and how to use the emergency facilities in case of a problem.

Course Contents:

Environment and Ecology: Introduction, components of environment, factors affecting environment.

Tannery and Environment: Tanning process and their environmental implications, major process sequences, chemical inputs and wastes -curing of hides and skins, beam house operations, tanning, post tanning activity - wet and mechanical processes, and finishing.

Water pollution: Introduction, definitions of water pollution, sources of water pollution, different types of water pollution and their harmful impacts on ground and surface water, factors

affecting surface water pollution, classification of water pollutants and effects of the various types of pollutants.

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, green house gases and green house 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.

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 tannery 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.

Tannery chemicals and waste generated in different tanning operations: Introduction, brief discussion of different types of chemicals used in leather processing.

Impact of tannery discharge on receiving waters: Introduction, presentation of receiving water and techniques used, results obtained and physico-chemical study, biological study and results obtained, specific analysis of chromium traces.

Pollution due to sulfur, chlorine and nitrogen: Introduction, ecotoxicity of chlorine, nitrogen and sulfur compounds; sulfur, chlorine and nitrogen in tannery effluents, study of effluents and treatment plants, balance in residual baths, tests for demonstrating nitrification.

Ecotoxicology: Introduction, toxic hazards and their control, controls of substance hazardous to health, hazard evaluation, risk assessment and control.

Safety manual on leather processing: Introduction, chemical safety, raw material handling, ranking of chemicals based on their hazard potential, storage instructions for hazardous and other chemicals, use of safety wares or personal protective equipment, upkeep of working and working surfaces.

Treatment technology: General outline of treatment-necessitated processes, types of treatment. Introduction, principle of pre, primary and secondary treatments, screening, settling. Chemical precipitation, removal of grease and oil, sulphide liquors, chromium, solid waste, primary treatment plant**.** Sedimentation tank, trickling filters system, biological fluidized beds. Different types of technologies used for the treatment of tannery wastes, primary and secondary treatment plant tertiary and quaternary treatment of tannery wastes.

Environmental Law and Industrial Pollution: Environmental pollution control, enforcement, monitoring and auditing, technical services government and industry policies, self-regulations by industry.

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 the operation of tanning and leather finishing facilities primarily include 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 tannery wastes for their reuse or safe disposal to the environment.
- Illustrate the safety recommendation and regulations for the workers working in the tanneries.
- Obtain the specific competencies necessary for working as a mentor in a tannery industry.

References:

1. Thierry Chambolle-Environment and Tannery
2. DE A.K. - Environmental chemistry
3. Society of Leather Technologists and 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 and3)

8. Fifield and Haines. -Environmental Analytical Chemistry.
9. Environmental Chemistry-B.K. Sharma and H. Kaur.
10. Roy M. Harrison-Pollution causes, Effects, and Control.
11. Richard J. Watts- Hazardous wastes: Sources, Pathways Receptors.
12. Thierry Chambolle-Environment and Tannery

LE-410: ENVIRONMENTAL SCIENCE AND POLLUTION CONTROL PRACTICAL

Class per week	Credit	Marks
2	2	Continuous assessment : 40, Course final examination 60

Introduction to the Course:

The course has been designed to teach the students to measure the level of water pollution originates mainly from tannery effluents that help to identify trends or changes in water quality parameters. It also enables students to estimate the amount of chemicals that absorb/adsorp on leather during the beamhouse, tanning and post-tanning operations.

Learning Objectives:

The learning objectives of this course are to

- Demonstrate the laboratory techniques used for quantification of various parameters of environmental samples.
- Offer the chance of gaining practical experience of analyzing various leather or environmental samples by titrimetric/spectrophotometric method.
- Impart practical knowledge on separation and quantification of chemicals extracted from leather by thin layer and/or high performance liquid chromatography.

Course Contents:

1. Determination of chloride content in alkaline solution.
2. Test for the identification of surface active groups.
3. Determination of bio-chemical oxygen demand from wastewater sample.
4. Determination of chemical oxygen demand from wastewater sample.
5. Determination of particle size and shape of supplied pigments.

