Outcome Based Education Curriculum

Part A

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

2. Name of the University: University of Dhaka

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

4. Mission of the University

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

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

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

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

6. Vision of the Program Offering Entity

The vision of Institute of Leather Engineering and Technology (ILET) is to enable innovation through research, advance educational programs in leather, footwear, leather products and allied sector and facilitate enrichment of human resources- the students, faculty and staff, thereby establishing itself as a center of excellence at the national and international level.

7. Mission of the Program Offering Entity

Conduct high quality state of the art research primarily at the postgraduate level with an aim to advance knowledge of Leather, Leather Products and Footwear fields and cultivate human talent for the welfare of mankind and apply this knowledge to support and influence national and international agenda. Through its educational and collaborative research activities introduce a high-tech and modern educational method in our local and international context. Moreover, guide the students develop themselves as human beings with high ethical and moral values and finally equip and prepare them to face the complex challenges of the 21st century and beyond.

8. Objectives of the Program Offering Entity

- To produce qualified manpower and skills in the field of tannery, footwear, and leather goods sector;
- To provide quality education leading to Bachelor of Science (B. Sc.), Master of Science (M.Sc.), Master of Philosophy (M.Phil), Doctor of Philosophy (Ph.D.) and Diploma degrees in the leather engineering and technology and related field;

- To initiate, organize and undertake research in the field of Leather Products Engineering and Technology;
- To provide in-plant and industry-oriented training programs in various fields of leather, footwear, and leather products;
- To provide quality control and laboratory facilities for testing raw materials, consumable, and finished goods;
- To organize seminars, conferences, workshops, exhibitions, and other events to disseminate knowledge about cutting-edge technology for raw hides/skins processing and the development of footwear and leather product;
- To provide consultancy and advisory services to institutions, NGOs, private and public sector corporations, who seek such assistance;
- To establish link-programs and research collaborations with various institutions/ organizations within the country and abroad;
- To establish Institute-Industry collaboration for achieving SDGs.

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

10. Description of the Program

The program provides its post-graduate students with the opportunity to participate in advanced professional courses and rigorous research training where students are attached to demand-based knowledge and they relate theories, concepts and techniques learned from the academic courses with real-life experiences. There are three semesters in the M. Sc. Program and a student must complete 40 credits. However, there are two groups in the M. Sc. program:

i. Thesis group: Students of this group are required to complete 24.0 credit course work and a thesis of 16.0 credits. From the beginning of the 1st semester students have to begin their thesis work which must be completed at the end of the 3rd semester. The detailed course structure of this group is described in sections 17 and 18 (a).

ii. General: Students of this group are required to complete 33.0 credit coursework, 2.0 credit industrial internship, 1.0 credit viva voce along with a 4.0 credit project work. The detailed course structure of this group is described in sections 17 and 18 (b).

Post-graduate education in Footwear Engineering is balanced and well-rounded. With a rationalized course curriculum and advanced tools and teaching methods, the capacity of graduates fulfills the international level and the students will be able to perform advanced professional activities.

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

Attribute-1: Knowledge profile
K1: A comprehensive and systematic, theory-based advanced understanding of the modern science and technology
K2: Conceptually based production techniques, formal aspects of emerging technologies, research and business intelligence, creativity and innovation to support analysis and modeling applicable to the discipline
K3: A systematic, theory-based formulation of engineering fundamentals required in the engineering discipline
K4: Engineering specialist knowledge that provides theoretical frameworks and bodies of knowledge for the accepted practice areas in the engineering discipline; much is at the forefront of the discipline
K5: Knowledge of engineering practice (technology) in the practice areas in the engineering discipline
K6: Engagement with selected knowledge in the research literature of the discipline
K7: Comprehension of the role of engineering in society and of the identified issues in engineering practice in the discipline: ethics and the engineer's professional responsibility to public safety; the impacts of engineering activity in economic, social, cultural, environmental and sustainability terms
Attribute-2: Oral communication
C1: Competency in English language for comprehensive communication through academic writing
C2: Skills for proper presentation in any relevant circumstances in the form of conference preceding, project presentation, oral speech etc.
C3: Engineering judgment based on the knowledge and relevance to the discipline and communication of judgment
C4: Discipline and sense of responsibility with strong ethical and moral value aligned with the international scientific norms
Attrubute-3: Aptitude in attending professional seminar and training (Work and interpersonal skills)
A1: Aptitude with regards to having professional degrees
A2: Various professional affiliations with internationally recognized organizations
A3: Time management skills
A4: Leadership and team work ability
A5: Independent thinking and self-confidence

12. Program Educational Objectives (PEOs)

PEO1: Impart advanced technical knowledge to students in the technological topics on footwear engineering and to provide them with opportunities in taking up advanced topics in the field of study.

PEO2: Create a congenial environment that promotes learning, growth and imparts ability to work with multi-disciplinary groups in professional, industry as well as research organizations.

PEO3: Broaden and deepen their capabilities in analytical and experimental research methods, analysis of data and drawing relevant conclusions for scholarly writing and presentation.

PEO4: Achieve professional success through the program's emphasis on experiential learning through ethical reasoning, critical thinking, and problem-solving skills.

PEO5: Provide guidance to students for their choices in research and professional career outlook and to encourage students to take up research for the sustainable development of footwear and related sectors.

13. Program Learning Outcomes (PLO)

The Master of Science in Footwear Engineering program is a rigorous and rewarding method of earning a graduate degree. Graduates of the Master of Science in Footwear Engineering program will be able to accomplish the following aspect.

PLO1: Engineering Knowledge

Able to apply knowledge of footwear engineering, mathematics, and science in a creative and innovative way to design, develop and produce new engineering models and products as specified in K1 to K5for the solution of complex engineering problems (K6).

PLO2: Environment and Sustainability

Create an ability to understand the impact of professional engineering solutions in societal and environmental contexts and demonstrate knowledge of and need for sustainable development by materializing every resource of the relevant field (K7).

PLO3: Ethical Reasoning

Students will be able to reason ethically in evaluating various perspectives, policies, and/or practices relevant to one’s field of research and study. Students will be able to recognize ethical responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, and societal contexts (K7).

PLO4: Communication

Graduates will be able to articulate their thoughts vocally and in writing (oral communication; written communication). Additionally, they will be able to present the

research output in the form of effective writing in international journals, conferences, patents, research proposals, and other scientific venues.

PLO5: Professional autonomy
Graduates would be able to demonstrate all-encompassing professionalism in footwear and allied engineering contexts and to make sound decisions that take into account the global, economic, environmental, and social implications of engineering solutions.

PLO6: Research and Execution
Graduates would be able to critically examine and comprehend scientific studies, current events, and new developments in the Footwear Engineering area to identify, formulate, research, analyze and reach substantiated conclusions along with recommendations for complex footwear and allied engineering problems.

PLO7: The Engineer and Society
Ability to apply reason informed by context to assess societal, health, safety, legal, and cultural issues and the resulting professional engineering responsibilities, as well as contribute to society by creating collaborative and inclusive environments and using problem-solving skills to make a more just world (K7).

PLO8: Leadership and Teamwork
Ability to function effectively as part of a team, collectively to offer leadership, foster an atmosphere of cooperation and inclusion, set and achieve goals, and organize and execute tasks effectively in a multi-disciplinary environment.

14. Mapping mission of the university with PEOs

	Mission I	**Mission II**	**Mission III**
PEO1	✓		✓
PEO2		✓	✓
PEO3	✓		
PEO4			✓
PEO5		✓	✓

15. Mapping of PLOs with PEOs

PLOs	PEO1	PEO2	PEO3	PEO4	PEO5
PLO1	✓				
PLO2		✓		✓	
PLO3		✓	✓	✓	
PLO4	✓		✓		✓
PLO5		✓		✓	✓
PLO6		✓	✓	✓	✓
PLO7			✓	✓	✓
PLO8		✓			✓

16. Mapping courses with the PLOs

Course Code	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8
0723-FE-6101	✓	✓				✓		✓
0723-FE-6103	✓			✓	✓	✓	✓	
0723-FE-6105	✓	✓	✓	✓		✓	✓	✓
0723-FE-6107	✓	✓	✓	✓	✓	✓	✓	
0723-FE-6109	✓	✓	✓	✓	✓	✓	✓	✓
0723-FE-6111	✓	✓		✓		✓	✓	✓
0723-FE-6213	✓	✓	✓	✓		✓	✓	✓
0723-FE-6215	✓	✓			✓	✓	✓	
0723-FE-6217	✓	✓	✓	✓	✓	✓	✓	✓
0723-FE-6219	✓	✓	✓	✓	✓	✓	✓	✓
0723-FE-6221	✓	✓	✓	✓	✓	✓	✓	✓
0723-FE-6000	✓	✓	✓	✓		✓	✓	✓
0723-FE-6300	✓	✓	✓	✓		✓	✓	✓
0723-FE- 6302	✓	✓		✓	✓	✓	✓	✓
0723-FE-6304	✓			✓				

Part B

17. Structure of the Curriculum

(a) **Duration of the Program:** Years: 1.5, Semesters: 3

(b) **Admission Requirements:**

i. Any applicant who has completed the undergraduate degree in Footwear Engineering, University of Dhaka and obtained CGPA of 3.0 or above will be eligible for M.Sc. by Research program. The academic committee may set further eligibility conditions.

ii. Students who have completed their bachelor's degree with a CGPA of 3.25 from Bangladeshi universities, other departments of DU will be able to enroll into the regular master's program. Aspirants will have to sit for a 100-mark written and viva test for empty seats available. The admission requirements and procedure will set by

academic committee of the institute and approved by the University authority. Students who have undergraduate degrees from universities overseas will also be allowed to enroll.

(c) Total credit requirement to complete the program: 40.0

(d) Total class weeks in a semester: 14-15 weeks

(e) Minimum CGPA requirements for post-graduation: 2.50

(f) Maximum academic years of completion: 1.5+1 academic years

(g) Category of Courses

i. General Education Courses: N/A

ii. Core Courses: In M.Sc. Engineering in Footwear Engineering program, ILET, DU would like to provide the core courses as following:

Core Courses

Course Code	Course Title	Course Credit	Semester
0723-FE-6101	Advanced Footwear Manufacturing	3.0	I
0723-FE-6103	Optimization Techniques of Footwear Manufacturing	3.0	I
0723-FE-6105	Research Methodology	3.0	I
0723-FE-6107	Industrial Hazards and Waste Management	3.0	I
0723-FE-6109	Ergonomics and Industrial Safety	3.0	I
0723-FE-6111	Pedorthic Footwear	3.0	I
0723-FE-6213	Environmental Management and Impact Assessment	3.0	II
0723-FE-6219	Product Design and Development*	3.0	II
0723-FE-6221	E-Commerce and International Trade*	3.00	II

***Additionally for general group**

iii. Elective Courses: There are two elective courses from which students (Thesis group) have to choose one.

Course Code	Course Title	Course Credit	Semester
0723-FE-6215	Nanotechnology for Leather and leather Products	3.0	II
0723-FE-6217	Industrial Automation	3.0	II

Note: These two courses are compulsory for students of general group.

iv. Capstone Course/Internship/Thesis

Course Code	Course Title	Credit	Semester
0723-FE-6000	Thesis	16.0	I-III
0723-FE-6300	Project	4.0	II, III
0723-FE-6302	Internship	2.0	III
0723-FE-6304	Viva voce	1.0	III

18. Semester wise distribution of courses

a) Thesis Group

Semester-I

Course Code	Course Title	Credits
0723-FE-6101	Advanced Footwear Manufacturing	3.0
0723-FE-6103	Optimization Techniques of Footwear Manufacturing	3.0
0723-FE-6105	Research Methodology	3.0
0723-FE-6107	Industrial Hazards and Waste Management	3.0
0723-FE-6109	Ergonomics and Industrial Safety	3.0
0723-FE-6111	Pedorthic Footwear	3.0
0723-FE-6000	Thesis	-
Total		**18.0**

Semester-II

Course Code	Course Title	Credits
0723-FE-6213	Environmental Management and Impact Assessment	3.0
0723-FE-6000	Thesis	-
Optional/Elective Course (Anyone from the following List)		
Course Code	**Course Title**	**Credits**
0723-FE-6215	Nanotechnology for Leather and Leather Products	3.0
0723-FE-6217	Industrial Automation	3.0
Total		**6.0**

Semester-III

Course Code	Course Title	Credits
0723-FE-6000	Thesis	16.0
Grand Total		**40.0**

N.B. The thesis work will start in Semester-I and be completed in Semester-III.

b) General Group

Semester-I

Course Code	Course Title	Credits
0723-FE-6101	Advanced Footwear Manufacturing	3.0
0723-FE-6103	Optimization Techniques of Footwear Manufacturing	3.0
0723-FE-6105	Research Methodology	3.0
0723-FE-6107	Industrial Hazards and Waste Management	3.0
0723-FE-6109	Ergonomics and Industrial Safety	3.0
0723-FE-6111	Pedorthic Footwear	3.0
Total		**18.0**

Semester-II

Course Code	Course Title	Credits
0723-FE-6213	Environmental Management and Impact Assessment	3.0
0723-FE-6215	Nanotechnology for Leather and Leather Products	3.0
0723-FE-6217	Industrial Automation	3.0
0723-FE-6219	Product Design and Development	3.0
0723-FE-6221	E-Commerce and International Trade	3.0
0723-FE-6300	Project	-
Total		**15.0**

Semester-III

Course Code	Course Title	Credits
0723-FE-6300	Project	4.0
0723-FE-6302	Internship	2.0
0723-FE-6304	Viva Voce	1.0
Total		**7.0**
Grand Total		**40.0**

N.B. Project to be taken from Semester-II and will complete in Semester-III.

Part C

19. Description of all courses of the program

Course Outline of 0723-FE-6101

Course Code: 0723-FE-6101

Course Title: Advanced Leather Processing

Credits: 3.0

Rationale of the Course: This course is intended to introduce students to various types of advanced manufacturing concepts of footwear. It will render the students about cutting-edge technology used in footwear industries. Moreover, it will help the students to understand the various aspects of footwear manufacturing paving the way for sustainability.

Course Contents:

Additive manufacturing (AM) techniques in footwear: Introduction to AM, AM in sports footwear, potential elements of AM, AM techniques: Stereolithography (SLA), PolyJet (PJ), selective laser sintering (SLS) and three-dimensional printing (3DP), suitability of different AM techniques and challenges of AM techniques, Major Applications of 3D Printing in Footwear; 3D knitted upper-footwear with 3D knitted upper, techniques and automation for the creation of 3D knitted fabrics, tight-to-toe approach, fit and comfort, box-toes and counters, air permeability, thermal and water vapor resistance, and sole attachment.

Sustainability in footwear production: Footwear and its role in sustainability, sustainable production practices from designing to packaging department, waste accumulation, controlling volatile organic chemicals, CO_2, polymers, water, restricted substances, implementation of labor law in footwear production, implementation of environment conservation rules in footwear production, reducing costs in footwear manufacturing.

Waterproof and cold weather footwear: Design and manufacturing requirements of waterproof and cold weather footwear, properties and specifications of footwear upper and bottom materials for waterproof and cold weather footwear, and related testing for performance.

Quick drying footwear: Introduction, importance of quick-drying, material selection, mechanism of water removal, quick-drying footwear construction, testing for performance, maintaining performance in production.

Platform shoe: Advantages and disadvantages of platform shoe, importance of keeping stable in platform shoe, controlling of toe spring, positioning the shank, controlling waist strength, design, materials and construction.

Special upper leather: Origins and properties of suede and nubuck leather, shoe-making problems with suede and nubuck leather, sensitive surfaces, protection during shoemaking, other shoemaking operations, wear properties, acceptable levels of color fastness, oily finished leather for shoe making and wearing, properties of patent leather, problems that may arise in the use of patent leathers.

Shoe upper permeability maximization: Breathability and foot comfort, factors affecting thermoregulation, different climates, permeability performance of different materials, selection of materials, upper construction, importance upper permeability.

Course Objectives:

a. To introduce students to advanced footwear manufacturing technology.
b. To familiarize students with sustainable footwear production practices.
c. To equip students with footwear manufacturing for cold weather and waterproof, quick-drying, and platform shoe.
d. To disseminate knowledge about special types of leather-made footwear and shoe upper permeability.

Course Learning Outcomes (CLOs) and Mapping of CLOs with Program Learning Outcomes (PLOs)

a) CLOs: Upon completion of this course, students will be able to:

	Course Learning Outcomes (CLOs)	**Learning Level**
CLO1	Outline the basic knowledge of additive manufacturing techniques, sustainable footwear production, and different special-purpose footwear.	C1, A1
CLO2	Explain the essential features of footwear materials related to waterproof, cold weather, quick drying, and platform footwear.	C2, A2
CLO3	Apply the principle of advanced manufacturing techniques in waterproof, cold weather, quick drying, and platform footwear.	C3, A3
CLO4	Analyze and rectify the related problems of special types of footwear manufacturing.	C4, A3

CLO5	Compare and justify the various aspects of manufacturing techniques in waterproof, cold weather, quick-drying, and platform shoes.	C5, A4

b) Mapping of CLO with PLO

CLOs	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8
CLO1	3	3	-	-	-	-	-	-
CLO2	3	3	-	-	-	-	-	-
CLO3	3	3	-	-	-	-	-	-
CLO4	3	3	-	-	-	3	-	-
CLO5	3	3	-	-	-	3	-	3

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

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

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture, Whiteboard illustration, Multimedia presentation	In-course assessment, Assignment; Final examination
CLO2	Lecture, Whiteboard illustration, Multimedia presentation	In-course Exam; Final Exam
CLO3	Lecture, Whiteboard illustration, Multimedia presentation	In-course Assessment, Case study; Final examination
CLO4	Lecture, Whiteboard illustration, Multimedia presentation	In-course assessment; Final examination
CLO5	Lecture, Whiteboard illustration, Multimedia presentation	In-course Assessment, Presentation; Final examination

Learning Materials

i. Recommended Readings

a) ROSSI, W. A. and TENNANT, R.-Professional Shoe Fitting, New York, Pedorthic Footwear Association.

b) STELLA, S.-The Innovation Notebooks for the Footwear Industry, Last, Italy, AssomacServizisrl.

c) Miller, R.G-Manual of Shoe Making, 5th ed. Printing Department, Clarks Ltd. C. & J. Clark Ltd.

d) Wade Motawi-Shoe Materials Design Guide.

ii. Supplementary Readings

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

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

Course Outline of 0723-FE-6103

Course Code: 0723-FE-6103

Course Title: Optimization Techniques of Footwear Manufacturing

Credits: 3.0

Rationale of the Course: The focus of this course is on theoretical concepts, data-driven models, and numerical techniques for optimization using actual variables. The course provides a thorough understanding in mathematical optimization theory, methods, and algorithms. The course will begin with linear optimization, and will go into detail about how to formulate problems and find solutions as well as to develop a methodology for footwear engineering design.

Course Contents:

Advanced Inventory Management: Demand and control system characteristics, inventory concept, inventory cost, inventory modeling, optimization and inventory control, Dynamic EOQ Models, probabilistic models and safety stock, probabilistic demand, probabilistic example, Single-Period Models, Multiperiod Models.

Aggregate Planning and Master Scheduling: Basic Strategies for Meeting Uneven Demand, Techniques for Aggregate Planning, Disaggregating the Aggregate Plan, Master Scheduling, the Master Scheduling Process, Methods for Aggregate Planning: Graphical Methods, Mathematical Approaches, and Comparison of Aggregate Planning Methods.

MRP, MRPII and ERP: Basic ideas of inventory MRP, benefits of MRP, inputs to MRP, bill of material (BOM), BOM examples for footwear manufacture, Master Production Schedule (MPS), MPS examples for footwear manufacture, time-phased product structure, MRP structure, determining gross requirements, gross requirements plan for footwear manufacture, gross requirements schedule, MRP management, Lot-sizing techniques, Lot-for-Lot examples, EOQ lot size examples, POQ lot size examples, material requirements planning II, distribution resource planning (DRP), enterprise resource planning (ERP), SAP's ERP modules.

Decision Modeling: The Decision Process in Operations; Fundamentals of Decision Making; Types of Decision-Making Environments; Decision Making under Uncertainty, Decision Making under Risk, Decision Making under Certainty, Expected Value of Perfect Information (EVPI); Decision Trees; A More Complex Decision Tree, Using Decision Trees in Ethical Decision Making.

Linear Programming Models: Why Use Linear Programming? Requirements of a Linear Programming Problem, Formulating Linear Programming Problems, Graphical Solution to a Linear Programming Problem, Sensitivity Analysis, Solving Minimization Problems, Linear Programming Applications, the Simplex Method of LP.

Transportations Modeling: Transportation Modeling; Developing an Initial Solution: The Northwest-Corner Rule, The Intuitive Lowest-Cost Method, The Stepping-Stone Method; Special Issues in Modeling: Demand Not Equal to Supply, Degeneracy; Using Software to Solve Transportation Problems; Case Studies.

Integer Programming and Dynamic Programming and Network Techniques: Integer programming - Cutting plane algorithm, Branch and bound technique, Zero-one implicit enumeration – Dynamic Programming – Formulation, Various applications using Dynamic Programming. Network Techniques – Shortest Path Model – Minimum Spanning Tree Problem – Maximal flow problem.

Problem solving tools and improvement strategies: Problem solving process, quality control tools, new management tools, quality function deployment, Deming wheel, zero defect concept, benchmarking, six- sigma.

Learning Objectives:

a. To introduce students with advanced inventory management and aggregate planning.
b. To familiarize students with various production planning methods.
c. To provide knowledge on different optimization models and their applications in footwear manufacturing.

Course Learning Outcomes (CLOs) and Mapping of CLOs with Program Learning Outcomes (PLOs)

a) CLOs: Upon completion of this course, students will be able to:

	Course Learning Outcomes (CLOs)	**Learning Level**
CLO1	Explore knowledge on various optimization techniques used in footwear manufacturing.	C1, C2, A1
CLO2	Explain the methods and ways to manage different optimization tools.	C2, A2
CLO3	Implement the advanced tools and techniques of operations research to manage the production in the footwear industry supply chain	C3, A2
CLO4	Manage new project related to new footwear products or business	C4
CLO5	Investigate the applicability of a specific tool or technique to a specific case.	C5

b) Mapping of CLO with PLO

(CLOs)	**PLO1**	**PLO2**	**PLO3**	**PLO4**	**PLO5**	**PLO6**	**PLO7**	**PLO8**
CLO1	3	-	-	-	-	-	-	-

CLO2	3	-	-	-	-	1	-	-
CLO3	3	-	-	-	1	2	2	-
CLO4	3	-	2	1	-	2	3	-
CLO5	3	-	2	-	2	2	1	-

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

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

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture, multimedia presentation, literature review and problem-based exercises	Group Presentation, Assignment, oral presentation, In-course Exam and Final Exam
CLO2	Lecture, group discussion and problem-based exercises, literature review.	Group Presentation, In-course Exam and Final Exam
CLO3	Lecture, multimedia presentation and problem-based learning: Identifying the problem to be solved	Assignment, Group Presentation, In-course Exam and Final Exam
CLO4	Lecture, multimedia presentation, group discussion, demonstration, and problem-based exercises	Group Presentation, Case study, Assignment, In-course Exam and Final Exam
CLO5	Lecture, multimedia presentation, group discussion, demonstration, and problem-based exercises	Group Presentation, Case study, Assignment, In-course Exam and Final Exam

Learning Materials

i. Recommended Readings

a) Jay Heizer, Barry Render, Chuck Munson- Operations Management: Sustainability and Supply Chain Management (13th Edition)
b) Jay Heizer, Barry Render- Operations Management (11th Edition)
c) Hamdy A. Taha, Operations Research – An Introduction, Prentice Hall of India, 1997
d) Gideon Halevi- Handbook of Production Management Methods
e) R. Panneerselvam, "Operations Research", Prentice Hall of India Private Limited, New Delhi 1 – 2005

ii. Supplementary Readings

a) Larry P. Ritzman, Lee J. Krajewski, and Manoj K. Malhotra- Operations Management: Processes and Supply Chains
b) Nicholas J. Aquilano and Richard B. Chase- Production and Operations Management

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

Course Outline of 0723-FE-6105

Course Code: 0723-FE-6105

Course Title: Research Methodology

Credits: 3.0

Rational of the Course: This course provides an opportunity for students to establish or advance their understanding of research through critical exploration of research language, ethics, and approaches. Students will be able to examine and be practically exposed to the main components of a research framework i.e., problem definition, research design, data collection, ethical issues in research, report writing, and presentation.

Course Contents:

Introduction to research: Definitions, characteristics, types, differences and role of research**,** research and investigation, research methods versus research methodology**,** criteria of good research, paradigms and ethics in research, proposition, axiom, postulate, theorem and model of research**,** variables and types**,** properties of relationships between variables**,** inductive and deductive method.

Literature review and research problem: Definition, objectives, advantages, principles and procedures of literature review, problem definition, finding a researchable problem**,** selecting the problem**,** importance of defining the problem, important qualities of a research problem**,** techniques involved in defining a problem**,** evaluating a proposed design.

Research questions and objectives: Research objective and research question**,** practical examples of research objectives and research question, formulation of research questions, criteria of research objectives, evaluation of research questions, classification and importance of research objectives.

Research hypothesis, design, and proposal: Source, functions, and characteristics of a good research hypothesis, formulation and possible difficulties of research hypothesis, research hypothesis versus research objectives; definition, function, classification of research design, feature of a good research design, qualitative research, observation studies**,** surveys**,** experimentation, steps in a research design; meaning of research proposal**,** contents of research proposal**,** steps in the development of a research proposal, criteria for evaluating research proposal.

Qualitative research tools, measurement and scaling technique: Definition**,** characteristics, uses, and general steps of qualitative research, qualitative research approaches, steps in grounded theory, nature of measurement**,** measurement scales, types of measurement scales, Likert scale.

Questionnaire design: Questionnaire and questionnaire design**,** consideration and types of questions**,** questionnaire designing process**,** necessary properties of questionnaire**,** characteristics of a good questionnaire**,** precaution required in the use of questionnaire**,** guidelines for constructing questions and questions sequence.

Sampling and sampling design: Concepts and importance of sampling**,** planning and designing a survey**,** classification of sampling techniques**,** probability sampling design**,** non-probability sampling design**,** determination of sample size.

Data collection and analysis: Data, data versus information, types and sources of data collection**,** secondary data collection methods**,** primary data collection methods**,** qualitative and quantitative methods of data collection**,** data validation, editing and coding**,** data entry and exploring**,** displaying and examining data**,** Univariate analysis**,** Bivariate analysis**,** Multivariate analysis**,** SWOT analysis**,** and Hypothesis testing.

Presenting insights and findings: Importance of the report and presentation**,** report preparation and presentations process**,** precautions in interpretation**,** research report**,** contents and precautions in writing research report**,** presentation of statistics**,** oral presentation**,** writing thesis/dissertation**,** writing journal articles and conference papers**,** bibliography and reference writing styles**,** copy right**,** plagiarism.

Course Objectives:

a. To familiarize the students with the key terms, concepts, and practices in the field of research.
b. To prepare research problems and/or hypotheses in a clear and concise format.
c. To demonstrate a systematic understanding of the range of advanced research techniques, be able to critically evaluate these techniques and apply them appropriately.
d. To evaluate and critically analyze the components of scholarly writing and published research.

Course Learning Outcomes (CLOs) and Mapping of CLOs with Program Learning Outcomes (PLOs)

a) CLOs: Upon completion of this course, students will be able to:

	Course Learning Outcomes (CLOs)	**Learning Level**
CLO1	Outline the basic framework of research process, and identify various sources of information for literature review and data collection.	C1, A1
CLO2	Explain the ethical dimensions of conducting basic and applied research.	C2, A2
CLO3	Design questionnaire, explain the procedures and techniques, and analyze data with different statistical tools and techniques using statistical computing for making better decisions.	C2, C3, A3
CLO4	Acquaint with the process of conducting research to identify real-life problems recurrently encounter and to suggest suitable and pragmatic solutions to those problems.	C4, A4
CLO5	Compare the advanced research techniques and critically analyze the components of scholarly writing and published research.	C5, A4

b) Mapping of CLO with PLO

(CLOs)	**PLO1**	**PLO2**	**PLO3**	**PLO4**	**PLO5**	**PLO6**	**PLO7**	**PLO8**
CLO1	3	-	3	-	-	2	-	-
CLO2	3	-	3	-	-	2	-	-
CLO3	3	-	3	-	-	3	-	2

CLO4	3	3	3	3	-	3	2	-
CLO5	3	2	3	3	-	3	3	-

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

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

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture, Whiteboard illustration, Multimedia presentation, Interactive Discussion	Assignment, Case study, In-course Exam and Final Exam
CLO2	Lecture, Whiteboard illustration, Multimedia presentation, Interactive Discussion	Assignment, Case study, In-course Exam and Final Exam
CLO3	Lecture, Whiteboard illustration, Multimedia presentation, Interactive Discussion	Assignment, Case study, In-course Exam and Final Exam
CLO4	Lecture Whiteboard illustration, Multimedia presentation, Interactive Discussion	Presentation, Assignment, In-course Exam and Final Exam
CLO5	Lecture, Whiteboard illustration, Multimedia presentation, Interactive Discussion	Presentation, Assignment, In-course Exam and Final Exam

Learning Materials

i. Recommended Readings

a) M. A. Salam Akanda (2019). Research Methodology-A Complete Direction for Learners. Latest Ed., Akanda& Sons, Dhaka.

b) C. R. Kothari (1996). Research Methodology- Methods & Techniques. Wishaw Prokashan, New Delhi, Wiley Eastern Limited.

c) An Introduction to Research Methods ; Author: M. Nurul Islam ; Year: 2011 ; Edition: 2nd ; Publisher: Mullick& Brothers

ii. Supplementary Readings

a) Ranjit Kumar (2005). *Research Methodology- A Step-by-Step Guide for Beginners*, 3rd Ed., Singapore, Pearson Education.

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

Course Outline of 0723-FE-6107

Course Code: 0723-FE-6107

Course Title: Industrial Hazards and Waste Management

Credits: 3.0

Rationale of the Course: This course is designed to provide in-depth knowledge of the exploitation of valuable products from tannery wastes by utilizing modern technology. This course will facilitate students with deeper understanding of different types and characteristics of industrial hazardous wastes and a comprehensive overview of hazardous waste management approaches.

Course Contents:

Industrial Hazards: Hazard, Types of industrial hazards, Identification of hazardous wastes, Hazardous waste management, Treatment technology, Disposal of radioactive materials, Ground water contamination and remediation. Route of industrial hazard entry into human body-Inhalation, Absorption, Swallowed, Injection, Food chain - Contaminated soil, Vegetables, Crops, Fish and Chicken, Adverse impact of hazard, Occupational cancer.

Solid Waste Generation in the Leather industry and its Utilization: Generation: Skin collagen waste, Fleshing waste, Wet blue, Trimming, Buffing, Chrome shaving, Chrome split, trimming from crust and finished leather. Utilization: Fleshing- Modified fleshing hydrolysate, Reactive protein (RP), feed ingredients.

Chrome shaving: Treatment with enzyme, MgO, Carbonates and other alkalies, application of hydrolysate.

Waste generation in Footwear and Leather Products Industry: Materials being processed: Leather, Natural rubber/poly-isoprene, Reaction Injection Moulded (RIM) polyurethane (PU), Polyvinyl Chloride (PVC) and blends, Ethylene Vinyl Acetate (EVA) and blends, Styrene Butadiene Rubber (SBR), Thermoplastic Polyurethane (TPU), Thermoplastic Rubber (TR), Leather, textile, cotton, polyesters, nylon, adhesive, solvent, oil.

Solid Waste Management: Solid waste – sources and engineering classification, characterization, generation and quantification. Transport - collection systems, collection equipment, transfer stations, collection route optimization.

Treatment methods – various methods of refuse, recovery, recycle, composting –aerobic and anaerobic, incineration, pyrolysis and energy recovery.

Disposal methods – Impacts of open dumping, site selection, sanitary land filling – design criteria and design examples, leachate and gas collection systems, and leachate treatment.

Hazardous Waste Management – Introduction, Sources, Classification, Physico-chemical, Chemical and biological Treatment of hazardous waste, regulations.

Thermal treatment – Incineration and pyrolysis.

Soil contamination and site remediation– Bioremediation processes, monitoring of disposal sites.

Removal of Refractory Organic Compounds: Theories on Advanced Oxidation Process viz., Photocatalytic treatment, Membrane separation, Homogenous catalysis system using hydrogen peroxide, ozone, etc. Heterocatalytic systems using metal oxides, activated carbon – Removal of inorganic compounds through electro dialysis, reverse osmosis, multiple effect evaporator, ion-exchange.

Course Objectives:

a. To provide the advance knowledge about the environmental problems, industrial hazards,and its methods of mitigation.
b. To estimate solid waste generation from tanning industry, and leather goods industry and their utilization using modern techniques.
c. To improve a comprehensive skill on tannery solid waste, biomedical and other hazardous wastes and integrated solid waste management system.
d. To familiarize students with modern biological techniques available for the wastewater treatment.

Course Learning Outcomes (CLOs) and Mapping of CLOs with Program Learning Outcomes (PLOs)

a) CLOs: Upon completion of this course, students will be able to:

	Course Learning Outcomes (CLOs)	**Learning Level**
CLO1	Narrate industrial hazards and their adverse impact on the environment and humans.	C1,A1
CLO2	Analyze tannery solid waste utilization into the valuable byproducts as part of circular economy and clean technology.	C3, A3
CLO3	Apply knowledge on the estimation of solid waste generated from leather and allied industries.	C4
CLO4	Justify modern techniques of wastewater treatment with traditional treatment processes.	C5, A4

b) Mapping of CLO with PLO

(CLOs)	**PLO1**	**PLO2**	**PLO3**	**PLO4**	**PLO5**	**PLO6**	**PLO7**	**PLO8**
CLO1	3	2	-	-	-	2	1	-
CLO2	2	3	3	-	-	2	3	-
CLO3	3	3	3	-	-	2	2	-
CLO4	3	3	-	3	3	2	3	-

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

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

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

Learning Materials

i. Recommended Readings

a) Arceivala S. J., "Waste water treatment and disposal" Marcel Dekkar Inc., New York, 1981.

b) Besselievie, B. E. and Schwartz, M., "The Treatment of Industrial wastes", 2nd edn., McGraw Hill.
c) Karia G.L., and Christian R.A., (2001), "Wastewater Treatment Concepts and Design Approach", Prentice Hall of India Pvt. Ltd., New Delhi.

ii. Supplementary Readings

a) Assessment of Tannery Solid Waste Management, a case study Sheba Leather Industry, UNIDO, 2018.
b) Benefield R.D., and Randal C.W., (1980), "Biological Process Design for Wastewater Treatment", Prentice Hall, Englewood Chiffs, New Jersey.

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

Course Outline of 0723-FE-6109

Course Code: 0723-FE-6109

Course Title: Ergonomics and Industrial Safety

Credits: 3.0

Rationale of the Course: This course is intended to instruct knowledge by different approaches to improve better workspace design and efficient work environment designs and management. After completion of this course, the students will be able to design better factory environment and thereby will be able to ensure effective safety management practices in the leather industry.

Course Contents:

Ergonomics

Introduction: What is Ergonomics; History of Development; Scope & Application of Ergonomics; Importance of Ergonomics; Anthropometry.

Muscle Physiology and Manual Material Handling: Muscle and Work Physiology; Measure of Physiological Strain; Physical Workload; Manual Materials Handling.

Hand Tools and Devices: Introduction to Hand Tools; Structure and Motion of Hand; Principles of Designing Hand Tools and Devices; Vibration & HAVS; Gripping Principles.

Workspace Design: Designing Workspace Envelopes for Seated and Standing Personnel; Designing Horizontal Work Surfaces; Designing Seated and Standing Work Surfaces.

Work Environment Design: Lighting in Work Environment; Vision and Structure of Eye; Visual Defects; Guidelines for Colour Selection; Measurement of Light Photometry; Lighting and Illumination; Reflectance; Lighting Problem; Improving Visibility; Characteristics and Efficiency of Light Sources; Lighting Design Considerations; Glare; Uniformity of Lighting; Complaints, Causes and Control Measures of Visual Discomforts; Sound Propagation; Structure of Human Ear; Process of Hearing; Health Effects of Noise Pollution; Control Measures for Noise Pollution; Thermal Balance; Heat Illness; Heat Acclimatization; Heat Stress Measurement; Cold Injury; Cold Climate Protection.

Safety Management

Introduction to Safety Management: Objectives; Importance of Safety Management; Occupational Health and Safety (OHS); Hazard and Risk.

Introduction to Workplace Safety: Aims; Considerations to Manage Workplace Safety Effectively; Nature, Functions and Benefits of Workplace Safety; Challenges for Practicing Safety; PDCA Cycle in OHS; Idea Generation.

Creating an Effective Workplace Safety Program: Core Regulatory Requirement; Program Review/Audit; Establishing Goals and Objectives; Management Commitment and Responsibility; Work-Site Analysis; Hazard Recognition and Resolution; Job Hazard Analysis (JHA)/Job Safety Analysis (JSA); Hazard Resolution; Incident Investigation; Best Practices.

Workers' Compensation and Record Keeping: Early and Modern Workers' Compensation Laws; Premium Calculation; Background Record Keeping; OSHA 300, 300A and 301 Forms; Recordable Occupational Injuries and Illness; First Aid Cases; Fatalities; Privacy Concern Cases; Posting Annual Summary Requirements.

Introduction to Industrial Hygiene: Definition; Toxicology; Industrial Hygiene Practice.

Fire Prevention and Protection: Means of Egress Regulations; Fire Tetrahedron; Categories of Fire; Categories of Fire Extinguisher.

System Safety: Importance of System Safety; System Life Cycle; Management of System Safety; Elements of A System Safety Program Plan (SPSS); Preliminary Hazard Analysis (PHA); Subsystem Hazard Analysis (SSHA); System Hazard Analysis (SHA); Technique of Operations Review (TOR); Failure Mode and Effect Analysis (FMEA).

Improving Safety Performance with Behavioural Safety: Introduction; Pilot Error Syndrome; Concepts of Risk; Incidents and Accidents; Loss Exposures; Control Techniques for Loss Exposures; Accident Causation Theories; Single Factor Theory; Heinrich's Domino Theory; Multiple Factors Theory; Human Factors Theory; Energy Release Theory; Further Incident Investigation.

