# COURSE

# CURRICULUM

***AND***

# DETAILED SYLLABI

***FOR***

# DEGREE

***OF***

## B.Tech. Chemical Technology-

## Leather Technology

**APPLICABLE FOR THE STUDENTS ADMITTED**

***FROM***

**THE ACADEMIC YEAR 2017-2018**

**Harcourt Butler Technical University**
Kanpur-208002, UP, India
www.hbtu.ac.in

**Annexure-I**

**HARCOURT BULTER TECHNICAL UNIVERSITY KANPUR**
**SCHOOL OF CHEMICAL TECHNOLOGY**
**DEPARTMENT OF CHEMICAL TECHNOLOGY - LEATHER TECHNOLOGY**

**Semester wise Course Structure**

**B. Tech. Chemical Technology - Leather Technology**
**(Applicable from Session 2017-2018 for new entrants)**

**Year I, Semester-I**

| Sl. No. | Course Type | Course Title | Subject Code | Credits | Periods | | | Sessional Marks | | | | ESE | Total Marks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | L | T | P | MES | TA | Lab | Total | | |
| 1 | BSC | Chemistry | BCY 101 | 4 | 3 | 0 | 2 | 15 | 20 | 15 | 50 | 50 | 100 |
| 2 | BSC | Mathematics I | BMA 101 | 4 | 3 | 1 | 0 | 30 | 20 | - | 50 | 50 | 100 |
| 3 | ESC | Electronics & Instrumentation Engineering | EET 101 | 3 | 3 | 0 | 0 | 30 | 20 | - | 50 | 50 | 100 |
| 4 | ESC | Engineering Graphics | ECE 101 | 3 | 0 | 0 | 6 | 30 | 20 | - | 50 | 50 | 100 |
| 5 | ESC | Computer Concept & Programming | ECS 101 | 4 | 3 | 0 | 2 | 15 | 20 | 15 | 50 | 50 | 100 |
| 6 | ESC | Workshop Practice | EWS 101 | 2 | 0 | 0 | 4 | - | 20 | 30 | 50 | 50 | 100 |
| 7 | MC ( Non Credit) | Environment & Ecology | ECE 103 | 0 | 2 | 0 | 0 | 30 | 20 | - | 50 | 50 | 100 |
| | | **Total Credits -20** | | | | | | | | | | | |

**Syllabus B Tech Chemical Technology-Leather Technology Degree, Board of Studies, March 27, 2018**

**HARCOURT BULTER TECHNICAL UNIVERSITY KANPUR**
**SCHOOL OF CHEMICAL TECHNOLOGY**
**DEPARTMENT OF CHEMICAL TECHNOLOGY - LEATHER TECHNOLOGY**

**Semester wise Course Structure**

**B. Tech. Chemical Technology - Leather Technology**
**(Applicable from Session 2017-2018 for new entrants)**

**Year I, Semester-II**

| Sl. No. | Course Type | Course Title | Subject Code | Credits | Periods | | | Sessional Marks | | | | ESE | Total Marks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | L | T | P | MES | TA | Lab | Total | | |
| 1 | BSC | Physics | BPH 102 | 4 | 3 | 0 | 2 | 15 | 20 | 15 | 50 | 50 | 100 |
| 2 | BSC | Mathematics II | BMA 102 | 4 | 3 | 1 | 0 | 30 | 20 | - | 50 | 50 | 100 |
| 3 | ESC | Electrical Engineering | EEE 102 | 4 | 3 | 0 | 2 | 15 | 20 | 15 | 50 | 50 | 100 |
| 4 | ESC | Engineering Mechanics | EME 102 | 3 | 3 | 0 | 0 | 30 | 20 | - | 50 | 50 | 100 |
| 5 | HSMC | English Language & Composition | HHS 102 | 2 | 2 | 0 | 0 | 30 | 20 | - | 50 | 50 | 100 |
| 6 | HSMC | Professional Communication | HHS 104 | 3 | 2 | 0 | 2 | 15 | 20 | 15 | 50 | 50 | 100 |
| | | **Total Credits -20** | | | | | | | | | | | |

**Syllabus B Tech Chemical Technology-Leather Technology Degree, Board of Studies, March 27, 2018**

**HARCOURT BULTER TECHNICAL UNIVERSITY KANPUR**
**SCHOOL OF CHEMICAL TECHNOLOGY**
**DEPARTMENT OF CHEMICAL TECHNOLOGY - LEATHER TECHNOLOGY**