6. Determination of chromium (VI) content from spent liquor using UV-VIS Spectrophotometer
7. Determination of Penta-chlorophenol using High Performance Liquid Chromatography
8. Determination of extractable fat content from leather sample
9. Identification of Phenolic components from leather using High Performance Liquid Chromatography
10. Identification of banned amines from leather using High Performance Thin Layer Chromatography

Learning Outcomes:

Upon completion of this course the students will be able to

- Identify, properly use, and care for equipment and supplies used in analytical laboratory.
- Analyze various leather or environmental samples by titrimetric/spectrophotometric method.
- Design and carry out environment related scientific experiments as well as accurately record, analyze and present the results of these experiments.
- Gain the specific laboratory skills necessary for working as an environmentalist in a research institution.

References:

1. Thierry Chambolle-Environment and Tannery
2. DE A.K. - Environmental chemistry
3. Society of Leather Technologists and 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 and3)
8. Fifield and Haines. -Environmental Analytical Chemistry.
9. Environmental Chemistry-B.K. Sharma and H. Kaur.
10. Roy M. Harrison-Pollution causes, Effects, and Control.
11. Richard J. Watts- Hazardous wastes: Sources, Pathways Receptors.
12. Thierry Chambolle-Environment and Tannery

LE-411: LEATHER-PRODUCTS TECHNOLOGY

Class per week	Credit	Marks
2	3	Course final Exam: 70, In-course assessment: 25, Class Attendance: 5. Total Class: 45

Introduction to the Course:

This course is designed for Manufacturing Technology of Leather Products in obtaining Bachelor of Science in Leather Engineering Degree. This course is about depth knowledge base and to provide adequate professional skills in the area of Leather Goods manufacturing. The course will also equip the students with knowledge and understanding of Production Technology of Leather goods and garments manufacturing which includes knowledge in pattern construction, Designing and styling development and production.

Course Objectives:

Specific objectives of this course are:

- 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:

Introduction of leather products and materials used in its manufacture: Definition, historical background of leather products, classification of leather goods, Materials and components for leather goods and their selection criteria, principles and methods of construction, layout design and styling, standardization of materials, machinery, hand tools and fittings.

Cutting operations for leather products : Automatic cutting, defining cutting operations, Classifying cutting systems for leather goods, manual die cutters, NC die cutters, automatic die cutters, universal die cutters, advantages of automatic die cutting systems, die-less cutting

system, specifications and architecture of cutting systems. advantages of continuous cutting systems. works to be done before cutting, during cutting and after cutting, qualification of a good cutter, pattern placement. cutting norms, wastage determination, types of wastage, principle of hand cutting.

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 and skiving.

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

Pattern making: Concept of pattern making, patterns-copied patterns, commercial patterns, ready-to-wear garments pattern, transferring the patterns, free hand drawing, 3D drawing, 3D-2D concept, allowance, 2D drawing, Basic pattern making techniques for rectangular, conical and base constructions, pattern making for coin purse, pen holder, card holder, ladies hand purse and shoulder bags.

Preparation and joining technique of different components of leather products: Joining techniques, hand stitching and machine stitching, types of stitching, Decorative stitches, preparation of seams, components and accessories, lining, stiffen materials, substitute of leather, edging tools, preparatory process, turning over, visible turnover, curved turnover, creasing, edge marking, roughing, stamping, assembling techniques, reinforcing and binding hide edges, laced hide edges, edge treatment.

Belts: Classification, Materials for belt, tools and equipment for belt manufacture, working order, covered hide belt fastening- buckles, attaching buckle, manufacture of classic waist belt and contour belt.

Wallets: Classification, Materials for wallets, tools and equipment for wallets manufacture, construction, putting the piece together manufacture of bi-fold and tri-fold wallets and passport wallet.

Bags: Classification, Materials for bags, tools and equipment for bags manufacture, Manufacture of ladies hand purse and shoulder bag.

Design techniques for leather garments: Clothing and its function, Development of a collection, fashion and fashion accessories, Materials and components for leather garments and their selection criteria. Machineries for leather garments production elements of cutting, types of cutting, lining cutting, different parts simple jacket, sketches and making up complete industrial pattern, use of body proportions, different types of sleeve, pockets, collar, waist bands, modification to basic block, design and pattern making, basic sewing exercise for components assembly computers in pattern grading and design, different parts of a simple trouser, basic trouser block.

Skirt: Classification, Basic measurements, Designing and pattern making of straight skirt, assembling and stitching of skirt.

Jacket: Classification, Basic measurements, Block making for casual jacket and waist coat, Designing and pattern making of jacket and waist coat, Assembling, stitching and finishing of jacket

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 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.