Learning Objectives:

a. To identify the components needed to provide a safe and healthful work environment through case studies and review of injury statistics provided in the course.
b. To identify potential workplace safety and health hazards and determine how to mitigate the hazards through engineering controls, administrative controls and personal protective equipment.
c. To conduct basic safety inspections using strategies that they have developed though hazard identification and job hazard analysis.
d. To identify the requirements of training programs in the workplace under the existing OSHA and State-OSHA requirements.
e. To understand essential elements of an occupational safety and health program and the components of international standard organizations in safety and health.

Course Learning Outcomes (CLOs) and Mapping of CLOs with Program Learning Outcomes (PLOs)

a) CLOs: Upon completion of this course, students will be able to:

	Course Learning Outcomes (CLOs)	Learning Level
CLO1	Recall knowledge of fundamentals of ergonomics and safety management related to leather engineering.	C1, A1
CLO2	Explain various methods and tools to ensure proper ergonomics facilities and safety managements.	C2, C3
CLO3	Apply various modern techniques to design an ergonomic friendly work environment as well as a safer workplace with protection from possible accidents and hazards.	C4
CLO4	Investigate and solve any problem/issue related to ergonomics and safety management in real world leather manufacturing.	C5, A4

b) Mapping of CLO with PLO

(CLOs)	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8
CLO1	3	-	-	-	-	-	-	-
CLO2	3	3	-	-	2	-	-	-
CLO3	3	3	3	-	2	3	2	-
CLO4	3	3	2	3	2	2	2	2

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

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

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

Learning Materials

i. Recommended Readings

a) Human Factors in Engineering & Design by Mark S. Sanders, Ph. D. and Ernest J. McCormick, Ph. D
b) Introduction to Ergonomics by R. S. Bridger
c) Workplace Safety A Guide for Small and Midsized Companies by Dan Hopwood, Steve Thompson
d) Fundamentals of Occupational Safety and Health (fourth edition) by Mark A. Friend and James P. Kohn

ii. Supplementary Readings

a) The Occupational Ergonomics Hand Book, Edited by Waldemar Karwowski and William S. Marras, CRC Press, New York, USA.

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

Course Outline of 0723-FE-6111

Course Code: 0723-FE-6111

Course Title: Pedorthic Footwear

Rationale of the Course: This course has been designed to deliver state-of-the-art knowledge to the students on pedorthic (medical-graded) footwear. This course includes foot problems of pedorthic patients, their remedies, and biomechanics of diabetic, orthopedic, and geriatric footwear. At the end of the course, students will be able to prepare guidelines for pedorthic footwear and also individual patients.

Course Contents:

Foot problems: Skin lesions- calluses, corns, plantar warts, ingrown nail, etc., arch problems- flat foot, claw foot, arch strains, metatarsalgia, foot fatigue, burning feet, rigid feet, aching in calf, toe problems- hallux valgus, bunion, tailor's bunion, hammer toe, children foot problems- in toeing, out toeing, pronation, crooked toes, etc.

Biomechanics: Basic concept of biomechanics and foot barograph, characteristics of the foot, muscles and joints, pressure points and load distribution, foot dynamics, foot motions, gait analysis, running, movements of joints during dynamic phase, muscles work during static and dynamic conditions, abnormal gait patterns, body weight distribution of feet, force platforms, angle of flexion at the joints, electromyography.

Diabetic footwear: Diabetes, types of diabetes, diabetic foot, foot complications due to diabetes, impact of diabetes on foot structure, foot pressure and gait, epidemiology of diabetic foot syndrome, the neuropathic foot, the neuroischaemic foot, prevention, treatment, diabetic footwear, development of diabetic footwear, necessity of diabetic footwear, features of diabetic footwear, sustainable design for diabetic footwear, materials selection, construction of diabetic footwear, orthotics, classification of orthotics, application and functions of orthotics, footgear, types, diabetic socks, physiological mechanism of diabetic footwear, diabetic foot and footwear care.

Orthopedic footwear: Introduction, classification, Impact of rheumatoid arthritis on foot structure, foot pressure and gait, orthotic men's and women's sandal with arch support, basic measurements, modular footwear measurements, fitting of modular footwear, anatomical insole, in-socks and sole, sustainable design and development of orthopedic footwear, shoes for plantar facilities, complication due to bone structure, materials selections, constructions, orthotics and insertions, design of foot orthoses, foot care products, turf toe, supination, pronation, foot odors and prevention.

Geriatric Footwear: The impact of aging and systematic diseases, Introduction to geriatric footwear, Geriatric foot problems: etiological and epidemiological factors, Changes in the foot in relation to age, Complicating foot problems, Psychosocial and psychological considerations, Considerations in sustainable shoe design, and Therapeutic footwear.

Course objectives:

a. To disseminate advanced knowledge about diabetic, orthopedic, and geriatric foot problems.
b. To provide in-depth knowledge of foot and footwear biomechanics and gait analysis.
c. To explain the types, designs, materials, and biomechanics of diabetic, orthopedic, and geriatric footwear.
d. To impart the latest management procedure for diabetic, orthopedic, and geriatric foot problems.

Course Learning Outcomes (CLOs) and Mapping of CLOs with Program Learning Outcomes (PLOs)

a) CLOs: Upon completion of this course, students will be able to:

	Course Learning Outcomes (CLOs)	**Learning Level**
CLO1	Explain different types of foot problems and basic requirements for diabetic, orthopedic, and geriatric footwear with biomechanical requirements.	C2, A2
CLO2	Relate different types of foot problems and foot biomechanics with sustainable manufacture of pedorthic footwear.	C3, A3
CLO3	Analyze the biomechanics requirements and other relevant factors in the sustainable designing and manufacturing of diabetic, orthopedic, and geriatric footwear.	C4, A3
CLO4	Justify and prepare the systematic guidelines for the proper management of diabetic, orthopedic, and geriatric patients with appropriate footwear.	C5, C6, A4

b) Mapping of CLO with PLO

(CLOs)	**PLO1**	**PLO2**	**PLO3**	**PLO4**	**PLO5**	**PLO6**	**PLO7**	**PLO8**
CLO1	3	1	-	-	-	-	-	-

CLO2	3	3	-	-	-	-	-	-
CLO3	3	3	-	-	-	3	2	-
CLO4	3	2	-	3	-	-	2	2

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

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

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

Learning Materials

i. Recommended Reading

a) Footwear and Foot Orthoses by Anita Williams and Chris Nester
b) Therapeutic footwear by Wendy Tyrrell and Gwenda Carter
c) The Science of Footwear by Ravindra S. Goonetilleke

ii. Supplementary Readings

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

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

Course Outline of 0723-FE-6213

Course Code: 0723-FE-6213

Course Title: Environmental Management and Impact Assessment

Credits: 3.0

Rational of the Course:

This course is designed to train the graduates in analysis and assessment methods applicable to environmental contamination problems, particularly national and international legislative frameworks. This course is contemplated for LWG and other environmental certification processes for leather industry.

Course Content:

Environmental Audit: Principles and philosophies of environmental auditing**,** basic steps in audit process, Auditing techniques Concept of industrial ecology, cleaner technologies in industrial processes and evaluation of processes, waste minimization

Environmental health hazard and risk assessment: Biological, chemical, physical and psychological health hazard; health risk assessment and management, toxicology, exposure measurement of toxic (carcinogenic and non-carcinogenic) substances

Clean Development Mechanism: Overview on sustainable development. Greenhouse gasses reduction mechanism, project cycle for the CDM, CDM for small scale projects, risks and opportunities for industries, financing of CDM projects, case studies.

Environmental Impact Assessment (EIA): Definition, purposes and characteristics of EIA, global evolution of EIA, participants in EIA process, stages of EIA, types of EIA, environmental inventory, baseline data on EIA-environmental data, project data and project alternative data, measurement of impact– physical, social, economic, natural, public participation in environmental decision making, framework of environmental assessment, description of environmental setting, Environmental impact factors and area consideration, environmental impact statement (EIS) and environmental management plan (EMP).

Environmental Impact Analysis: Impact identification and methods of impact identification- adhoc method, checklist, matrix, network, overlay and index methods; impact prediction and predictive methodologies, impact evaluation (assessment) and impact mitigation. Basic steps for the impact identification, prediction and assessment of air, water, noise, vegetation and wildlife environment with case studies.

Environmental Management System (EMS): Basic definitions and terms, Framework for environmental management system, approach for developing Environmental Management System, International standards, environmental management systems in tanneries and their implementation, environmental reporting, Occupational health and safety management, cross-boundary environmental management, mandatory regulations and ecolabelling criteria governing various substance in leather, life -cycle assessment and carbon footprint in leather industries.

Hazard Mitigation: Classification of hazards, basic concept of disaster (causative factors of disaster, classification of disasters), Hazards due to dams and reservoirs, nuclear power plants, industrial hazards, occupational hazards, mitigation measures, hazard assessment, risk assessment.

EIA in Bangladesh: An overview of history, current procedures, practices and guidelines for Environmental Clearance Certificate, EIA of water resource projects, industries, mining and quarrying, highway construction, and tourism developments.

Course Objectives:

a. To provide knowledge on legal and policy frameworks within which quantitative environmental assessment activities are carried out and
b. To conduct systematic EIA and auditing methodologies in the leather industry.
c. To carry out quantitative techniques of analysis for direct determination of contaminant concentrations and distributions within environmental systems.
d. To investigate statistical and computer modeling techniques for analysis of data.

Course Learning Outcomes (CLOs) and Mapping of CLOs with Program Learning Outcomes (PLOs)

a) CLOs: Upon completion of this course, students will be able to:

	Course Learning Outcomes (CLOs)	**Learning Level**
CLO1	Recognize ethical and narrate professional responsibilities in engineering situations and make judgments.	C1, A1
CLO2	Familiarize with the application of a variety of professional tools for predicting environmental impacts.	C2, A2
CLO3	Developing perspectives on impact assessment and relating to practical industrial activities.	C3, C4

b) Mapping of CLO with PLO

CLOs	**PLO1**	**PLO2**	**PLO3**	**PLO4**	**PLO5**	**PLO6**	**PLO7**	**PLO8**
CLO1	3	3	-	-	-	-	-	-
CLO2	-	3	3	3	-	3	3	-
CLO3	3	2	-	-	-	3	2	3

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

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

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

Learning Materials

i. **Recommended Readings**

a) Morris, P and Therivel, R. 2001. Methods of environmental impact assessment. London. UCL press.

b) Introduction to Environmental Impact Assessment : Principles and Procedures, Process, Practice and Prospects - 2nd edition. J. Glasson, R. Therivel, A. Chadwick

c) Environmental Impact Assessment Methodologies, Y. Anjaneyulu, Valli Manickam, BS Publication

d) Environmental and Health Risk Assessment and Management: Principles and Practices, ISBN: 9789048169610,9048169615

ii. **Supplementary Reading**

a) Bregman, J.I. and Mackenthum, K.M. 1992. Environmental impact statements. Chelsia Michigan: Lewis.

b) Calow, P. 1997. Handbook of environmental risk assessment and management. Oxford: Blackwell Science.

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

Course Outline of 0723-FE-6215

Course Code: 0723-LE-6215

Course Title: Nanotechnology for Leather and Leather Products

Credits: 3.0

Rational of the Course: This course is designed to provide in-depth theoretical knowledge of nanotechnology and outlines its applicationsin leather and allied engineering fields. The course also deals with the design of nanosystems, nanomaterials together with their processing, properties and characterization.

Course Contents

Introduction to Nanoscience and Nanotechnology: Introduction, history and importance of nanotechnology, properties of nanomaterials, difference between bulk and nanomaterials, molecular building blocks for nanostructured systems, influence of nano structure on mechanical, optical, electronic, magnetic and chemical properties, overview of different nanomaterials available, chemistry and physics of nanomaterials, electronic phenomenon in nanostructures, optical absorption in solids, quantum dot, quantum effects, nanocomposites.

Nanomaterials Fabrication:

Chemical Methods: Sol- gel process, self-assembly process, electrodeposition, pyrolysis, metal nanocrystals by reduction, solvothermal synthesis, photochemical synthesis, sonochemical synthesis, reverse micelles and microemulsions, combustion method, template process, chemical vapor deposition, metal organic chemical vapor deposition.

Physical Methods: Ball milling, inert gas condensation technique, thermal evaporation, pulsed laser deposition, DC/RF magnetron sputtering, molecular beam epitaxy, microlithography, etching, wet cleaning, atomic layer deposition.

Biological Synthesis: Protein based nanostructure formation, DNA template nanostructure formation, protein assembly, biologically inspired nanocomposites.

Nanomaterials Characterization:

Structural Characterization: X-ray diffraction (XRD) analysis, FT-IR analysis, Raman spectroscopy

Microscopic and Surface Analysis: Electron microscopes: scanning electron microscopy (SEM), transmission electron microscopy (TEM); scanning probe microscopy: atomic force microscopy (AFM), scanning tunneling microscopy (STM).

Spectroscopy: X-ray photoelectron spectroscopy (XPS), fluorescence spectroscopy,UV-visible spectroscopy, nuclear magnetic resonance (NMR)spectroscopy, electron spin resonance (ESR) spectroscopy.

Electrical, Mechanical and Magnetic Properties: Impedance analysis, electro-analytical techniques: potentiometry, voltammetry, cyclic voltammetry.

Thermal and Optical Properties: Differential scanning calorimetry (DSC) analysis, Differential thermal analysis (DTA), Thermogravimetric analysis (TGA), contact angle measurement. Dynamic light scattering (DLS) method.

Applications of nanotechnology in the relevant field and non-leather chemicals: Possible industrial applications of nanomaterials in leather, footwear and leather productsindustries, application of nano materials on collagen matrix at various stages of processing techniques, synthesis of nano based materials for leather manufacture: syntans, reinforcing materials, finishing chemicals.

Environmental aspects of nanotechnology: Handling, safety and hazard of nanomaterials processing, effects of nanomaterials exposure on human and living stock, long term and short term effects, case studies of exposure, effects of nanoparticles on air, water and soil, food and food supplements.

Course Objectives:

a. To introduce and provide a broad view of the nascent field of nanoscience and nanotechnology.

b. To promote interdisciplinary interactions among engineering, technology, science, and industrial management/technology majors.
c. To utilize knowledge about developing new products and systems in leather sector.

Course Learning Outcomes (CLOs) and Mapping of CLOs with Program Learning Outcomes (PLOs)

a) CLOs: Upon completion of this course, students will be able to:

	Course Learning Outcomes (CLOs)	**Learning Level**
CLO1	Define and explain the structure, properties and applications of nanomaterials together with associated chemicals	C1, C2
CLO2	Illustrate the importance of dimensional reduction in materials and its relationship with properties.	C3
CLO3	Compare numerous methods of nanomaterials preparation and analyze nanomaterials thoroughly using engineering tools	C5
CLO4	Assess environmental pollutions/concerns by nano based materials during its production and real-life applications.	C5

b) Mapping of CLO with PLO

CLOs	**PLO1**	**PLO2**	**PLO3**	**PLO4**	**PLO5**	**PLO6**	**PLO7**	**PLO8**
CLO1	3	-	-	-	-	2	-	-
CLO2	3	-	-	-	-	3		-
CLO3	3	2	-	-	3	3	2	-
CLO4	2	3	-	-	2	2	2	-

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

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

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

	discussion, literature review, video presentation, demonstration, and problem-based exercises	Presentation, In-course Exam, and Final Exam

Learning Materials

i. Recommended Readings

a) Hand book of Nano science, Engineering, and Technology, William A. Goddard, CRC press 2003.
b) Nanolithography and patterning techniques in microelectronics, David G.Bucknall, Wood head publishing 2005.
c) Nanocomposite science and technology, Pulikel M. Ajayan, Wiley-VCH 2005

ii. Supplementary Readings:

a) Nanotechnology Environmental health and Safety: Risks Regulation and Management, Matthew Hull and Diana Bowman, Elsevier 2010
b) Hand book of Nano science, Engineering, and Technology, William A. Goddard, CRC press 2003.

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

Course Outline of 0723-FE-6217

Course Code: 0723-LE-6217

Course Title: Industrial Automation

Credits: 3.0

Rationale of the Course: This course provides an overview of the technologies of industrial automation and control as it is commonly encountered in factories of all types including leather and footwear items. Automation of the production process increases the efficiency of labor and the overall rate of growth. By ending this course, students will able to have a fundamental knowledge of current industrial automation technologies and their application.

Course Contents:

Introduction to Automation and Artificial Intelligence: Introduction, Principles and strategies, Basic elements of an automated system, Advanced automation functions, Levels of automations, Automated flow lines and transfer mechanisms, Introduction of AI, Historical development, Intelligent Systems, Types of Intelligent Agents, Components of AI, Foundations of AI, Scope of AI, Current trends in AI, Relevance to Leather, Products and Footwear Engineering

Boolean Algebra and Logic Circuits and Programmable Logic Controller (PLC): Various logic gates, Truth tables, Logic functions, Boolean Laws, Karnaugh maps, Block diagram of PLC, Programming languages of PLC, Basic instruction sets, Networking of PLC, Overview of safety of PLC with case studies. Process Safety Automation: Levels of process safety through use of PLCs,

Controllers, Sensors and Actuators: Control Modes, PID and Digital Controllers, Velocity Control, Adaptive Control, Microprocessor and Microcontrollers, important characteristics,

Main industrial sensors, Classification of sensors and their usage, Description of different kinds of sensors, Overview of Actuators, usage of Actuators in Robotics, Classification of Actuators (Pneumatic, Hydraulic, Electric), Basics of Pneumatic and Hydraulic Actuation Systems, Mechanical Actuation Systems, Electrical Actuation Systems.

Robots and their applications: Introduction to robots, Types, Classifications, Selection of robots, Robot Degrees of freedom, Robot configuration, Accuracy and repeatability, Specification of a robot, Robot feedback controls: Point to point control and Continuous path control, Control system for robot joint, Drives and transmission systems, End effectors, Industrial robot applications.

Concept and Algorithms, No programming or numerical: Problem Solving: Tree and Graph Search, Uninformed v/s informed search, uninformed methods: depth first search, breadth first search, Informed search: heuristic search, Best first search, branch and bound; Machine Learning: Introduction, types of machine learning; Learning with Decision Trees, Classification and Regression Trees, K means clustering algorithm, K nearest neighbors algorithm, hierarchical clustering, Concept of ensemble methods.

Artificial Neural Networks and Introduction to AI Technologies: Concept of ANN, Basic Models, Important Terminologies of ANNs McCulloch-Pitts Neuron, NN architecture, perceptron, delta learning rule, back propagation algorithm, Gradient Descent algorithm, feed forward networks, activation functions, Introduction to AI Technologies in the realm of Automation Concept of Natural Language Processing, Machine Vision, Deep learning, Expert systems, Genetic Algorithms, Industry 4.0.

Course Objectives:

a. To provide fundamental knowledge of automated machines and equipment including AI application in leather industry.
b. To impart the role of Boolean algebra and PLC in industrial automation.
c. To develop the operating skill of various sensors, actuators and controllers.
d. To familiarize with the application of robotic systems and artificial neural networks in automated manufacturing processes.

Course Learning Outcomes (CLOs) and Mapping of CLOs with Program Learning Outcomes (PLOs)

a) CLOs: Upon completion of this course, students will be able to:

	Course Learning Outcomes (CLOs)	**Learning Level**
CLO1	Explore their knowledge on fundamentals of industrial automation and its importance in modern manufacturing.	C1, A1
CLO2	Define and explain various automation technologies in leather and leather products manufacturing and process industries.	C1, C2, A2
CLO3	Apply various modern technologies to design an automated production facility including materials handling with robotics application.	C3, A2
CLO4	Investigate and solve any hurdle related to automation with the help of Artificial Intelligence (AI) applications.	C4, C5

b) Mapping of CLO with PLO

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

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

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

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

Learning Materials

i. Recommended Readings

a) Handbook of Industrial Automation-Richard L. Shell, Ernest L. Hall
b) Introduction to Industrial Automation- Stamatios Manesis, George Nikolakopoulos
c) Introduction to Artificial Intelligence By Wolfgang Ertel.

ii. Supplementary Readings

a) Introduction to Mechatronics and Measurement Systems by David G. Alciatore.

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

Course Outline of 0723-FE-6219

Course Code: 0723-FE-6219

Course Title: Product Design and Development.

Credits: 3.0

Rationale of the Course: Product design and development is a very important stage for any kind of product. This program is designed to deliver the latest knowledge about the product development stages and its further stages for successful product launching. This program comprises product development processes, product concept development, product planning, product architecture, industrial design, design for manufacturing, prototyping and robust design, patents and intellectual property, product development economies, managing projects, design for environment.

Course contents

Introduction: Characteristics, duration, cost, the challenges of product development.

Development Processes and Organizations: A generic development process, adapting the generic product development process, product development process flows, product development organizations, organizational links with functions, projects.

Product Planning: The product planning process, identify opportunities, evaluate and prioritize projects, allocate resources and plan timing, complete pre-project planning, reflect on the results and the process.

Product Concept Development: Identifying customer needs, product specifications, concept generation, concept selection and concept testing, present the key activities of the concept development phase.

Product Architecture: The implications of product architecture on product change, product variety, component standardization, products performance, manufacturing cost, and project management.

Industrial Design: Assessing the need for industrial design, the impact of industrial design, the industrial design process, management of the industrial design process, assessing the quality of industrial design.

Design for Manufacturing (DFM): Overview the steps of DFM process; estimate the manufacturing costs, reduce the costs of components, reduce the costs of assembly, reduce the costs of supporting production, consider the impact of DFM decisions on other factors.

Prototyping and Robust design: Basics, types, importance, principles of prototyping, prototyping technologies, planning for prototypes. Definition, design of experiments (DOE), robust design processes.

Patents and Intellectual Property: Definition, overview of patents, utility patents, preparing a disclosure in seven steps.

Product Development Economies: Elements of economic analysis, time of economic analysis, and economic analysis process steps.

Managing Projects: Understanding and representing tasks, Gantt Charts, PERT Charts, the critical path, baseline project planning, project execution, assessing project status, corrective actions, postmortem project evaluation.

Design for Environment (DFE): Basic concept, importance of DFE, four kinds of integration, a sense of timelessness, contemporary footwear and leather products design, functional planning, specific problems, studio projects.

Course Objectives:

a. To provide the basic knowledge of product design, process design, production planning, product concept development, product architecture, product prototyping, product development economics and design for environment etc.
b. To impart the idea generations of different products design, process planning of a product and will learn how to provide visual representation of a product initially through prototyping.

Course Learning Outcomes (CLOs) and Mapping of CLOs with Program Learning Outcomes (PLOs)

a) CLOs: Upon completion of this course, students will be able to:

CLOs	Course Learning Outcomes (CLOs)	Learning Level
CLO1	Identify different terms and phrases associated with product development.	C1, A1
CLO2	Explain products design through prototype.	C2, P2
CLO3	Analyze different product development processes and planning.	C4
CLO4	Justify different manufacturing problems and solutions.	C5, A3
CLO5	Evaluate product market opportunities and future of the product.	C5

b) Mapping of CLO with PLO

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

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

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

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture, Multimedia presentation.	Group Presentation, In-course

		Exam; Final Exam
CLO2	Lecture, group discussion.	Group Presentation, In-course Exam; Final Exam
CLO3	Lecture, Multimedia presentation and group discussion.	In-course Exam, and Final Exam
CLO4	Lecture, multimedia presentation, group discussion.	Group Presentation, In-course Exam, and Final Exam
CLO5	Lecture, group discussion	In-course Exam, and Final Exam

Learning Materials

i. **Recommended Readings:**
   a) Product Design and Development, TATA McGraw-Hill, Third Edition, New Delhi, 2008-Ulrich, Karl T.and Eppinger, Steven D.
   b) The Mechanical Design Process, TATA McGraw-Hill, Second Edition, 1997-Ullman, David G.
   c) Design through discovery -Marjorie Elliott Bevlin.

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

Course Outline of 0723-FE-6221

Course Code: 0723-FE-6221

Course Title: E-Commerce and International Trade

Credits: 3.0

Rationale of the Course: This course comprises basic concept of e-commerce, mobile commerce, website evaluation and usability testing, internet marketing, e-security, e-core values, osCommerce, which will help students to establish online business channel. Also, this course includes introduction to international trade, modes of operations, export strategy and marketing, which will deliver ideas to students how the leather, footwear, and leather products export market can be enlarged. Therefore, this course is crucial in this program for professional life of the students.

Course Contents:

Introduction to e-commerce: Conceptual understanding of e-commerce, e-business and e-strategy, E-commerce Drivers, Benefits of the Internet, Role of E-strategy, Value-chain in e-commerce, Analyzing Value Chain Activities, and supply-chain management and how they relate to e-commerce and e-business, Business models of the e-environment, Path to Successful E-commerce, A trend toward integrating e-commerce, E-commerce Business Models.

Mobile Commerce: Concept of Mobile Commerce, benefits of M commerce, M-Commerce Services and Applications available, Attributes of M-Commerce**,** Services of mobile

commerce**,** Mobile payment**,** Mobile Commerce Application**,** Challenges of Mobile commerce**,** Advantages, and disadvantages of M commerce.

Web Site Evaluation and Usability Testing: Characteristics of Lame Web Sites, Common Mistakes, Questions When Evaluating a Web Site, Basic Web Site Anatomy, Color and Its Psychological Effects, Consumer Association with Key Shapes, Site Evaluation Criteria, Components of Personalization, Steps to Operationalize Personalization, Popular Myths About Cookies, Web Site Usability, Effective Web Site Design, User Testing, Site Performance Issues, Managing Content and Site Traffic.

Internet Marketing: The Pros and Cons of Online Shopping, Justifying an Internet Business, Internet Marketing Techniques, and Applications, Aggressive Internet Marketing, Pop-up Advertising, Permission Marketing, The E-cycle of Internet Marketing, Examples of the "Best" and "Worst" Web Sites, New Format Brand Ads, Personalization - the fifth "P", Important Personalization Rules, Marketing Implications, Guidelines for Attracting Customers to your Site,

Getting the Money: Real-world and electronic cash and their unique features and uses**,** the key requirements for Internet-based payments**,** The many ways people pay to purchase goods and services on the Internet**,** Business-to-business methods of payment: DigiCash, E-Cash and E-Wallet,Paying for goods and services via the mobile phone**,** Issues and implications behind electronic money transactions and payments.

E-Security and the USA Patriot Act: Equal Credit Opportunity Act, Maine's Anti-Hacker laws, Spyware and Adware, Spyware Solutions, Compliance Legislation, Levels of Virus Damage, Steps for Antivirus Strategy, Steps to Prevent E-Commerce Fraud, Security Protection and Recovery, Creating Strong Password, Firewall Design and Implementation Issues, Corporate Networks and Firewalls, Cycle of Recovery from Attack, Biometric Security, Types of Biometrics and Select Application Areas, Terrorism, How Modern Terrorism Uses the Internet, National Strategy to Secure Cyberspace,

E-Core Values: Ethical issues and how to improve the ethical climate in e-commerce, Legal issues in terms of liability, warranties, copyrights, trademarks, and trade names, Taxation issues, legal disputes, and domain name disputes, Encryption laws and what they mean, international issues, especially with regard to intellectual property and developing countries.

Building online store with osCommerce: Introduction to E-Commerce with osCommerce, Setting Up the Development Environment, How osCommerce Works, Basic Configuration, Working with Data, Customization, Taxes, Payments, and Shipping, Securing Your Store, Advanced Features, Tools, Tips, and Tricks, Deployment and Maintenance, Building Your Business, A case study on building online store with osCommerce.

International trade: Introduction, International trade theory, Barriers to trade, non-tariff barriers to trade, Foreign Exchange Exposure and Foreign Trade, foreign exchange market, Exchange rate, Traditional Foreign exchange Instruments: Currency swaps, Futures contracts. Export and Import: characteristics, types, Export Documentation.

Modes of Operations: Modes of operation in International Business and the Economic Environments facing businesses. Factors influencing the choice of a particular mode of international business. Various forms of contractual entry mode and challenges in choosing a particular mode. Importance of economic environments, Elements of the economic environment and its impact, Balance of Payments and Balance of Trade.

Export Strategy and Export Marketing: Marketing strategies, Export marketing plan, setting of marketing objectives, market research, product characteristics, export pricing, distribution channels, find export opportunities, deciding on exports marketing objectives, and preparing action plans to achieve the objectives.

Course Objectives:

a. To provide the terms and phrases associated with E-Commerce and International Trade.
b. To introduce the importance of E-Commerce and International Trade.
c. To impart the role of e-commerce and international trade in leather, leather products and footwear.
d. To expose to various techniques employed in internet marketing, e-security and e-core values.
e. To acquire knowledge on how to develop ecommerce online store, international trade and Export Strategy and Export Marketing.

Course Learning Outcomes (CLOs) and Mapping of CLOs with Program Learning Outcomes (PLOs)

a) CLOs: Upon completion of this course, students will be able to:

	Course Learning Outcomes (CLOs)	**Learning Level**
CLO1	Explain e-commerce, international trade, mode of operations, export strategy and export marketing and identify the most favorable way for their business.	C2, A2
CLO2	Identify various Business-to-business methods of payment, E-Security and E-Core Values and also recognize the ethical responsibilities in business.	C3, A3
CLO3	Analyze the value chain activities and supply chain management related to e-commerce and integrate teamwork in e-business.	C4, A5
CLO4	Create an e-commerce website to explore their theoretical knowledge on professional life.	C6
CLO5	Summarize and integrate the impact of e-commerce and international trade on global economy and environmental sustainability.	C6, A5

b) Mapping of CLO with PLO

CLOs	**PLO1**	**PLO2**	**PLO3**	**PLO4**	**PLO5**	**PLO6**	**PLO7**	**PLO8**
CLO1	3	-	-	-	2	2	-	-
CLO2	3	-	3	-	3	-	2	-

CLO3	3	-	-	2	-	2	2	3
CLO4	3	-	-	-	-	2	2	2
CLO5	3	3	-	2	2	2	2	-

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

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

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

Learning Materials

i. Recommended Reading

a) Electronic Commerce: From Vision to Fulfillment by Elias M. Awad, Pearson College Div, 3rd edition.
b) Building Online Stores with osCommerce: Professional Edition by David Mercer, PACKT Publishing, Mumbai.
c) Francis Cherunilam, International Business, Text and Cases, Himalaya Publishing Company

ii. Supplementary Readings

a) T. A. S. Balagopal: Export Management, Himalaya Publishing House
b) D. C. Kapoor: Export Management, Vikas Publishing House Pvt Ltd

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

Course Outline of 0723-FE-6000

Course Code: 0723-LE-6000

Course Title: Thesis

Credit Value: 16.0

Rationale of the Course: Students for the M.Sc. in Footwear Engineering have to complete a

thesis that demonstrates their ability to conduct in-depth research into a specific area and how it will relate to their own academic backgrounds and professionalism. After completing the thesis, students will be able to think independently about specific problems and develop a research methodology.

Course Contents:

Preparation of Research Proposal: Background, aim and objectives; review of relevant research; methodology; expected outcomes.

Conformation of Research Proposal: Proposal submission, presentation, and evaluation.

Literature Review: In-depth review of literature, data collection, research gap analysis.

Experimental Work: Materials and methods, method optimization, data generation and analysis, modelling and solution.

Midterm Presentation and Thesis Paper Preparation: Presentation on preliminary findings, drafting, review and editing of thesis paper, final thesis paper.

Submission and Defense: Final thesis paper submission and oral presentation.

Course Objectives:

a. To acquaint students with research culture, ethics, and research methodology.
b. To make the students capable of thinking individually for creative development.
c. To acquire skills for identifying and analyzing problems as well as devising innovative solutions.
d. To develop effective communicative skills to present research outcomes.

Course Learning Outcomes (CLOs) and Mapping of CLOs with Program Learning Outcomes (PLOs)

a) CLOs: At the completion of this course students will be able to:

	Course Learning Outcomes (CLOs)	**Learning Level**
CLO1	Explain the background of the proposed research project and identify the research gaps.	C2, P2
CLO2	Develop research proposal and present it orally to disseminate the identified problem.	C3, A2, P3
CLO3	Analyze the existing methods and modify them based on the literature review.	C4, C5, A4, P4,
CLO4	Optimize new methods and generate, analyze, and modeling of relevant data based on the research outcomes.	C5, A4, P4
CLO5	Prepare a thesis paper with existing standards and present the results of the research through writing and orally.	C6, A5, P5

b) Mapping of CLO with PLO

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

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

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

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Discussion and encouragement	Thesis defense and report evaluation by external as well as internal
CLO2	Discussion and encouragement	
CLO3	Self-study	
CLO4	Self-work	
CLO5	Lecture, discussion, demonstration, writing, final proof-reading	

Learning Materials

i. Recommended Readings:

a) Writing the Winning Thesis or Dissertation: A Step-by-Step Guide - By Allan A. Glatthorn, Randy L. Joyner.

b) Relevant books, scientific journals, handbooks, patents and manuals.

Course Outline of 0723-FE-6300

Course Code: 0723-FE-6300

Course Title: Project

Credit Value: 4.0

Rational of the Course: Master's project is the concluding requirement for the M.Sc. in Leather Products Engineering. It is mostly designed to develop research aptitude among the students. Candidates are expected to complete a project that demonstrates their ability to conduct in-depth investigation of a specific problem to find feasible solution.

Course Contents

During project work, experimental and theoretical investigation of various problems related to leather and allied industry, environmental science, nanotechnology, industrial

engineeringetc. will be carried out. The topic should provide an opportunity to the student in developingproblem-solving skills, team work capability, argumentative skills, excellent writing ability, creativity and technical knowledge etc. Student is expected to complete the literature review/survey, selection of suitable methodology for conducting investigation and submission of an individual research proposal. At the end, student is expected to draw conclusion, prepare the dissertation, submit to the committee and appear for the project defense.

Course Objectives:

a. To develop values and attitudes related to ethical research work among students.
b. To ensure utilization of gathered knowledge in solving new real-life problems.
c. Enhance the ability of the students to analyze and summarize information available in the literature.
d. Develop effective communicative skills to present research on leather and allied issues.

Course Learning Outcomes (CLOs) and Mapping of CLOs with Program Learning Outcomes (PLOs)

a) CLOs: At the completion of this course students will be able to:

	Course Learning Outcomes (CLOs)	**Learning Level**
CLO1	Identify, analyze and formulate a research problem and use extensive investigation for obtaining its solution.	C1
CLO2	Explain the concept of ethics in research and impact of leather products engineering solutions on society and environment.	C2
CLO3	Deliver designed project findings through oral presentations, demonstrations, and written technical report format.	C2, C3

b) Mapping of CLO with PLO

CLOs	**PLO1**	**PLO2**	**PLO3**	**PLO4**	**PLO5**	**PLO6**	**PLO7**	**PLO8**
CLO1	3	-	-	-	-	2	2	1
CLO2	3	3	3	-	-	3	3	-
CLO3	3	-	-	3	-	2	-	-

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

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

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Discussion, encouragement, self-study	Project defense and report evaluation by external as well as internal
CLO2	Lecture, discussion, demonstration	
CLO3	Writing and proofreading	

Learning Materials

i. Recommended Readings:

a) Writing the Winning thesis or Dissertation: A Step-by-Step Guide - By Allan A. Glatthorn, Randy L. Joyner.
b) An Introduction to Research Methods- M. Nurul Islam
c) Relevant books, scientific journals, handbooks, patents and manuals.

Course Outline of 0723-FE-6302

Course Code: 0723-FE-6302

Course Title: Internship

Credit Value: 2.0

Rationale of the Course: The course is designed to expose students to the working environment in the industry. The intensive training will enable students to understand the theories studied with more detailed and hands-on practice within a real job situation. Furthermore, students will learn how to do a work following the specified instructions coupled with their own technical knowledge, creativity and artistry.

Course Contents

Factory inside out, product design and development, cutting, skiving, splitting, sewing and finishing, quality control, merchandising and waste management.

Course Objectives:

a. To expose students to the actual working environment and get acquainted with the organization structure, business operations and administrative functions.
b. To have hands-on experience in unit operation and unit process involved in leather products manufacturing process
c. To enhance industry- academia collaboration and co-operation.

Course learning outcomes (CLOs) and mapping of CLOs with program learning outcomes (PLOs)

a) CLOs: At the completion of this course students will be able to:

	Course Learning Outcomes (CLOs)	**Learning Level**
CLO1	Demonstrate acquired skills in the actual working environment.	C3, A3
CLO2	Analyze and evaluate layout, modern technologies, production process and waste management facilities.	C3, C4
CLO3	Summarize the collected data to generate technical reports.	C4

b) Mapping of CLO with PLO

CLOs	**PLO1**	**PLO2**	**PLO3**	**PLO4**	**PLO5**	**PLO6**	**PLO7**	**PLO8**
CLO1	3	-	-	-	2	2	2	2
CLO2	3	1	-	-	-	2	2	3
CLO3	3	-	-	2	-	-	-	-

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

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

CLOs	**Teaching-Learning Strategy**	**Assessment Strategy**
CLO1	Lecture, display, demonstration, interactive discussion, self-study and motivation	Presentation and Viva voce Report Evaluation
CLO2	Lecture, display, demonstration, interactive discussion, self-study and motivation	
CLO3	Interactive discussion, lecture, motivation and self-study	

Learning Materials

i. Recommended Readings

a) Writing the Winning Thesis or Dissertation: A Step-by-Step Guide - By Allan A. Glatthorn, Randy L. Joyner.

b) Why (and How) to Take a Plant Tour by David M. Upton and Stephen E. Macadam, published on Harvard Business Review.

Course Outline of 0723-FE-6304

Course Code: 0723-FE-6304

Course Title: Viva Voce

Credits: 1.0

Rational of the Course: This course shall ensure that the students are able to present the knowledge, skills and practical experience they earned throughout the program to the panel of experts'/ Examination committee in the most effective way.

Course Contents

It is based on all the courses the students have studied during the M. Sc. in Leather Products Engineering program.

Course Objectives:

a. To equip the students with analytical and evaluation abilities to respond to impromptu questions by the examination panel members.
b. To train the students to face the expert panel and present the knowledge, skills and problems in well-organized way.

Course Learning Outcomes (CLOs) and Mapping of CLOs with Program Learning Outcomes (PLOs)

a) CLOs: At the completion of this course students will be able to:

	Course Learning Outcomes (CLOs)	**Learning Level**
CLO1	Demonstrate the acquired knowledge and expertise in the interview panel.	C3, A3

b) Mapping of CLO with PLO

(CLOs)	**PLO1**	**PLO2**	**PLO3**	**PLO4**	**PLO5**	**PLO6**	**PLO7**	**PLO8**
CLO1	3	-	-	-	-	-	-	-

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

Learning Materials

All the books of all the semesters and the journals, data bases, real problems of leather and allied sector.