**Semester wise Course Structure**

**B. Tech. Chemical Technology - Leather Technology**
**(Applicable from Session 2018-2019 for new entrants)**

**Year II, Semester-III**

| Sl. No. | Course Type | Course Title | Subject Code | Credits | Periods | | | Sessional Marks | | | | ESE | Total Marks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | L | T | P | MES | TA | Lab | Total | | |
| 1 | BSC | Mathematics III | BMA 201 | 4 | 3 | 1 | 0 | 30 | 20 | - | 50 | 50 | 100 |
| 2 | ESC | Materials & Energy Balance | TCH 201 | 5 | 3 | 2 | 0 | 30 | 20 | - | 50 | 50 | 100 |
| 3 | PCC | Fluid Flow & Unit operation | TCH 203 | 5 | 3 | 1 | 3 | 15 | 20 | 15 | 50 | 50 | 100 |
| 4 | PCC | Leather Microscopy and Bacteriology | TLT 201 | 5 | 3 | 0 | 6 | 15 | 20 | 15 | 50 | 50 | 100 |
| 5 | HSMC | Organisational Behavior | HHS 203 | 3 | 3 | 0 | 0 | 30 | 20 | - | 50 | 50 | 100 |
| 6 | MC (Non-Credit) | Cyber Security | ECS 205 | 0 | 2 | 0 | 0 | 30 | 20 | - | 50 | 50 | 100 |
| | | **Total Credits -22** | | | | | | | | | | | |

**Syllabus B Tech Chemical Technology-Leather Technology Degree, Board of Studies, March 27, 2018**

**HARCOURT BULTER TECHNICAL UNIVERSITY KANPUR**
**SCHOOL OF CHEMICAL TECHNOLOGY**
**DEPARTMENT OF CHEMICAL TECHNOLOGY - LEATHER TECHNOLOGY**

**Semester wise Course Structure**

**B. Tech. Chemical Technology - Leather Technology**
**(Applicable from Session 2018-2019 for new entrants)**

**Year II, Semester-IV**

| Sl. No. | Course Type | Course Title | Subject Code | Credits | Periods | | | Sessional Marks | | | | ESE | Total Marks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | L | T | P | MES | TA | Lab | Total | | |
| 1 | BSC | Modern Analytical Techniques | BCY 202 | 4 | 3 | 0 | 3 | 15 | 20 | 15 | 50 | 50 | 100 |
| 2 | BSC | Computer Oriented Numerical Methods | BMA 206 | 5 | 3 | 1 | 3 | 15 | 20 | 15 | 50 | 50 | 100 |
| 3 | ESC | Heat Transfer Operation | TCH 202 | 3 | 3 | 0 | 0 | 30 | 20 | - | 50 | 50 | 100 |
| 4 | ESC | Chemical Engineering Thermodynamics | TCH 204 | 3 | 3 | 0 | 0 | 30 | 20 | - | 50 | 50 | 100 |
| 5 | PCC | Skin Protein and Pre-Tannages | TLT 202 | 4 | 3 | 0 | 3 | 15 | 20 | 15 | 50 | 50 | 100 |
| 6 | HSMC | Engg Economics & Management | HHS 202 | 3 | 3 | 0 | 0 | 30 | 20 | - | 50 | 50 | 100 |
| 7 | MC (Non-Credit) | Indian Constitution | HHS 206 | 0 | 2 | 0 | 0 | 30 | 20 | | 50 | 50 | 100 |
| | | **Total Credits -22** | | | | | | | | | | | |

**Syllabus B Tech Chemical Technology-Leather Technology Degree, Board of Studies, March 27, 2018**

**HARCOURT BULTER TECHNICAL UNIVERSITY KANPUR**
**SCHOOL OF CHEMICAL TECHNOLOGY**
**DEPARTMENT OF CHEMICAL TECHNOLOGY - LEATHER TECHNOLOGY**