References:

1. Batsford- Fashion with leather
2. Attwater W.A.-Leather Craft
3. Roland Kilgus- Clothing Technology
4. Moseley G.C. – Leather Goods Manufacture
5. Gerhard John- Possible defects in leather production.
6. Swayam Siddha -Product Knowledge
7. Swayam Siddha -The Skill of Seam Reducing
8. Martin M. Shoben and Janet P.Ward-Pattern Cutting And Making Up

LE-412: LEATHER PRODUCTS TECHNOLOGY PRACTICAL

Class per week	Credit	Marks
2	4	Continuous assessment : 40, Course final examination 60

Introduction to the Course:

This course is designed for Manufacturing Technology of Leather Products in obtaining Bachelor of Science in Leather Engineering Degree. It contains details about the Leather products manufacture through cutting, Pre assembling, assembling, bench operations, sewing and finishing operations. Then it contains the topics for getting the details idea about specific types of leather products such as ladies bags, purse, gent's executive bags. Leather garments, skirts, gloves. The course will also equip the students with knowledge and understanding of Production Technology of Leather goods and garments manufacturing which includes knowledge in pattern construction, Designing and styling development and production.

Course 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:

Leather Products: (Practical)

1. Introduction of tools and their uses and tooling technique.
2. Introduction of pattern cutting technique, consideration of allowance, lining construction, working pattern making.
3. Assembly of pleated pocket and flap, Gusset pocket, assembly of gusset pocket and flap, piping pocket, false pocket. Conical shape pattern making.

4. Card holder making, Key ring making.
5. Money Bang Making, Passport case Making
6. Skirt manufacture
7. Waist coat manufacture making.
8. Ladies bag making
9. Document case Making
10. Belts making

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.

LE-413: PRODUCTION PLANNING AND QUALITY CONTROL

Class per week	Credit	Marks
2	3	Course final Exam: 70, In-course assessment: 25, Class Attendance: 5. Total Class: 45

Introduction to the course:

This course covers the knowledge, skills and attitude required about the concept, models, issues, and concerns in quality planning, quality control and total quality management. It also provide update knowledge of current practices in material handling, inventory management and control, production engineering design, development and management to sustain in the competitive market.

Course Objectives:

The objective of this course is:

- To understand and interpret the knowledge and skill about the production planning and quality control.
- To learn about different productivity improvement technique for leather manufacturing.
- To familiarize quality assurance system in leather manufacturing.

- To introduce the quality management systems (ISO-9000 series) and Environmental management systems (ISO 14000 series).
- To know overall idea of quality control for different stages in leather manufacturing.

Course Contents:

Introduction: Concept of production system, scope and importance of production, elements of production, production planning, determination of factors of production and their control.

Plant Layout: Types of plant layout-production, process layout, activities and layout design, departmental space requirements, departmental arrangement.

Materials handling: Classification of material handling system, objectives of material handling, description and design of belt, chain conveyors, handling of raw hides and skins, handling of wet-blue, crust and finished leather, handling of leather chemicals, packaging and shipment.

Inventory management: Types of inventory control, inventory costs and control, classification of stocks-raw hides and skins stock, wet-blue stock, crust and finished stock, stock-in-process, safety-stock, out of stock, lead-time, reorder point, economic order quantity (EOQ), inventory models under certainty, inventory control under risk.

Resource scheduling: Introduction, objectives, scheduling and sequencing, Gantt chart, 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.

Sales forecasting*:* Introduction, purpose of sales forecasting, methods of sales forecasting, time series analysis of sales forecasting, forecasting for new products, co-ordination between sales, manufacturing and purchase departments

Productivity concept:

Introduction, productivity of materials, land, building, machine and manpower, factors contributing to productivity improvement. Techniques for productivity improvement:

Introduction, work content and ineffective time, productivity improvement by reducing work content, productivity improvement by reducing ineffective time, management of productivity. Work study: Introduction, basic procedure, prerequisites of conducting a work study, human factors, the influence of working condition, Ergonomics. Method study and Work measurement improvement, parameters for fitness for use.

Quality policies and objectives: Need for quality policies, corporate quality policies, quality policies for specific parameters and formulation o

Quality: Definition of quality and quality control, important terminology used in quality control, quality function, quality planning and f quality policies, quality objectives, zero defects.

Total quality management (TQM): Total quality management concept, internalization of quality, customer driven quality activity, system development for TQM, ideal TQM system, application of TQM on leather industry.