Part D

20. Grading/Evaluation

1. Grading Scale: The letter grade system shall be used to assess the performance of the student and shall be as follows:

Marks Obtained	Grade	Grade	Grade Description
80% or above	A+	4.00	***Grade A*:** Excellent performance; all course objectives achieved; objectives met in a consistently outstanding manner.
75% to less than 80%	A	3.75	
70% to less than 75%	A-	3.50	
65% to less than 70%	B+	3.25	***Grade B*:** Very good performance; significantly more than the majority (at least two-thirds) of the course objectives achieved; objectives met in a consistently thorough manner.
60% to less than 65%	B	3.00	
55% to less than 60%	B-	2.75	
50% to less than 55%	C+	2.50	***Grade C*:** Satisfactory performance; at least majority of the course objectives achieved; objectives met satisfactorily.
45% to less than 50%	C	2.25	
40% to less than 45%	D	2.00	***Grade D:*** Minimally acceptable performance; less than majority but more than the minimum required course objectives achieved.
Less than 40%	F	0.00	***Grade F*:** Failed in the course
Incomplete	I	-	
Withdrawn	W	-	

2. Grades: In the points-based grading system, there is a total number student can earn in a particular course, based on class attendance, in-course exam and final exam scores for a theoretical course. Thus, grade point of a particular course is the summation of possible marks distribution. Provided that, a fraction number in grading calculation shall be considered as the next higher consolidated number.

3. **Grade Point Average (GPA) and Cumulative Grade Point Average (CGPA):** GPA obtained in all the courses passed/completed by a student in a Semester. 'F' grades will not be counted for GPA calculation. GPA of a Semester will be calculated as follows:

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

The Cumulative Grade Point Average (CGPA) gives the cumulative performance of the student from first semester up to any other semester to which it refers and is computed by dividing the total grade points accumulated up to the date by the total credit hours.

$$\frac{\sum(GPA \times Credits\ in\ a\ semester)}{\sum(Total\ credits\ of\ all\ semester)}$$

Both GPA and CGPA will be rounded off to the second place of decimal for reporting.

4.Course Withdrawal: If a student is unable to complete any semester (Semester-I &/or Semester-II) due to illness, accident or any other valid reason etc., he/she may apply to the Registrar through the Director of the institute for total withdrawal from the Semester before the start of semester final examination.

5. Incomplete (I) courses: Incomplete 'I' grade is indicative of a situation where a student, for non-academic reasons beyond his control, is unable to complete the full requirements of the course for not being able to sit for the Semester Final Examination. *Students who fail a course are also said to have an incomplete course.* Meanwhile, the student concerned will be promoted to the next semester. Provided that, for promotion from First Year to Second Year, a student requires to earn a minimum CGPA (calculated for first and second semesters combined) of 2.50. A student can't earn the degree if they have any incomplete or failed courses.

6. **Retake**: A student will be allowed maximum of one chance to clear F grade/grades with the immediate next. He/she shall repeat the course(s) like a regular student with prior application to the Director of the institute. A student getting F grade in any theory course (courses) has to attend only the final examination for that (those) course (courses). In that case, the maximum grade obtainable in any course by the student shall be B^+.

7. **Grade Improvement**: A student may sit for improvement exam for courses where grade obtained is less than or equal to C^+ (grade point-2.50) and the best grade that a student can be awarded is B^+. A student will not be allowed for grade improvement if he or she passes and the final semester result is published. However, if the grade is not improved the previous grade will remain valid.

8. **Dropout/ Re-admission:** A student failing to get promotion may seek re-admission to study with the following batch. In the case of re-admission, all previously earned grades for the two semesters of that year will be cancelled. For re-admission, he or she has at least 30% (thirty percent) attendance in the previous semester or year. A student may take re-admission only one time. Re-admission will be allowed only after the approval of the Academic Committee of ILET. A student failing to get minimum required CGPA even after taking re-admission will be dropped out of the program.

Course Learning Outcomes (CLOs) Attainment Report

Course Learning Outcomes (CLOs)	Assessment										
	SFE (Summative) 80%				CA (Formative) 20%						CLO Attainment (%)
	Incourse/Class Test/Mid-Semester (30%)		Final Examination (60%)		MCQ/MQ/ Quiz (10%)		Assignment/ Case Study (5%)		Presentation (5%)		
	AM	AC	AM	AC	AM	AC	AM	AC	AM	AC	
CLO1											
CLO2											
CLO3											
CLO4											
CLO5											
CLO6											
CLO7											

AM: Actual Marks = (Given Marks/Total Given Marks of Component) × (% of the Course)

AC: Assessment Contribution; M=Average Marks in % and W = Weightage=C/T

Attainment (A) = $\sum_{i=1}^{M}(M_i \times W_i)$

Or Marks of CLO1 = (% marks distributed Assessment Type1×% Overall)+(% marks distributed Assessment Type-2×% Overall)+(% marks distributed Assessment Type-3×% Overall)+.....

Part E

21. Course outline

Curriculum
M.Sc. in Footwear Engineering (Thesis Group)
Institute of Leather Engineering and Technology (ILET)
UNIVERSITY OF DHAKA

Semester-I

Course Code	Course Title	Credits
0723-FE-6101	Advanced Footwear Manufacturing	3.00
0723-FE-6103	Optimization Techniques of Footwear Manufacturing	3.00
0723-FE-6105	Research Methodology	3.00
0723-FE-6107	Industrial Hazards and Waste Management	3.00
0723-FE-6109	Ergonomics and Industrial Safety	3.00
0723-FE-6111	Pedorthic Footwear	3.00
0723-FE-6000	Thesis	-
Total		**18.0**

Semester-II

Course Code	Course Title	Credits
0723-FE-6213	Environmental Management and Impact Assessment	3.00
0723-FE-6000	Thesis	-
	Optional Course (Any one from the following List)	
Course Code	**Course Title**	**Credits**
0723-FE-6215	Nanotechnology for Leather and Leather Products	3.00
0723-FE-6217	Industrial Automation	3.00
Total		**6.00**

Semester-III

Course Code	Course Title	Credits
0723-FE-6000	Thesis	16.00
Grand Total		**40.00**

N.B. Thesis to be taken from Semester-I and will complete in Semester-III.

DETAIL COURSE CONTENTS

Semester-I

Course Code	Course Title	Credits
0723-FE-6101	Advanced Footwear Manufacturing	3.00
0723-FE-6103	Optimization Techniques of Footwear Manufacturing	3.00
0723-FE-6105	Research Methodology	3.00
0723-FE-6107	Industrial Hazards and Waste Management	3.00
0723-FE-6109	Ergonomics and Industrial Safety	3.00
0723-FE-6111	Pedorthic Footwear	3.00
0723-FE-6000	Thesis	-
Total		**18.0**

Course Outline of 0723-FE-6101

Part A

1. Course Code: 0723-FE-6101

2. Course Title: Advanced Footwear Manufacturing

3. Course Type: Core Course

4. Year / Semester: Semester: I

5. Academic Session: 2022-23

6. Course Teachers: Noor Mohammad, Assistant Professor, ILET, DU
Md. Mukter Alam, Lecturer, ILET, DU

7. Prerequisite(s): N/A

8. Credits: 3.0

9. Contact Hours: 42

10. Total Marks: 100

11. Rationale of the Course: This course is intended to introduce students to various types of advanced manufacturing concepts of footwear. It will render the students about cutting-edge technology used in footwear industries. Moreover, it will help the students to understand the various aspects of footwear manufacturing paving the way for sustainability.

Course Contents:

Additive manufacturing (AM) techniques in footwear: Introduction to AM, AM in sports footwear, potential elements of AM, AM techniques: Stereolithography (SLA), PolyJet (PJ), selective laser sintering (SLS) and three-dimensional printing (3DP), suitability of different AM techniques and challenges of AM techniques, Major Applications of 3D Printing in

Footwear; 3D knitted upper-footwear with 3D knitted upper, techniques and automation for the creation of 3D knitted fabrics, tight-to-toe approach, fit and comfort, box-toes and counters, air permeability, thermal and water vapor resistance, and sole attachment.

Sustainability in footwear production: Footwear and its role in sustainability, sustainable production practices from designing to packaging department, waste accumulation, controlling volatile organic chemicals, CO_2, polymers, water, restricted substances, implementation of labor law in footwear production, implementation of environment conservation rules in footwear production, reducing costs in footwear manufacturing.

Waterproof and cold weather footwear: Design and manufacturing requirements of waterproof and cold weather footwear, properties and specifications of footwear upper and bottom materials for waterproof and cold weather footwear, and related testing for performance.

Quick drying footwear: Introduction, importance of quick-drying, material selection, mechanism of water removal, quick-drying footwear construction, testing for performance, maintaining performance in production.

Platform shoe: Advantages and disadvantages of platform shoe, importance of keeping stable in platform shoe, controlling of toe spring, positioning the shank, controlling waist strength, design, materials and construction.

Special upper leather: Origins and properties of suede and nubuck leather, shoe-making problems with suede and nubuck leather, sensitive surfaces, protection during shoemaking, other shoemaking operations, wear properties, acceptable levels of color fastness, oily finished leather for shoe making and wearing, properties of patent leather, problems that may arise in the use of patent leathers.

Shoe upper permeability maximization: Breathability and foot comfort, factors affecting thermoregulation, different climates, permeability performance of different materials, selection of materials, upper construction, importance upper permeability.

12. Course Objectives:

a. To introduce students to advanced footwear manufacturing technology.
b. To familiarize students with sustainable footwear production practices.
c. To equip students with footwear manufacturing for cold weather and waterproof, quick-drying, and platform shoe.
d. To disseminate knowledge about special types of leather-made footwear and shoe upper permeability.

13. Course Learning Outcomes (CLOs) and Mapping of CLOs with Program Learning Outcomes (PLOs)

a) CLOs: Upon completion of this course, students will be able to:

	Course Learning Outcomes (CLOs)	**Learning Level**
CLO1	Outline the basic knowledge of additive manufacturing techniques, sustainable footwear production, and different special-purpose footwear.	C1, A1
CLO2	Explain the essential features of footwear materials related to waterproof, cold weather, quick drying, and platform footwear.	C2, A2
CLO3	Apply the principle of advanced manufacturing techniques in waterproof, cold weather, quick drying, and platform footwear.	C3, A3
CLO4	Analyze and rectify the related problems of special types of footwear manufacturing.	C4, A3
CLO5	Compare and justify the various aspects of manufacturing techniques in waterproof, cold weather, quick-drying, and platform shoes.	C5, A4

b) Mapping of CLO with PLO

CLOs	**PLO1**	**PLO2**	**PLO3**	**PLO4**	**PLO5**	**PLO6**	**PLO7**	**PLO8**
CLO1	3	3	-	-	-	-	-	-
CLO2	3	3	-	-	-	-	-	-
CLO3	3	3	-	-	-	-	-	-
CLO4	3	3	-	-	-	3	-	-
CLO5	3	3	-	-	-	3	-	3

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

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

CLOs	**Teaching-Learning Strategy**	**Assessment Strategy**
CLO1	Lecture, Whiteboard illustration, Multimedia presentation	In-course assessment, Assignment; Final examination

CLO2	Lecture, Whiteboard illustration, Multimedia presentation	In-course Exam; Final Exam
CLO3	Lecture, Whiteboard illustration, Multimedia presentation	In-course Assessment, Case study; Final examination
CLO4	Lecture, Whiteboard illustration, Multimedia presentation	In-course assessment; Final examination
CLO5	Lecture, Whiteboard illustration, Multimedia presentation	In-course Assessment, Presentation; Final examination

Part B

14. Course plan specifying content, CLOs, co-curricular activities (if any), teaching-learning, and assessment strategy mapped with CLOs

Time Period	Topic	Teaching-Learning Strategy	Assessment Method	Corresponding CLOs
Week-01	**Additive manufacturing (AM) techniques in footwear:** Introduction to AM, AM in sports footwear, potential elements of AM, AM techniques: Stereolithography (SLA), PolyJet (PJ), selective laser sintering (SLS) and three-dimensional printing (3DP), suitability of different AM techniques and challenges of AM techniques.	• Interactive discussion • Lecture with multimedia • Whiteboard illustration	• In-course Exam • Final Exam	CLO1, CLO2
Week -02	Major Applications of 3D Printing in Footwear; 3D knitted upper-footwear with 3D knitted upper, techniques and automation for the creation of 3D knitted fabrics, tight-to-toe approach, fit and comfort, box-toes and counters, air permeability, thermal and water vapour resistance, and sole attachment.	• Interactive discussion • Lecture with multimedia • Whiteboard illustration	• In-course Exam • Final Exam	CLO1, CLO2

Week -03	**Sustainability in footwear production:** Footwear and its role in sustainability, sustainable production practices from designing to packaging department, waste accumulation, controlling volatile organic chemicals, CO_2, polymers, and water.	• Interactive discussion • Lecture with multimedia • Whiteboard illustration	• In-course Exam • Final Exam	CLO1
Week -04	Restricted substances, implementation of labor law in footwear production, implementation of environment conservation rules in footwear production, reducing costs in footwear manufacturing.	• Interactive discussion • Lecture with multimedia • Whiteboard illustration	• In-course Exam • Assignment • Final Exam	CLO1
Week -05	**Waterproof and cold weather footwear:** Design and manufacturing requirements of waterproof and cold weather footwear.	• Interactive discussion • Lecture with multimedia • Whiteboard illustration	• In-course Exam • Final Exam	CLO2, CLO3
Week -06	Properties and specifications of footwear upper materials for waterproof and cold weather footwear, and related testing for performance.	• Interactive discussion • Lecture with multimedia • Whiteboard illustration	• In-course Exam • Final Exam	CLO2, CLO3, CLO5
Week -07	Properties and specifications of footwear bottom materials for waterproof and cold weather footwear, and related testing for performance.	• Interactive discussion • Lecture with multimedia • Whiteboard illustration	• In-course Exam • Case study • Final Exam	CLO2, CLO3, CLO5
Week -08	**Quick drying footwear:** Introduction, importance of	• Interactive discussion	• In-course Exam	CLO1, CLO2

	quick-drying, material selection, mechanism of water removal.	• Lecture with multimedia • Whiteboard illustration	• Final Exam	
Week -09	Quick-drying footwear construction, testing for performance, and maintaining performance in production.	• Interactive discussion • Lecture with multimedia • Whiteboard illustration	• In-course Exam • Final Exam	CLO3, CLO5
Week -10	**Platform shoe manufacture:** Advantages and disadvantages of platform shoe, importance of keeping stable in platform shoe, controlling of toe spring, positioning the shank, controlling waist strength, design and construction.	• Interactive discussion • Lecture with multimedia • Whiteboard illustration	• In-course Exam • Final Exam	CLO3, CLO5
Week -11	**Special upper leather footwear:** Origins and structures of suede and nubuck leather, properties of suede and nubuck leather, shoe making problems with suede and nubuck leather, sensitive surfaces, protection during shoemaking, other shoemaking operations, wear properties, dye fixatives, surface fixatives.	• Interactive discussion • Lecture with multimedia • Whiteboard illustration	• In-course Exam • Final Exam	CLO1, CLO2, CLO4
Week -12	Acceptable levels of colour fastness, customer awareness; properties of oily finished leather, surface appearance, problems that may arise in the use of oily finished leather for shoe making and wearing-soiling, cleaning and adhesion, properties of patent leather, problems that may arise in the use of patent leathers-tear	• Interactive discussion • Lecture with multimedia • Whiteboard illustration	• In-course Exam • Final Exam	CLO4, CLO5

	strength problem, orange-peel effects, heat stress cracking, flexing problem, coating peeling, abrasion damage, surface friction effects, care taken for producing footwear with patent leather.			
Week -13	**Shoe upper permeability maximization:** Breathability and foot comfort, factors affecting thermoregulation.	• Interactive discussion • Lecture with multimedia • Whiteboard illustration	• Final Exam	CLO2, CLO4, CLO5
Week -14	Different climates, permeability performance of different materials, selection of materials, upper construction, importance upper permeability.	• Interactive discussion • Lecture with multimedia • Whiteboard illustration	• Presentation • Final Exam	CLO2, CLO4, CLO5

Part C

15. Assessment and Evaluation

i) Assessment Strategy

Strategy	**Percentage of Total marks**
Class attendance and participation	10
In-course Exam/Class Test	30
Semester Final Examination (3 hours duration)	60
Total	**100**

ii) Marks distribution:

- Continuous Assessment: 40%
- Summative: 60%
- Make-up Procedures: Two in-course exams will be taken and average marks will be counted. Feedback on in-course assessment is given to the students immediately after the test. If students are very weak in particular topics of this course, additional instruction will be given to help them catch up.

Part D

16. Learning Materials

iv. Recommended Readings

a) ROSSI, W. A. and TENNANT, R.-Professional Shoe Fitting, New York, Pedorthic Footwear Association.
b) STELLA, S.-The Innovation Notebooks for the Footwear Industry, Last, Italy, AssomacServizisrl.
c) Miller, R.G-Manual of Shoe Making, 5th ed. Printing Department, Clarks Ltd. C. & J. Clark Ltd.
d) Wade Motawi-Shoe Materials Design Guide.

v. Supplementary Readings

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

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

Course Outline of 0723-FE-6103

Part A

1. Course Code: 0723-LPE 6103

2. Course Title: Optimization Techniques of Footwear Manufacturing

3. Course Type: Core Course

4. Year / Semester: Semester: I

5. Academic Session: 2022-23

6. Course Teachers: Uttam Kumar Roy, Associate Professor, ILET, DU.

Md. Abdus Shabur, Lecturer, ILET, DU.

7. Prerequisite(s): N/A

8. Credits: 3.0

9. Contact Hours: 42

10. Total Marks: 100

11. Rationale of the Course: The focus of this course is on theoretical concepts, data-driven models, and numerical techniques for optimization using actual variables. The course provides a thorough understanding in mathematical optimization theory, methods, and algorithms. The course will begin with linear optimization, and will go into detail about how to formulate problems and find solutions as well as to develop a methodology for footwear engineering design.

Course Contents:

Advanced Inventory Management: Demand and control system characteristics, inventory concept, inventory cost, inventory modeling, optimization and inventory control, Dynamic EOQ Models, probabilistic models and safety stock, probabilistic demand, probabilistic example, Single-Period Models, Multiperiod Models.

Aggregate Planning and Master Scheduling: Basic Strategies for Meeting Uneven Demand, Techniques for Aggregate Planning, Disaggregating the Aggregate Plan, Master Scheduling, the Master Scheduling Process, Methods for Aggregate Planning: Graphical Methods, Mathematical Approaches, and Comparison of Aggregate Planning Methods.

MRP, MRPII and ERP: Basic ideas of inventory MRP, benefits of MRP, inputs to MRP, bill of material (BOM), BOM examples for footwear manufacture, Master Production Schedule (MPS), MPS examples for footwear manufacture, time-phased product structure, MRP structure, determining gross requirements, gross requirements plan for footwear manufacture, gross requirements schedule, MRP management, Lot-sizing techniques, Lot-for-Lot examples, EOQ lot size examples, POQ lot size examples, material requirements planning II, distribution resource planning (DRP), enterprise resource planning (ERP), SAP's ERP modules.

Decision Modeling: The Decision Process in Operations; Fundamentals of Decision Making; Types of Decision-Making Environments; Decision Making under Uncertainty, Decision Making under Risk, Decision Making under Certainty, Expected Value of Perfect Information (EVPI); Decision Trees; A More Complex Decision Tree, Using Decision Trees in Ethical Decision Making.

Linear Programming Models: Why Use Linear Programming? Requirements of a Linear Programming Problem, Formulating Linear Programming Problems, Graphical Solution to a Linear Programming Problem, Sensitivity Analysis, Solving Minimization Problems, Linear Programming Applications, the Simplex Method of LP.

Transportations Modeling: Transportation Modeling; Developing an Initial Solution: The Northwest-Corner Rule, The Intuitive Lowest-Cost Method, The Stepping-Stone Method; Special Issues in Modeling: Demand Not Equal to Supply, Degeneracy; Using Software to Solve Transportation Problems; Case Studies.

Integer Programming and Dynamic Programming and Network Techniques: Integer programming - Cutting plane algorithm, Branch and bound technique, Zero-one implicit enumeration – Dynamic Programming – Formulation, Various applications using Dynamic Programming. Network Techniques – Shortest Path Model – Minimum Spanning Tree Problem – Maximal flow problem.

Problem solving tools and improvement strategies: Problem solving process, quality control tools, new management tools, quality function deployment, Deming wheel, zero defect concept, benchmarking, six- sigma.

12. Learning Objectives:

a. To introduce students with advanced inventory management and aggregate planning.
b. To familiarize students with various production planning methods.
c. To provide knowledge on different optimization models and their applications in footwear manufacturing.

13. Course Learning Outcomes (CLOs) and Mapping of CLOs with Program Learning Outcomes (PLOs)

a) CLOs: Upon completion of this course, students will be able to:

	Course Learning Outcomes (CLOs)	Learning Level
CLO1	Explore knowledge on various optimization techniques used in footwear manufacturing.	C1, C2, A1
CLO2	Explain the methods and ways to manage different optimization tools.	C2, A2
CLO3	Implement the advanced tools and techniques of operations research to manage the production in the footwear industry supply chain	C3, A2
CLO4	Manage new project related to new footwear products or business	C4
CLO5	Investigate the applicability of a specific tool or technique to a specific case.	C5

b) Mapping of CLO with PLO

(CLOs)	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8
CLO1	3	-	-	-	-	-	-	-
CLO2	3	-	-	-	-	1	-	-
CLO3	3	-	-	-	1	2	2	-
CLO4	3	-	2	1	-	2	3	-
CLO5	3	-	2	-	2	2	1	-

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

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

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

	based exercises	Final Exam
CLO5	Lecture, multimedia presentation, group discussion, demonstration, and problem-based exercises	Group Presentation, Case study, Assignment, In-course Exam and Final Exam

Part B

14. Course plan specifying content, CLOs, co-curricular activities (if any), teaching learning and assessment strategy mapped with CLOs

Time Period	Topic	Teaching-Learning Strategy	Assessment Strategy	Corresponding CLOs
Week-01	**Advanced Inventory Management:** Demand and control system characteristics, inventory concept, inventory cost, inventory modeling, optimization and inventory control.	• Lecture • Group Discussion • Multimedia Presentation • Literature review	• In-course Exam • Final Exam	CLO1, CLO2, CLO3
Week -02	Dynamic EOQ Models, probabilistic models and safety stock, probabilistic demand, probabilistic example, Single-Period Models, Multiperiod Models.	• Lecture • Group Discussion • Multimedia Presentation • Literature review	• In-course Exam • Final Exam	CLO1, CLO2, CLO3
Week -03	**Aggregate Planning and Master Scheduling:** Basic Strategies for Meeting Uneven Demand, Techniques for Aggregate Planning, Disaggregating the Aggregate Plan.	• Lecture • Group Discussion • Multimedia Presentation	• Assignment • In-course Exam • Final Exam	CLO1, CLO2
Week -04	Master Scheduling, The Master Scheduling Process, Methods for	• Lecture • Group Discussion	• In-course Exam	CLO1, CLO2

	Aggregate Planning: Graphical Methods, Mathematical approaches, Comparison of Aggregate Planning Methods.	Multimedia Presentation • Problem solving	• Final Exam	
Week -05	**MRP, MRPII and ERP**: Basic ideas of inventory MRP, benefits of MRP, inputs to MRP, bill of material (BOM), BOM examples for footwear manufacture, Master Production Schedule (MPS).	• Lecture • Group Discussion • Multimedia Presentation	• Case study • In-course Exam • Final Exam	CLO1, CLO2, CLO3
Week -06	MPS examples for footwear manufacture, time-phased product structure, MRP structure, determining gross requirements, gross requirements plan for footwear manufacture, gross requirements schedule.	• Lecture • Group Discussion • Multimedia Presentation	• In-course Exam • Final Exam	CLO2, CLO3, CLO5
Week -07	**MRP management**, Lot-sizing techniques, Lot-for-Lot examples, EOQ lot size examples, POQ lot size examples, material requirements planning II, distribution resource planning (DRP), enterprise resource planning (ERP), SAP's ERP modules.	• Lecture • Group Discussion • Multimedia Presentation	• Case Study • In-course Exam • Final Exam	CLO2

Week -08	**Decision Modeling**: The Decision Process in Operations; Fundamentals of Decision Making; Types of Decision-Making Environments; Decision Making under Uncertainty.	• Lecture • Group Discussion • Multimedia Presentation	• In-course Exam • Final Exam	CLO3, CLO4, CLO5
Week -09	Decision Making under Risk, Decision Making under Certainty, Expected Value of Perfect Information (EVPI); Decision Trees; A More Complex Decision Tree, Using Decision Trees in Ethical Decision Making.	• Lecture • Group Discussion • Multimedia Presentation	• Group Presentation • In-course Exam • Final Exam	CLO3, CLO4, CLO5
Week -10	**Linear Programming Models**: Why Use Linear Programming? Requirements of a Linear Programming Problem, Formulating Linear Programming Problems, Graphical Solution to a Linear Programming Problem, Sensitivity Analysis, Solving Minimization Problems, Linear Programming Applications, The Simplex Method of LP.	• Lecture • Group Discussion • Multimedia Presentation	• In-course Exam • Final Exam	CLO1, CLO3
Week -11	**Transportations Modeling:** Transportation Modeling; Developing an Initial Solution: The Northwest-Corner	• Lecture • Group Discussion • Multimedia Presentation	• In-course Exam • Final Exam	CLO1, CLO3, CLO5

	Rule, The Intuitive Lowest-Cost Method, The Stepping-Stone Method; Special Issues in Modeling: Demand Not Equal to Supply, Degeneracy; Using Software to Solve Transportation Problems; Case Studies.	• Problem solving		
Week -12	**Integer Programming** and Dynamic Programming and Network Techniques: Integer programming - Cutting plane algorithm, Branch and bound technique, Zero-one implicit enumeration – Dynamic Programming – Formulation.	• Lecture • Group Discussion • Multimedia Presentation	• In-course Exam • Final Exam	CLO1, CLO3
Week -13	Various applications using Dynamic Programming. Network Techniques – Shortest Path Model – Minimum Spanning Tree Problem – Maximal flow problem.	• Lecture • Group Discussion • Multimedia Presentation • Problem solving	• Oral Presentation • In-course Exam • Final Exam	CLO3
Week -14	**Problem solving tools and improvement strategies**: Problem solving process, quality control tools, new management tools, quality function deployment, Deming wheel, zero defect concept, benchmarking, six- sigma.	• Lecture • Group Discussion • Multimedia Presentation • Literature review	• In-course Exam • Final Exam	CLO1, CLO3, CLO4, CLO5

Part C

15. Assessment and Evaluation

i) Assessment Strategy

Strategy	Percentage of Total marks
Class attendance and participation	10
In-course Exam/Class Test	30
Semester Final Examination (3 hours duration)	60
Total	**100**

ii) Marks distribution:

- Continuous Assessment: 40%
- Summative: 60%
- Make-up Procedures: Two in-course exams will be taken and average marks will be counted. Feedback on in-course assessment is given to the students immediately after the test. If students are very weak in particular topics of this course, additional instruction will be given to help them catch up.

Part D

16. Learning Materials

iv. Recommended Readings

a) Jay Heizer, Barry Render, Chuck Munson- Operations Management: Sustainability and Supply Chain Management (13th Edition)
b) Jay Heizer, Barry Render- Operations Management (11th Edition)
c) Hamdy A. Taha, Operations Research – An Introduction, Prentice Hall of India, 1997
d) Gideon Halevi- Handbook of Production Management Methods
e) R. Panneerselvam, "Operations Research", Prentice Hall of India Private Limited, New Delhi 1 – 2005

v. Supplementary Readings

a) Larry P. Ritzman, Lee J. Krajewski, and Manoj K. Malhotra- Operations Management: Processes and Supply Chains
b) Nicholas J. Aquilano and Richard B. Chase- Production and Operations Management

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

Course Outline of 0723-FE-6105

Part A

1. Course Code: 0723-FE-6105

2. Course Title: Research Methodology

3. Course Type: Core Course

4. Year / Semester: Semester: I

5. Academic Session: 2022-23

6. Course Teacher: Dr. Mohammed Mizanur Rahman, Professor and Director, ILET, DU

7. Prerequisite(s): N/A

8. Credits: 3.0

9. Contact Hours: 42

10. Total Marks: 100

11. Rational of the Course: This course provides an opportunity for students to establish or advance their understanding of research through critical exploration of research language, ethics, and approaches. Students will be able to examine and be practically exposed to the main components of a research framework i.e., problem definition, research design, data collection, ethical issues in research, report writing, and presentation.

Course Contents:

Introduction to research: Definitions, characteristics, types, differences and role of research**,** research and investigation, research methods versus research methodology**,** criteria of good research, paradigms and ethics in research, proposition, axiom, postulate, theorem and model of research**,** variables and types**,** properties of relationships between variables**,** inductive and deductive method.

Literature review and research problem: Definition, objectives, advantages, principles and procedures of literature review, problem definition, finding a researchable problem**,** selecting the problem**,** importance of defining the problem, important qualities of a research problem**,** techniques involved in defining a problem**,** evaluating a proposed design.

Research questions and objectives: Research objective and research question**,** practical examples of research objectives and research question, formulation of research questions, criteria of research objectives, evaluation of research questions, classification and importance of research objectives.

Research hypothesis, design, and proposal: Source, functions, and characteristics of a good research hypothesis, formulation and possible difficulties of research hypothesis, research hypothesis versus research objectives; definition, function, classification of research design, feature of a good research design, qualitative research, observation studies**,** surveys**,** experimentation, steps in a research design; meaning of research proposal**,** contents of research proposal**,** steps in the development of a research proposal, criteria for evaluating research proposal.

Qualitative research tools, measurement and scaling technique: Definition**,** characteristics, uses, and general steps of qualitative research, qualitative research approaches, steps in grounded theory, nature of measurement**,** measurement scales, types of measurement scales, Likert scale.

Questionnaire design: Questionnaire and questionnaire design**,** consideration and types of questions**,** questionnaire designing process**,** necessary properties of questionnaire**,** characteristics of a good questionnaire**,** precaution required in the use of questionnaire**,** guidelines for constructing questions and questions sequence.

Sampling and sampling design: Concepts and importance of sampling**,** planning and designing a survey**,** classification of sampling techniques**,** probability sampling design**,** non-probability sampling design**,** determination of sample size.

Data collection and analysis: Data, data versus information, types and sources of data collection**,** secondary data collection methods**,** primary data collection methods**,** qualitative and quantitative methods of data collection**,** data validation, editing and coding**,** data entry and exploring**,** displaying and examining data**,** Univariate analysis**,** Bivariate analysis**,** Multivariate analysis**,** SWOT analysis**,** and Hypothesis testing.

Presenting insights and findings: Importance of the report and presentation**,** report preparation and presentations process**,** precautions in interpretation**,** research report**,** contents and precautions in writing research report**,** presentation of statistics**,** oral presentation**,** writing thesis/dissertation**,** writing journal articles and conference papers**,** bibliography and reference writing styles**,** copy right**,** plagiarism.

12. Course Objectives:

a. To familiarize the students with the key terms, concepts, and practices in the field of research.
b. To prepare research problems and/or hypotheses in a clear and concise format.
c. To demonstrate a systematic understanding of the range of advanced research techniques, be able to critically evaluate these techniques and apply them appropriately.
d. To evaluate and critically analyze the components of scholarly writing and published research.

13. Course Learning Outcomes (CLOs) and Mapping of CLOs with Program Learning Outcomes (PLOs)

a) CLOs: Upon completion of this course, students will be able to:

	Course Learning Outcomes (CLOs)	**Learning Level**
CLO1	Outline the basic framework of research process, and identify various sources of information for literature review and data collection.	C1, A1
CLO2	Explain the ethical dimensions of conducting basic and applied research.	C2, A2
CLO3	Design questionnaire, explain the procedures and techniques, and analyze data with different statistical tools and techniques using statistical computing for making better decisions.	C2, C3, A3
CLO4	Acquaint with the process of conducting research to identify real-life problems recurrently encounter and to suggest suitable and pragmatic solutions to those problems.	C4, A4
CLO5	Compare the advanced research techniques and critically analyze the components of scholarly writing and published research.	C5, A4

b) Mapping of CLO with PLO

(CLOs)	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8
CLO1	3	-	3	-	-	2	-	-
CLO2	3	-	3	-	-	2	-	-
CLO3	3	-	3	-	-	3	-	2
CLO4	3	3	3	3	-	3	2	-
CLO5	3	2	3	3	-	3	3	-

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

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

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture, Whiteboard illustration, Multimedia presentation, Interactive Discussion	Assignment, Case study, In-course Exam and Final Exam
CLO2	Lecture, Whiteboard illustration, Multimedia presentation, Interactive Discussion	Assignment, Case study, In-course Exam and Final Exam
CLO3	Lecture, Whiteboard illustration, Multimedia presentation, Interactive Discussion	Assignment, Case study, In-course Exam and Final Exam
CLO4	Lecture Whiteboard illustration, Multimedia presentation, Interactive Discussion	Presentation, Assignment, In-course Exam and Final Exam
CLO5	Lecture, Whiteboard illustration, Multimedia presentation, Interactive Discussion	Presentation, Assignment, In-course Exam and Final Exam

Part B

14. Course plan specifying content, CLOs, co-curricular activities (if any), teaching learning and assessment strategy mapped with CLOs.

Time Period	Topic	Teaching-Learning Strategy	Assessment Strategy	Corresponding CLOs
Week -01	**Introduction to research:** Definitions, characteristics, types, differences and role of research**,** research and investigation, research methods versus research methodology**,** criteria of good research, paradigms and ethics in research.	• Lecture • Whiteboard illustration	• In-Course Exam • Final Exam	CLO1, CLO2
Week -02	Proposition, axiom, postulate, theorem and	• Lecture • Multimedia	• In-Course Exam	CLO1, CLO2

	model of research**,** variables and types**,** properties of relationships between variables**,** inductive and deductive method.	presentation	• Final Exam	
Week -03	**Literature review and research problem:** Definition, objectives, advantages, principles and procedures of literature review, problem definition, finding a researchable problem**,** selecting the problem**,** importance of defining the problem, important qualities of a research problem**,** techniques involved in defining a problem**,** evaluating a proposed design.	• Lecture • Multimedia presentation • Case study	• In-Course Exam • Assignment • Final Exam	CLO1, CLO2, CLO4
Week -04	**Research questions and objectives:** Research objective and research question**,** practical examples of research objectives and research question, formulation of research questions, criteria of research objectives, evaluation of research questions, classification and importance of research objectives.	• Lecture • Multimedia presentation • Whiteboard illustration	• In-Course Exam • Final Exam	CLO1, CLO2, CLO3
Week -05	**Research hypothesis, design, and proposal:** Source, functions, and characteristics of a good research hypothesis, formulation and possible	• Lecture • Multimedia presentation • Whiteboard illustration	• In-Course Exam • Case study • Final Exam	CLO1, CLO2, CLO3

	difficulties of research hypothesis, research hypothesis versus research objectives; definition, function, classification of research design, feature of a good research design.			
Week -06	Qualitative research, observation studies, surveys, experimentation, steps in a research design; meaning of research proposal**,** contents of research proposal**,** steps in the development of a research proposal, criteria for evaluating research proposal.	• Lecture • Multimedia presentation	• In-Course Exam • Final Exam	CLO1, CLO2, CLO3
Week -07	**Qualitative research tools, measurement and scaling technique:** Definition**,** characteristics, uses, and general steps of qualitative research, qualitative research approaches, steps in grounded theory, nature of measurement**,** measurement scales, types of measurement scales, Likert scale.	• Lecture • Video presentation • Whiteboard illustration	In-Course Exam Final Exam	CLO2, CLO3, CLO5
Week -08	**Questionnaire design:** Questionnaire and questionnaire design**,** consideration and types of questions**,** questionnaire designing process**,** necessary properties of	• Lecture • Interactive discussion • Whiteboard illustration	• In-Course Exam • Final Exam	CLO2, CLO3

	questionnaire**,** characteristics of a good questionnaire**.**			
Week -09	Precaution required in the use of questionnaire, guidelines for constructing questions, and questions sequence. **Sampling and sampling design:** Concepts and importance of sampling**,** planning and designing a survey**,** classification of sampling techniques.	• Lecture • Multimedia presentation	• In-Course Exam • Final Exam	CLO2, CLO3, CLO4
Week -10	Probability sampling design**,** non-probability sampling design**,** and determination of sample size. **Data collection and analysis:** Data, data versus information, types and sources of data collection**,** secondary data collection methods**,** primary data collection methods.	• Lecture • Multimedia presentation	• In-Course Exam • Final Exam	CLO2, CLO3
Week -11	Qualitative and quantitative methods of data collection, data validation, editing and coding**,** data entry and exploring**,** displaying and examining data**,** Univariate analysis**,** Bivariate analysis**,** Multivariate analysis**,** SWOT analysis**,** and Hypothesis testing.	• Lecture • Whiteboard illustration • Multimedia presentation	• In-Course Exam • Presentation • Final Exam	CLO3, CLO4, CLO5
Week -12	**Presenting insights and findings:** Importance of	• Lecture • Multimedia	• In-Course Exam	CLO3, CLO4, CLO5

	the report and presentation, report preparation and presentations process, precautions in interpretation, research report, contents and precautions in writing research report.	presentation	• Final Exam	
Week -13	Presentation of statistics, oral presentation, writing thesis/dissertation, writing journal articles and conference papers, bibliography and reference writing styles, copyright, plagiarism.	• Lecture • Case study	• Assignment • Final Exam	CLO3, CLO4, CLO5
Week -14	Review	• Interactive discussion	• Final Exam	CLO1-CLO5

Part C

15. Assessment and Evaluation

i) Assessment Strategy

Strategy	**Percentage of Total marks**
Class attendance and participation	10
In-course Exam/Class Test	30
Semester Final Examination (3 hours duration)	60
Total	**100**

ii) Marks distribution:

- Continuous Assessment: 40%
- Summative: 60%
- Make-up Procedures: Two in-course exams will be taken and average marks will be counted. Feedback on in-course assessment is given to the students immediately after the test. If students are very weak in particular topics of this course, additional instruction will be given to help them catch up.