**Semester wise Course Structure**

**B. Tech. Chemical Technology - Leather Technology**
**(Applicable from Session 2019-2020 for new entrants)**

**Year III, Semester-V**

| Sl. No. | Course Type | Course Title | Subject Code | Credits | Periods | | | Sessional Marks | | | | ESE | Total Marks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | L | T | P | MES | TA | Lab | Total | | |
| 1 | ESC | Mass Transfer Operation | TCH 301 | 4 | 3 | 1 | 0 | 30 | 20 | - | 50 | 50 | 100 |
| 2 | ESC | Chemical Reaction Engineering | TCH 303 | 4 | 3 | 1 | 0 | 30 | 20 | - | 50 | 50 | 100 |
| 3 | PCC | Inorganic Tannages | TLT 301 | 3 | 3 | 0 | 0 | 30 | 20 | - | 50 | 50 | 100 |
| 4 | PCC | Analysis of Materials of Leather Manufacture | TLT 303 | 5 | 3 | 0 | 6 | 15 | 20 | 15 | 50 | 50 | 100 |
| 5 | OEC (Mechanical) | Mechanical Operations and Machines | EME 325 | 3 | 3 | 0 | 0 | 30 | 20 | - | 50 | 50 | 100 |
| 6 | OEC (Humanities) | Entrepreneurship Development | HHS 341 | 3 | 3 | 0 | 0 | 30 | 20 | - | 50 | 50 | 100 |
| | | **Total Credits -22** | | | | | | | | | | | |

**Syllabus B Tech Chemical Technology-Leather Technology Degree, Board of Studies, March 27, 2018**

**HARCOURT BULTER TECHNICAL UNIVERSITY KANPUR**
**SCHOOL OF CHEMICAL TECHNOLOGY**
**DEPARTMENT OF CHEMICAL TECHNOLOGY - LEATHER TECHNOLOGY**

**Semester wise Course Structure**

**B. Tech. Chemical Technology - Leather Technology**
**(Applicable from Session 2019-2020 for new entrants)**

**Year III, Semester-VI**

| Sl. No. | Course Type | Course Title | Subject Code | Credits | Periods | | | Sessional Marks | | | | ESE | Total Marks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | L | T | P | MES | TA | Lab | Total | | |
| 1 | ESC | Instrumentation & Process Control | TCH 302 | 5 | 3 | 1 | 3 | 15 | 20 | 15 | 50 | 50 | 100 |
| 2 | PCC | Post Tanning and Finishing Operation | TLT 302 | 4 | 3 | 1 | 0 | 30 | 20 | - | 50 | 50 | 100 |
| 3 | PCC | Processing of Leather-I | TLT 304 | 5 | 3 | 0 | 6 | 15 | 20 | 15 | 50 | 50 | 100 |
| 4 | PCC | Leather Analysis and Quality Control | TLT 306 | 5 | 3 | 0 | 6 | 15 | 20 | 15 | 50 | 50 | 100 |
| 5 | OEC (Maths) | Operations Research | BMA302 | 3 | 3 | 0 | 0 | 30 | 20 | - | 50 | 50 | 100 |
| | | **Total Credits -22** | | | | | | | | | | | |

**Syllabus B Tech Chemical Technology-Leather Technology Degree, Board of Studies, March 27, 2018**

**HARCOURT BULTER TECHNICAL UNIVERSITY KANPUR**
**SCHOOL OF CHEMICAL TECHNOLOGY**
**DEPARTMENT OF CHEMICAL TECHNOLOGY - LEATHER TECHNOLOGY**

**Semester wise Course Structure**

**B. Tech. Chemical Technology - Leather Technology**
**(Applicable from Session 2020-2021 for new entrants)**

**Year IV, Semester-VII**

| Sl. No. | Course Type | Course Title | Subject Code | Credits | Periods | | | Sessional Marks | | | | ESE | Total Marks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | L | T | P | MES | TA | Lab | Total | | |
| 1 | PCC | Processing of Leather-II | TLT 401 | 4 | 3 | 0 | 3 | 15 | 20 | 15 | 50 | 50 | 100 |
| 2 | PEC | Programme Elective Course I<br>Leather Auxialaries Technology<br>Leather biotechnology | TLT 403 | 3 | 3 | 0 | 0 | 30 | 20 | - | 50 | 50 | 100 |
| 3 | PEC | Programme Elective Course II<br>Organic Tannages<br>Animal and Tannery by Products | TLT 405 | 2 | 2 | 0 | 0 | 30 | 20 | - | 50 | 50 | 100 |
| 4 | PEC | Programme Elective Course III<br>Footwear Technology<br>Footwear materials and Components | TLT 407 | 2 | 2 | 0 | 0 | 30 | 20 | - | 50 | 50 | 100 |
| 5 | OEC (Leather Tech.) | Introduction to Leather Technology | TLT 409 | 3 | 3 | 0 | 0 | 30 | 20 | - | 50 | 50 | 100 |
| 6 | | Industrial Training | TLT 461 | 2 | 0 | 0 | 4 | | 50 | | 50 | 50 | 100 |
| 7 | | Seminar | TLT 471 | 2 | 0 | 0 | 4 | | 50 | | 50 | 50 | 100 |
| 8 | | Project | TLT 497 | 4 | 0 | 0 | 8 | | 50 | | 50 | 50 | 100 |
| 9 | | Educational Tour | TLT 417 | 0 | 0 | 0 | 0 | | | | | | |
| | | **Total Credits -22** | | | | | | | | | | | |