Standards for leather testing: International Standards, national standards, Testing of leather, Testing of lining leather, Testing other products components,

Quality control for different stages of leather manufacturing: Quality control in soaking, liming, deliming, bating, pickling, tanning, retanning, fat liquoring and dyeing and finishing-spraying, ironing, polishing, handing, storage, preservation, packaging and delivery.

Recommended quality requirements: For leathers or non-leather materials, cotton lining materials, other hidden quality requirement.

Health and safety in leather products manufacture: Hazards and potential accidents, safety measures.

Quality assurance in leather products manufacture: Quality assurance, quality control, raw materials, design department, production planning and control in cutting department, during preparation for sewing, in the sewing room, intermediate inspection, final inspection, cost of quality, cost of conformance, cost of non-conformance.

Quality management systems: Perceptions of quality, development of ISO-9000 series, content and application field of ISO-9000-9004 series.

Environmental management systems: Introduction, ISO 14000 series: structure of the ISO 14001 standard, occupational health hazards and industries, environmental impact assessment (EIA) and audit, environmental audit (EA), environmental management plan.

Learning Outcomes:

After completion of this unit the Students will able to:

- Discuss current concept and theoretical models, issues, and concerns in quality planning, quality control and total quality management.
- Describe current practices in material handling, inventory management and control.
- Evaluate existing method and production layout and apply the general problem solving process and tools to improve productivity in leather processing industry.
- Work effectively in small groups through well-developed problem solving skills and be able to organize the group to optimize performance and results.

- Possess the skills in production engineering design, development and management to sustain in the competitive market.
- Understand ISO 9000 and ISO 14000 series issues and impact on the organization.

References:

1. European Organization of Quality Control; Glossary of Terms Used in Quality Control. Berne, Switzerland.
2. Juran J.M, Gryna F.M - Juran's Quality Control Hand Book. McGraw-Hill Book Company.
3. Ott ; Process Quality Control.. McGraw-Hill Book Company.
4. Taylor - Quality Control Systems. McGraw-Hill Book Company.
5. Juran J. M.- Juran on Planning for Quality. The Free Press, New York.
6. UNIDO, Acceptable Quality standards in the Leather and Footwear Industry.
7. Roland Kilgus - Clothing Technology

LE-415: ENTREPRENEURSHIP AND BUSINESS DEVELOPMENT

Class per week	Credit	Marks
2	3	Course final Exam: 70, In-course assessment: 25, Class Attendance: 5. Total Class: 45

Introduction to the course:

The course is about entrepreneurship and entrepreneurial business development. Entrepreneurship is the act of being an entrepreneur or one who undertakes innovations, finance and business acumen in an effort to transform innovations into economic goods. This may result in new organizations or may be part of revitalizing mature organizations in response to a perceived opportunity. The most obvious form of entrepreneurship is that of starting new businesses (referred as a startup strategy); however, in recent years, the term has been extended to include social and political forms of entrepreneurial activity. When entrepreneurship is describing activities within a firm or large organization it is referred to as intra-preneurship and may include corporate venturing, when large entities spin-off organizations. Entrepreneurship is

generally synonymous with resourcefulness, ingenuity, and the ability to take calculated risks in order to introduce a new, untested product or service into the marketplace.

Course Objectives:

- To give an overview of fundamental issues, concept, principles, functions, objectives, modus operandi of entrepreneurship and business development.
- To facilitate acquiring necessary knowledge and skills required for organizing and carrying out entrepreneurial activities.
- To develop the ability of analyzing and understanding business situations in which entrepreneurs act
- To help master the knowledge necessary to plan entrepreneurial activities.
- To develop the ability of analyzing various aspects of entrepreneurship especially of taking over the risk, and the specificities as well as the pattern of entrepreneurship development
- To contribute to their entrepreneurial and managerial potentials.

Course Contents:

Business: Meaning, element, characteristics, function, importance, advantages, relation with economics.

Entrepreneurs: Meaning, function, qualities, factors, role of business entrepreneurs

Business method and Business organization: Meaning, importance, distinction, types, principles, evolution, factors influence.

Sole proprietorship business: Meaning, features, advantages, importance, fields suitable for sole proprietorship business

Partnership business: Meaning, element, advantages, disadvantages, contents of Partnership deed, power of Partner, reconstruction of Partnership business, difference between sole trade ship and Partnership business.