Part D

16. Learning Materials

i. Recommended Readings

a) M. A. Salam Akanda (2019). Research Methodology-A Complete Direction for Learners. Latest Ed., Akanda& Sons, Dhaka.

b) C. R. Kothari (1996). Research Methodology- Methods & Techniques. Wishaw Prokashan, New Delhi, Wiley Eastern Limited.

c) An Introduction to Research Methods ; Author: M. Nurul Islam ; Year: 2011 ; Edition: 2nd ; Publisher: Mullick& Brothers

ii. Supplementary Readings

a) Ranjit Kumar (2005). *Research Methodology- A Step-by-Step Guide for Beginners*, 3rd Ed., Singapore, Pearson Education.

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

Course Outline of 0723-FE-6107

Part A

1. Course Code: 0723-FE-6107

2. Course Title: Industrial Hazards and Waste Management

3. Course Type: Core Course

4. Year / Semester: Semester: I

5. Academic Session: 2022-23

6. Course Teachers: Dr. Md. Abdul Mottalib, Professor, ILET, DU.

Sunzida Haque Rimu, Lecturer, ILET, DU.

7. Prerequisite(s): N/A

8. Credits: 3.0

9. Contact Hours: 42

10. Total Marks: 100

11. Rationale of the Course: This course is designed to provide in-depth knowledge of the exploitation of valuable products from tannery wastes by utilizing modern technology. This course will facilitate students with deeper understanding of different types and characteristics of industrial hazardous wastes and a comprehensive overview of hazardous waste management's approaches.

Course Contents:

Industrial Hazards: Hazard, Types of industrial hazards, Identification of hazardous wastes, Hazardous waste management, Treatment technology, Disposal of radioactive materials, Ground water contamination and remediation. Route of industrial hazard entry into human body-Inhalation, Absorption, Swallowed, Injection, Food chain - Contaminated soil, Vegetables, Crops, Fish and Chicken, Adverse impact of hazard, Occupational cancer.

Solid Waste Generation in the Leather industry and its Utilization: Generation: Skin collagen waste, Fleshing waste, Wet blue, Trimming, Buffing, Chrome shaving, Chrome split, trimming from crust and finished leather. Utilization: Fleshing- Modified fleshing hydrolysate, Reactive protein (RP), feed ingredients.

Chrome shaving: Treatment with enzyme, MgO, Carbonates and other alkalies, application of hydrolysate.

Waste generation in Footwear and Leather Products Industry: Materials being processed: Leather, Natural rubber/poly-isoprene, Reaction Injection Moulded (RIM) polyurethane (PU), Polyvinyl Chloride (PVC) and blends, Ethylene Vinyl Acetate (EVA) and blends, Styrene Butadiene Rubber (SBR), Thermoplastic Polyurethane (TPU), Thermoplastic Rubber (TR), Leather, textile, cotton, polyesters, nylon, adhesive, solvent, oil.

Solid Waste Management: Solid waste – sources and engineering classification, characterization, generation and quantification. Transport - collection systems, collection equipment, transfer stations, collection route optimization.

Treatment methods – various methods of refuse, recovery, recycle, composting –aerobic and anaerobic, incineration, pyrolysis and energy recovery.

Disposal methods – Impacts of open dumping, site selection, sanitary land filling – design criteria and design examples, leachate and gas collection systems, and leachate treatment.

Hazardous Waste Management – Introduction, Sources, Classification, Physico-chemical, Chemical and biological Treatment of hazardous waste, regulations.

Thermal treatment – Incineration and pyrolysis.

Soil contamination and site remediation– Bioremediation processes, monitoring of disposal sites.

Removal of Refractory Organic Compounds: Theories on Advanced Oxidation Process viz., Photocatalytic treatment, Membrane separation, Homogenous catalysis system using hydrogen peroxide, ozone, etc. Heterocatalytic systems using metal oxides, activated carbon – Removal of inorganic compounds through electro dialysis, reverse osmosis, multiple effect evaporator, ion-exchange.

12. Course Objectives:

a. To provide the advance knowledge about the environmental problems, industrial hazards,and its methods of mitigation.
b. To estimate solid waste generation from tanning industry, and leather goods industry and their utilization using modern techniques.
c. To improve a comprehensive skill on tannery solid waste, biomedical and other hazardous wastes and integrated solid waste management system.
d. To familiarize students with modern biological techniques available for the wastewater treatment.

13. Course Learning Outcomes (CLOs) and Mapping of CLOs with Program Learning Outcomes (PLOs)

a) CLOs: Upon completion of this course, students will be able to:

	Course Learning Outcomes (CLOs)	**Learning Level**
CLO1	Narrate industrial hazards and their adverse impact on the environment and humans.	C1,A1
CLO2	Analyze tannery solid waste utilization into the valuable byproducts as part of circular economy and clean technology.	C3, A3
CLO3	Apply knowledge on the estimation of solid waste generated from leather and allied industries.	C4
CLO4	Justify modern techniques of wastewater treatment with traditional treatment processes.	C5, A4

b) Mapping of CLO with PLO

(CLOs)	**PLO1**	**PLO2**	**PLO3**	**PLO4**	**PLO5**	**PLO6**	**PLO7**	**PLO8**
CLO1	3	2	-	-	-	2	1	-
CLO2	2	3	3	-	-	2	3	-
CLO3	3	3	3	-	-	2	2	-
CLO4	3	3	-	3	3	2	3	-

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

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

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

Part B

14. Course plan specifying content, CLOs, co-curricular activities (if any), teaching learning and assessment strategy mapped with CLOs

Time Period	Topic	Teaching-Learning Strategy	Assessment Strategy	Corresponding CLOs
Week -01	**Industrial Hazards:** Hazard, Types of industrial hazards, Identification of hazardous wastes, Hazardous waste management, Treatment technology, Absorption.	• Lecture • Multimedia presentation • Demonstration	• In-course Exam • Final Exam	CLO1
Week -02	Disposal of radioactive materials, Ground water contamination and remediation. Route of industrial hazard entry into human body-Inhalation.	• Interactive class lecture • Multimedia presentation • Demonstration	• In-course Exam • Final Exam	CLO1, CLO2
Week -03	Swallowed, injection, food chain - contaminated soil, vegetables, crops, fish and chicken, adverse impact of hazard, occupational cancer.	• Interactive class lecture • Multimedia presentation • Whiteboard illustration	• In-course Exam • Final Exam • Assignments	CLO1, CLO2
Week -04	**Solid Waste Generation**: Skin collagen waste, fleshing waste, wet blue, trimming, buffing, chrome shaving, chrome split, trimming from crust and finished leather.	• Audiovisual Lecture • Multimedia presentation • Demonstration	• In-course Exam • Final Exam	CLO1, CLO2
Week -05	Utilization: Fleshing-Modified fleshing hydrolysate, reactive protein (RP), feed	• Audiovisual Lecture • Multimedia presentation	• In-course Exam • Final Exam	CLO1, CLO2

	ingredients.	• Demonstration		
Week -06	Chrome shaving: Treatment with enzyme, MgO, Carbonates and other alkalis, applications of protein hydrolysate.	• Interactive class lecture • Visual presentation • Whiteboard illustration	• Final Exam	CLO2, CLO3
Week -07	**Waste generation in Footwear and Leather Products Industry:** Materials being processed: Leather, Natural rubber/poly-isoprene, Reaction Injection Moulded (RIM) polyurethane (PU), Polyvinyl Chloride (PVC) and blends.	• Lecture • Multimedia presentation • Group-discussion	• In-course Exam • Final Exam	CLO2, CLO3
Week -08	Ethylene Vinyl Acetate (EVA) and blends, Styrene Butadiene Rubber (SBR), Thermoplastic Polyurethane (TPU), Thermoplastic Rubber (TR), Leather, textile, cotton, polyesters, nylon, adhesive, solvent, oil.	• Lecture • Multimedia presentation • Problem-based discussion	• In-course Exam • Final Exam	CLO2, CLO3
Week -09	**Solid Waste Management:** Solid waste–sources and engineering classification, characterization, generation and quantification. Transport - collection systems, collection equipment, transfer stations, collection	• Audiovisual Lecture • Multimedia presentation • Demonstration	• In-course Exam • Final Exam	CLO2, CLO4

	route optimization. Treatment methods - various methods of refuse, recovery, recycle.			
Week -10	Composting –aerobic and anaerobic, incineration, pyrolysis and energy recovery. Disposal methods – Impacts of open dumping, site selection, sanitary land filling – design criteria and design examples.	• Interactive class lecture • Visual presentation • Whiteboard illustration	• In-course Exam • Final Exam • Assignments	CLO2, CLO3
Week -11	Leachate and gas collection systems, and leachate treatment, hazardous waste management- introduction, sources, classification, physico-chemical, chemical and biological treatment of hazardous waste, regulations.	• Interactive class lecture • Problem solving	• In-course Exam • Final Exam	CLO3, CLO4
Week -12	Thermal treatment - Incineration and pyrolysis, soil contamination and site remediation – bioremediation processes, monitoring of disposal sites.	• Interactive Class lecture • Visual presentation • Whiteboard illustration	• In-course Exam • Final Exam	CLO2
Week -13	**Removal of Refractory Organic Compounds:** Theories on advanced oxidation process viz., photocatalytic treatment, membrane separation, homogenous catalysis	• Interactive lecture • Visual presentation • Whiteboard illustration	• Final Exam	CLO3

	system using hydrogen peroxide, ozone.			
Week -14	Heterocatalytic systems using metal oxides, activated carbon, removal of organic compounds through electro dialysis, reverse osmosis etc.	• Interactive lecture • Visual presentation • Whiteboard illustration	• Final Exam	CLO3, CLO4

Part C

15. Assessment and Evaluation

i) Assessment Strategy

Strategy	**Percentage of Total marks**
Class attendance and participation	10
In-course Exam/Class Test	30
Semester Final Examination (3 hours duration)	60
Total	**100**

ii) Marks distribution:

- Continuous Assessment: 40%
- Summative: 60%
- Make-up Procedures:
  Two in-course exams will be taken and average marks will be counted. Feedback on continuous assessment is given to the students immediately after the test. Based on the students' feedback additional class/assignment may be taken by the course teacher.

Part D

16. Learning Materials

i. Recommended Readings

a) Arceivala S. J., "Waste water treatment and disposal" Marcel Dekkar Inc., New York, 1981.
b) Besselievie, B. E. and Schwartz, M., "The Treatment of Industrial wastes", 2nd edn., McGraw Hill.
c) Karia G.L., and Christian R.A., (2001), "Wastewater Treatment Concepts and Design Approach", Prentice Hall of India Pvt. Ltd., New Delhi.

ii. Supplementary Readings

a) Assessment of Tannery Solid Waste Management, a case study Sheba Leather Industry, UNIDO, 2018.
b) Benefield R.D., and Randal C.W., (1980), "Biological Process Design for Wastewater Treatment", Prentice Hall, Englewood Chiffs, New Jersey.

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

Course Outline for 0723-FE-6109

Part A

1. Course Code: 0723-FE-6109

2. Course Title: Ergonomics and Industrial Safety

3. Course Type: Core Course

4. Year / Semester: Semester: I

5. Academic Session: 2022-23

6. Course Teachers: Md. AbdusShabur, Lecturer, ILET, DU.

7. Prerequisite(s): N/A

8. Credits: 3.0

9. Contact Hours: 42

10. Total Marks: 100

11. Rationale of the Course: This course intended to instruct knowledge by different approaches to improve better workspace design and efficient work environment designs and management. After completion of this course, the students will be able to design better factory environment and thereby will be able to ensure effective safety management practice in leather industry.

Course Contents:

Ergonomics

Introduction: What is Ergonomics; History of Development; Scope & Application of Ergonomics; Importance of Ergonomics; Anthropometry.

Muscle Physiology and Manual Material Handling: Muscle and Work Physiology; Measure of Physiological Strain; Physical Workload; Manual Materials Handling.

Hand Tools and Devices: Introduction to Hand Tools; Structure and Motion of Hand; Principles of Designing Hand Tools and Devices; Vibration & HAVS; Gripping Principles.

Workspace Design: Designing Workspace Envelopes for Seated and Standing Personnel; Designing Horizontal Work Surfaces; Designing Seated and Standing Work Surfaces.

Work Environment Design: Lighting in Work Environment; Vision and Structure of Eye; Visual Defects; Guidelines for Colour Selection; Measurement of Light Photometry; Lighting and Illumination; Reflectance; Lighting Problem; Improving Visibility; Characteristics and Efficiency of Light Sources; Lighting Design Considerations; Glare; Uniformity of Lighting; Complaints, Causes and Control Measures of Visual Discomforts; Sound Propagation; Structure of Human Ear; Process of Hearing; Health Effects of Noise Pollution; Control Measures for Noise Pollution; Thermal Balance; Heat Illness; Heat Acclimatization; Heat Stress Measurement; Cold Injury; Cold Climate Protection.

Safety Management

Introduction to Safety Management: Objectives; Importance of Safety Management; Occupational Health and Safety (OHS); Hazard and Risk.

Introduction to Workplace Safety: Aims; Considerations to Manage Workplace Safety Effectively; Nature, Functions and Benefits of Workplace Safety; Challenges for Practicing Safety; PDCA Cycle in OHS; Idea Generation.

Creating an Effective Workplace Safety Program: Core Regulatory Requirement; Program Review/Audit; Establishing Goals and Objectives; Management Commitment and Responsibility; Work-Site Analysis; Hazard Recognition and Resolution; Job Hazard Analysis (JHA)/Job Safety Analysis (JSA); Hazard Resolution; Incident Investigation; Best Practices.

Workers' Compensation and Record Keeping: Early and Modern Workers' Compensation Laws; Premium Calculation; Background Record Keeping; OSHA 300, 300A and 301 Forms; Recordable Occupational Injuries and Illness; First Aid Cases; Fatalities; Privacy Concern Cases; Posting Annual Summary Requirements.

Introduction to Industrial Hygiene: Definition; Toxicology; Industrial Hygiene Practice.

Fire Prevention and Protection: Means of Egress Regulations; Fire Tetrahedron; Categories of Fire; Categories of Fire Extinguisher.

System Safety: Importance of System Safety; System Life Cycle; Management of System Safety; Elements of A System Safety Program Plan (SPSS); Preliminary Hazard Analysis (PHA); Subsystem Hazard Analysis (SSHA); System Hazard Analysis (SHA); Technique of Operations Review (TOR); Failure Mode and Effect Analysis (FMEA).

Improving Safety Performance with Behavioural Safety: Introduction; Pilot Error Syndrome; Concepts of Risk; Incidents and Accidents; Loss Exposures; Control Techniques for Loss Exposures; Accident Causation Theories; Single Factor Theory; Heinrich's Domino Theory; Multiple Factors Theory; Human Factors Theory; Energy Release Theory; Further Incident Investigation.

12. Learning Objectives:

a. To identify the components needed to provide a safe and healthful work environment through case studies and review of injury statistics provided in the course.
b. To identify potential workplace safety and health hazards and determine how to mitigate the hazards through engineering controls, administrative controls and personal protective equipment.
c. To conduct basic safety inspections using strategies that they have developed though hazard identification and job hazard analysis.
d. To identify the requirements of training programs in the workplace under the existing OSHA and State-OSHA requirements.
e. To understand essential elements of an occupational safety and health program and the components of international standard organizations in safety and health.

13. Course Learning Outcomes (CLOs) and Mapping of CLOs with Program Learning Outcomes (PLOs)

a) CLOs: Upon completion of this course, students will be able to:

	Course Learning Outcomes (CLOs)	**Learning Level**
CLO1	Recall knowledge of fundamentals of ergonomics and safety management related to leather engineering.	C1, A1
CLO2	Explain various methods and tools to ensure proper ergonomics facilities and safety managements.	C2, C3
CLO3	Apply various modern techniques to design an ergonomic friendly work environment as well as a safer workplace with protection from possible accidents and hazards.	C4
CLO4	Investigate and solve any problem/issue related to ergonomics and safety management in real world leather manufacturing.	C5, A4

b) Mapping of CLO with PLO

(CLOs)	**PLO1**	**PLO2**	**PLO3**	**PLO4**	**PLO5**	**PLO6**	**PLO7**	**PLO8**
CLO1	3	-	-	-	-	-	-	-
CLO2	3	3	-	-	2	-	-	-
CLO3	3	3	3	-	2	3	2	-
CLO4	3	3	2	3	2	2	2	2

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

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

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

Part B

14. Course plan specifying content, CLOs, co-curricular activities (if any), teaching learning and assessment strategy mapped with CLOs

Time Period	Topic	Teaching-Learning Strategy	Assessment Strategy	Corresponding CLOs
Week -01	**Introduction:** What is Ergonomics; History of Development; Scope & Application of Ergonomics; Importance of Ergonomics; Anthropometry, Muscle Physiology and Manual Material Handling: Muscle and Work Physiology; Measure of Physiological Strain; Physical Workload; Manual Materials Handling.	• Lecture • Group Discussion • Multimedia Presentation • Literature review	• In-course Exam • Final Exam	CLO1, CLO2
Week -02	**Hand Tools and Devices:** Introduction to Hand Tools; Structure and Motion of Hand; Principles of Designing Hand Tools and Devices; Vibration & HAVS; Gripping Principles.	• Lecture • Group Discussion • Multimedia Presentation • Literature review	• In-course Exam • Final Exam	CLO1, CLO2, CLO3
Week -03	**Workspace Design:** Designing Workspace Envelopes for Seated and Standing Personnel; Designing Horizontal Work Surfaces; Designing Seated and Standing Work Surfaces.	• Lecture • Group Discussion • Multimedia Presentation	• Assignment • In-course Exam • Final Exam	CLO2, CLO3, CLO4

Week -04	**Work Environment Design:** Lighting in Work Environment; Vision and Structure of Eye; Visual Defects; Guidelines for Colour Selection; Measurement of Light Photometry; Lighting and Illumination; Reflectance; Lighting Problem; Improving Visibility; Characteristics and Efficiency of Light Sources; Lighting Design Considerations; Glare.	• Lecture • Group Discussion • Multimedia Presentation • Problem solving	• In-course Exam • Final Exam	CLO2, CLO3, CLO4
Week -05	Uniformity of Lighting; Complaints, Causes and Control Measures of Visual Discomforts; Sound Propagation; Structure of Human Ear; Process of Hearing; Health Effects of Noise Pollution; Control Measures for Noise Pollution; Thermal Balance; Heat Illness; Heat Acclimatization; Heat Stress Measurement; Cold Injury; Cold Climate Protection.	• Lecture • Group Discussion • Multimedia Presentation	• Case study • In-course Exam • Final Exam	CLO2, CLO3, CLO4
Week -06	**Introduction to Safety Management:** Objectives; Importance of Safety Management; Occupational Health and Safety (OHS); Hazard and Risk.	• Group Discussion • Multimedia Presentation • Lecture	• In-course Exam • Final Exam	CLO2, CLO3

Week -07	**Introduction to Workplace Safety:** Aims; Considerations to Manage Workplace Safety Effectively; Nature, Functions and Benefits of Workplace Safety; Challenges for Practicing Safety; PDCA Cycle in OHS; Idea Generation.	• Lecture • Group Discussion • Multimedia Presentation	• Case Study • In-course Exam • Final Exam	CLO1, CLO2
Week -08	**Creating an Effective Workplace Safety Program:** Core Regulatory Requirement; Program Review/Audit; Establishing Goals and Objectives; Management Commitment and Responsibility.	• Lecture • Group Discussion • Multimedia Presentation	• In-course Exam • Final Exam	CLO2, CLO3
Week -09	Work-Site Analysis; Hazard Recognition and Resolution; Job Hazard Analysis (JHA)/Job Safety Analysis (JSA); Hazard Resolution; Incident Investigation; Best Practices.	• Lecture • Group Discussion • Multimedia Presentation	• Group Presentation • In-course Exam • Final Exam	CLO3, CLO4,
Week -10	**Workers' Compensation and Record Keeping:** Early and Modern Workers' Compensation Laws; Premium Calculation; Background Record Keeping; OSHA 300, 300A and 301 Forms; Recordable Occupational Injuries and Illness.	• Lecture • Group Discussion • Multimedia Presentation	• In-course Exam • Final Exam	CLO2, CLO3
Week -11	First Aid Cases; Fatalities; Privacy	• Lecture • Group	• In-course Exam	CLO1, CLO3

	Concern Cases; Posting Annual Summary Requirements. Introduction to Industrial Hygiene: Definition; Toxicology; Industrial Hygiene Practice.	Discussion • Multimedia Presentation • Problem solving	• Final Exam	
Week -12	**Fire Prevention and Protection:** Means of Egress Regulations; Fire Tetrahedron; Categories of Fire; Categories of Fire Extinguisher. System Safety: Importance of System Safety; System Life Cycle; Management of System Safety.	• Lecture • Group Discussion • Multimedia presentation	• In-course Exam • Final Exam	CLO2, CLO3, CLO4
Week -13	Elements of A System Safety Program Plan (SPSS); Preliminary Hazard Analysis (PHA); Subsystem Hazard Analysis (SSHA); System Hazard Analysis (SHA); Technique of Operations Review (TOR); Failure Mode and Effect Analysis (FMEA).	• Lecture • Group Discussion • Multimedia Presentation	• Oral Presentation • In-course Exam • Final Exam	CLO2, CLO3
Week -14	Improving Safety Performance with Behavioural Safety: Introduction; Pilot Error Syndrome; Concepts of Risk; Incidents and Accidents; Loss Exposures; Control Techniques for Loss Exposures; Accident Causation Theories; Single Factor Theory;	• Lecture • Group Discussion • Multimedia Presentation • Literature review	• In-course Exam • Final Exam	CLO1- CLO4

	Heinrich's Domino Theory; Multiple Factors Theory; Human Factors Theory; Energy Release Theory; Further Incident Investigation. **Review class**			

Part C

15. Assessment and Evaluation

i) Assessment Strategy

Strategy	**Percentage of Total marks**
Class attendance and participation	10
In-course Exam/Class Test	30
Semester Final Examination (3 hours duration)	60
Total	**100**

ii) Marks distribution:

- Continuous Assessment: 40%
- Summative: 60%
- Make-up Procedures: Two in-course exams will be taken and average marks will be counted. Feedback on in-course assessment is given to the students immediately after the test. If students are very weak in particular topics of this course, additional instruction will be given to help them catch up.

Part D

16. Learning Materials

i. Recommended Readings

a) Human Factors in Engineering & Design by Mark S. Sanders, Ph. D. and Ernest J. McCormick, Ph. D
b) Introduction to Ergonomics by R. S. Bridger
c) Workplace Safety A Guide for Small and Midsized Companies by Dan Hopwood, Steve Thompson
d) Fundamentals of Occupational Safety and Health (fourth edition) by Mark A. Friend and James P. Kohn

ii. Supplementary Readings

a) The Occupational Ergonomics Hand Book, Edited by Waldemar Karwowski and William S. Marras, CRC Press, New York, USA.

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

Course Outline of 0723-FE-6111

Part A

1. Course Code: 0723-FE-6111

2. Course Title: Pedorthic Footwear

3. Course Type: Core Course

4. Year / Semester: Semester: I

5. Academic Session: 2022-23

6. Course Teachers: Dr. Amal Kanti Deb, Associate Professor, ILET, DU

Mr. Noor Mohammad, Assistant Professor, ILET, DU.

7. Prerequisite(s): N/A

8. Credits: 3.0

9. Contact Hours: 42

10. Total Marks: 100

11. Rationale of the Course: This course has been designed to deliver state-of-the-art knowledge to the students on pedorthic (medical-graded) footwear. This course includes foot problems of pedorthic patients, their remedies, and biomechanics of diabetic, orthopedic, and geriatric footwear. At the end of the course, students will be able to prepare guidelines for pedorthic footwear and also individual patients.

Course Contents:

Foot problems: Skin lesions- calluses, corns, plantar warts, ingrown nail, etc., arch problems- flat foot, claw foot, arch strains, metatarsalgia, foot fatigue, burning feet, rigid feet, aching in calf, toe problems- hallux valgus, bunion, tailor's bunion, hammer toe, children foot problems- in toeing, out toeing, pronation, crooked toes, etc.

Biomechanics: Basic concept of biomechanics and foot barograph, characteristics of the foot, muscles and joints, pressure points and load distribution, foot dynamics, foot motions, gait analysis, running, movements of joints during dynamic phase, muscles work during static and dynamic conditions, abnormal gait patterns, body weight distribution of feet, force platforms, angle of flexion at the joints, electromyography.

Diabetic footwear: Diabetes, types of diabetes, diabetic foot, foot complications due to diabetes, impact of diabetes on foot structure, foot pressure and gait, epidemiology of diabetic foot syndrome, the neuropathic foot, the neuroischaemic foot, prevention, treatment, diabetic footwear, development of diabetic footwear, necessity of diabetic footwear, features of diabetic footwear, sustainable design for diabetic footwear, materials selection, construction of diabetic footwear, orthotics, classification of orthotics, application and functions of

orthotics, footgear, types, diabetic socks, physiological mechanism of diabetic footwear, diabetic foot and footwear care.

Orthopedic footwear: Introduction, classification, Impact of rheumatoid arthritis on foot structure, foot pressure and gait, orthotic men's and women's sandal with arch support, basic measurements, modular footwear measurements, fitting of modular footwear, anatomical insole, in-socks and sole, sustainable design and development of orthopedic footwear, shoes for plantar facilities, complication due to bone structure, materials selections, constructions, orthotics and insertions, design of foot orthoses, foot care products, turf toe, supination, pronation, foot odors and prevention.

Geriatric Footwear: The impact of aging and systematic diseases, Introduction to geriatric footwear, Geriatric foot problems: etiological and epidemiological factors, Changes in the foot in relation to age, Complicating foot problems, Psychosocial and psychological considerations, Considerations in sustainable shoe design, and Therapeutic footwear.

12. Course objectives:

a. To disseminate advanced knowledge about diabetic, orthopedic, and geriatric foot problems.
b. To provide in-depth knowledge of foot and footwear biomechanics and gait analysis.
c. To explain the types, designs, materials, and biomechanics of diabetic, orthopedic, and geriatric footwear.
d. To impart the latest management procedure for diabetic, orthopedic, and geriatric foot problems.

13. Course Learning Outcomes (CLOs) and Mapping of CLOs with Program Learning Outcomes (PLOs)

a) CLOs: Upon completion of this course, students will be able to:

	Course Learning Outcomes (CLOs)	**Learning Level**
CLO1	Explain different types of foot problems and basic requirements for diabetic, orthopedic, and geriatric footwear with biomechanical requirements.	C2, A2
CLO2	Relate different types of foot problems and foot biomechanics with sustainable manufacture of pedorthic footwear.	C3, A3
CLO3	Analyze the biomechanics requirements and other relevant factors in the sustainable designing and manufacturing of diabetic, orthopedic, and geriatric footwear.	C4, A3
CLO4	Justify and prepare the systematic guidelines for the proper management of diabetic, orthopedic, and geriatric patients with appropriate footwear.	C5, C6, A4

b) Mapping of CLO with PLO

(CLOs)	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8
CLO1	3	1	-	-	-	-	-	-
CLO2	3	3	-	-	-	-	-	-
CLO3	3	3	-	-	-	3	2	-
CLO4	3	2	-	3	-	-	2	2

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

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

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

Part B

14. Course plan specifying content, CLOs, co-curricular activities (if any), teaching learning and assessment strategy mapped with CLOs

Time Period	Topic	Teaching-Learning Strategy	Assessment Strategy	Corresponding CLOs
Week-01	**Foot problems:** Skin lesions- calluses, corns, plantar warts, ingrown nail, etc., arch	• Interactive discussion • Lecture discussion with	• In-course Exam • Final Exam	CLO1

	problems- flat foot, claw foot, arch strains.	multimedia • Whiteboard illustration		
Week -02	Metatarsalgia, foot fatigue, burning feet, rigid feet, aching in calf, toe problems- hallux valgus, bunion, tailor's bunion, hammer toe.	• Interactive discussion • Lecture discussion with multimedia • Whiteboard illustration	• In-course Exam • Final Exam	CLO1
Week -03	Children foot problems- in toeing, out toeing, pronation, crooked toes, etc.	• Interactive discussion • Lecture discussion with multimedia • Whiteboard illustration	• In-course Exam • Final Exam	CLO1, CLO2
Week -04	**Biomechanics:** Basic concept of biomechanics and foot barograph, characteristics of the foot, muscles and joints, pressure points and load distribution.	• Interactive discussion • Lecture discussion with multimedia • Whiteboard illustration	• In-course Exam • Final Exam	CLO2, CLO3
Week -05	Gait analysis, running, movements of joints during dynamic phase, muscles work during static and dynamic conditions.	• Interactive discussion • Lecture discussion with multimedia • Whiteboard illustration	• In-course Exam • Final Exam	CLO2, CLO3
Week -06	**A**bnormal gait patterns, body weight distribution of feet, force platforms, angle of flexion at the joints, electromyography.	• Interactive discussion • Lecture discussion with multimedia • Whiteboard illustration	• In-course Exam • Final Exam	CLO2, CLO3

Week -07	**Diabetic footwear:** Diabetes, types of diabetes, diabetic foot, foot complications due to diabetes, impact of diabetes on foot structure, foot pressure and gait, epidemiology of diabetic foot syndrome.	• Interactive discussion • Lecture discussion with multimedia • Whiteboard illustration • Problem-based learning (PBL)	• In-course Exam • Final Exam	CLO1, CLO2
Week -08	The neuropathic foot, the neuroischaemic foot, prevention, treatment, diabetic footwear, development of diabetic footwear, necessity of diabetic footwear, features of diabetic footwear, design for diabetic footwear, materials selection, construction of diabetic footwear.	• Interactive discussion • Lecture discussion with multimedia • Whiteboard illustration • Problem-based learning (PBL)	• Assignment • In-course Exam • Final Exam	CLO2, CLO3
Week -09	Orthotics, classification of orthotics, application and functions of orthotics, footgear, types, diabetic socks, physiological mechanism of diabetic footwear, diabetic foot and footwear care.	• Interactive discussion • Lecture discussion with multimedia • Whiteboard illustration • Problem-based learning (PBL)	• Assignment • Group Presentation • In-course Exam • Final Exam	CLO3, CLO4
Week -10	**Orthopedic footwear:** Introduction, classification, Impact of rheumatoid arthritis on foot structure, foot pressure and gait, orthotic men's and women's sandal with arch support.	• Interactive discussion • Lecture discussion with multimedia • Whiteboard illustration • Problem-based learning (PBL)	• In-course Exam • Final Exam	CLO1, CLO2

Week -11	Basic measurements, modular footwear measurements, fitting of modular footwear, anatomical insole, in-socks and sole, design and development of orthopedic footwear, shoes for plantar facilities, complication due to bone structure.	• Lecture discussion with multimedia, • Group discussion, • Literature review, • Demonstration, and problem-based exercises	• Assignment • Group Presentation • In-course Exam • Final Exam	CLO2, CLO3
Week -12	Materials selections, constructions, orthotics and insertions, design of foot orthoses, foot care products, turf toe, supination, pronation, foot odors and prevention.	• Lecture discussion with multimedia, • Group discussion, • Literature review, • Demonstration, and problem-based exercises	• Assignment • Group Presentation • Final Exam	CLO3, CLO4
Week -13	**Geriatric Footwear:** The impact of aging and systematic diseases, Introduction to geriatric footwear, Geriatric foot problems: etiological and epidemiological factors.	• Lecture discussion with multimedia, • Group discussion, • Literature review, • Demonstration, and problem-based exercises	• Assignment • Final Exam	CLO1, CLO2
Week -14	Changes in the foot in relation to age, Complicating foot problems, Psychosocial and psychological considerations, Considerations in shoe design, and Therapeutic footwear.	• Lecture discussion with multimedia, • Group discussion, • Literature review, • Demonstration, and problem-based exercises	• Group Presentation • Final Exam	CLO3, CLO4

Part C

15. Assessment and Evaluation

i) Assessment Strategy

Strategy	**Percentage of Total marks**
Class attendance and participation	10
In-course Exam/Class Test	30
Semester Final Examination (3 hours duration)	60
Total	**100**

ii) Marks distribution:

- Continuous Assessment: 40%
- Summative: 60%
- Make-up Procedures: Two in-course exams will be taken and average marks will be counted. Feedback on in-course assessment is given to the students immediately after the test. If students are very weak in particular topics of this course, additional instruction will be given to help them catch up.

Part D

16. Learning Materials

i. Recommended Reading

a) Footwear and Foot Orthoses by Anita Williams and Chris Nester
b) Therapeutic footwear by Wendy Tyrrell and Gwenda Carter
c) The Science of Footwear by Ravindra S. Goonetilleke

ii. Supplementary Readings

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

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

Semester-II

Course Code	Course Title	Credits
0723-FE-6213	Environmental Management and Impact Assessment	3.00
0723-FE-6000	Thesis	-
	Optional Course (Any one from the following List)	
Course Code	**Course Title**	**Credits**
0723-FE-6215	Nanotechnology for Leather and Leather Products	3.00
0723-FE-6217	Industrial Automation	3.00
Total		**6.00**

Course Outline for 0723-FE-6213

Part A

1. Course Code: 0723-FE-6213

2. Course Title: Environmental Management and Impact Assessment

3. Course Type: Core Course

4. Year/Semester: Year: Semester: II

5. Academic Session: 2022-2023

6. Course Teacher: Sunzida Haque Rimu, Lecturer, ILET, DU.

7. Prerequisite(s): N/A

8. Credits: 3

9. Contact Hours: 42

10. Total Marks: 100

11. Rational of the Course:

This course is designed to train the graduates in analysis and assessment methods applicable to environmental contamination problems, particularly national and international legislative frameworks. This course is contemplated for LWG and other environmental certification processes for leather industry.

Course Content:

Environmental Audit: Principles and philosophies of environmental auditing**,** basic steps in audit process, Auditing techniques Concept of industrial ecology, cleaner technologies in industrial processes and evaluation of processes, waste minimization

Environmental health hazard and risk assessment: Biological, chemical, physical and psychological health hazard; health risk assessment and management, toxicology, exposure measurement of toxic (carcinogenic and non-carcinogenic) substances

Clean Development Mechanism: Overview on sustainable development. Greenhouse gasses reduction mechanism, project cycle for the CDM, CDM for small scale projects, risks and opportunities for industries, financing of CDM projects, case studies.

Environmental Impact Assessment (EIA): Definition, purposes and characteristics of EIA, global evolution of EIA, participants in EIA process, stages of EIA, types of EIA, environmental inventory, baseline data on EIA-environmental data, project data and project alternative data, measurement of impact– physical, social, economic, natural, public participation in environmental decision making, framework of environmental assessment, description of environmental setting, Environmental impact factors and area consideration, environmental impact statement (EIS) and environmental management plan (EMP).

Environmental Impact Analysis: Impact identification and methods of impact identification- adhoc method, checklist, matrix, network, overlay and index methods; impact prediction and predictive methodologies, impact evaluation (assessment) and impact mitigation. Basic steps for the impact identification, prediction and assessment of air, water, noise, vegetation and wildlife environment with case studies.

Environmental Management System (EMS): Basic definitions and terms, Framework for environmental management system, approach for developing Environmental Management System, International standards, environmental management systems in tanneries and their implementation, environmental reporting, Occupational health and safety management, cross-boundary environmental management, mandatory regulations and ecolabelling criteria governing various substance in leather, life -cycle assessment and carbon footprint in leather industries.

Hazard Mitigation: Classification of hazards, basic concept of disaster (causative factors of disaster, classification of disasters), Hazards due to dams and reservoirs, nuclear power plants, industrial hazards, occupational hazards, mitigation measures, hazard assessment, risk assessment.

EIA in Bangladesh: An overview of history, current procedures, practices and guidelines for Environmental Clearance Certificate, EIA of water resource projects, industries, mining and quarrying, highway construction, and tourism developments.

12. Course Objectives:

a. To provide knowledge on legal and policy frameworks within which quantitative environmental assessment activities are carried out and
b. To conduct systematic EIA and auditing methodologies in the leather industry.
c. To carry out quantitative techniques of analysis for direct determination of contaminant concentrations and distributions within environmental systems.
d. To investigate statistical and computer modeling techniques for analysis of data.

13. Course Learning Outcomes (CLOs) and Mapping of CLOs with Program Learning Outcomes (PLOs)

a) CLOs: Upon completion of this course, students will be able to:

	Course Learning Outcomes (CLOs)	**Learning Level**
CLO1	Recognize ethical and narrate professional responsibilities in engineering situations and make judgments.	C1, A1

CLO2	Familiarize with the application of a variety of professional tools for predicting environmental impacts.	C2, A2
CLO3	Developing perspectives on impact assessment and relating to practical industrial activities.	C3, C4

b) Mapping of CLO with PLO

CLOs	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8
CLO1	3	3	-	-	-	-	-	-
CLO2	-	3	3	3	-	3	3	-
CLO3	3	2	-	-	-	3	2	3

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

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

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

Part B

14. Course plan specifying content, CLOs, teaching learning and assessment strategy mapped with CLOs

Time Period	Topic	Teaching-Learning Strategy	Assessment Method	Corresponding CLOs
Week-01	**Environmental Audit:** Principles and philosophies of environmental auditing**,** basic steps in audit process, Auditing techniques, Concept of	• Lecture • Group discussion • Literature	• In-course • Final exam • Quiz	CLO1

	industrial ecology.			
Week -02	Cleaner technologies in industrial processes and evaluation of processes, waste minimization incorporated with industrial ecology.	• Lecture • Literature	• In-course • Final exam	CLO1
Week -03	**Environmental health hazard and risk assessment:** Biological, chemical, physical and psychological health hazard**,** health risk assessment and management, toxicology, exposure measurement of toxic (carcinogenic and non-carcinogenic) substances.	• Lecture • Group • Discussion • Literature	• In-course • Final exam	CLO1
Week -04	**Clean Development Mechanism:** Overview on sustainable development, greenhouse gasses reduction mechanism, project cycle for the CDM, CDM for small scale projects, risks and opportunities for industries, financing of CDM projects, case studies.	• Lecture • Literature • Group • Assignment	• In-course • Final exam • Assignment	CLO1
Week -05	**Environmental Impact Assessment (EIA):** Definition, purposes and characteristics of EIA, global evolution of EIA, participants in EIA process, stages of EIA, types of EIA, environmental inventory, baseline data on EIA, environmental data, project data and project alternative data,	Lecture, Literature, Case studies	Assignment, In-course exam, Final exam	CLO1, CLO2

	measurement of impact– physical, social, economic, natural, public participation in environmental decision making.			
Week -06	Framework of environmental assessment, description of environmental setting, Environmental impact factors and area consideration, Environmental impact statement (EIS) and environmental management plan (EMP)	• Lecture • Literature • Case studies	• Assignment • Quiz • Final Exam	CLO1, CLO2
Week -07	**Environmental Impact Analysis:** Impact identification and methods of impact identification-adhoc method, checklist, matrix, network, overlay and index methods, impact prediction and predictive methodologies, impact evaluation (assessment) and impact mitigation.	• Lecture • Literature • Assignment	• In-course • Final Exam • Assignment	CLO3
Week -08	Basic steps for the impact identification, prediction and assessment of air, water, noise, vegetation and wildlife environment with case studies.	• Lecture • Literature	• In-course • Final Exam • Assignment	CLO3
Week -09	**Environmental Management System (EMS):** Basic definitions and terms, framework for environmental management system, approach for developing Environmental Management System.	• Lecture • Literature	• In-course • Final Exam	CLO1, CLO3
Week -10	International standards**,** environmental management	• Lecture • Literature	• In-course • Final Exam	CLO1, CLO3

	systems in tanneries and their implementation**,** environmental reporting.	• Case studies		
Week -11	Occupational health and safety management, cross-boundary environmental management**,** mandatory regulations and ecolabelling criteria governing various substance in leather**,** life-cycle assessment and carbon footprint in leather industries.	• Lecture • Literature	• In-course • Final Exam	CLO1, CLO2
Week -12	**Hazard Mitigation**: Classification of hazards, basic concept of disaster (causative factors of disaster, classification of disasters), Hazards due to dams and reservoirs, nuclear power plants, industrial hazards, occupational hazards, mitigation measures, hazard assessment, risk assessment.	• Lecture • Literature • Case studies	• In-course • Final exam	CLO1, CLO2
Week -13	**EIA in Bangladesh:** An overview of history, current procedures, practices and guidelines for Environmental Clearance Certificate, EIA of water resource projects, industries, mining and quarrying, highway construction, tourism developments.	• Lecture • Literature • Case studies	• In-course • Final exam	CLO1, CLO2, CLO3
Week-14	Review of the whole content	• Problem oriented exercises		CLO1, CLO2, CLO3

Part C

15. Assessment and Evaluation

i) Assessment Strategy

Strategy	Percentage of Total marks
Class attendance and participation	10
In-course Exam/Class Test	30
Semester Final Examination (3 hours duration)	60
Total	**100**

ii) Marks distribution:

- Continuous Assessment: 40%
- Summative: 60%
- Make-up Procedures: Two in-course exams will be taken and average marks will be counted. Feedback on in-course assessment is given to the students immediately after the test. If students are very weak in particular topics of this course, additional instruction will be given to help them catch up.

Part D

16. Learning Materials

i. Recommended Readings

a) Morris, P and Therivel, R. 2001. Methods of environmental impact assessment. London. UCL press.

b) Introduction to Environmental Impact Assessment : Principles and Procedures, Process, Practice and Prospects - 2nd edition. J. Glasson, R. Therivel, A. Chadwick

c) Environmental Impact Assessment Methodologies, Y. Anjaneyulu, Valli Manickam, BS Publication

d) Environmental and Health Risk Assessment and Management: Principles and Practices, ISBN: 9789048169610,9048169615

ii. Supplementary Reading

a) Bregman, J.I. and Mackenthum, K.M. 1992. Environmental impact statements. Chelsia Michigan: Lewis.

b) Calow, P. 1997. Handbook of environmental risk assessment and management. Oxford: Blackwell Science.

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

Course Outline of 0723-FE-6215

Part A

1. Course Code: 0723-FE-6215

2. Course Title: Nanotechnology for Leather and Leather Products

3. Course Type: Core Course

4. Year/ Semester: Semester: II

5. Academic Session: 2022-23

6. Course Teachers: 1**.** Dr. Mohammed Mizanur Rahman, Professor, ACCE, DU.

2. Md. Adib Hossain Chisty, Lecturer, ILET, DU.

7. Prerequisite(s): N/A

8. Credits: 3.0

9. Contact Hours: 42 hours

10. Total Marks: 100

11. Rational of the Course: This course is designed to provide in-depth theoretical knowledge of nanotechnology and outlines its applicationsin leather and allied engineering fields. The course also deals with the design of nanosystems, nanomaterials together with their processing, properties and characterization.

Course Contents

Introduction to Nanoscience and Nanotechnology: Introduction, history and importance of nanotechnology, properties of nanomaterials, difference between bulk and nanomaterials, molecular building blocks for nanostructured systems, influence of nano structure on mechanical, optical, electronic, magnetic and chemical properties, overview of different nanomaterials available, chemistry and physics of nanomaterials, electronic phenomenon in nanostructures, optical absorption in solids, quantum dot, quantum effects, nanocomposites.

Nanomaterials Fabrication:

Chemical Methods: Sol- gel process, self-assembly process, electrodeposition, pyrolysis, metal nanocrystals by reduction, solvothermal synthesis, photochemical synthesis, sonochemical synthesis, reverse micelles and microemulsions, combustion method, template process, chemical vapor deposition, metal organic chemical vapor deposition.

Physical Methods: Ball milling, inert gas condensation technique, thermal evaporation, pulsed laser deposition, DC/RF magnetron sputtering, molecular beam epitaxy, microlithography, etching, wet cleaning, atomic layer deposition.

Biological Synthesis: Protein based nanostructure formation, DNA template nanostructure formation, protein assembly, biologically inspired nanocomposites.

Nanomaterials Characterization:

Structural Characterization: X-ray diffraction (XRD) analysis, FT-IR analysis, Raman spectroscopy

Microscopic and Surface Analysis: Electron microscopes: scanning electron microscopy (SEM), transmission electron microscopy (TEM); scanning probe microscopy: atomic force microscopy (AFM), scanning tunneling microscopy (STM).

Spectroscopy: X-ray photoelectron spectroscopy (XPS), fluorescence spectroscopy,UV-visible spectroscopy, nuclear magnetic resonance (NMR)spectroscopy, electron spin resonance (ESR) spectroscopy.

Electrical, Mechanical and Magnetic Properties: Impedance analysis, electro-analytical techniques: potentiometry, voltammetry, cyclic voltammetry.

Thermal and Optical Properties: Differential scanning calorimetry (DSC) analysis, Differential thermal analysis (DTA), Thermogravimetric analysis (TGA), contact angle measurement. Dynamic light scattering (DLS) method.

Applications of nanotechnology in the relevant field and non-leather chemicals: Possible industrial applications of nanomaterials in leather, footwear and leather productsindustries, application of nano materials on collagen matrix at various stages of processing techniques, synthesis of nano based materials for leather manufacture: syntans, reinforcing materials, finishing chemicals.

Environmental aspects of nanotechnology: Handling, safety and hazard of nanomaterials processing, effects of nanomaterials exposure on human and living stock, long term and short term effects, case studies of exposure, effects of nanoparticles on air, water and soil, food and food supplements.

12. Course Objectives:

a. To introduce and provide a broad view of the nascent field of nanoscience and nanotechnology.
b. To promote interdisciplinary interactions among engineering, technology, science, and industrial management/technology majors.
c. To utilize knowledge about developing new products and systems in leather sector.

13. Course Learning Outcomes (CLOs) and Mapping of CLOs with Program Learning Outcomes (PLOs)

a) CLOs: Upon completion of this course, students will be able to:

	Course Learning Outcomes (CLOs)	**Learning Level**
CLO1	Define and explain the structure, properties and applications of nanomaterials together with associated chemicals	C1, C2
CLO2	Illustrate the importance of dimensional reduction in materials and its relationship with properties.	C3
CLO3	Compare numerous methods of nanomaterials preparation and analyze nanomaterials thoroughly using engineering tools	C5
CLO4	Assess environmental pollutions/concerns by nano based materials during its production and real-life applications.	C5

b) Mapping of CLO with PLO

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

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

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

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

Part B

14. Course plan specifying content, CLOs, co-curricular activities (if any), teaching learning and assessment strategy mapped with CLOs

Time Period	Topic	Teaching-Learning Strategy	Assessment Method	Corresponding CLOs
Week-01	**Introduction to Nanoscience and Nanotechnology:** Introduction, history and importance of nanotechnology, properties of nanomaterials, difference between bulk and nanomaterials, molecular building blocks for nanostructured systems.	• Class Lecture	• In-course • Exam • Final Exam	CLO1, CLO2
Week -02	Influence of nano structure on mechanical, optical, electronic, magnetic and chemical properties, overview of different nanomaterials available, chemistry and physics of nanomaterials, electronic phenomenon in nanostructures, optical absorption in solids, quantum dot, quantum effects, nanocomposites.	• Class Lecture • Slide Presentation	• In-course Exam • Final Exam	CLO1, CLO2
Week -03	**Nanomaterials Fabrication:** **Chemical Methods:** Sol-gel process, self-assembly process, electrodeposition, pyrolysis, metal nanocrystals by reduction, solvothermal synthesis, photochemical synthesis.	• Class Lecture • Slide Presentation	• In-course • Exam • Final Exam	CLO1, CLO3

Week -04	Sonochemical synthesis, reverse micelles and microemulsions, combustion method, template process, chemical vapor deposition, metal organic chemical vapor deposition.	• Class Lecture	• In-course • Exam • Final Exam	CLO3
Week -05	**Physical Methods:** Ball milling, inert gas condensation technique, thermal evaporation, pulsed laser deposition, DC/RF magnetron sputtering, molecular beam epitaxy, microlithography, etching, wet cleaning, atomic layer deposition.	• Class Lecture • Assignment	• In-course Exam • Final Exam	CLO3
Week -06	**Biological Synthesis:** Protein based nanostructure formation, DNA template nanostructure formation, protein assembly, biologically inspired nanocomposites. **Nanomaterials Characterization:** Structural Characterization: X-ray diffraction (XRD) analysis, FT-IR analysis, Raman spectroscopy.	• Class Lecture • Assignment	• In-course Exam • Final Exam	CLO3
Week -07	**Microscopic and Surface Analysis:** Electron microscopes: scanning electron microscopy (SEM), transmission electron microscopy (TEM); scanning probe microscopy: atomic force	• Class Lecture • Slide Presentation	• In-course Exam • Final Exam	CLO3

	microscopy (AFM), scanning tunneling microscopy (STM).			
Week -08	**Spectroscopy:** X-ray photoelectron spectroscopy (XPS), fluorescence spectroscopy, UV-visible spectroscopy.	• Class Lecture	• In-course Exam • Final Exam	CLO3
Week -09	Nuclear magnetic resonance (NMR) spectroscopy, electron spin resonance (ESR) spectroscopy. Electrical.	• Class Lecture • Assignment	• In-course Exam	CLO3
Week -10	**Mechanical and Magnetic Properties:** Impedance analysis., electro-analytical techniques: potentiometry, voltammetry, cyclic voltammetry.	• Class Lecture	• In-course Exam • Final Exam	CLO3
Week -11	**Thermal and Optical Properties:** Differential scanning calorimetry (DSC) analysis, Differential thermal analysis (DTA), Thermogravimetric analysis (TGA), contact angle measurement. Dynamic light scattering (DLS) method.	• Class Lecture • Assignment	• In-course Exam • Final Exam	CLO1, CLO2, CLO3
Week -12	**Applications of nanotechnology in the relevant field and non-leather chemicals:** Possible industrial applications of nanomaterials in leather, footwear and leather products industries,application of	• Class Lecture	• In-course Exam • Final Exam	CLO1, CLO3

	nano materials on collagen matrix at various stages of processing, synthesis of nano based materials for leather manufacture: syntans, reinforcing materials, finishing chemicals.			
Week -13	**Environmental aspects of nanotechnology:** Handling, safety and hazard of nanomaterials processing, effects of nanomaterials exposure on human and living stock, long term and short term effects, case studies of exposure, effects of nanoparticles on air, water and soil, food and food supplements.	• Class Lecture	• Final Exam • Assignment	CLO1, CLO3, CLO4
Week -14	Review Class	• Class Lecture • Presentation • Assignment	• Final Exam • Assignment	CLO1 - CLO4

Part C

15. Assessment and Evaluation

i) Assessment Strategy

Strategy	**Percentage of Total marks**
Class attendance and participation	10
In-course Exam/Class Test	30
Semester Final Examination (3 hours duration)	60
Total	**100**

ii) Marks distribution:

- Continuous Assessment: 40%
- Summative: 60%
- Make-up Procedures: Two in-course exams will be taken and average marks will be counted. Feedback on in-course assessment is given to the students immediately after the test. If students are very weak in particular topics of this course, additional instruction will be given to help them catch up.

Part D

16. Learning Materials

i. Recommended Readings

a) Hand book of Nano science, Engineering, and Technology, William A. Goddard, CRC press 2003.
b) Nanolithography and patterning techniques in microelectronics, David G.Bucknall, Wood head publishing 2005.
c) Nanocomposite science and technology, Pulikel M. Ajayan, Wiley-VCH 2005

ii. Supplementary Readings:

a) Nanotechnology Environmental health and Safety: Risks Regulation and Management, Matthew Hull and Diana Bowman, Elsevier 2010
b) Hand book of Nano science, Engineering, and Technology, William A. Goddard, CRC press 2003.

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

Course Outline of 0723-FE-6217

Part A

1. Course Code: 0723-FE 6217

2. Course Title: Industrial Automation

3. Course Type: Core Course

4. Year / Semester: Semester: II

5. Academic Session: 2022-23

6. Course Teachers: Md. Abdus Shabur, Lecturer, ILET, DU.

7. Prerequisite(s): N/A

8. Credits: 3.0

9. Contact Hours: 42

10. Total Marks: 100

11. Rationale of the Course: This course provides an overview of the technologies of industrial automation and control as it is commonly encountered in factories of all types including leather and footwear items. Automation of the production process increases the efficiency of labor and the overall rate of growth. By ending this course, students will able to have a fundamental knowledge of current industrial automation technologies and their application.

Course Contents:

Introduction to Automation and Artificial Intelligence: Introduction, Principles and strategies, Basic elements of an automated system, Advanced automation functions, Levels of

automations, Automated flow lines and transfer mechanisms, Introduction of AI, Historical development, Intelligent Systems, Types of Intelligent Agents, Components of AI, Foundations of AI, Scope of AI, Current trends in AI, Relevance to Leather, Products and Footwear Engineering

Boolean Algebra and Logic Circuits and Programmable Logic Controller (PLC): Various logic gates, Truth tables, Logic functions, Boolean Laws, Karnaugh maps, Block diagram of PLC, Programming languages of PLC, Basic instruction sets, Networking of PLC, Overview of safety of PLC with case studies. Process Safety Automation: Levels of process safety through use of PLCs,

Controllers, Sensors and Actuators: Control Modes, PID and Digital Controllers, Velocity Control, Adaptive Control, Microprocessor and Microcontrollers, important characteristics, Main industrial sensors, Classification of sensors and their usage, Description of different kinds of sensors, Overview of Actuators, usage of Actuators in Robotics, Classification of Actuators (Pneumatic, Hydraulic, Electric), Basics of Pneumatic and Hydraulic Actuation Systems, Mechanical Actuation Systems, Electrical Actuation Systems.

Robots and their applications: Introduction to robots, Types, Classifications, Selection of robots, Robot Degrees of freedom, Robot configuration, Accuracy and repeatability, Specification of a robot, Robot feedback controls: Point to point control and Continuous path control, Control system for robot joint, Drives and transmission systems, End effectors, Industrial robot applications.

Concept and Algorithms, No programming or numerical: Problem Solving: Tree and Graph Search, Uninformed v/s informed search, uninformed methods: depth first search, breadth first search, Informed search: heuristic search, Best first search, branch and bound; Machine Learning: Introduction, types of machine learning; Learning with Decision Trees, Classification and Regression Trees, K means clustering algorithm, K nearest neighbors algorithm, hierarchical clustering, Concept of ensemble methods.

Artificial Neural Networks and Introduction to AI Technologies: Concept of ANN, Basic Models, Important Terminologies of ANNs McCulloch-Pitts Neuron, NN architecture, perceptron, delta learning rule, back propagation algorithm, Gradient Descent algorithm, feed forward networks, activation functions, Introduction to AI Technologies in the realm of Automation Concept of Natural Language Processing, Machine Vision, Deep learning, Expert systems, Genetic Algorithms, Industry 4.0.

12. Course Objectives:

a. To provide fundamental knowledge of automated machines and equipment including AI application in leather industry.
b. To impart the role of Boolean algebra and PLC in industrial automation.
c. To develop the operating skill of various sensors, actuators and controllers.
d. To familiarize with the application of robotic systems and artificial neural networks in automated manufacturing processes.

13. Course Learning Outcomes (CLOs) and Mapping of CLOs with Program Learning Outcomes (PLOs)

a) CLOs: Upon completion of this course, students will be able to:

	Course Learning Outcomes (CLOs)	**Learning Level**
CLO1	Explore their knowledge on fundamentals of industrial automation and its importance in modern manufacturing.	C1, A1
CLO2	Define and explain various automation technologies in leather and leather products manufacturing and process industries.	C1, C2, A2
CLO3	Apply various modern technologies to design an automated production facility including materials handling with robotics application.	C3, A2
CLO4	Investigate and solve any hurdle related to automation with the help of Artificial Intelligence (AI) applications.	C4, C5

b) Mapping of CLO with PLO

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

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

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

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

Part B

14. Course plan specifying content, CLOs, co-curricular activities (if any), teaching learning and assessment strategy mapped with CLOs

Time Period	Topic	Teaching-Learning Strategy	Assessment Strategy	Corresponding CLOs
Week-01	**Introduction to Automation and Artificial Intelligence:** Introduction, Principles and strategies, Basic elements of an automated system, Advanced automation functions, Levels of automations, Automated flow lines and transfer mechanisms.	• Lecture • Group Discussion • Multimedia Presentation • Literature review	• In-course Exam • Final Exam	CLO1, CLO2
Week -02	Introduction of AI, Historical development, Intelligent Systems, Types of Intelligent Agents, Components of AI, Foundations of AI, Scope of AI, Current trends in AI, Relevance to Leather, Products and Footwear Engineering.	• Lecture • Group Discussion • Multimedia Presentation • Literature review	• In-course Exam • Final Exam	CLO1, CLO2
Week -03	**Boolean Algebra and Logic Circuits:** Various logic gates, Truth tables, Logic functions, Boolean Laws, Karnaugh maps.	• Lecture • Multimedia Presentation • Problem solving	• Assignment • In-course Exam • Final Exam	CLO1 - CLO4
Week -04	Block diagram of PLC, Programming languages of PLC, Basic instruction sets, Networking of PLC, Overview of safety of	• Lecture • Group Discussion • Multimedia Presentation	• In-course Exam • Final Exam	CLO1 - CLO4

	PLC with case studies. Process Safety Automation: Levels of process safety through use of PLCs.			
Week -05	**Controllers:** Control Modes, PID and Digital Controllers, Velocity Control, Adaptive Control, Microprocessor and Microcontrollers.	• Lecture • Group Discussion • Multimedia Presentation	• Case study • In-course Exam • Final Exam	CLO1, CLO2, CLO3
Week -06	Important characteristics of sensors, Main industrial sensors, Classification of sensors and their usage, Description of different kinds of sensors.	• Lecture • Group Discussion • Multimedia Presentation	• In-course Exam • Final Exam	CLO2, CLO3
Week -07	Overview of Actuators, usage of Actuators in Robotics, Classification of Actuators (Pneumatic, Hydraulic, Electric), Basics of Pneumatic and Hydraulic Actuation Systems, Mechanical Actuation Systems, Electrical Actuation Systems.	• Lecture • Group Discussion • Multimedia Presentation	• Case Study • In-course Exam • Final Exam	CLO2, CLO3, CLO4
Week -08	**Robots and their applications:** Introduction to robots, Types, Classifications, Selection of robots, Robot Degrees of freedom, Robot configuration, Accuracy and repeatability, Specification of a robot, Robot feedback controls.	• Lecture • Group Discussion • Multimedia Presentation	• Group Presentation • In-course Exam • Final Exam	CLO1, CLO2

Week -09	Point to point control and Continuous path control, Control system for robot joint, Adaptive control, Drives and transmission systems, End effectors, Industrial robot applications of robots.	• Lecture • Group Discussion • Multimedia Presentation	• In-course Exam • Final Exam Assignment	CLO3, CLO4,
Week -10	**Concept and Algorithms, No programming or numerical:** Problem Solving: Tree and Graph Search, Uninformed v/s informed search, uninformed methods: depth first search, breadth first search, Informed search: heuristic search.	• Lecture • Group Discussion • Multimedia Presentation	• In-course Exam • Final Exam	CLO1, CLO3, CLO4
Week -11	Best first search, branch and bound; Machine Learning: Introduction, types of machine learning: supervised, unsupervised, reinforcement learning; Learning with Decision Trees: Introduction to Decision Trees.	• Lecture, Group Discussion • Multimedia Presentation • Problem solving	• In-course Exam • Final Exam	CLO1, CLO3, CLO4
Week -12	Classification and Regression Trees, K means clustering algorithm, K nearest neighbors algorithm, hierarchical clustering, Concept of ensemble methods.	• Lecture • Group Discussion • Multimedia Presentation	• In-course Exam • Final Exam	CLO2, CLO3, CLO4

Week -13	Concept of ANN, Basic Models, Important Terminologies of ANNs McCulloch-Pitts Neuron, NN architecture, perceptron, delta learning rule, backpropagation algorithm, Gradient Descent algorithm, feed forward networks, activation functions.	• Lecture • Group Discussion • Multimedia Presentation	• Oral Presentation • In-course Exam • Final Exam	CLO1, CLO2
Week -14	Introduction to AI Technologies in the realm of Automation Concept of Natural Language Processing, Machine Vision, Deep learning, Expert systems, Genetic Algorithms, Industry 4.0.	• Lecture • Group Discussion • Multimedia Presentation	• In-course Exam • Final Exam	CLO1, CLO3, CLO4

Part C

15. Assessment and Evaluation

i) Assessment Strategy

Strategy	**Percentage of Total marks**
Class attendance and participation	10
In-course Exam/Class Test	30
Semester Final Examination (3 hours duration)	60
Total	**100**

ii) Marks distribution:

- Continuous Assessment: 40%
- Summative: 60%
- Make-up Procedures: Two in-course exams will be taken and average marks will be counted. Feedback on in-course assessment is given to the students immediately after the test. If students are very weak in particular topics of this course, additional instruction will be given to help them catch up.

Part D

16. Learning Materials

i. Recommended Readings

a) Handbook of Industrial Automation-Richard L. Shell, Ernest L. Hall

b) Introduction to Industrial Automation- Stamatios Manesis, George Nikolakopoulos

c) Introduction to Artificial Intelligence By Wolfgang Ertel.

ii. Supplementary Readings

a) Introduction to Mechatronics and Measurement Systems by David G. Alciatore.

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

Semester-III

Course Code	Course Title	Credits
0723-FE-6000	Thesis	16.00
Grand Total		40.00

Course Outline of 0723-FE-6000

Part A

1. Course Code: 0723-FE-6000

2. Course Title: Thesis

3. Course Type: Core course

4. Year/Semester: Semester: I, II and III

5. Academic Session: 2022-2023

6. Course Teacher: Respective Supervisor/Co-supervisor, ILET, DU.

7. Pre-requisite: N/A

8. Credit Value: 16.0

9. Contact Hour: No specific contact hour per week.

10. Total Marks: 300

11. Rationale of the Course: Students for the M.Sc. in Footwear Engineering have to complete a thesis that demonstrates their ability to conduct in-depth research into a specific area and how it will relate to their own academic backgrounds and professionalism. After completing the thesis, students will be able to think independently about specific problems and develop a research methodology.

Course Contents:
Preparation of Research Proposal: Background, aim and objectives; review of relevant research; methodology; expected outcomes.
Conformation of Research Proposal: Proposal submission, presentation, and evaluation.
Literature Review: In-depth review of literature, data collection, research gap analysis.
Experimental Work: Materials and methods, method optimization, data generation and analysis, modelling and solution.
Midterm Presentation and Thesis Paper Preparation: Presentation on preliminary findings, drafting, review and editing of thesis paper, final thesis paper.
Submission and Defense: Final thesis paper submission and oral presentation.

12. Course Objectives:

a. To acquaint students with research culture, ethics, and research methodology.
b. To make the students capable of thinking individually for creative development.
c. To acquire skills for identifying and analyzing problems as well as devising

innovative solutions.

d. To develop effective communicative skills to present research outcomes.

13. Course Learning Outcomes (CLOs) and Mapping of CLOs with Program Learning Outcomes (PLOs)

a) CLOs: At the completion of this course students will be able to:

	Course Learning Outcomes (CLOs)	**Learning Level**
CLO1	Explain the background of the proposed research project and identify the research gaps.	C2, P2
CLO2	Develop research proposal and present it orally to disseminate the identified problem.	C3, A2, P3
CLO3	Analyze the existing methods and modify them based on the literature review.	C4, C5, A4, P4,
CLO4	Optimize new methods and generate, analyze, and modeling of relevant data based on the research outcomes.	C5, A4, P4
CLO5	Prepare a thesis paper with existing standards and present the results of the research through writing and orally.	C6, A5, P5

b) Mapping of CLO with PLO

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

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

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

CLOs	**Teaching-Learning Strategy**	**Assessment Strategy**
CLO1	Discussion and encouragement	Thesis defense and report evaluation by external as well as internal
CLO2	Discussion and encouragement	
CLO3	Self-study	
CLO4	Self-work	

CLO5	Lecture, discussion, demonstration, writing, final proof-reading	

Part B

14. Course plan specifying content, CLOs, co-curricular activities (if any), teaching learning and assessment strategy mapped with CLOs

Month	Topic	Teaching-Learning Strategy	Assessment Strategy	Corresponding CLOs
1–3	**Preparation of Research Proposal:** Background, aim and objectives; review of relevant research; methodology; expected outcomes.	• Discussion and encouragement	Thesis defense and report evaluation by external as well as internal	CLO1
4	**Conformation of Research Proposal**: Proposal submission, presentation, and evaluation.	• Discussion and encouragement		CLO2
5–7	**Literature Review:** In-depth review of literature, data collection, research gap analysis. Start the experimental work.	• Self-study		CLO3
8–15	**Experimental Work**: Materials and methods, method optimization, data generation, and analysis, modeling and solution.	• Self-work		CLO4
16	**Midterm Presentation and Thesis Paper Preparation:** Presentation on preliminary findings, drafting.	• Lecture • Discussion and demonstration		CLO5
17	Review and editing of thesis paper, final thesis paper.	• Writing • Final proofreading		
18	**Submission and Defense:** Final thesis paper submission and oral presentation.	• Demonstration		

Part C

15. Assessment and Evaluation

i) Assessment Strategy

Strategy	**Percentage of total marks**
Thesis defense	40
Dissertation Submission	60
Total	**100**

ii) Marks distribution:

a) Continuous Assessment/defense: 40%
b) Summative: 60%
c) Make-up Procedures: N/A.

Part D

16. Learning Materials

i. Recommended Readings:

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

Curriculum
M.Sc. in Footwear Engineering (General Group)
Institute of Leather Engineering and Technology (ILET)
UNIVERSITY OF DHAKA

Semester-I

Course Code	Course Title	Credits
0723-FE-6101	Advanced Footwear Manufacturing	3.00
0723-FE-6103	Optimization Techniques of Footwear Manufacturing	3.00
0723-FE-6105	Research Methodology	3.00
0723-FE-6107	Industrial Hazards and Waste Management	3.00
0723-FE-6109	Ergonomics and Industrial Safety	3.00
0723-FE-6111	Pedorthic Footwear	3.00
Total		**18.0**

Semester-II

Course Code	Course Title	Credits
0723-FE-6213	Environmental Management and Impact Assessment	3.00
0723-FE-6215	Nanotechnology for Leather and Leather Products	3.00
0723-FE-6217	Industrial Automation	3.00
0723-FE-6219	Product Design and Development	3.00
0723-FE-6221	E-Commerce and International Trade	3.00
Total		**15.00**

Semester-III

Course Code	Course Title	Credits
0723-FE-6300	Project	4.00
0723-FE-6302	Internship	2.00
0723-FE-6304	Viva Voce	1.00
Total		7.00
Grand Total		**40.00**

N.B. Project to be taken from Semester-II and will complete in Semester-III.

DETAIL COURSE CONTENTS

Semester-I

Course Code	Course Title	Credits
0723-FE-6101	Advanced Footwear Manufacturing	3.00
0723-FE-6103	Optimization Techniques of Footwear Production	3.00
0723-FE-6105	Research Methodology	3.00
0723-FE-6107	Industrial Hazards and Waste Management	3.00
0723-FE-6109	Ergonomics and Industrial Safety	3.00
0723-FE-6111	Materials and Quality Management of Leather Products	3.00
Total		**18.0**

Course Outline of 0723-FE-6101

Part A

1. Course Code: 0723-FE-6101

2. Course Title: Advanced Footwear Manufacturing

3. Course Type: Core Course

4. Year / Semester: Semester: I

5. Academic Session: 2022-23

6. Course Teachers: Noor Mohammad, Assistant Professor, ILET, DU
Md. Mukter Alam, Lecturer, ILET, DU

7. Prerequisite(s): N/A

8. Credits: 3.0

9. Contact Hours: 42

10. Total Marks: 100

11. Rationale of the Course: This course is intended to introduce students to various types of advanced manufacturing concepts of footwear. It will render the students about cutting-edge technology used in footwear industries. Moreover, it will help the students to understand the various aspects of footwear manufacturing paving the way for sustainability.

Course Contents:

Additive manufacturing (AM) techniques in footwear: Introduction to AM, AM in sports footwear, potential elements of AM, AM techniques: Stereolithography (SLA), PolyJet (PJ), selective laser sintering (SLS) and three-dimensional printing (3DP), suitability of different AM techniques and challenges of AM techniques, Major Applications of 3D Printing in Footwear; 3D knitted upper-footwear with 3D knitted upper, techniques and automation for

the creation of 3D knitted fabrics, tight-to-toe approach, fit and comfort, box-toes and counters, air permeability, thermal and water vapor resistance, and sole attachment.

Sustainability in footwear production: Footwear and its role in sustainability, sustainable production practices from designing to packaging department, waste accumulation, controlling volatile organic chemicals, CO_2, polymers, water, restricted substances, implementation of labor law in footwear production, implementation of environment conservation rules in footwear production, reducing costs in footwear manufacturing.

Waterproof and cold weather footwear: Design and manufacturing requirements of waterproof and cold weather footwear, properties and specifications of footwear upper and bottom materials for waterproof and cold weather footwear, and related testing for performance.

Quick drying footwear: Introduction, importance of quick-drying, material selection, mechanism of water removal, quick-drying footwear construction, testing for performance, maintaining performance in production.

Platform shoe: Advantages and disadvantages of platform shoe, importance of keeping stable in platform shoe, controlling of toe spring, positioning the shank, controlling waist strength, design, materials and construction.

Special upper leather: Origins and properties of suede and nubuck leather, shoe-making problems with suede and nubuck leather, sensitive surfaces, protection during shoemaking, other shoemaking operations, wear properties, acceptable levels of color fastness, oily finished leather for shoe making and wearing, properties of patent leather, problems that may arise in the use of patent leathers.

Shoe upper permeability maximization: Breathability and foot comfort, factors affecting thermoregulation, different climates, permeability performance of different materials, selection of materials, upper construction, importance upper permeability.

12. Course Objectives:

a. To introduce students to advanced footwear manufacturing technology.
b. To familiarize students with sustainable footwear production practices.
c. To equip students with footwear manufacturing for cold weather and waterproof, quick-drying, and platform shoe.
d. To disseminate knowledge about special types of leather-made footwear and shoe upper permeability.

13. Course Learning Outcomes (CLOs) and Mapping of CLOs with Program Learning Outcomes (PLOs)

a) CLOs: Upon completion of this course, students will be able to:

	Course Learning Outcomes (CLOs)	**Learning Level**
CLO1	Outline the basic knowledge of additive manufacturing techniques, sustainable footwear production, and different special-purpose footwear.	C1, A1

CLO2	Explain the essential features of footwear materials related to waterproof, cold weather, quick drying, and platform footwear.	C2, A2
CLO3	Apply the principle of advanced manufacturing techniques in waterproof, cold weather, quick drying, and platform footwear.	C3, A3
CLO4	Analyze and rectify the related problems of special types of footwear manufacturing.	C4, A3
CLO5	Compare and justify the various aspects of manufacturing techniques in waterproof, cold weather, quick-drying, and platform shoes.	C5, A4

b) Mapping of CLO with PLO

CLOs	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8
CLO1	3	3	-	-	-	-	-	-
CLO2	3	3	-	-	-	-	-	-
CLO3	3	3	-	-	-	-	-	-
CLO4	3	3	-	-	-	3	-	-
CLO5	3	3	-	-	-	3	-	3

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

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

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture, Whiteboard illustration, Multimedia presentation	In-course assessment, Assignment; Final examination
CLO2	Lecture, Whiteboard illustration, Multimedia presentation	In-course Exam; Final Exam
CLO3	Lecture, Whiteboard illustration, Multimedia presentation	In-course Assessment, Case study; Final examination
CLO4	Lecture, Whiteboard illustration, Multimedia presentation	In-course assessment; Final examination
CLO5	Lecture, Whiteboard illustration, Multimedia presentation	In-course Assessment, Presentation; Final examination

Part B

14. Course plan specifying content, CLOs, co-curricular activities (if any), teaching-learning, and assessment strategy mapped with CLOs

Time Period	Topic	Teaching-Learning Strategy	Assessment Method	Corresponding CLOs
Week-01	**Additive manufacturing (AM) techniques in footwear:** Introduction to AM, AM in sports footwear, potential elements of AM, AM techniques: Stereolithography (SLA), PolyJet (PJ), selective laser sintering (SLS) and three-dimensional printing (3DP), suitability of different AM techniques and challenges of AM techniques.	• Interactive discussion • Lecture with multimedia • Whiteboard illustration	• In-course Exam • Final Exam	CLO1, CLO2
Week -02	Major Applications of 3D Printing in Footwear; 3D knitted upper-footwear with 3D knitted upper, techniques and automation for the creation of 3D knitted fabrics, tight-to-toe approach, fit and comfort, box-toes and counters, air permeability, thermal and water vapour resistance, and sole attachment.	• Interactive discussion • Lecture with multimedia • Whiteboard illustration	• In-course Exam • Final Exam	CLO1, CLO2
Week -03	**Sustainability in footwear production:** Footwear and its role in sustainability, sustainable production practices from designing to packaging	• Interactive discussion • Lecture with multimedia • Whiteboard illustration	• In-course Exam • Final Exam	CLO1

	department, waste accumulation, controlling volatile organic chemicals, CO_2, polymers, and water.			
Week -04	Restricted substances, implementation of labor law in footwear production, implementation of environment conservation rules in footwear production, reducing costs in footwear manufacturing.	• Interactive discussion • Lecture with multimedia • Whiteboard illustration	• In-course Exam • Assignment • Final Exam	CLO1
Week -05	**Waterproof and cold weather footwear:** Design and manufacturing requirements of waterproof and cold weather footwear.	• Interactive discussion • Lecture with multimedia • Whiteboard illustration	• In-course Exam • Final Exam	CLO2, CLO3
Week -06	Properties and specifications of footwear upper materials for waterproof and cold weather footwear, and related testing for performance.	• Interactive discussion • Lecture with multimedia • Whiteboard illustration	• In-course Exam • Final Exam	CLO2, CLO3, CLO5
Week -07	Properties and specifications of footwear bottom materials for waterproof and cold weather footwear, and related testing for performance.	• Interactive discussion • Lecture with multimedia • Whiteboard illustration	• In-course Exam • Case study • Final Exam	CLO2, CLO3, CLO5
Week -08	**Quick drying footwear:** Introduction, importance of quick-drying, material selection, mechanism of water removal.	• Interactive discussion • Lecture with multimedia • Whiteboard illustration	• In-course Exam • Final Exam	CLO1, CLO2

Week -09	Quick-drying footwear construction, testing for performance, and maintaining performance in production.	• Interactive discussion • Lecture with multimedia • Whiteboard illustration	• In-course Exam • Final Exam	CLO3, CLO5
Week -10	**Platform shoe manufacture:** Advantages and disadvantages of platform shoe, importance of keeping stable in platform shoe, controlling of toe spring, positioning the shank, controlling waist strength, design and construction.	• Interactive discussion • Lecture with multimedia • Whiteboard illustration	• In-course Exam • Final Exam	CLO3, CLO5
Week -11	**Special upper leather footwear:** Origins and structures of suede and nubuck leather, properties of suede and nubuck leather, shoe making problems with suede and nubuck leather, sensitive surfaces, protection during shoemaking, other shoemaking operations, wear properties, dye fixatives, surface fixatives.	• Interactive discussion • Lecture with multimedia • Whiteboard illustration	• In-course Exam • Final Exam	CLO1, CLO2, CLO4
Week -12	Acceptable levels of colour fastness, customer awareness; properties of oily finished leather, surface appearance, problems that may arise in the use of oily finished leather for shoe making and wearing- soiling, cleaning and adhesion, properties of patent leather, problems that	• Interactive discussion • Lecture with multimedia • Whiteboard illustration	• In-course Exam • Final Exam	CLO4, CLO5

	may arise in the use of patent leathers-tear strength problem, orange-peel effects, heat stress cracking, flexing problem, coating peeling, abrasion damage, surface friction effects, care taken for producing footwear with patent leather.			
Week -13	**Shoe upper permeability maximization:** Breathability and foot comfort, factors affecting thermoregulation.	• Interactive discussion • Lecture with multimedia • Whiteboard illustration	• Final Exam	CLO2, CLO4, CLO5
Week -14	Different climates, permeability performance of different materials, selection of materials, upper construction, importance upper permeability.	• Interactive discussion • Lecture with multimedia • Whiteboard illustration	• Presentation • Final Exam	CLO2, CLO4, CLO5

Part C

15. Assessment and Evaluation

i) Assessment Strategy

Strategy	**Percentage of Total marks**
Class attendance and participation	10
In-course Exam/Class Test	30
Semester Final Examination (3 hours duration)	60
Total	**100**

ii) Marks distribution:

- Continuous Assessment: 40%
- Summative: 60%
- Make-up Procedures: Two in-course exams will be taken and average marks will be counted. Feedback on in-course assessment is given to the students immediately after the test. If students are very weak in particular topics of this course, additional instruction will be given to help them catch up.