Joint Stock Company: Meaning, characteristics, advantages, disadvantages, difference between JSC and Partnership business, classification of JSC and Private and public limited company.

Export Management: Meaning, Function, Principles, Factors, types, Leather export: Introduction-A profile of industry- Leather manufacture; basic steps in leather making-Grading – quality control- Animal and tannery by-products-Leather products- Technical aspects of footwear manufacture- Garment construction- Machinery- Role of council for Leather Exports-Schemes for Government for leather Exports; Medium term export Strategy for 2002-2007;

EPCG schemes; Duty exemption schemes; Duty remission schemes etc.- Schedule of rates under duty entitlement Pass book scheme and draw back.

Learning Outcomes:

- Students will be able to sell themselves and their ideas. They will master oral and visual presentation skills and establish a foundation of confidence in the skills necessary to cause others to act.
- They will be able to find problems worth solving and advance their skills in customer development, customer validation, competitive analysis, and iteration while utilizing design thinking and process tools to evaluate in real-world problems and projects.
- They will be able to mobilize people and resources and identify and secure customers, stakeholders, and team members through networks, primary customer research, and competitive and industry analyses in order to prioritize and pursue an initial target market in real-world projects.
- Students will be able to create value and to create presentations and business plans that articulate and apply financial, operational, organizational, market, and sales knowledge to identify paths to value creation through 1) company formation (for-profit); 2) social innovation (nonprofit); or 3) intellectual property licensing.
- They will develop and cultivate endurance and increase their awareness and deliberately practice the skills and disciplines necessary to increase confidence and agency; foster self-efficacy and self-advocacy; improve communication and problem-solving skills, manage strong impulses and feelings; and identify personal purpose.

Reference:

1. Business systems and commercial letter- Md. Khalekhuzaman
2. W. H. Newman – Business Policies Management.
3. I. B Ghosh – Business organization, A. Mukherjess Co.
4. M. C. Shukla – Business organization and Management.

LE-416: PROJECT WORK AND SEMINAR

Credit: 2	Project Work: 75 Seminar: 25

Project and Seminar:

Each student is required to submit a report on the project assigned to him/her by the department. Prior to the submission of the project report, each student should present a seminar based on the work done.

Course Objectives: The objective of this course is:

- To help students to develop research skills and competencies.
- To acquaint them with contemporary real life aspects of Leather Products Engineering.
- To improve the effectiveness of their independent research work, which is required for the successful completion of the degree.

Learning Outcomes:

After completion of this unit the Students will able to:

- Professional orientation of students to help them choose the field and topic of their field.
- Poses academic skills, including preparing and conducting project in the field of Leather Products Manufacturing.
- Gather knowledge systematize and process information and prepare analytic reports and documents.
- Acquaint students with the standard workflow.
- Able to write and publish papers and articles.

LE-418: INDUSTRIAL TRAINING

Credit:2	Marks: 50 Duration -2 months

Introduction to the course:

Industrial Training refers to practical contact with and observation of facts or events during the program of study that is relevant to professional or practical development prior to the completion of the theoretical courses. In this course student will go to the leather processing industry for two months training at any suitable time of 4th year based on the availability of the industry located in the suitable area of the country.

Course Objectives:

The learning objectives of this course are:

- To prepare students for future employment in their chosen industrial discipline.
- To boost up the practical knowledge by experiencing the theoretical knowledge into practical perspective.
- To develop understanding of the functioning and organization of a industrial process.
- To permit students to practice what they have learned.
- To learn problem solving process for sustainable development.

Learning Outcomes:

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

- Demonstrate and apply practical knowledge of basic leather products designing, including pattern making and product manufacturing.
- Understand the concepts of industrial process.
- Possess the skills in problem solving process.
- Analyze and evaluate the existing production layout.
- Use the techniques, skills, and modern engineering and Management tools necessary for leather products engineering.
- Work effectively in small groups through well-developed problem solving skills and be able to organize the group to optimize performance and results.
- Adopt a factual approach for decision making.

LE-420: COURSE VIVA

Credit:2	Marks: 50

Introduction to the course:

At the end of the 4th year (after completing all the courses of 4 years) a student will sit for an oral examination. Members of the examination committee will evaluate the students by asking questions relevant to the courses of the 4 years. The teacher panel interviews the students on subjects studied 4 years-long and measure their competency and understanding.

Course Objectives:

The learning objectives of this course are:

- To prepare the students to face interview both at the academic and the industrial sector.