Part D

16. Learning Materials

i. Recommended Readings

a) ROSSI, W. A. and TENNANT, R.-Professional Shoe Fitting, New York, Pedorthic Footwear Association.
b) STELLA, S.-The Innovation Notebooks for the Footwear Industry, Last, Italy, AssomacServizisrl.
c) Miller, R.G-Manual of Shoe Making, 5th ed. Printing Department, Clarks Ltd. C. & J. Clark Ltd.
d) Wade Motawi-Shoe Materials Design Guide.

ii. Supplementary Readings

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

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

Course Outline of 0723-FE-6103

Part A

1. Course Code: 0723-LPE 6103

2. Course Title: Optimization Techniques of Footwear Manufacturing

3. Course Type: Core Course

4. Year / Semester: Semester: I

5. Academic Session: 2022-23

6. Course Teachers: Uttam Kumar Roy, Associate Professor, ILET, DU.

Md. Abdus Shabur, Lecturer, ILET, DU.

7. Prerequisite(s): N/A

8. Credits: 3.0

9. Contact Hours: 42

10. Total Marks: 100

11. Rationale of the Course: The focus of this course is on theoretical concepts, data-driven models, and numerical techniques for optimization using actual variables. The course provides a thorough understanding in mathematical optimization theory, methods, and algorithms. The course will begin with linear optimization, and will go into detail about how to formulate problems and find solutions as well as to develop a methodology for footwear engineering design.

Course Contents:

Advanced Inventory Management: Demand and control system characteristics, inventory concept, inventory cost, inventory modeling, optimization and inventory control, Dynamic EOQ Models, probabilistic models and safety stock, probabilistic demand, probabilistic example, Single-Period Models, Multiperiod Models.

Aggregate Planning and Master Scheduling: Basic Strategies for Meeting Uneven Demand, Techniques for Aggregate Planning, Disaggregating the Aggregate Plan, Master Scheduling, the Master Scheduling Process, Methods for Aggregate Planning: Graphical Methods, Mathematical Approaches, and Comparison of Aggregate Planning Methods.

MRP, MRPII and ERP: Basic ideas of inventory MRP, benefits of MRP, inputs to MRP, bill of material (BOM), BOM examples for footwear manufacture, Master Production Schedule (MPS), MPS examples for footwear manufacture, time-phased product structure, MRP structure, determining gross requirements, gross requirements plan for footwear manufacture, gross requirements schedule, MRP management, Lot-sizing techniques, Lot-for-Lot examples, EOQ lot size examples, POQ lot size examples, material requirements planning II, distribution resource planning (DRP), enterprise resource planning (ERP), SAP's ERP modules.

Decision Modeling: The Decision Process in Operations; Fundamentals of Decision Making; Types of Decision-Making Environments; Decision Making under Uncertainty, Decision Making under Risk, Decision Making under Certainty, Expected Value of Perfect Information (EVPI); Decision Trees; A More Complex Decision Tree, Using Decision Trees in Ethical Decision Making.

Linear Programming Models: Why Use Linear Programming? Requirements of a Linear Programming Problem, Formulating Linear Programming Problems, Graphical Solution to a Linear Programming Problem, Sensitivity Analysis, Solving Minimization Problems, Linear Programming Applications, the Simplex Method of LP.

Transportations Modeling: Transportation Modeling; Developing an Initial Solution: The Northwest-Corner Rule, The Intuitive Lowest-Cost Method, The Stepping-Stone Method; Special Issues in Modeling: Demand Not Equal to Supply, Degeneracy; Using Software to Solve Transportation Problems; Case Studies.

Integer Programming and Dynamic Programming and Network Techniques: Integer programming - Cutting plane algorithm, Branch and bound technique, Zero-one implicit enumeration – Dynamic Programming – Formulation, Various applications using Dynamic Programming. Network Techniques – Shortest Path Model – Minimum Spanning Tree Problem – Maximal flow problem.

Problem solving tools and improvement strategies: Problem solving process, quality control tools, new management tools, quality function deployment, Deming wheel, zero defect concept, benchmarking, six- sigma.

12. Learning Objectives:

a. To introduce students with advanced inventory management and aggregate planning.
b. To familiarize students with various production planning methods.
c. To provide knowledge on different optimization models and their applications in footwear manufacturing.

13. Course Learning Outcomes (CLOs) and Mapping of CLOs with Program Learning Outcomes (PLOs)

a) CLOs: Upon completion of this course, students will be able to:

	Course Learning Outcomes (CLOs)	Learning Level
CLO1	Explore knowledge on various optimization techniques used in footwear manufacturing.	C1, C2, A1
CLO2	Explain the methods and ways to manage different optimization tools.	C2, A2
CLO3	Implement the advanced tools and techniques of operations research to manage the production in the footwear industry supply chain	C3, A2
CLO4	Manage new project related to new footwear products or business	C4
CLO5	Investigate the applicability of a specific tool or technique to a specific case.	C5

b) Mapping of CLO with PLO

(CLOs)	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8
CLO1	3	-	-	-	-	-	-	-
CLO2	3	-	-	-	-	1	-	-
CLO3	3	-	-	-	1	2	2	-
CLO4	3	-	2	1	-	2	3	-
CLO5	3	-	2	-	2	2	1	-

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

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

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

	based exercises	Final Exam
CLO5	Lecture, multimedia presentation, group discussion, demonstration, and problem-based exercises	Group Presentation, Case study, Assignment, In-course Exam and Final Exam

Part B

14. Course plan specifying content, CLOs, co-curricular activities (if any), teaching learning and assessment strategy mapped with CLOs

Time Period	Topic	Teaching-Learning Strategy	Assessment Strategy	Corresponding CLOs
Week-01	**Advanced Inventory Management:** Demand and control system characteristics, inventory concept, inventory cost, inventory modeling, optimization and inventory control.	• Lecture • Group Discussion • Multimedia Presentation • Literature review	• In-course Exam • Final Exam	CLO1, CLO2, CLO3
Week -02	Dynamic EOQ Models, probabilistic models and safety stock, probabilistic demand, probabilistic example, Single-Period Models, Multiperiod Models.	• Lecture • Group Discussion • Multimedia Presentation • Literature review	• In-course Exam • Final Exam	CLO1, CLO2, CLO3
Week -03	**Aggregate Planning and Master Scheduling:** Basic Strategies for Meeting Uneven Demand, Techniques for Aggregate Planning, Disaggregating the Aggregate Plan.	• Lecture • Group Discussion • Multimedia Presentation	• Assignment • In-course Exam • Final Exam	CLO1, CLO2
Week -04	Master Scheduling, The Master Scheduling Process, Methods for	• Lecture • Group Discussion	• In-course Exam	CLO1, CLO2

	Aggregate Planning: Graphical Methods, Mathematical approaches, Comparison of Aggregate Planning Methods.	Multimedia Presentation • Problem solving	• Final Exam	
Week -05	**MRP, MRPII and ERP**: Basic ideas of inventory MRP, benefits of MRP, inputs to MRP, bill of material (BOM), BOM examples for footwear manufacture, Master Production Schedule (MPS).	• Lecture • Group Discussion • Multimedia Presentation	• Case study • In-course Exam • Final Exam	CLO1, CLO2, CLO3
Week -06	MPS examples for footwear manufacture, time-phased product structure, MRP structure, determining gross requirements, gross requirements plan for footwear manufacture, gross requirements schedule.	• Lecture • Group Discussion • Multimedia Presentation	• In-course Exam • Final Exam	CLO2, CLO3, CLO5
Week -07	**MRP management**, Lot-sizing techniques, Lot-for-Lot examples, EOQ lot size examples, POQ lot size examples, material requirements planning II, distribution resource planning (DRP), enterprise resource planning (ERP), SAP's ERP modules.	• Lecture • Group Discussion • Multimedia Presentation	• Case Study • In-course Exam • Final Exam	CLO2

Week -08	**Decision Modeling**: The Decision Process in Operations; Fundamentals of Decision Making; Types of Decision-Making Environments; Decision Making under Uncertainty.	• Lecture • Group Discussion • Multimedia Presentation	• In-course Exam • Final Exam	CLO3, CLO4, CLO5
Week -09	Decision Making under Risk, Decision Making under Certainty, Expected Value of Perfect Information (EVPI); Decision Trees; A More Complex Decision Tree, Using Decision Trees in Ethical Decision Making.	• Lecture • Group Discussion • Multimedia Presentation	• Group Presentation • In-course Exam • Final Exam	CLO3, CLO4, CLO5
Week -10	**Linear Programming Models**: Why Use Linear Programming? Requirements of a Linear Programming Problem, Formulating Linear Programming Problems, Graphical Solution to a Linear Programming Problem, Sensitivity Analysis, Solving Minimization Problems, Linear Programming Applications, The Simplex Method of LP.	• Lecture • Group Discussion • Multimedia Presentation	• In-course Exam • Final Exam	CLO1, CLO3
Week -11	**Transportations Modeling:** Transportation Modeling; Developing an Initial Solution: The Northwest-Corner	• Lecture • Group Discussion • Multimedia Presentation	• In-course Exam • Final Exam	CLO1, CLO3, CLO5

	Rule, The Intuitive Lowest-Cost Method, The Stepping-Stone Method; Special Issues in Modeling: Demand Not Equal to Supply, Degeneracy; Using Software to Solve Transportation Problems; Case Studies.	• Problem solving		
Week -12	**Integer Programming** and Dynamic Programming and Network Techniques: Integer programming - Cutting plane algorithm, Branch and bound technique, Zero-one implicit enumeration – Dynamic Programming – Formulation.	• Lecture • Group Discussion • Multimedia Presentation	• In-course Exam • Final Exam	CLO1, CLO3
Week -13	Various applications using Dynamic Programming. Network Techniques – Shortest Path Model – Minimum Spanning Tree Problem – Maximal flow problem.	• Lecture • Group Discussion • Multimedia Presentation • Problem solving	• Oral Presentation • In-course Exam • Final Exam	CLO3
Week -14	**Problem solving tools and improvement strategies**: Problem solving process, quality control tools, new management tools, quality function deployment, Deming wheel, zero defect concept, benchmarking, six- sigma.	• Lecture • Group Discussion • Multimedia Presentation • Literature review	• In-course Exam • Final Exam	CLO1, CLO3, CLO4, CLO5

Part C

15. Assessment and Evaluation

i) Assessment Strategy

Strategy	Percentage of Total marks
Class attendance and participation	10
In-course Exam/Class Test	30
Semester Final Examination (3 hours duration)	60
Total	**100**

ii) Marks distribution:

- Continuous Assessment: 40%
- Summative: 60%
- Make-up Procedures: Two in-course exams will be taken and average marks will be counted. Feedback on in-course assessment is given to the students immediately after the test. If students are very weak in particular topics of this course, additional instruction will be given to help them catch up.

Part D

16. Learning Materials

i. Recommended Readings

a) Jay Heizer, Barry Render, Chuck Munson- Operations Management: Sustainability and Supply Chain Management (13th Edition)

b) Jay Heizer, Barry Render- Operations Management (11th Edition)

c) Hamdy A. Taha, Operations Research – An Introduction, Prentice Hall of India, 1997

d) Gideon Halevi- Handbook of Production Management Methods

e) R. Panneerselvam, "Operations Research", Prentice Hall of India Private Limited, New Delhi 1 – 2005

ii. Supplementary Readings

a) Larry P. Ritzman, Lee J. Krajewski, and Manoj K. Malhotra- Operations Management: Processes and Supply Chains

b) Nicholas J. Aquilano and Richard B. Chase- Production and Operations Management

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

Course Outline of 0723-FE-6105

Part A

1. Course Code: 0723-FE-6105

2. Course Title: Research Methodology

3. Course Type: Core Course

4. Year / Semester: Semester: I

5. Academic Session: 2022-23

6. Course Teacher: Dr. Mohammed Mizanur Rahman, Professor and Director, ILET, DU

7. Prerequisite(s): N/A

8. Credits: 3.0

9. Contact Hours: 42

10. Total Marks: 100

11. Rational of the Course: This course provides an opportunity for students to establish or advance their understanding of research through critical exploration of research language, ethics, and approaches. Students will be able to examine and be practically exposed to the main components of a research framework i.e., problem definition, research design, data collection, ethical issues in research, report writing, and presentation.

Course Contents:

Introduction to research: Definitions, characteristics, types, differences and role of research**,** research and investigation, research methods versus research methodology**,** criteria of good research, paradigms and ethics in research, proposition, axiom, postulate, theorem and model of research**,** variables and types**,** properties of relationships between variables**,** inductive and deductive method.

Literature review and research problem: Definition, objectives, advantages, principles and procedures of literature review, problem definition, finding a researchable problem**,** selecting the problem**,** importance of defining the problem, important qualities of a research problem**,** techniques involved in defining a problem**,** evaluating a proposed design.

Research questions and objectives: Research objective and research question**,** practical examples of research objectives and research question, formulation of research questions, criteria of research objectives, evaluation of research questions, classification and importance of research objectives.

Research hypothesis, design, and proposal: Source, functions, and characteristics of a good research hypothesis, formulation and possible difficulties of research hypothesis, research hypothesis versus research objectives; definition, function, classification of research design, feature of a good research design, qualitative research, observation studies**,** surveys**,** experimentation, steps in a research design; meaning of research proposal**,** contents of research proposal**,** steps in the development of a research proposal, criteria for evaluating research proposal.

Qualitative research tools, measurement and scaling technique: Definition**,** characteristics, uses, and general steps of qualitative research, qualitative research approaches, steps in grounded theory, nature of measurement**,** measurement scales, types of measurement scales, Likert scale.

Questionnaire design: Questionnaire and questionnaire design**,** consideration and types of questions**,** questionnaire designing process**,** necessary properties of questionnaire**,** characteristics of a good questionnaire**,** precaution required in the use of questionnaire**,** guidelines for constructing questions and questions sequence.

Sampling and sampling design: Concepts and importance of sampling, planning and designing a survey, classification of sampling techniques, probability sampling design, non-probability sampling design, determination of sample size.
Data collection and analysis: Data, data versus information, types and sources of data collection, secondary data collection methods, primary data collection methods, qualitative and quantitative methods of data collection, data validation, editing and coding, data entry and exploring, displaying and examining data, Univariate analysis, Bivariate analysis, Multivariate analysis, SWOT analysis, and Hypothesis testing.
Presenting insights and findings: Importance of the report and presentation, report preparation and presentations process, precautions in interpretation, research report, contents and precautions in writing research report, presentation of statistics, oral presentation, writing thesis/dissertation, writing journal articles and conference papers, bibliography and reference writing styles, copy right, plagiarism.

12. Course Objectives:

a. To familiarize the students with the key terms, concepts, and practices in the field of research.
b. To prepare research problems and/or hypotheses in a clear and concise format.
c. To demonstrate a systematic understanding of the range of advanced research techniques, be able to critically evaluate these techniques and apply them appropriately.
d. To evaluate and critically analyze the components of scholarly writing and published research.

13. Course Learning Outcomes (CLOs) and Mapping of CLOs with Program Learning Outcomes (PLOs)

a) CLOs: Upon completion of this course, students will be able to:

	Course Learning Outcomes (CLOs)	**Learning Level**
CLO1	Outline the basic framework of research process, and identify various sources of information for literature review and data collection.	C1, A1
CLO2	Explain the ethical dimensions of conducting basic and applied research.	C2, A2
CLO3	Design questionnaire, explain the procedures and techniques, and analyze data with different statistical tools and techniques using statistical computing for making better decisions.	C2, C3, A3
CLO4	Acquaint with the process of conducting research to identify real-life problems recurrently encounter and to suggest suitable and pragmatic solutions to those problems.	C4, A4
CLO5	Compare the advanced research techniques and critically analyze the components of scholarly writing and published research.	C5, A4

b) Mapping of CLO with PLO

(CLOs)	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8
CLO1	3	-	3	-	-	2	-	-
CLO2	3	-	3	-	-	2	-	-
CLO3	3	-	3	-	-	3	-	2
CLO4	3	3	3	3	-	3	2	-
CLO5	3	2	3	3	-	3	3	-

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

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

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture, Whiteboard illustration, Multimedia presentation, Interactive Discussion	Assignment, Case study, In-course Exam and Final Exam
CLO2	Lecture, Whiteboard illustration, Multimedia presentation, Interactive Discussion	Assignment, Case study, In-course Exam and Final Exam
CLO3	Lecture, Whiteboard illustration, Multimedia presentation, Interactive Discussion	Assignment, Case study, In-course Exam and Final Exam
CLO4	Lecture Whiteboard illustration, Multimedia presentation, Interactive Discussion	Presentation, Assignment, In-course Exam and Final Exam
CLO5	Lecture, Whiteboard illustration, Multimedia presentation, Interactive Discussion	Presentation, Assignment, In-course Exam and Final Exam

Part B

14. Course plan specifying content, CLOs, co-curricular activities (if any), teaching learning and assessment strategy mapped with CLOs.

Time Period	Topic	Teaching-Learning Strategy	Assessment Strategy	Corresponding CLOs
Week -01	**Introduction to research:** Definitions, characteristics, types, differences and role of research**,** research and investigation, research methods versus research methodology**,** criteria of good research, paradigms and ethics in research.	• Lecture • Whiteboard illustration	• In-Course Exam • Final Exam	CLO1, CLO2
Week -02	Proposition, axiom, postulate, theorem and	• Lecture	• In-Course	CLO1, CLO2

	model of research**,** variables and types**,** properties of relationships between variables**,** inductive and deductive method.	• Multimedia presentation	Exam • Final Exam	
Week -03	**Literature review and research problem:** Definition, objectives, advantages, principles and procedures of literature review, problem definition, finding a researchable problem**,** selecting the problem**,** importance of defining the problem, important qualities of a research problem**,** techniques involved in defining a problem**,** evaluating a proposed design.	• Lecture • Multimedia presentation • Case study	• In-Course Exam • Assignment • Final Exam	CLO1, CLO2, CLO4
Week -04	**Research questions and objectives:** Research objective and research question**,** practical examples of research objectives and research question, formulation of research questions, criteria of research objectives, evaluation of research questions, classification and importance of research objectives.	• Lecture • Multimedia presentation • Whiteboard illustration	• In-Course Exam • Final Exam	CLO1, CLO2, CLO3
Week -05	**Research hypothesis, design, and proposal:** Source, functions, and	• Lecture • Multimedia	• In-Course Exam	CLO1, CLO2, CLO3

	characteristics of a good research hypothesis, formulation and possible difficulties of research hypothesis, research hypothesis versus research objectives; definition, function, classification of research design, feature of a good research design.	presentation • Whiteboard illustration	• Case study • Final Exam	
Week -06	Qualitative research, observation studies, surveys, experimentation, steps in a research design; meaning of research proposal**,** contents of research proposal**,** steps in the development of a research proposal, criteria for evaluating research proposal.	• Lecture • Multimedia presentation	• In-Course Exam • Final Exam	CLO1, CLO2, CLO3
Week -07	**Qualitative research tools, measurement and scaling technique:** Definition**,** characteristics, uses, and general steps of qualitative research, qualitative research approaches, steps in grounded theory, nature of measurement**,** measurement scales, types of measurement scales, Likert scale.	• Lecture • Video presentation • Whiteboard illustration	In-Course Exam Final Exam	CLO2, CLO3, CLO5

Week -08	**Questionnaire design:** Questionnaire and questionnaire design**,** consideration and types of questions**,** questionnaire designing process**,** necessary properties of questionnaire**,** characteristics of a good questionnaire**.**	• Lecture • Interactive discussion • Whiteboard illustration	• In-Course Exam • Final Exam	CLO2, CLO3
Week -09	Precaution required in the use of questionnaire, guidelines for constructing questions, and questions sequence. **Sampling and sampling design:** Concepts and importance of sampling**,** planning and designing a survey**,** classification of sampling techniques.	• Lecture • Multimedia presentation	• In-Course Exam • Final Exam	CLO2, CLO3, CLO4
Week -10	Probability sampling design**,** non-probability sampling design**,** and determination of sample size. **Data collection and analysis:** Data, data versus information, types and sources of data collection**,** secondary data collection methods**,** primary data collection methods.	• Lecture • Multimedia presentation	• In-Course Exam • Final Exam	CLO2, CLO3

Week -11	Qualitative and quantitative methods of data collection, data validation, editing and coding**,** data entry and exploring**,** displaying and examining data**,** Univariate analysis**,** Bivariate analysis**,** Multivariate analysis**,** SWOT analysis**,** and Hypothesis testing.	• Lecture • Whiteboard illustration • Multimedia presentation	• In-Course Exam • Presentation • Final Exam	CLO3, CLO4, CLO5
Week -12	**Presenting insights and findings:** Importance of the report and presentation**,** report preparation and presentations process**,** precautions in interpretation**,** research report**,** contents and precautions in writing research report.	• Lecture • Multimedia presentation	• In-Course Exam • Final Exam	CLO3, CLO4, CLO5
Week -13	Presentation of statistics**,** oral presentation**,** writing thesis/dissertation**,** writing journal articles and conference papers**,** bibliography and reference writing styles**,** copyright, plagiarism.	• Lecture • Case study	• Assignment • Final Exam	CLO3, CLO4, CLO5
Week -14	Review.	• Interactive discussion	• Final Exam	CLO1 - CLO5

Part C

15. Assessment and Evaluation

i) Assessment Strategy

Strategy	Percentage of Total marks
Class attendance and participation	10
In-course Exam/Class Test	30
Semester Final Examination (3 hours duration)	60
Total	**100**

ii) Marks distribution:

- Continuous Assessment: 40%
- Summative: 60%
- Make-up Procedures: Two in-course exam will be taken and average marks will be counted. Feedback on in-course assessment is given to the students immediately after the test. If students is very weak in particular topics of this course, additional instruction will be given to help them catch up.

Part D

16. Learning Materials

i. Recommended Readings

a) M. A. Salam Akanda (2019). Research Methodology-A Complete Direction for Learners. Latest Ed., Akanda& Sons, Dhaka.

b) C. R. Kothari (1996). Research Methodology- Methods & Techniques. Wishaw Prokashan, New Delhi, Wiley Eastern Limited.

c) An Introduction to Research Methods ; Author: M. Nurul Islam ; Year: 2011 ; Edition: 2nd ; Publisher: Mullick& Brothers

ii. Supplementary Readings

a) Ranjit Kumar (2005). *Research Methodology- A Step-by-Step Guide for Beginners*, 3rd Ed., Singapore, Pearson Education.

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

Course Outline of 0723-FE-6107

Part A

1. Course Code: 0723-FE-6107

2. Course Title: Industrial Hazards and Waste Management

3. Course Type: Core Course

4. Year / Semester: Semester: I

5. Academic Session: 2022-23

6. Course Teachers: Dr. Md. Abdul Mottalib, Professor, ILET, DU.

Sunzida Haque Rimu, Lecturer, ILET, DU.

7. Prerequisite(s): N/A

8. Credits: 3.0

9. Contact Hours: 42

10. Total Marks: 100

11. Rationale of the Course: This course is designed to provide in-depth knowledge of the exploitation of valuable products from tannery wastes by utilizing modern technology. This course will facilitate students with deeper understanding of different types and characteristics of industrial hazardous wastes and a comprehensive overview of hazardous waste management's approaches.

Course Contents:

Industrial Hazards: Hazard, Types of industrial hazards, Identification of hazardous wastes, Hazardous waste management, Treatment technology, Disposal of radioactive materials, Ground water contamination and remediation. Route of industrial hazard entry into human body-Inhalation, Absorption, Swallowed, Injection, Food chain - Contaminated soil, Vegetables, Crops, Fish and Chicken, Adverse impact of hazard, Occupational cancer.

Solid Waste Generation in the Leather industry and its Utilization: Generation: Skin collagen waste, Fleshing waste, Wet blue, Trimming, Buffing, Chrome shaving, Chrome split, trimming from crust and finished leather. Utilization: Fleshing- Modified fleshing hydrolysate, Reactive protein (RP), feed ingredients.

Chrome shaving: Treatment with enzyme, MgO, Carbonates and other alkalies, application of hydrolysate.

Waste generation in Footwear and Leather Products Industry: Materials being processed: Leather, Natural rubber/poly-isoprene, Reaction Injection Moulded (RIM) polyurethane (PU), Polyvinyl Chloride (PVC) and blends, Ethylene Vinyl Acetate (EVA) and blends, Styrene Butadiene Rubber (SBR), Thermoplastic Polyurethane (TPU), Thermoplastic Rubber (TR), Leather, textile, cotton, polyesters, nylon, adhesive, solvent, oil.

Solid Waste Management: Solid waste – sources and engineering classification, characterization, generation and quantification. Transport - collection systems, collection equipment, transfer stations, collection route optimization.

Treatment methods – various methods of refuse, recovery, recycle, composting –aerobic and anaerobic, incineration, pyrolysis and energy recovery.

Disposal methods – Impacts of open dumping, site selection, sanitary land filling – design criteria and design examples, leachate and gas collection systems, and leachate treatment.

Hazardous Waste Management – Introduction, Sources, Classification, Physico-chemical, Chemical and biological Treatment of hazardous waste, regulations.

Thermal treatment – Incineration and pyrolysis.

Soil contamination and site remediation– Bioremediation processes, monitoring of disposal sites.

Removal of Refractory Organic Compounds: Theories on Advanced Oxidation Process viz., Photocatalytic treatment, Membrane separation, Homogenous catalysis system using hydrogen peroxide, ozone, etc. Heterocatalytic systems using metal oxides, activated carbon – Removal of inorganic compounds through electro dialysis, reverse osmosis, multiple effect evaporator, ion-exchange.

12. Course Objectives:

a. To provide the advance knowledge about the environmental problems, industrial hazards,and its methods of mitigation.
b. To estimate solid waste generation from tanning industry, and leather goods industry and their utilization using modern techniques.
c. To improve a comprehensive skill on tannery solid waste, biomedical and other hazardous wastes and integrated solid waste management system.
d. To familiarize studentswith modern biological techniques available for the wastewater treatment.

13. Course Learning Outcomes (CLOs) and Mapping of CLOs with Program Learning Outcomes (PLOs)

a) CLOs: Upon completion of this course, students will be able to:

	Course Learning Outcomes (CLOs)	**Learning Level**
CLO1	Narrate industrial hazards and their adverse impact on the environment and humans.	C1, A1
CLO2	Analyze tannery solid waste utilization into the valuable byproducts as part of circular economy and clean technology.	C3, A3
CLO3	Apply knowledge on the estimation of solid waste generated from leather and allied industries.	C4
CLO4	Justify modern techniques of wastewater treatment with traditional treatment processes.	C5, A4

b) Mapping of CLO with PLO

(CLOs)	**PLO1**	**PLO2**	**PLO3**	**PLO4**	**PLO5**	**PLO6**	**PLO7**	**PLO8**
CLO1	3	2	-	-	-	2	1	-
CLO2	2	3	3	-	-	2	3	-
CLO3	3	3	3	-	-	2	2	-
CLO4	3	3	-	3	3	2	3	-

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

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

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture, Multimedia presentation, demonstration and problem-based exercises	In-course Exam; Final Exam
CLO2	Lecture, audiovisual presentation, group discussion and problem-based exercises, literature review	Presentation, In-course Exam; Final Exam
CLO3	Lecture, problem-based learning (PBL): Identifying the problem to be solved	Assignment, Group Presentation, In-course Exam, and Final Exam
CLO4	Lecture, multimedia presentation, group discussion, literature review, demonstration, and problem-based exercises	Assignment, In-course Exam, and Final Exam

Part B

14. Course plan specifying content, CLOs, co-curricular activities (if any), teaching learning and assessment strategy mapped with CLOs

Time Period	Topic	Teaching-Learning Strategy	Assessment Strategy	Corresponding CLOs
Week -01	**Industrial Hazards:** Hazard, Types of industrial hazards, Identification of hazardous wastes, Hazardous waste management, Treatment technology, Absorption.	• Lecture • Multimedia presentation • Demonstration	• In-course Exam • Final Exam	CLO1
Week -02	Disposal of radioactive materials, Ground water contamination and remediation. Route of industrial hazard entry into human body- Inhalation.	• Interactive class lecture • Multimedia presentation • Demonstration	• In-course Exam • Final Exam	CLO1, CLO2
Week -03	Swallowed, injection, food chain - contaminated soil, vegetables, crops, fish and chicken, adverse	• Interactive class lecture • Multimedia presentation • Whiteboard	• In-course Exam • Final Exam • Assignments	CLO1, CLO2

	impact of hazard, occupational cancer.	illustration		
Week -04	**Solid Waste Generation**: Skin collagen waste, fleshing waste, wet blue, trimming, buffing, chrome shaving, chrome split, trimming from crust and finished leather.	• Audiovisual Lecture • Multimedia presentation • Demonstration	• In-course Exam • Final Exam	CLO1, CLO2
Week -05	Utilization: Fleshing-Modified fleshing hydrolysate, reactive protein (RP), feed ingredients.	• Audiovisual Lecture • Multimedia presentation • Demonstration	• In-course Exam • Final Exam	CLO1, CLO2
Week -06	Chrome shaving: Treatment with enzyme, MgO, Carbonates and other alkalis, applications of protein hydrolysate.	• Interactive class lecture • Visual presentation • Whiteboard illustration	• Final Exam	CLO2, CLO3
Week -07	**Waste generation in Footwear and Leather Products Industry:** Materials being processed: Leather, Natural rubber/poly-isoprene, Reaction Injection Moulded (RIM) polyurethane (PU), Polyvinyl Chloride (PVC) and blends.	• Lecture • Multimedia presentation • Group-discussion	• In-course Exam • Final Exam	CLO2, CLO3
Week -08	Ethylene Vinyl Acetate (EVA) and blends, Styrene Butadiene Rubber (SBR), Thermoplastic	• Lecture • Multimedia presentation • Problem-based discussion	• In-course Exam • Final Exam	CLO2, CLO3

	Polyurethane (TPU), Thermoplastic Rubber (TR), Leather, textile, cotton, polyesters, nylon, adhesive, solvent, oil.			
Week -09	**Solid Waste Management:** Solid waste–sources and engineering classification, characterization, generation and quantification. Transport - collection systems, collection equipment, transfer stations, collection route optimization. Treatment methods - various methods of refuse, recovery, recycle.	• Audiovisual Lecture • Multimedia presentation • Demonstration	• In-course Exam • Final Exam	CLO2, CLO4
Week -10	Composting –aerobic and anaerobic, incineration, pyrolysis and energy recovery. Disposal methods – Impacts of open dumping, site selection, sanitary land filling – design criteria and design examples.	• Interactive class lecture • Visual presentation • Whiteboard illustration	• In-course Exam • Final Exam • Assignments	CLO2, CLO3
Week -11	Leachate and gas collection systems, and leachate treatment, hazardous waste management-introduction, sources, classification, physico-chemical, chemical and biological treatment of hazardous waste,	• Interactive class lecture • Problem solving	• In-course Exam • Final Exam	CLO3, CLO4

	regulations.			
Week -12	Thermal treatment - Incineration and pyrolysis, soil contamination and site remediation – bioremediation processes, monitoring of disposal sites.	• Interactive Class lecture • Visual presentation • Whiteboard illustration	• In-course Exam • Final Exam	CLO2
Week -13	**Removal of Refractory Organic Compounds:** Theories on advanced oxidation process viz., photocatalytic treatment, membrane separation, homogenous catalysis system using hydrogen peroxide, ozone.	• Interactive lecture • Visual presentation • Whiteboard illustration	• Final Exam	CLO3
Week -14	Heterocatalytic systems using metal oxides, activated carbon, removal of organic compounds through electro dialysis, reverse osmosis etc.	• Interactive lecture • Visual presentation • Whiteboard illustration	• Final Exam	CLO3, CLO4

Part C

15. Assessment and Evaluation

i) Assessment Strategy

Strategy	**Percentage of Total marks**
Class attendance and participation	10
In-course Exam/Class Test	30
Semester Final Examination (3 hours duration)	60
Total	**100**

ii) Marks distribution:

- Continuous Assessment: 40%

- Summative: 60%
- Make-up Procedures:
  Two in-course exams will be taken and average marks will be counted. Feedback on continuous assessment is given to the students immediately after the test. Based on the students' feedback additional class/assignment may be taken by the course teacher

Part D

16. Learning Materials

i **Recommended Readings**

a) Arceivala S. J., "Waste water treatment and disposal" Marcel Dekkar Inc., New York, 1981.
b) Besselievie, B. E. and Schwartz, M., "The Treatment of Industrial wastes", 2nd edn., McGraw Hill.
c) Karia G.L., and Christian R.A., (2001), "Wastewater Treatment Concepts and Design Approach", Prentice Hall of India Pvt. Ltd., New Delhi.

ii **Supplementary Readings**

a) Assessment of Tannery Solid Waste Management, a case study Sheba Leather Industry, UNIDO, 2018.
b) Benefield R.D., and Randal C.W., (1980), "Biological Process Design for Wastewater Treatment", Prentice Hall, Englewood Chiffs, New Jersey.

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

Course Outline for 0723-FE-6109

Part A

1. Course Code: 0723-FE-6109

2. Course Title: Ergonomics and Industrial Safety

3. Course Type: Core Course

4. Year / Semester: Semester: I

5. Academic Session: 2022-23

6. Course Teachers: Md. AbdusShabur, Lecturer, ILET, DU.

7. Prerequisite(s): N/A

8. Credits: 3.0

9. Contact Hours: 42

10. Total Marks: 100

11. Rationale of the Course: This course intended to instruct knowledge by different approaches to improve better workspace design and efficient work environment designs and management. After completion of this course, the students will be able to design better factory environment and thereby will be able to ensure effective safety management practice in leather industry.

Course Contents:

Ergonomics

Introduction: What is Ergonomics; History of Development; Scope & Application of Ergonomics; Importance of Ergonomics; Anthropometry.

Muscle Physiology and Manual Material Handling: Muscle and Work Physiology; Measure of Physiological Strain; Physical Workload; Manual Materials Handling.

Hand Tools and Devices: Introduction to Hand Tools; Structure and Motion of Hand; Principles of Designing Hand Tools and Devices; Vibration & HAVS; Gripping Principles.

Workspace Design: Designing Workspace Envelopes for Seated and Standing Personnel; Designing Horizontal Work Surfaces; Designing Seated and Standing Work Surfaces.

Work Environment Design: Lighting in Work Environment; Vision and Structure of Eye; Visual Defects; Guidelines for Colour Selection; Measurement of Light Photometry; Lighting and Illumination; Reflectance; Lighting Problem; Improving Visibility; Characteristics and Efficiency of Light Sources; Lighting Design Considerations; Glare; Uniformity of Lighting; Complaints, Causes and Control Measures of Visual Discomforts; Sound Propagation; Structure of Human Ear; Process of Hearing; Health Effects of Noise Pollution; Control Measures for Noise Pollution; Thermal Balance; Heat Illness; Heat Acclimatization; Heat Stress Measurement; Cold Injury; Cold Climate Protection.

Safety Management

Introduction to Safety Management: Objectives; Importance of Safety Management; Occupational Health and Safety (OHS); Hazard and Risk.

Introduction to Workplace Safety: Aims; Considerations to Manage Workplace Safety Effectively; Nature, Functions and Benefits of Workplace Safety; Challenges for Practicing Safety; PDCA Cycle in OHS; Idea Generation.

Creating an Effective Workplace Safety Program: Core Regulatory Requirement; Program Review/Audit; Establishing Goals and Objectives; Management Commitment and Responsibility; Work-Site Analysis; Hazard Recognition and Resolution; Job Hazard Analysis (JHA)/Job Safety Analysis (JSA); Hazard Resolution; Incident Investigation; Best Practices.

Workers' Compensation and Record Keeping: Early and Modern Workers' Compensation Laws; Premium Calculation; Background Record Keeping; OSHA 300, 300A and 301 Forms; Recordable Occupational Injuries and Illness; First Aid Cases; Fatalities; Privacy Concern Cases; Posting Annual Summary Requirements.

Introduction to Industrial Hygiene: Definition; Toxicology; Industrial Hygiene Practice.

Fire Prevention and Protection: Means of Egress Regulations; Fire Tetrahedron; Categories of Fire; Categories of Fire Extinguisher.

System Safety: Importance of System Safety; System Life Cycle; Management of System Safety; Elements of A System Safety Program Plan (SPSS); Preliminary Hazard Analysis

(PHA); Subsystem Hazard Analysis (SSHA); System Hazard Analysis (SHA); Technique of Operations Review (TOR); Failure Mode and Effect Analysis (FMEA).

Improving Safety Performance with Behavioural Safety: Introduction; Pilot Error Syndrome; Concepts of Risk; Incidents and Accidents; Loss Exposures; Control Techniques for Loss Exposures; Accident Causation Theories; Single Factor Theory; Heinrich's Domino Theory; Multiple Factors Theory; Human Factors Theory; Energy Release Theory; Further Incident Investigation.

12. Learning Objectives:

a. To identify the components needed to provide a safe and healthful work environment through case studies and review of injury statistics provided in the course.

b. To identify potential workplace safety and health hazards and determine how to mitigate the hazards through engineering controls, administrative controls and personal protective equipment.

c. To conduct basic safety inspections using strategies that they have developed though hazard identification and job hazard analysis.

d. To identify the requirements of training programs in the workplace under the existing OSHA and State-OSHA requirements.

e. To understand essential elements of an occupational safety and health program and the components of international standard organizations in safety and health.

13. Course Learning Outcomes (CLOs) and Mapping of CLOs with Program Learning Outcomes (PLOs)

a) CLOs: Upon completion of this course, students will be able to:

	Course Learning Outcomes (CLOs)	**Learning Level**
CLO1	Recall knowledge of fundamentals of ergonomics and safety management related to leather engineering.	C1, A1
CLO2	Explain various methods and tools to ensure proper ergonomics facilities and safety managements.	C2, C3
CLO3	Apply various modern techniques to design an ergonomic friendly work environment as well as a safer workplace with protection from possible accidents and hazards.	C4
CLO4	Investigate and solve any problem/issue related to ergonomics and safety management in real world leather manufacturing.	C5, A4

b) Mapping of CLO with PLO

(CLOs)	**PLO1**	**PLO2**	**PLO3**	**PLO4**	**PLO5**	**PLO6**	**PLO7**	**PLO8**
CLO1	3	-	-	-	-	-	-	-

CLO2	3	3	-	-	2	-	-	-
CLO3	3	3	3	-	2	3	2	-
CLO4	3	3	2	3	2	2	2	2

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

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

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

Part B

14. Course plan specifying content, CLOs, co-curricular activities (if any), teaching learning and assessment strategy mapped with CLOs

Time Period	Topic	Teaching-Learning Strategy	Assessment Strategy	Corresponding CLOs
Week -01	**Introduction:** What is Ergonomics; History of Development; Scope & Application of Ergonomics; Importance of Ergonomics; Anthropometry, Muscle Physiology and Manual Material Handling: Muscle and Work Physiology; Measure of Physiological Strain; Physical Workload;	• Lecture • Group Discussion • Multimedia Presentation • Literature review	• In-course Exam • Final Exam	CLO1, CLO2

	Manual Materials Handling.			
Week -02	**Hand Tools and Devices:** Introduction to Hand Tools; Structure and Motion of Hand; Principles of Designing Hand Tools and Devices; Vibration & HAVS; Gripping Principles.	• Lecture • Group Discussion • Multimedia Presentation • Literature review	• In-course Exam • Final Exam	CLO1, CLO2, CLO3
Week -03	**Workspace Design:** Designing Workspace Envelopes for Seated and Standing Personnel; Designing Horizontal Work Surfaces; Designing Seated and Standing Work Surfaces.	• Lecture • Group Discussion • Multimedia Presentation	• Assignment • In-course Exam • Final Exam	CLO2, CLO3, CLO4
Week -04	**Work Environment Design:** Lighting in Work Environment; Vision and Structure of Eye; Visual Defects; Guidelines for Colour Selection; Measurement of Light Photometry; Lighting and Illumination; Reflectance; Lighting Problem; Improving Visibility; Characteristics and Efficiency of Light Sources; Lighting Design Considerations; Glare.	• Lecture • Group Discussion • Multimedia Presentation • Problem solving	• In-course Exam • Final Exam	CLO2, CLO3, CLO4
Week -05	Uniformity of Lighting; Complaints, Causes and Control Measures of Visual Discomforts; Sound Propagation; Structure of Human Ear; Process of Hearing;	• Lecture • Group Discussion • Multimedia Presentation	• Case study • In-course Exam • Final Exam	CLO2, CLO3, CLO4

	Health Effects of Noise Pollution; Control Measures for Noise Pollution; Thermal Balance; Heat Illness; Heat Acclimatization; Heat Stress Measurement; Cold Injury; Cold Climate Protection.			
Week -06	**Introduction to Safety Management:** Objectives; Importance of Safety Management; Occupational Health and Safety (OHS); Hazard and Risk.	• Group Discussion • Multimedia Presentation • Lecture	• In-course Exam • Final Exam	CLO2, CLO3
Week -07	**Introduction to Workplace Safety:** Aims; Considerations to Manage Workplace Safety Effectively; Nature, Functions and Benefits of Workplace Safety; Challenges for Practicing Safety; PDCA Cycle in OHS; Idea Generation.	• Lecture • Group Discussion • Multimedia Presentation	• Case Study • In-course Exam • Final Exam	CLO1, CLO2
Week -08	**Creating an Effective Workplace Safety Program:** Core Regulatory Requirement; Program Review/Audit; Establishing Goals and Objectives; Management Commitment and Responsibility.	• Lecture • Group Discussion • Multimedia Presentation	• In-course Exam • Final Exam	CLO2, CLO3
Week -09	Work-Site Analysis; Hazard Recognition and Resolution; Job Hazard Analysis (JHA)/Job	• Lecture • Group Discussion • Multimedia	• Group Presentation • In-course Exam	CLO3, CLO4,

	Safety Analysis (JSA); Hazard Resolution; Incident Investigation; Best Practices.	Presentation	• Final Exam	
Week -10	**Workers' Compensation and Record Keeping:** Early and Modern Workers' Compensation Laws; Premium Calculation; Background Record Keeping; OSHA 300, 300A and 301 Forms; Recordable Occupational Injuries and Illness.	• Lecture • Group Discussion • Multimedia Presentation	• In-course Exam • Final Exam	CLO2, CLO3
Week -11	First Aid Cases; Fatalities; Privacy Concern Cases; Posting Annual Summary Requirements. Introduction to Industrial Hygiene: Definition; Toxicology; Industrial Hygiene Practice.	• Lecture • Group Discussion • Multimedia Presentation • Problem solving	• In-course Exam • Final Exam	CLO1, CLO3
Week -12	**Fire Prevention and Protection:** Means of Egress Regulations; Fire Tetrahedron; Categories of Fire; Categories of Fire Extinguisher. System Safety: Importance of System Safety; System Life Cycle; Management of System Safety.	• Lecture • Group Discussion • Multimedia presentation	• In-course Exam • Final Exam	CLO2, CLO3, CLO4
Week -13	Elements of A System Safety Program Plan (SPSS); Preliminary Hazard Analysis (PHA); Subsystem Hazard	• Lecture • Group Discussion • Multimedia Presentation	• Oral Presentation • In-course Exam	CLO2, CLO3

	Analysis (SSHA); System Hazard Analysis (SHA); Technique of Operations Review (TOR); Failure Mode and Effect Analysis (FMEA).		• Final Exam	
Week -14	Improving Safety Performance with Behavioural Safety: Introduction; Pilot Error Syndrome; Concepts of Risk; Incidents and Accidents; Loss Exposures; Control Techniques for Loss Exposures; Accident Causation Theories; Single Factor Theory; Heinrich's Domino Theory; Multiple Factors Theory; Human Factors Theory; Energy Release Theory; Further Incident Investigation. **Review class**	• Lecture • Group Discussion • Multimedia Presentation • Literature review	• In-course Exam • Final Exam	CLO1- CLO4

Part C

15. Assessment and Evaluation

i) Assessment Strategy

Strategy	**Percentage of Total marks**
Class attendance and participation	10
In-course Exam/Class Test	30
Semester Final Examination (3 hours duration)	60
Total	**100**

ii) Marks distribution:

- Continuous Assessment: 40%
- Summative: 60%
- Make-up Procedures: Two in-course exam will be taken and average marks will be counted. Feedback on in-course assessment is given to the students immediately after the test. If students is very weak in particular topics of this course, additional instruction will be given to help them catch up.

Part D

16. Learning Materials

i **Recommended Readings**

a) Human Factors in Engineering & Design by Mark S. Sanders, Ph. D. and Ernest J. McCormick, Ph. D
b) Introduction to Ergonomics by R. S. Bridger
c) Workplace Safety A Guide for Small and Midsized Companies by Dan Hopwood, Steve Thompson
d) Fundamentals of Occupational Safety and Health (fourth edition) by Mark A. Friend and James P. Kohn

ii **Supplementary Readings**

a) The Occupational Ergonomics Hand Book, Edited by Waldemar Karwowski and William S. Marras, CRC Press, New York, USA.

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

Course Outline of 0723-FE-6111

Part A

1. Course Code: 0723-FE-6111

2. Course Title: Pedorthic Footwear

3. Course Type: Core Course

4. Year / Semester: Semester: I

5. Academic Session: 2022-23

6. Course Teachers: Dr. Amal Kanti Deb, Associate Professor, ILET, DU

Mr. Noor Mohammad, Assistant Professor, ILET, DU.

7. Prerequisite(s): N/A

8. Credits: 3.0

9. Contact Hours: 42

10. Total Marks: 100

11. Rationale of the Course: This course has been designed to deliver state-of-the-art knowledge to the students on pedorthic (medical-graded) footwear. This course includes foot problems of pedorthic patients, their remedies, and biomechanics of diabetic, orthopedic, and geriatric footwear. At the end of the course, students will be able to prepare guidelines for pedorthic footwear and also individual patients.

Course Contents:

Foot problems: Skin lesions- calluses, corns, plantar warts, ingrown nail, etc., arch problems- flat foot, claw foot, arch strains, metatarsalgia, foot fatigue, burning feet, rigid feet, aching in calf, toe problems- hallux valgus, bunion, tailor's bunion, hammer toe, children foot problems- in toeing, out toeing, pronation, crooked toes, etc.

Biomechanics: Basic concept of biomechanics and foot barograph, characteristics of the foot, muscles and joints, pressure points and load distribution, foot dynamics, foot motions, gait analysis, running, movements of joints during dynamic phase, muscles work during static and dynamic conditions, abnormal gait patterns, body weight distribution of feet, force platforms, angle of flexion at the joints, electromyography.

Diabetic footwear: Diabetes, types of diabetes, diabetic foot, foot complications due to diabetes, impact of diabetes on foot structure, foot pressure and gait, epidemiology of diabetic foot syndrome, the neuropathic foot, the neuroischaemic foot, prevention, treatment, diabetic footwear, development of diabetic footwear, necessity of diabetic footwear, features of diabetic footwear, sustainable design for diabetic footwear, materials selection, construction of diabetic footwear, orthotics, classification of orthotics, application and functions of orthotics, footgear, types, diabetic socks, physiological mechanism of diabetic footwear, diabetic foot and footwear care.

Orthopedic footwear: Introduction, classification, Impact of rheumatoid arthritis on foot structure, foot pressure and gait, orthotic men's and women's sandal with arch support, basic measurements, modular footwear measurements, fitting of modular footwear, anatomical insole, in-socks and sole, sustainable design and development of orthopedic footwear, shoes for plantar facilities, complication due to bone structure, materials selections, constructions, orthotics and insertions, design of foot orthoses, foot care products, turf toe, supination, pronation, foot odors and prevention.

Geriatric Footwear: The impact of aging and systematic diseases, Introduction to geriatric footwear, Geriatric foot problems: etiological and epidemiological factors, Changes in the foot in relation to age, Complicating foot problems, Psychosocial and psychological considerations, Considerations in sustainable shoe design, and Therapeutic footwear.

12. Course objectives:

a. To disseminate advanced knowledge about diabetic, orthopedic, and geriatric foot problems.
b. To provide in-depth knowledge of foot and footwear biomechanics and gait analysis.
c. To explain the types, designs, materials, and biomechanics of diabetic, orthopedic, and geriatric footwear.
d. To impart the latest management procedure for diabetic, orthopedic, and geriatric foot problems.

13. Course Learning Outcomes (CLOs) and Mapping of CLOs with Program Learning Outcomes (PLOs)

a) CLOs: Upon completion of this course, students will be able to:

	Course Learning Outcomes (CLOs)	Learning Level
CLO1	Explain different types of foot problems and basic requirements for diabetic, orthopedic, and geriatric footwear with biomechanical requirements.	C2, A2
CLO2	Relate different types of foot problems and foot biomechanics with sustainable manufacture of pedorthic footwear.	C3, A3
CLO3	Analyze the biomechanics requirements and other relevant factors in the sustainable designing and manufacturing of diabetic, orthopedic, and geriatric footwear.	C4, A3
CLO4	Justify and prepare the systematic guidelines for the proper management of diabetic, orthopedic, and geriatric patients with appropriate footwear.	C5, C6, A4

b) Mapping of CLO with PLO

(CLOs)	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8
CLO1	3	1	-	-	-	-	-	-
CLO2	3	3	-	-	-	-	-	-
CLO3	3	3	-	-	-	3	2	-
CLO4	3	2	-	3	-	-	2	2

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

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

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Interactive discussion, lecture discussion with multimedia, and whiteboard illustration	In-course Exam and Final Exam
CLO2	Interactive discussion, lecture discussion with multimedia, whiteboard illustration, and problem-based learning	Assignment, In-course Exam and Final Exam
CLO3	Lecture discussion with multimedia, whiteboard illustration, and problem-based learning (PBL): Identifying the problem to be	Assignment, Group Presentation, In-course Exam and Final Exam

	solved	
CLO4	Lecture discussion with multimedia, whiteboard illustration, group discussion, and problem-based learning (PBL): Identifying the problem to be solved	Assignment, Group Presentation, In-course Exam and Final Exam

Part B

14. Course plan specifying content, CLOs, co-curricular activities (if any), teaching learning and assessment strategy mapped with CLOs

Time Period	Topic	Teaching-Learning Strategy	Assessment Strategy	Corresponding CLOs
Week-01	**Foot problems:** Skin lesions- calluses, corns, plantar warts, ingrown nail, etc., arch problems- flat foot, claw foot, arch strains.	• Interactive discussion • Lecture discussion with multimedia • Whiteboard illustration	• In-course Exam • Final Exam	CLO1
Week -02	Metatarsalgia, foot fatigue, burning feet, rigid feet, aching in calf, toe problems- hallux valgus, bunion, tailor's bunion, hammer toe.	• Interactive discussion • Lecture discussion with multimedia • Whiteboard illustration	• In-course Exam • Final Exam	CLO1
Week -03	Children foot problems- in toeing, out toeing, pronation, crooked toes, etc.	• Interactive discussion • Lecture discussion with multimedia • Whiteboard illustration	• In-course Exam • Final Exam	CLO1, CLO2
Week -04	**Biomechanics:** Basic concept of biomechanics and foot barograph, characteristics of the foot, muscles and	• Interactive discussion • Lecture discussion with multimedia • Whiteboard	• In-course Exam • Final Exam	CLO2, CLO3

	joints, pressure points and load distribution.	illustration		
Week -05	Gait analysis, running, movements of joints during dynamic phase, muscles work during static and dynamic conditions.	• Interactive discussion • Lecture discussion with multimedia • Whiteboard illustration	• In-course Exam • Final Exam	CLO2, CLO3
Week -06	**A**bnormal gait patterns, body weight distribution of feet, force platforms, angle of flexion at the joints, electromyography.	• Interactive discussion • Lecture discussion with multimedia • Whiteboard illustration	• In-course Exam • Final Exam	CLO2, CLO3
Week -07	**Diabetic footwear:** Diabetes, types of diabetes, diabetic foot, foot complications due to diabetes, impact of diabetes on foot structure, foot pressure and gait, epidemiology of diabetic foot syndrome.	• Interactive discussion • Lecture discussion with multimedia • Whiteboard illustration • Problem-based learning (PBL)	• In-course Exam • Final Exam	CLO1, CLO2
Week -08	The neuropathic foot, the neuroischaemic foot, prevention, treatment, diabetic footwear, development of diabetic footwear, necessity of diabetic footwear, features of diabetic footwear, design for diabetic	• Interactive discussion • Lecture discussion with multimedia • Whiteboard illustration • Problem-based learning (PBL)	• Assignment • In-course Exam • Final Exam	CLO2, CLO3

	footwear, materials selection, construction of diabetic footwear.			
Week -09	Orthotics, classification of orthotics, application and functions of orthotics, footgear, types, diabetic socks, physiological mechanism of diabetic footwear, diabetic foot and footwear care.	• Interactive discussion • Lecture discussion with multimedia • Whiteboard illustration • Problem-based learning (PBL)	• Assignment • Group Presentation • In-course Exam • Final Exam	CLO3, CLO4
Week -10	**Orthopedic footwear:** Introduction, classification, Impact of rheumatoid arthritis on foot structure, foot pressure and gait, orthotic men's and women's sandal with arch support.	• Interactive discussion • Lecture discussion with multimedia • Whiteboard illustration • Problem-based learning (PBL)	• In-course Exam • Final Exam	CLO1, CLO2
Week -11	Basic measurements, modular footwear measurements, fitting of modular footwear, anatomical insole, in-socks and sole, design and development of orthopedic footwear, shoes for plantar facilities, complication due to bone structure.	• Lecture discussion with multimedia, • Group discussion, • Literature review, • Demonstration, and problem-based exercises	• Assignment • Group Presentation • In-course Exam • Final Exam	CLO2, CLO3

Week -12	Materials selections, constructions, orthotics and insertions, design of foot orthoses, foot care products, turf toe, supination, pronation, foot odors and prevention.	• Lecture discussion with multimedia, • Group discussion, • Literature review, • Demonstration, and problem-based exercises	• Assignment • Group Presentation • Final Exam	CLO3, CLO4
Week -13	**Geriatric Footwear:** The impact of aging and systematic diseases, Introduction to geriatric footwear, Geriatric foot problems: etiological and epidemiological factors.	• Lecture discussion with multimedia, • Group discussion, • Literature review, • Demonstration, and problem-based exercises	• Assignment • Final Exam	CLO1, CLO2
Week -14	Changes in the foot in relation to age, Complicating foot problems, Psychosocial and psychological considerations, Considerations in shoe design, and Therapeutic footwear.	• Lecture discussion with multimedia, • Group discussion, • Literature review, • Demonstration, and problem-based exercises	• Group Presentation • Final Exam	CLO3, CLO4

Part C

15. Assessment and Evaluation

i) Assessment Strategy

Strategy	**Percentage of Total marks**
Class attendance and participation	10
In-course Exam/Class Test	30
Semester Final Examination (3 hours duration)	60
Total	**100**

ii) Marks distribution:

- Continuous Assessment: 40%

- Summative: 60%
- Make-up Procedures: Two in-course exams will be taken and average marks will be counted. Feedback on in-course assessment is given to the students immediately after the test. If students are very weak in particular topics of this course, additional instruction will be given to help them catch up.

Part D

16. Learning Materials

i. **Recommended Reading**

a) Footwear and Foot Orthoses by Anita Williams and Chris Nester
b) Therapeutic footwear by Wendy Tyrrell and Gwenda Carter
c) The Science of Footwear by Ravindra S. Goonetilleke

ii. **Supplementary Readings**

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

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

Semester-II

Course Code	Course Title	Credits
0723-FE-6213	Environmental Management and Impact Assessment	3.00
0723-FE-6215	Nanotechnology for Leather and Leather Products	3.00
0723-FE-6217	Industrial Automation	3.00
0723-FE-6219	Product Design and Development	3.00
0723-FE-6221	E-Commerce and International Trade	3.00
Total		**15.00**

Course Outline for 0723-FE-6213

Part A

1. Course Code: 0723-FE-6213

2. Course Title: Environmental Management and Impact Assessment

3. Course Type: Core Course

4. Year/Semester: Year: Semester: II

5. Academic Session: 2022-2023

6. Course Teacher: Sunzida Haque Rimu, Lecturer, ILET, DU.

7. Prerequisite(s): N/A

8. Credits: 3

9. Contact Hours: 42

10. Total Marks: 100

11. Rational of the Course:
This course is designed to train the graduates in analysis and assessment methods applicable to environmental contamination problems, particularly national and international legislative frameworks. This course is contemplated for LWG and other environmental certification processes for leather industry.

Course Contents
Environmental Audit: Principles and philosophies of environmental auditing**,** basic steps in audit process, Auditing techniques Concept of industrial ecology, cleaner technologies in industrial processes and evaluation of processes, waste minimization.
Environmental health hazard and risk assessment: Biological, chemical, physical and psychological health hazard; health risk assessment and management, toxicology, exposure measurement of toxic (carcinogenic and non-carcinogenic) substances

Clean Development Mechanism: Overview on sustainable development. Greenhouse gasses reduction mechanism, project cycle for the CDM, CDM for small scale projects, risks and opportunities for industries, financing of CDM projects, case studies.

Environmental Impact Assessment (EIA): Definition, purposes and characteristics of EIA, global evolution of EIA, participants in EIA process, stages of EIA, types of EIA, environmental inventory, baseline data on EIA-environmental data, project data and project alternative data, measurement of impact– physical, social, economic, natural, public participation in environmental decision making, framework of environmental assessment, description of environmental setting, Environmental impact factors and area consideration, environmental impact statement (EIS) and environmental management plan (EMP).

Environmental Impact Analysis: Impact identification and methods of impact identification- adhoc method, checklist, matrix, network, overlay and index methods; impact prediction and predictive methodologies, impact evaluation (assessment) and impact mitigation. Basic steps for the impact identification, prediction and assessment of air, water, noise, vegetation and wildlife environment with case studies.

Environmental Management System (EMS): Basic definitions and terms, Framework for environmental management system, approach for developing Environmental Management System, International standards, environmental management systems in tanneries and their implementation, environmental reporting, Occupational health and safety management, cross-boundary environmental management, mandatory regulations and ecolabelling criteria governing various substance in leather, life -cycle assessment and carbon footprint in leather industries.

Hazard Mitigation: Classification of hazards, basic concept of disaster (causative factors of disaster, classification of disasters), Hazards due to dams and reservoirs, nuclear power plants, industrial hazards, occupational hazards, mitigation measures, hazard assessment, risk assessment.

EIA in Bangladesh: An overview of history, current procedures, practices and guidelines for Environmental Clearance Certificate, EIA of water resource projects, industries, mining and quarrying, highway construction, and tourism developments.

12. Course Objectives:

a. To provide knowledge on legal and policy frameworks within which quantitative environmental assessment activities are carried out and
b. To conduct systematic EIA and auditing methodologies in the leather industry.
c. To carry out quantitative techniques of analysis for direct determination of contaminant concentrations and distributions within environmental systems.
d. To investigate statistical and computer modeling techniques for analysis of data.

13. Course Learning Outcomes (CLOs) and Mapping of CLOs with Program Learning Outcomes (PLOs)

a) CLOs: Upon completion of this course, students will be able to:

	Course Learning Outcomes (CLOs)	**Learning Level**
CLO1	Recognize ethical and narrate professional responsibilities in engineering situations and make judgments.	C1, A1
CLO2	Familiarize with the application of a variety of professional tools for predicting environmental impacts.	C2, A2
CLO3	Developing perspectives on impact assessment and relating to practical industrial activities.	C3, C4

b) Mapping of CLO with PLO

CLOs	**PLO1**	**PLO2**	**PLO3**	**PLO4**	**PLO5**	**PLO6**	**PLO7**	**PLO8**
CLO1	3	3	-	-	-	-	-	-
CLO2	-	3	3	3	-	3	3	-
CLO3	3	2	-	-	-	3	2	3

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

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

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

Part B

14. Course plan specifying content, CLOs, teaching learning and assessment strategy mapped with CLOs

Time Period	Topic	Teaching-Learning Strategy	Assessment Method	Corresponding CLOs
Week-01	**Environmental Audit:** Principles and philosophies of environmental auditing**,** basic steps in audit process, Auditing techniques, Concept of industrial ecology.	• Lecture • Group discussion • Literature	• In-course • Final exam • Quiz	CLO1
Week -02	Cleaner technologies in industrial processes and evaluation of processes, waste minimization incorporated with industrial ecology.	• Lecture • Literature	• In-course • Final exam	CLO1
Week -03	**Environmental health hazard and risk assessment:** Biological, chemical, physical and psychological health hazard**,** health risk assessment and management, toxicology, exposure measurement of toxic (carcinogenic and non-carcinogenic) substances.	• Lecture • Group • Discussion • Literature	• In-course • Final exam	CLO1
Week -04	**Clean Development Mechanism:** Overview on sustainable development, greenhouse gasses reduction mechanism, project cycle for the CDM, CDM for small scale projects, risks and opportunities for industries, financing of CDM projects, case	• Lecture • Literature • Group • Assignment	• In-course • Final exam • Assignment	CLO1

	studies.			
Week -05	**Environmental Impact Assessment (EIA):** Definition, purposes and characteristics of EIA, global evolution of EIA, participants in EIA process, stages of EIA, types of EIA, environmental inventory, baseline data on EIA, environmental data, project data and project alternative data, measurement of impact– physical, social, economic, natural, public participation in environmental decision making.	Lecture, Literature, Case studies	Assignment, In-course exam, Final exam	CLO1, CLO2
Week -06	Framework of environmental assessment, description of environmental setting, Environmental impact factors and area consideration, Environmental impact statement (EIS) and environmental management plan (EMP)	• Lecture • Literature • Case studies	• Assignment • Quiz • Final Exam	CLO1, CLO2
Week -07	**Environmental Impact Analysis:** Impact identification and methods of impact identification-adhoc method, checklist, matrix, network, overlay and index methods, impact prediction and predictive methodologies, impact evaluation (assessment) and impact mitigation.	• Lecture • Literature • Assignment	• In-course • Final Exam • Assignment	CLO3
Week -08	Basic steps for the impact identification, prediction and assessment of air,	• Lecture • Literature	• In-course • Final Exam • Assignment	CLO3

	water, noise, vegetation and wildlife environment with case studies.			
Week -09	**Environmental Management System (EMS):** Basic definitions and terms, framework for environmental management system, approach for developing Environmental Management System.	• Lecture • Literature	• In-course • Final Exam	CLO1, CLO3
Week -10	International standards**,** environmental management systems in tanneries and their implementation**,** environmental reporting.	• Lecture • Literature • Case studies	• In-course • Final Exam	CLO1, CLO3
Week -11	Occupational health and safety management, cross-boundary environmental management**,** mandatory regulations and ecolabelling criteria governing various substance in leather**,** life-cycle assessment and carbon footprint in leather industries.	• Lecture • Literature	• In-course • Final Exam	CLO1, CLO2
Week -12	**Hazard Mitigation**: Classification of hazards, basic concept of disaster (causative factors of disaster, classification of disasters), Hazards due to dams and reservoirs, nuclear power plants, industrial hazards, occupational hazards, mitigation measures, hazard assessment, risk assessment.	• Lecture • Literature • Case studies	• In-course • Final exam	CLO1, CLO2
Week -13	**EIA in Bangladesh:** An overview of history, current procedures,	• Lecture • Literature • Case studies	• In-course • Final exam	CLO1, CLO2, CLO3

	practices and guidelines for Environmental Clearance Certificate, EIA of water resource projects, industries, mining and quarrying, highway construction, tourism developments.			
Week-14	Review of the whole content	• Problem oriented exercises		CLO1, CLO2, CLO3

Part C

15. Assessment and Evaluation

i) Assessment Strategy

Strategy	**Percentage of Total marks**
Class attendance and participation	10
In-course Exam/Class Test	30
Semester Final Examination (3 hours duration)	60
Total	**100**

ii) Marks distribution:

- Continuous Assessment: 40%
- Summative: 60%
  - Make-up Procedures: Two in-course exams will be taken and average marks will be counted. Feedback on in-course assessment is given to the students immediately after the test. If students are very weak in particular topics of this course, additional instruction will be given to help them catch up.

Part D

16. Learning Materials

i. **Recommended Readings**

a) Morris, P and Therivel, R. 2001. Methods of environmental impact assessment. London. UCL press.

b) Introduction to Environmental Impact Assessment : Principles and Procedures, Process, Practice and Prospects - 2nd edition. J. Glasson, R. Therivel, A. Chadwick

c) Environmental Impact Assessment Methodologies, Y. Anjaneyulu, Valli Manickam, BS Publication

d) Environmental and Health Risk Assessment and Management: Principles and Practices, ISBN: 9789048169610,9048169615

ii. **Supplementary Reading**

a) Bregman, J.I. and Mackenthum, K.M. 1992. Environmental impact statements. Chelsia Michigan: Lewis.

b) Calow, P. 1997. Handbook of environmental risk assessment and management. Oxford: Blackwell Science.

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

Course Outline of 0723-FE-6215

Part A

1. Course Code: 0723-FE-6215

2. Course Title: Nanotechnology for Leather and Leather Products

3. Course Type: Core Course

4. Year/ Semester: Semester: II

5. Academic Session: 2022-23

6. Course Teachers: Dr. Mohammed Mizanur Rahman, Professor, ACCE, DU.

Md. Adib Hossain Chisty, Lecturer, ILET, DU.

7. Prerequisite(s): N/A

8. Credits: 3.0

9. Contact Hours: 42 hours

10. Total Marks: 100

11. Rational of the Course: This course is designed to provide in-depth theoretical knowledge of nanotechnology and outlines its applicationsin leather and allied engineering fields. The course also deals with the design of nanosystems, nanomaterials together with their processing, properties and characterization.

Course Contents

Introduction to Nanoscience and Nanotechnology: Introduction, history and importance of nanotechnology, properties of nanomaterials, difference between bulk and nanomaterials, molecular building blocks for nanostructured systems, influence of nano structure on mechanical, optical, electronic, magnetic and chemical properties, overview of different nanomaterials available, chemistry and physics of nanomaterials, electronic phenomenon in nanostructures, optical absorption in solids, quantum dot, quantum effects, nanocomposites.

Nanomaterials Fabrication:

Chemical Methods: Sol- gel process, self-assembly process, electrodeposition, pyrolysis, metal nanocrystals by reduction, solvothermal synthesis, photochemical synthesis, sonochemical synthesis, reverse micelles and microemulsions, combustion method, template process, chemical vapor deposition, metal organic chemical vapor deposition.

Physical Methods: Ball milling, inert gas condensation technique, thermal evaporation, pulsed laser deposition, DC/RF magnetron sputtering, molecular beam epitaxy, microlithography, etching, wet cleaning, atomic layer deposition.

Biological Synthesis: Protein based nanostructure formation, DNA template nanostructure formation, protein assembly, biologically inspired nanocomposites.

Nanomaterials Characterization:

Structural Characterization: X-ray diffraction (XRD) analysis, FT-IR analysis, Raman spectroscopy

Microscopic and Surface Analysis: Electron microscopes: scanning electron microscopy (SEM), transmission electron microscopy (TEM); scanning probe microscopy: atomic force microscopy (AFM), scanning tunneling microscopy (STM).

Spectroscopy: X-ray photoelectron spectroscopy (XPS), fluorescence spectroscopy,UV-visible spectroscopy, nuclear magnetic resonance (NMR)spectroscopy, electron spin resonance (ESR) spectroscopy.

Electrical, Mechanical and Magnetic Properties: Impedance analysis, electro-analytical techniques: potentiometry, voltammetry, cyclic voltammetry.

Thermal and Optical Properties: Differential scanning calorimetry (DSC) analysis, Differential thermal analysis (DTA), Thermogravimetric analysis (TGA), contact angle measurement. Dynamic light scattering (DLS) method.

Applications of nanotechnology in the relevant field and non-leather chemicals: Possible industrial applications of nanomaterials in leather, footwear and leather productsindustries, application of nano materials on collagen matrix at various stages of processing techniques, synthesis of nano based materials for leather manufacture: syntans, reinforcing materials, finishing chemicals.

Environmental aspects of nanotechnology: Handling, safety and hazard of nanomaterials processing, effects of nanomaterials exposure on human and living stock, long term and short term effects, case studies of exposure, effects of nanoparticles on air, water and soil, food and food supplements.

12. Course Objectives:

a. To introduce and provide a broad view of the nascent field of nanoscience and nanotechnology.
b. To promote interdisciplinary interactions among engineering, technology, science, and industrial management/technology majors.
c. To utilize knowledge about developing new products and systems in leather sector.

13. Course Learning Outcomes (CLOs) and Mapping of CLOs with Program Learning Outcomes (PLOs)

a) CLOs: Upon completion of this course, students will be able to:

	Course Learning Outcomes (CLOs)	**Learning Level**
CLO1	Define and explain the structure, properties and applications of	C1, C2

	nanomaterials together with associated chemicals	
CLO2	Illustrate the importance of dimensional reduction in materials and its relationship with properties.	C3
CLO3	Compare numerous methods of nanomaterials preparation and analyze nanomaterials thoroughly using engineering tools	C5
CLO4	Assess environmental pollutions/concerns by nano based materials during its production and real-life applications.	C5

b) Mapping of CLO with PLO

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

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

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

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

Part B

14. Course plan specifying content, CLOs, co-curricular activities (if any), teaching learning and assessment strategy mapped with CLOs

Time Period	Topic	Teaching-Learning Strategy	Assessment Strategy	Corresponding CLOs
Week -01	**Introduction to research:** Definitions, characteristics, types, differences and role of research**,** research and investigation, research methods versus research methodology**,** criteria of good research, paradigms and ethics in research.	• Lecture • Whiteboard illustration	• In-Course Exam • Final Exam	CLO1, CLO2
Week -02	Proposition, axiom, postulate, theorem and model of research**,** variables and types**,** properties of relationships between variables**,** inductive and deductive method.	• Lecture • Multimedia presentation	• In-Course Exam • Final Exam	CLO1, CLO2
Week -03	**Literature review and research problem:** Definition, objectives, advantages, principles and procedures of literature review, problem definition, finding a researchable problem**,** selecting the problem**,** importance of defining the problem, important qualities of a research problem**,** techniques involved in defining a problem**,** evaluating a proposed design.	• Lecture • Multimedia presentation • Case study	• In-Course Exam • Assignment • Final Exam	CLO1, CLO2, CLO4

Week -04	**Research questions and objectives:** Research objective and research question**,** practical examples of research objectives and research question, formulation of research questions, criteria of research objectives, evaluation of research questions, classification and importance of research objectives.	• Lecture • Multimedia presentation • Whiteboard illustration	• In-Course Exam • Final Exam	CLO1, CLO2, CLO3
Week -05	**Research hypothesis, design, and proposal:** Source, functions, and characteristics of a good research hypothesis, formulation and possible difficulties of research hypothesis, research hypothesis versus research objectives; definition, function, classification of research design, feature of a good research design.	• Lecture • Multimedia presentation • Whiteboard illustration	• In-Course Exam • Case study • Final Exam	CLO1, CLO2, CLO3
Week -06	Qualitative research, observation studies, surveys, experimentation, steps in a research design; meaning of research proposal**,** contents of research proposal**,** steps in the development of a research proposal, criteria for evaluating research proposal.	• Lecture • Multimedia presentation	• In-Course Exam • Final Exam	CLO1, CLO2, CLO3
Week -07	**Qualitative research tools, measurement and**	• Lecture	In-Course Exam	CLO2, CLO3,

	scaling technique: Definition**,** characteristics, uses, and general steps of qualitative research, qualitative research approaches, steps in grounded theory, nature of measurement**,** measurement scales, types of measurement scales, Likert scale.	• Video presentation • Whiteboard illustration	Final Exam	CLO5
Week -08	**Questionnaire design:** Questionnaire and questionnaire design**,** consideration and types of questions**,** questionnaire designing process**,** necessary properties of questionnaire**,** characteristics of a good questionnaire**.**	• Lecture • Interactive discussion • Whiteboard illustration	• In-Course Exam • Final Exam	CLO2, CLO3
Week -09	Precaution required in the use of questionnaire, guidelines for constructing questions, and questions sequence. **Sampling and sampling design:** Concepts and importance of sampling**,** planning and designing a survey**,** classification of sampling techniques.	• Lecture • Multimedia presentation	• In-Course Exam • Final Exam	CLO2, CLO3, CLO4
Week -10	Probability sampling design**,** non-probability sampling design**,** and determination of sample size. **Data collection and analysis:** Data, data versus information, types	• Lecture • Multimedia presentation	• In-Course Exam • Final Exam	CLO2, CLO3

	and sources of data collection**,** secondary data collection methods**,** primary data collection methods.			
Week -11	Qualitative and quantitative methods of data collection, data validation, editing and coding**,** data entry and exploring**,** displaying and examining data**,** Univariate analysis**,** Bivariate analysis**,** Multivariate analysis**,** SWOT analysis**,** and Hypothesis testing.	• Lecture • Whiteboard illustration • Multimedia presentation	• In-Course Exam • Presentation • Final Exam	CLO3, CLO4, CLO5
Week -12	**Presenting insights and findings:** Importance of the report and presentation**,** report preparation and presentations process**,** precautions in interpretation**,** research report**,** contents and precautions in writing research report.	• Lecture • Multimedia presentation	• In-Course Exam • Final Exam	CLO3, CLO4, CLO5
Week -13	Presentation of statistics**,** oral presentation**,** writing thesis/dissertation**,** writing journal articles and conference papers**,** bibliography and reference writing styles**,** copyright, plagiarism.	• Lecture • Case study	• Assignment • Final Exam	CLO3, CLO4, CLO5
Week -14	Review	• Interactive discussion	• Final Exam	CLO1-CLO5

Part C

15. Assessment and Evaluation

i) Assessment Strategy

Strategy	**Percentage of Total marks**
Class attendance and participation	10
In-course Exam/Class Test	30
Semester Final Examination (3 hours duration)	60
Total	**100**

ii) Marks distribution:

- Continuous Assessment: 40%
- Summative: 60%
- Make-up Procedures: Two in-course exams will be taken and average marks will be counted. Feedback on in-course assessment is given to the students immediately after the test. If students are very weak in particular topics of this course, additional instruction will be given to help them catch up.

Part D

16. Learning Materials

i. Recommended Readings

a) Hand book of Nano science, Engineering, and Technology, William A. Goddard, CRC press 2003.
b) Nanolithography and patterning techniques in microelectronics, David G.Bucknall, Wood head publishing 2005.
c) Nanocomposite science and technology, Pulikel M. Ajayan, Wiley-VCH 2005

ii. Supplementary Readings:

a) Nanotechnology Environmental health and Safety: Risks Regulation and Management, Matthew Hull and Diana Bowman, Elsevier 2010
b) Hand book of Nano science, Engineering, and Technology, William A. Goddard, CRC press 2003.

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

Course Outline of 0723-FE-6217

Part A

1. Course Code: 0723-FE 6217

2. Course Title: Industrial Automation

3. Course Type: Core Course

4. Year / Semester: Semester: II

5. Academic Session: 2022-23

6. Course Teachers: Md. Abdus Shabur, Lecturer, ILET, DU.

7. Prerequisite(s): N/A

8. Credits: 3.0

9. Contact Hours: 42

10. Total Marks: 100

11. Rationale of the Course: This course provides an overview of the technologies of industrial automation and control as it is commonly encountered in factories of all types including leather and footwear items. Automation of the production process increases the efficiency of labor and the overall rate of growth. By ending this course, students will able to have a fundamental knowledge of current industrial automation technologies and their application.

Course Contents:

Introduction to Automation and Artificial Intelligence: Introduction, Principles and strategies, Basic elements of an automated system, Advanced automation functions, Levels of automations, Automated flow lines and transfer mechanisms, Introduction of AI, Historical development, Intelligent Systems, Types of Intelligent Agents, Components of AI, Foundations of AI, Scope of AI, Current trends in AI, Relevance to Leather, Products and Footwear Engineering

Boolean Algebra and Logic Circuits and Programmable Logic Controller (PLC): Various logic gates, Truth tables, Logic functions, Boolean Laws, Karnaugh maps, Block diagram of PLC, Programming languages of PLC, Basic instruction sets, Networking of PLC, Overview of safety of PLC with case studies. Process Safety Automation: Levels of process safety through use of PLCs,

Controllers, Sensors and Actuators: Control Modes, PID and Digital Controllers, Velocity Control, Adaptive Control, Microprocessor and Microcontrollers, important characteristics, Main industrial sensors, Classification of sensors and their usage, Description of different kinds of sensors, Overview of Actuators, usage of Actuators in Robotics, Classification of Actuators (Pneumatic, Hydraulic, Electric), Basics of Pneumatic and Hydraulic Actuation Systems, Mechanical Actuation Systems, Electrical Actuation Systems.

Robots and their applications: Introduction to robots, Types, Classifications, Selection of robots, Robot Degrees of freedom, Robot configuration, Accuracy and repeatability, Specification of a robot, Robot feedback controls: Point to point control and Continuous path control, Control system for robot joint, Drives and transmission systems, End effectors, Industrial robot applications.

Concept and Algorithms, No programming or numerical: Problem Solving: Tree and Graph Search, Uninformed v/s informed search, uninformed methods: depth first search, breadth first search, Informed search: heuristic search, Best first search, branch and bound; Machine Learning: Introduction, types of machine learning; Learning with Decision Trees, Classification and Regression Trees, K means clustering algorithm, K nearest neighbors algorithm, hierarchical clustering, Concept of ensemble methods.

Artificial Neural Networks and Introduction to AI Technologies: Concept of ANN, Basic Models, Important Terminologies of ANNs McCulloch-Pitts Neuron, NN architecture,

perceptron, delta learning rule, back propagation algorithm, Gradient Descent algorithm, feed forward networks, activation functions, Introduction to AI Technologies in the realm of Automation Concept of Natural Language Processing, Machine Vision, Deep learning, Expert systems, Genetic Algorithms, Industry 4.0.

12. Course Objectives:

a. To provide fundamental knowledge of automated machines and equipment including AI application in leather industry.
b. To impart the role of Boolean algebra and PLC in industrial automation.
c. To develop the operating skill of various sensors, actuators and controllers.
d. To familiarize with the application of robotic systems and artificial neural networks in automated manufacturing processes.

13. Course Learning Outcomes (CLOs) and Mapping of CLOs with Program Learning Outcomes (PLOs)

a) CLOs: Upon completion of this course, students will be able to:

	Course Learning Outcomes (CLOs)	**Learning Level**
CLO1	Explore their knowledge on fundamentals of industrial automation and its importance in modern manufacturing.	C1, A1
CLO2	Define and explain various automation technologies in leather and leather products manufacturing and process industries.	C1, C2, A2
CLO3	Apply various modern technologies to design an automated production facility including materials handling with robotics application.	C3, A2
CLO4	Investigate and solve any hurdle related to automation with the help of Artificial Intelligence (AI) applications.	C4, C5

b) Mapping of CLO with PLO

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

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

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

CLOs	**Teaching-Learning Strategy**	**Assessment Strategy**
CLO1	Lecture, multimedia presentation, literature	Group Presentation, Assignment,

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

Part B

14. Course plan specifying content, CLOs, co-curricular activities (if any), teaching learning and assessment strategy mapped with CLOs

Time	Topic	Teaching-Learning Strategy	Assessment Strategy	Corresponding CLOs
Week-01	**Introduction to Automation and Artificial Intelligence:** Introduction, Principles and strategies, Basic elements of an automated system, Advanced automation functions, Levels of automations, Automated flow lines and transfer mechanisms.	• Lecture • Group Discussion • Multimedia Presentation • Literature review	• In-course Exam • Final Exam	CLO1, CLO2
Week -02	Introduction of AI, Historical development, Intelligent Systems, Types of Intelligent Agents, Components of AI, Foundations of AI, Scope of AI, Current trends in AI, Relevance to Leather, Products and Footwear Engineering.	• Lecture • Group Discussion • Multimedia Presentation • Literature review	• In-course Exam • Final Exam	CLO1, CLO2

Week -03	**Boolean Algebra and Logic Circuits:** Various logic gates, Truth tables, Logic functions, Boolean Laws, Karnaugh maps.	• Lecture • Multimedia Presentation • Problem solving	• Assignment • In-course Exam • Final Exam	CLO1 – CLO4
Week -04	Block diagram of PLC, Programming languages of PLC, Basic instruction sets, Networking of PLC, Overview of safety of PLC with case studies. Process Safety Automation: Levels of process safety through use of PLCs.	• Lecture • Group Discussion • Multimedia Presentation	• In-course Exam • Final Exam	CLO1 – CLO4
Week -05	**Controllers:** Control Modes, PID and Digital Controllers, Velocity Control, Adaptive Control, Microprocessor and Microcontrollers.	• Lecture • Group Discussion • Multimedia Presentation	• Case study • In-course Exam • Final Exam	CLO1, CLO2, CLO3
Week -06	Important characteristics of sensors, Main industrial sensors, Classification of sensors and their usage, Description of different kinds of sensors.	• Lecture • Group Discussion • Multimedia Presentation	• In-course Exam • Final Exam	CLO2, CLO3
Week -07	Overview of Actuators, usage of Actuators in Robotics, Classification of Actuators (Pneumatic, Hydraulic, Electric), Basics of Pneumatic and Hydraulic Actuation Systems, Mechanical	• Lecture • Group Discussion • Multimedia Presentation	• Case Study • In-course Exam • Final Exam	CLO2, CLO3, CLO4

	Actuation Systems, Electrical Actuation Systems.			
Week -08	**Robots and their applications:** Introduction to robots, Types, Classifications, Selection of robots, Robot Degrees of freedom, Robot configuration, Accuracy and repeatability, Specification of a robot, Robot feedback controls.	• Lecture • Group Discussion • Multimedia Presentation	• Group Presentation • In-course Exam • Final Exam	CLO1, CLO2
Week -09	Point to point control and Continuous path control, Control system for robot joint, Adaptive control, Drives and transmission systems, End effectors, Industrial robot applications of robots	• Lecture • Group Discussion • Multimedia Presentation	• In-course Exam • Final Exam Assignment	CLO3, CLO4,
Week -10	**Concept and Algorithms, No programming or numerical:** Problem Solving: Tree and Graph Search, Uninformed v/s informed search, uninformed methods: depth first search, breadth first search, Informed search: heuristic search.	• Lecture • Group Discussion • Multimedia Presentation	• In-course Exam • Final Exam	CLO1, CLO3, CLO4
Week -11	Best first search, branch and bound; Machine Learning: Introduction,	• Lecture, Group Discussion	• In-course Exam	CLO1, CLO3, CLO4

	types of machine learning: supervised, unsupervised, reinforcement learning; Learning with Decision Trees: Introduction to Decision Trees.	• Multimedia Presentation • Problem solving	• Final Exam	
Week -12	Classification and Regression Trees, K means clustering algorithm, K nearest neighbors algorithm, hierarchical clustering, Concept of ensemble methods.	• Lecture • Group Discussion • Multimedia Presentation	• In-course Exam • Final Exam	CLO2, CLO3, CLO4
Week -13	Concept of ANN, Basic Models, Important Terminologies of ANNs McCulloch-Pitts Neuron, NN architecture, perceptron, delta learning rule, backpropagation algorithm, Gradient Descent algorithm, feed forward networks, activation functions.	• Lecture • Group Discussion • Multimedia Presentation	• Oral Presentation • In-course Exam • Final Exam	CLO1, CLO2
Week -14	Introduction to AI Technologies in the realm of Automation Concept of Natural Language Processing, Machine Vision, Deep learning, Expert systems, Genetic Algorithms, Industry 4.0.	• Lecture • Group Discussion • Multimedia Presentation	• In-course Exam • Final Exam	CLO1, CLO3, CLO4

Part C

15. Assessment and Evaluation

i) Assessment Strategy

Strategy	Percentage of Total marks
Class attendance and participation	10
In-course Exam/Class Test	30
Semester Final Examination (3 hours duration)	60
Total	**100**

ii) Marks distribution:

- Continuous Assessment: 40%
- Summative: 60%
- Make-up Procedures: Two in-course exams will be taken and average marks will be counted. Feedback on in-course assessment is given to the students immediately after the test. If students are very weak in particular topics of this course, additional instruction will be given to help them catch up.

Part D

16. Learning Materials

i. Recommended Readings

a) Handbook of Industrial Automation-Richard L. Shell, Ernest L. Hall
b) Introduction to Industrial Automation- Stamatios Manesis, George Nikolakopoulos
c) Introduction to Artificial Intelligence By Wolfgang Ertel.

ii. Supplementary Readings

a) Introduction to Mechatronics and Measurement Systems by David G. Alciatore.

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

Course Outline of 0723-FE-6219

Part A

1. Course Code: 0723-FE-6219

2. Course Title: Product Design and Development.

3. Course Type: Core Course

4. Year/ Semester: Semester: II

5. Academic Session: 2022-23

6. Course Teacher: Kawsar Akhtar, Lecturer, ILET, DU

Md. Arafat Hossain, Lecturer, ILET, DU

7. Prerequisite(s): Leather Products Design and Development (LPE303)

8. Credits: 3

9. Contact Hours: 42

10. Total Marks: 100

11. Rationale of the Course: Product design and development is a very important stage for any kind of product. This program is designed to deliver the latest knowledge about the product development stages and its further stages for successful product launching. This program comprises product development processes, product concept development, product planning, product architecture, industrial design, design for manufacturing, prototyping and robust design, patents and intellectual property, product development economies, managing projects, design for environment.

Course contents

Introduction: Characteristics, duration, cost, the challenges of product development.

Development Processes and Organizations: A generic development process, adapting the generic product development process, product development process flows, product development organizations, organizational links with functions, projects.

Product Planning: The product planning process, identify opportunities, evaluate and prioritize projects, allocate resources and plan timing, complete pre-project planning, reflect on the results and the process.

Product Concept Development: Identifying customer needs, product specifications, concept generation, concept selection and concept testing, present the key activities of the concept development phase.

Product Architecture: The implications of product architecture on product change, product variety, component standardization, products performance, manufacturing cost, and project management.

Industrial Design: Assessing the need for industrial design, the impact of industrial design, the industrial design process, management of the industrial design process, assessing the quality of industrial design.

Design for Manufacturing (DFM): Overview the steps of DFM process; estimate the manufacturing costs, reduce the costs of components, reduce the costs of assembly, reduce the costs of supporting production, consider the impact of DFM decisions on other factors.

Prototyping and Robust design: Basics, types, importance, principles of prototyping, prototyping technologies, planning for prototypes. Definition, design of experiments (DOE), robust design processes.

Patents and Intellectual Property: Definition, overview of patents, utility patents, preparing a disclosure in seven steps.

Product Development Economies: Elements of economic analysis, time of economic analysis, and economic analysis process steps.

Managing Projects: Understanding and representing tasks, Gantt Charts, PERT Charts, the critical path, baseline project planning, project execution, assessing project status, corrective actions, postmortem project evaluation.

Design for Environment (DFE): Basic concept, importance of DFE, four kinds of integration, a sense of timelessness, contemporary footwear and leather products design, functional planning, specific problems, studio projects.

12. Course Objectives:

a. To provide the basic knowledge of product design, process design, production planning, product concept development, product architecture, product prototyping, product development economics and design for environment etc.
b. To impart the idea generations of different products design, process planning of a product and will learn how to provide visual representation of a product initially through prototyping.

13. Course Learning Outcomes (CLOs) and Mapping of CLOs with Program Learning Outcomes (PLOs)

a) CLOs: Upon completion of this course, students will be able to:

CLOs	Course Learning Outcomes (CLOs)	Learning Level
CLO1	Identify different terms and phrases associated with product development.	C1, A1
CLO2	Explain products design through prototype.	C2, P2
CLO3	Analyze different product development processes and planning.	C4
CLO4	Justify different manufacturing problems and solutions.	C5, A3
CLO5	Evaluate product market opportunities and future of the product.	C5

b) Mapping of CLO with PLO

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

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

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

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture, Multimedia presentation.	Group Presentation, In-course Exam; Final Exam
CLO2	Lecture, group discussion.	Group Presentation, In-course Exam; Final Exam
CLO3	Lecture, Multimedia presentation and group discussion.	In-course Exam, and Final Exam
CLO4	Lecture, multimedia presentation, group discussion.	Group Presentation, In-course Exam, and Final Exam
CLO5	Lecture, group discussion	In-course Exam, and Final Exam

Part B

14. Course plan specifying content, CLOs, co-curricular activities (if any), teaching learning and assessment strategy mapped with CLOs

Time Period	Topic	Teaching-Learning Strategy	Assessment Method	Corresponding CLOs
Week-01	**Introduction:** Characteristics, duration, cost, the challenges of product development.	• Lecture	• In-course Exam • Group Presentation • Final exam	CLO1, CLO3
Week-02	**Development Processes and Organizations:** A generic development process, adapting the generic product development process.	• Lecture	• In-course Exam • Final exam	CLO1,CLO3
Week-03	Product development process flows, product development organizations, organizational links with functions, projects.	• Lecture • Multimedia presentation • Group discussion	• In-course Exam • Final exam	CLO1, CLO3
Week-04	**Product Planning:** The product planning process, identify opportunities, evaluate and prioritize projects, allocate resources and plan timing, complete pre-project planning,	• Lecture • Multimedia presentation	• In-course Exam • Group Presentation • Final exam	CLO1, CLO3, CLO4

	reflect on the results and the process.			
Week-05	**Product Concept Development**: Identifying customer needs, product specifications, concept generation, concept selection and concept testing, present the key activities of the concept development phase.	• Lecture • Multimedia presentation	• In-course Exam • Group Presentation • Final exam	CLO1, CLO3
Week-06	**Product Architecture:** The implications of product architecture on product change, product variety, component standardization, products performance, manufacturing cost, and project management.	• Lecture • Multimedia presentation Group discussion	• In-course exam • Final exam	CLO1, CLO2, CLO4
Week-07	**Industrial Design:** Assessing the need for industrial design, the impact of industrial design, the industrial design process, management of the industrial design process, assessing the quality of industrial design.	• Lecture • Multimedia presentation Group discussion	• In-course Exam • Final exam	CLO1, CLO2
Week-08	**Design for Manufacturing (DFM):** Overview the steps of DFM process; estimate the manufacturing costs, reduce the costs of components, reduce the costs of assembly, reduce the costs of supporting production, consider the impact of DFM decisions on other factors.	• Lecture • Multimedia presentation	• In-course Exam • Final exam	CLO1, CLO3, CLO4

Week-09	**Prototyping and Robust design**: Basics, types, importance, principles of prototyping, prototyping technologies, planning for prototypes. Definition, design of experiments (DOE), robust design processes.	• Lecture • Multimedia presentation Group discussion	• In-course Exam • Group Presentation • Final exam	CLO1, CLO2, CLO4
Week- 10	**Patents and Intellectual Property:** Definition, overview of patents, utility patents, preparing a disclosure in seven steps.	• Lecture • Multimedia presentation	• In-course Exam • Final exam	CLO1, CLO3
Week-11	**Product Development Economies**: Elements of economic analysis, time of economic analysis, and economic analysis process steps.	• Lecture	• In-course Exam • Group Presentation • Final exam	CLO1
Week-12	**Managing Projects:** Understanding and representing tasks, Gantt Charts, PERT Charts, the critical path, baseline project planning, project execution, assessing project status, corrective actions, postmortem project evaluation.	• Lecture • Multimedia presentation	• In-course Exam • Final exam	CLO1, CLO3
Week-13	**Design for Environment (DFE):** Basic concept, importance of DFE, four kinds of integration, a sense of timelessness, contemporary footwear and leather products design, functional planning, specific problems, studio projects.	• Lecture • Multimedia presentation Group discussion	• In-course Exam • Final exam	CLO1, CLO3
Week-14	Basic concept, importance of DFE, four kinds of integration, a sense of	• Lecture • Multimedia presentation	• In-course Exam • Group	CLO1, CLO3

	timelessness, contemporary footwear and leather products design, functional planning, specific problems, studio projects.		Presentation • Final exam	

Part C

15. Assessment and Evaluation

i) Assessment Strategy

Strategy	**Percentage of Total marks**
Class attendance and participation	10
In-course Exam/Class Test	30
Semester Final Examination (3 hours duration)	60
Total	**100**

ii) Marks distribution:

- Continuous Assessment: 40%
- Summative: 60%
- Make-up Procedures: Two in-course exams will be taken and average marks will be counted. Feedback on in-course assessment is given to the students immediately after the test. If students are very weak in particular topics of this course, additional instruction will be given to help them catch up.

Part D

16. Learning Materials

i. Recommended Readings:

a) Product Design and Development, TATA McGraw-Hill, Third Edition, New Delhi, 2008-Ulrich, Karl T.and Eppinger, Steven D.

b) The Mechanical Design Process, TATA McGraw-Hill, Second Edition, 1997-Ullman, David G.

c) Design through discovery -Marjorie Elliott Bevlin.

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

Course Outline of 0723-FE-6221

Part A

1. Course Code: 0723-FE-6221

2. Course Title: E-Commerce and International Trade

3. Course Type: Core Course

4. Year / Semester: Semester: II

5. Academic Session: 2022-23

6. Course Teachers: Kawsar Akhtar, Lecturer, ILET, DU.

7. Prerequisite(s): N/A

8. Credits: 3.0

9. Contact Hours: 42

10. Total Marks: 100

11. Rationale of the Course: This course comprises basic concept of e-commerce, mobile commerce, website evaluation and usability testing, internet marketing, e-security, e-core values, osCommerce, which will help students to establish online business channel. Also, this course includes introduction to international trade, modes of operations, export strategy and marketing, which will deliver ideas to students how the leather, footwear, and leather products export market can be enlarged. Therefore, this course is crucial in this program for professional life of the students.

Course Contents:

Introduction to e-commerce: Conceptual understanding of e-commerce, e-business and e-strategy, E-commerce Drivers, Benefits of the Internet, Role of E-strategy, Value-chain in e-commerce, Analyzing Value Chain Activities, and supply-chain management and how they relate to e-commerce and e-business, Business models of the e-environment, Path to Successful E-commerce, A trend toward integrating e-commerce, E-commerce Business Models.

Mobile Commerce: Concept of Mobile Commerce, benefits of M commerce, M-Commerce Services and Applications available, Attributes of M-Commerce**,** Services of mobile commerce**,** Mobile payment**,** Mobile Commerce Application**,** Challenges of Mobile commerce**,** Advantages, and disadvantages of M commerce.

Web Site Evaluation and Usability Testing: Characteristics of Lame Web Sites, Common Mistakes, Questions When Evaluating a Web Site, Basic Web Site Anatomy, Color and Its Psychological Effects, Consumer Association with Key Shapes, Site Evaluation Criteria, Components of Personalization, Steps to Operationalize Personalization, Popular Myths About Cookies, Web Site Usability, Effective Web Site Design, User Testing, Site Performance Issues, Managing Content and Site Traffic.

Internet Marketing: The Pros and Cons of Online Shopping, Justifying an Internet Business, Internet Marketing Techniques, and Applications, Aggressive Internet Marketing, Pop-up Advertising, Permission Marketing, The E-cycle of Internet Marketing, Examples of the "Best" and "Worst" Web Sites, New Format Brand Ads, Personalization - the fifth "P", Important Personalization Rules, Marketing Implications, Guidelines for Attracting Customers to your Site,

Getting the Money: Real-world and electronic cash and their unique features and uses**,** the key requirements for Internet-based payments**,** The many ways people pay to purchase goods and services on the Internet**,** Business-to-business methods of payment: DigiCash, E-Cash and E-Wallet,Paying for goods and services via the mobile phone**,** Issues and implications behind electronic money transactions and payments.

E-Security and the USA Patriot Act: Equal Credit Opportunity Act, Maine's Anti-Hacker laws, Spyware and Adware, Spyware Solutions, Compliance Legislation, Levels of Virus Damage, Steps for Antivirus Strategy, Steps to Prevent E-Commerce Fraud, Security Protection and Recovery, Creating Strong Password, Firewall Design and Implementation Issues, Corporate Networks and Firewalls, Cycle of Recovery from Attack, Biometric Security, Types of Biometrics and Select Application Areas, Terrorism, How Modern Terrorism Uses the Internet, National Strategy to Secure Cyberspace,

E-Core Values: Ethical issues and how to improve the ethical climate in e-commerce, Legal issues in terms of liability, warranties, copyrights, trademarks, and trade names, Taxation issues, legal disputes, and domain name disputes, Encryption laws and what they mean, international issues, especially with regard to intellectual property and developing countries.

Building online store with osCommerce: Introduction to E-Commerce with osCommerce, Setting Up the Development Environment, How osCommerce Works, Basic Configuration, Working with Data, Customization, Taxes, Payments, and Shipping, Securing Your Store, Advanced Features, Tools, Tips, and Tricks, Deployment and Maintenance, Building Your Business, A case study on building online store with osCommerce.

International trade: Introduction, International trade theory, Barriers to trade, non-tariff barriers to trade, Foreign Exchange Exposure and Foreign Trade, foreign exchange market, Exchange rate, Traditional Foreign exchange Instruments: Currency swaps, Futures contracts. Export and Import: characteristics, types, Export Documentation.

Modes of Operations: Modes of operation in International Business and the Economic Environments facing businesses. Factors influencing the choice of a particular mode of international business. Various forms of contractual entry mode and challenges in choosing a particular mode. Importance of economic environments, Elements of the economic environment and its impact, Balance of Payments and Balance of Trade.

Export Strategy and Export Marketing: Marketing strategies, Export marketing plan, setting of marketing objectives, market research, product characteristics, export pricing, distribution channels, find export opportunities, deciding on exports marketing objectives, and preparing action plans to achieve the objectives.

12. Course Objectives:

a. To provide the terms and phrases associated with E-Commerce and International Trade.

b. To introduce the importance of E-Commerce and International Trade.
c. To impart the role of e-commerce and international trade in leather, leather products and footwear.
d. To expose to various techniques employed in internet marketing, e-security and e-core values.
e. To acquire knowledge on how to develop ecommerce online store, international trade and Export Strategy and Export Marketing.

13. Course Learning Outcomes (CLOs) and Mapping of CLOs with Program Learning Outcomes (PLOs)

a) CLOs: Upon completion of this course, students will be able to:

	Course Learning Outcomes (CLOs)	**Learning Level**
CLO1	Explain e-commerce, international trade, mode of operations, export strategy and export marketing and identify the most favorable way for their business.	C2, A2
CLO2	Identify various Business-to-business methods of payment, E-Security and E-Core Values and also recognize the ethical responsibilities in business.	C3, A3
CLO3	Analyze the value chain activities and supply chain management related to e-commerce and integrate teamwork in e-business.	C4, A5
CLO4	Create an e-commerce website to explore their theoretical knowledge on professional life.	C6
CLO5	Summarize and integrate the impact of e-commerce and international trade on global economy and environmental sustainability.	C6, A5

b) Mapping of CLO with PLO

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

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

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

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

Part B

14. Course plan specifying content, CLOs, co-curricular activities (if any), teaching learning and assessment strategy mapped with CLOs

Time Period	Topic	Teaching-Learning Strategy	Assessment Strategy	Corresponding CLOs
Week-01	**Introduction to e-commerce**: Conceptual understanding of e-commerce, e-business and e-strategy, E-commerce Drivers, Benefits of the Internet, Role of E-strategy.	• Lecture • Multimedia presentation • Demonstration • Problem-based exercises	• Group Presentation • In-course Exam • Final Exam	CLO1
Week -02	Value-chain in e-commerce, Analyzing Value Chain Activities, and supply-chain management and how they relate to e-commerce and e-business, Business	• Lecture • Multimedia presentation • Demonstration • Guided reading • Problem-based learning	• Group • Presentation • In-course Exam • Final Exam	CLO1, CLO3

	models of the e-environment, Path to Successful E-commerce, A trend toward integrating e-commerce, E-commerce Business Models.			
Week -03	**Mobile Commerce:** Concept ofMobile Commerce, benefits of M commerce, M-Commerce Services and Applications available,Attributes of M-Commerce**,** Services of mobile commerce**,** Mobile payment**,** Mobile Commerce Application**,** Challenges of Mobile commerce**,** Advantages, and disadvantages of M commerce.	• Lecture • Group discussion • Problem-based exercises	• Group Presentation • In-course Exam • Final Exam	CLO1, CLO2
Week -04	**Web Site Evaluation and Usability Testing:** Characteristics of Lame Web Sites, Common Mistakes, Questions When Evaluating a Web Site, Basic Web Site Anatomy, Color and Its Psychological Effects.	• Lecture • Multimedia presentation • Group discussion Literature review • Demonstration • Problem-based exercises	• Group Presentation • In-course Exam • Final Exam	CLO4
Week -05	Consumer Association with Key Shapes, Site Evaluation Criteria,	• Lecture • Multimedia presentation	• Group Presentation • In-course	CLO4

	Components of Personalization, Steps to Operationalize Personalization, Popular Myths About Cookies, Web Site Usability, Effective Web Site Design, User Testing, Site Performance Issues, Managing Content and Site Traffic.	• Group discussion • Literature review Demonstration • Problem-based exercises	Exam • Final Exam	
Week -06	**Internet Marketing:** The Pros and Cons of Online Shopping, Justifying an Internet Business, Internet Marketing Techniques, and Applications, Aggressive Internet Marketing. Pop-up Advertising, Permission Marketing, The E-cycle of Internet Marketing, Examples of the "Best" and "Worst" Web Sites, New Format Brand Ads, Personalization - the fifth "P", Important Personalization Rules, Marketing Implications, Guidelines for Attracting Customers to your	• Lecture • Multimedia presentation • Demonstration Guided reading • Problem-based learning	• Group Presentation • In-course Exam • Final Exam	CLO2, CLO3

	Site.			
Week -07	Pop-up Advertising, Permission Marketing, The E-cycle of Internet Marketing, Examples of the "Best" and "Worst" Web Sites, New Format Brand Ads, Personalization - the fifth "P", Important Personalization Rules, Marketing Implications, Guidelines for Attracting Customers to your Site.	• Lecture • Group discussion Problem-based exercises	• Group Presentation • In-course Exam • Final Exam	CLO2
Week -08	**Getting the Money:** Real-world and electronic cash and their unique features and uses**,** the key requirements for Internet-based payments**,** The many ways people pay to purchase goods and services on the Internet**,** Business-to-business methods of payment: DigiCash, E-Cash and E-Wallet,Paying for goods and services via the mobile phone**,** Issues and implications behind electronic money transactions and payments.	• Lecture • Group discussion Problem-based exercises	• Group Presentation • In-course Exam • Final Exam	CLO2

Week -09	**E-Security and the USA Patriot Act:** Equal Credit Opportunity Act, Maine's Anti-Hacker laws, Spyware and Adware, Spyware Solutions, Compliance Legislation, Levels of Virus Damage, Steps for Antivirus Strategy, Steps to Prevent E-Commerce Fraud, Security Protection and Recovery, Creating Strong Password, Firewall Design and Implementation Issues, Corporate Networks and Firewalls, Cycle of Recovery from Attack, Biometric Security, Types of Biometrics and Select Application Areas, Terrorism, How Modern Terrorism Uses the Internet, National Strategy to Secure Cyberspace.	• Lecture • Group discussion Problem-based exercises	• Group Presentation • In-course Exam • Final Exam	CLO1, CLO2
Week -10	**E-Core Values:** Ethical issues and how to improve the ethical climate in e-commerce, Legal issues in terms of liability, warranties,	• Lecture • Group discussion Problem-based exercises	• Group Presentation • In-course Exam • Final Exam	CLO2

	copyrights, trademarks, and trade names, Taxation issues, legal disputes, and domain name disputes, Encryption laws and what they mean, international issues, especially with regard to intellectual property and developing countries.			
Week -11	**Building online store with osCommerce:** Introduction to E-Commerce with osCommerce, Setting Up the Development Environment, How osCommerce Works, Basic Configuration, Working with Data, Customization, Taxes, Payments, and Shipping, Securing Your Store, Advanced Features, Tools, Tips, and Tricks, Deployment and Maintenance, Building Your Business, A case study on building online store with osCommerce.	• Lecture • Multimedia presentation • Group discussion Literature review • Demonstration • Problem-based exercises	• Group Presentation • In-course Exam • Final Exam	CLO4
Week -12	**International trade:** Introduction, International trade	• Lecture • Multimedia presentation	• Group Presentation • In-course	CLO1, CLO5

	theory, Barriers to trade, non-tariff barriers to trade, Foreign Exchange Exposure and Foreign Trade, foreign exchange market, Exchange rate, Traditional Foreign exchange Instruments: Currency swaps, Futures contracts. Export and Import: characteristics, types, Export Documentation.	• Demonstration • Literature review • Problem-based exercises	Exam • Final Exam	
Week -13	**Modes of Operations:** Modes of operation in International Business and the Economic Environments facing businesses. Factors influencing the choice of a particular mode of international business. Various forms of contractual entry mode and challenges in choosing a particular mode. Importance of economic environments, Elements of the economic environment and its impact, Balance of Payments and	• Lecture • Multimedia presentation • Demonstration Problem-based exercises	• Group Presentation • In-course Exam • Final Exam	CLO1

	Balance of Trade.			
Week -14	**Export Strategy and Export Marketing**: Marketing strategies, Export marketing plan, setting of marketing objectives, market research, product characteristics, export pricing, distribution channels, find export opportunities, deciding on exports marketing objectives, and preparing action plans to achieve the objectives.	• Lecture • Multimedia presentation • Demonstration • Literature review Problem-based exercises	• Group Presentation • In-course Exam • Final Exam	CLO1, CLO5

Part C

15. Assessment and Evaluation

i) Assessment Strategy

Strategy	**Percentage of Total marks**
Class attendance and participation	10
In-course Exam/Class Test	30
Semester Final Examination (3 hours duration)	60
Total	**100**

ii) Marks distribution:

- Continuous Assessment: 40%
- Summative: 60%
- Make-up Procedures: Two in-course exams will be taken and average marks will be counted. Feedback on in-course assessment is given to the students immediately after the test. If students are very weak in particular topics of this course, additional instruction will be given to help them catch up.

Part D

16. Learning Materials

i. Recommended Reading

a) Electronic Commerce: From Vision to Fulfillment by Elias M. Awad, Pearson College Div, 3rd edition.

b) Building Online Stores with osCommerce: Professional Edition by David Mercer, PACKT Publishing, Mumbai.

c) Francis Cherunilam, International Business, Text and Cases, Himalaya Publishing Company

ii. Supplementary Readings

a) T. A. S. Balagopal: Export Management, Himalaya Publishing House

b) D. C. Kapoor: Export Management, Vikas Publishing House Pvt Ltd

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

Semester-III

Course Code	Course Title	Credits
FE 6300	Project	4.00
FE 6302	Internship	2.00
FE 6304	Viva Voce	1.00
Total		7.00
Grand Total		**40.00**

Course Outline of 0723-FE-6300

Part A

1. Course Code: 0723-FE-6300

2. Course Title: Project

3. Course Type: Core course

4. Year/Semester: Semester: II and III

5. Academic Session: 2022-2023

6. Course Teacher: Respective Supervisor/Co-supervisor, ILET, DU.

7. Pre-requisite: N/A

8. Credit Value: 4.0

9. Contact Hour: No specific contact hour per week

10. Total Marks: 100

11. Rational of the Course: Master's project is the concluding requirement for the M.Sc. in Leather Products Engineering. It is mostly designed to develop research aptitude among the students. Candidates are expected to complete a project that demonstrates their ability to conduct in-depth investigation of a specific problem to find feasible solution.

Course Contents

During project work, experimental and theoretical investigation of various problems related to leather and allied industry, environmental science, nanotechnology, industrial engineeringetc. will be carried out. The topic should provide an opportunity to the student in developingproblem-solving skills, team work capability, argumentative skills, excellent writing ability, creativity and technical knowledge etc. Student is expected to complete the literature review/survey, selection of suitable methodology for conducting investigation and submission of an individual research proposal. At the end, student is expected to draw conclusion, prepare the dissertation, submit to the committee and appear for the project defense.

12. Course Objectives:

a. To develop values and attitudes related to ethical research work among students.
b. To ensure utilization of gathered knowledge in solving new real-life problems.
c. Enhance the ability of the students to analyze and summarize information available in the literature.
d. Develop effective communicative skills to present research on leather and allied issues.

13. Course Learning Outcomes (CLOs) and Mapping of CLOs with Program Learning Outcomes (PLOs)

a) CLOs: At the completion of this course students will be able to:

	Course Learning Outcomes (CLOs)	**Learning Level**
CLO1	Identify, analyze and formulate a research problem and use extensive investigation for obtaining its solution.	C1
CLO2	Explain the concept of ethics in research and impact of leather products engineering solutions on society and environment.	C2
CLO3	Deliver designed project findings through oral presentations, demonstrations, and written technical report format.	C2, C3

b) Mapping of CLO with PLO

CLOs	**PLO1**	**PLO2**	**PLO3**	**PLO4**	**PLO5**	**PLO6**	**PLO7**	**PLO8**
CLO1	3	-	-	-	-	2	2	1
CLO2	3	3	3	-	-	3	3	-
CLO3	3	-	-	3	-	2	-	-

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

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

CLOs	**Teaching-Learning Strategy**	**Assessment Strategy**
CLO1	Discussion, encouragement, self-study	Project defense and report evaluation by external as well as internal
CLO2	Lecture, discussion, demonstration	
CLO3	Writing and proofreading	

Part B

14. Course plan specifying content, CLOs, co-curricular activities (if any), teaching-learning, and assessment strategy mapped with CLOs

Month	Topic	Teaching-Learning Strategy	Assessment Strategy	Corresponding CLOs
1	Interactive Lecture session on research methodology. Introduction to project and area of project.	• Discussion and encouragement	Project defense and report evaluation by external as well as internal	CLO1
1	Independent Study on selected research area and Topic selection	• Self-study		
2-10	Self-work in Laboratory/ Field/Industry	• Discussion		
11	Motivation builds upon documentation ethics. Discussion on how result analysis and performance evaluation are done	• Lecture • Discussion and demonstration		CLO1, CLO2
11	Project dissertation preparation	• Writing		CLO3
12	Proofing the dissertation, approval from advisor. Submission and Defense.	• Writing • Final proofreading		CLO3

Part C

15. Assessment and Evaluation

i) Assessment Strategy

Strategy	Percentage of total marks
Project defense	40
Dissertation Submission	60
Total	**100**

ii) Marks distribution:

- Continuous Assessment/defense: 40%
- Summative: 60%
- Make-up Procedures: N/A.

Part D

16. Learning Materials

i. Recommended Readings:

a) Writing the Winning thesis or Dissertation: A Step-by-Step Guide - By Allan A. Glatthorn, Randy L. Joyner.
b) An Introduction to Research Methods- M. Nurul Islam
c) Relevant books, scientific journals, handbooks, patents and manuals.

Course Outline of 0723-FE-6302

Part A

1. Course Code: 0723-FE-6302

2. Course Title: Internship

3. Course Type: Core course

4. Year/Semester: Semester: III

5. Academic Session: 2022-2023

6. Course Teacher: Respective Guide Teachers, Institute of Leather Engineering and Technology, DU.

7. Pre-requisite: N/A

8. Credit Value: 2.0

9. Contact Hour: 2 months

10. Total Marks: 100

11. Rationale of the Course: The course is designed to expose students to the working environment in the industry. The intensive training will enable students to understand the theories studied with more detailed and hands-on practice within a real job situation. Furthermore, students will learn how to do a work following the specified instructions coupled with their own technical knowledge, creativity and artistry.

Course Contents

Factory inside out, product design and development, cutting, skiving, splitting, sewing and finishing, quality control, merchandising and waste management.

12. Course Objectives:

a. To expose students to the actual working environment and get acquainted with the organization structure, business operations and administrative functions.
b. To have hands-on experience in unit operation and unit process involved in leather products manufacturing process

c. To enhance industry- academia collaboration and co-operation.

13. Course learning outcomes (CLOs) and mapping of CLOs with program learning outcomes (PLOs)

a) CLOs: At the completion of this course students will be able to:

	Course Learning Outcomes (CLOs)	**Learning Level**
CLO1	Demonstrate acquired skills in the actual working environment.	C3, A3
CLO2	Analyze and evaluate layout, modern technologies, production process and waste management facilities.	C3, C4
CLO3	Summarize the collected data to generate technical reports.	C4

b) Mapping of CLO with PLO

CLOs	**PLO1**	**PLO2**	**PLO3**	**PLO4**	**PLO5**	**PLO6**	**PLO7**	**PLO8**
CLO1	3	-	-	-	2	2	2	2
CLO2	3	1	-	-	-	2	2	3
CLO3	3	-	-	2	-	-	-	-

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

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

CLOs	**Teaching-Learning Strategy**	**Assessment Strategy**
CLO1	Lecture, display, demonstration, interactive discussion, self-study and motivation	Presentation and Viva voce Report Evaluation
CLO2	Lecture, display, demonstration, interactive discussion, self-study and motivation	
CLO3	Interactive discussion, lecture, motivation and self-study	

Part B

14. Course plan specifying contents, CLOs, co-curricular activities (if any), with teaching-learning and assessment strategies mapped with CLOs

Week	**Topic**	**Teaching-Learning Strategy**	**Assessment Strategy**	**Corresponding CLOs**
1	Introductory discussion on industrial training: Objectives, Plan and Significance	Class lecture by guide teacher	• Presentation • Viva voce • Report	CLO1

2-3	Factory inside out	Display and demonstration at the industry	Evaluation	CLO2
4	Product design and development	Interactive discussion		
5-6	Cutting, skiving, splitting, sewing and finishing	Self-study and interactive discussion		
7	Quality Control, merchandising and waste management	Interactive discussion and motivation at the industry		
8	Preparation of report and presentation slide	Lectures by guide teacher		CLO3

Part C

15. Assessment and Evaluation

i) Assessment Strategy

Strategy	**Percentage of Total Marks**
Presentation and Viva voce	40
Report Submission	60
Total	**100**

ii) Marks distribution

- Continuous Assessment/defense: 40%
- Summative: 60%
- Make-up Procedures: N/A

Part D

16. Learning Materials

i. Recommended Readings

a) Writing the Winning Thesis or Dissertation: A Step-by-Step Guide - By Allan A. Glatthorn, Randy L. Joyner.

- Why (and How) to Take a Plant Tour by David M. Upton and Stephen E. Macadam, published on Harvard Business Review.

Course Outline of 0723-FE-6304

Part A

1. Course Code: 0723-FE-6304

2. Course Title: Viva Voce

3. Course Type: Core Course

4. Year/ Semester: Semester: III

5. Academic Session: 2022-23

6. Course Teachers: N/A

7. Prerequisite(s): N/A

8. Credits: 1.0

9. Contact Hours: N/A

10. Total Marks: 50

11. Rational of the Course: This course shall ensure that the students are able to present the knowledge, skills and practical experience they earned throughout the program to the panel of experts'/ Examination committee in the most effective way.

Course Contents
It is based on all the courses the students have studied during the M. Sc. in Leather Products Engineering program.

12. Course Objectives:

a. To equip the students with analytical and evaluation abilities to respond to impromptu questions by the examination panel members.
b. To train the students to face the expert panel and present the knowledge, skills and problems in well-organized way.

13. Course Learning Outcomes (CLOs) and Mapping of CLOs with Program Learning Outcomes (PLOs)

a) CLOs: At the completion of this course students will be able to:

	Course Learning Outcomes (CLOs)	**Learning Level**
CLO1	Demonstrate the acquired knowledge and expertise in the interview panel.	C3, A3

b) Mapping of CLO with PLO

(CLOs)	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8
CLO1	3	-	-	-	-	-	-	-

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

Part B

14. Course plan specifying content, CLOs, co-curricular activities (if any), teaching learning and assessment strategy mapped with CLOs: Not Applicable.

Part C

15. Assessment and Evaluation: Comprehensive Viva: 100%

Part D

16. Learning Materials

All the books of all the semesters and the journals, data bases, real problems of leather and allied sector.