**Syllabus B Tech Chemical Technology-Leather Technology Degree, Board of Studies, March 27, 2018**

**HARCOURT BULTER TECHNICAL UNIVERSITY KANPUR**
**SCHOOL OF CHEMICAL TECHNOLOGY**
**DEPARTMENT OF CHEMICAL TECHNOLOGY - LEATHER TECHNOLOGY**

**Semester wise Course Structure**

**B. Tech. Chemical Technology - Leather Technology**
**(Applicable from Session 2020-2021 for new entrants)**

**Year IV, Semester-VIII**

| Sl. No. | Course Type | Course Title | Subject Code | Credits | Periods | | | Sessional Marks | | | | ESE | Total Marks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | L | T | P | MES | TA | Lab | Total | | |
| 1 | OEC (Chemical Engg.) | Transport Phenomenon | TCH 402 | 4 | 3 | 1 | 0 | 30 | 20 | - | 50 | 50 | 100 |
| 2 | PEC | Programme Elective Course IV | | 3 | 3 | 0 | 0 | 30 | 20 | - | 50 | 50 | 100 |
| | | Tannery Effluent Treatment | TLT 402 | | | | | | | | | | |
| | | Leather Products Technology | TLT 404 | | | | | | | | | | |
| 3 | PEC | Programme Elective Course V | | 3 | 3 | 0 | 0 | 30 | 20 | - | 50 | 50 | 100 |
| | | Process Modeling & Simulation | TCH404 | | | | | | | | | | |
| | | Process Equipment Design | TCH 406 | | | | | | | | | | |
| 4 | PEC | Programme Elective Course VI | | 2 | 2 | 0 | 0 | 30 | 20 | - | 50 | 50 | 100 |
| | | Leather Trades Engineering | TLT 406 | | | | | | | | | | |
| | | Computer Aided Leather Product Design | TLT 408 | | | | | | | | | | |
| 5 | | Project | TLT 498 | 10 | 0 | 0 | 20 | | 50 | | 50 | 50 | 100 |
| | | **Total Credits -22** | | | | | | | | | | | |

***Project Viva-Voice will be conducted by External Examiner.**

**Annexure-II**

# Harcourt Butler Technical University

## DEPARTMENT OF CHEMICAL TECHNOLOGY - LEATHER TECHNOLOGY

## SCHOOL OF CHEMICAL TECHNOLOGY

### THE UNIVERSITY

***VISION***

"To Become a Leader of Innovation in the field of Technological Developments, capable of producing Quality Engineers and Technologists compatible with World Standards to deliver the benefits of developed technologies to the people".

***MISSION***

"To create an Environment Conducive to Provide Opportunity to the Budding, Technologists and Practicing from Industry for Fusion of their Ideas in Developing Areas of Cutting Edge Technologies in Thrust Areas for betterment of industry at Large"

### THE PROGRAM

***I. VISION***

Department of Leather Technology at HBTU aims at being a leader of innovation in the area of Leather to produce quality technologists of world standards to deliver the benefits of the developed technologies to the people.

**II. MISSION**

1. **To achieve academic excellence and practical knowledge in the fields of Leather, Leather Application, and allied areas.**
2. **To inculcate technical competence in students for formulation, manufacture and application of advanced Leather with eco -friendly and sustainable approach.**
3. **To develop state-of-art facilities for testing and consultancy for industry to make the department a center of excellence in the field of Leather at global level.**

4. **To develop indigenous and adaptable technologies related to Leather for small scale production and to develop entrepreneurial skills, towards betterment of society.**

## III. PROGRAM EDUCATIONAL OBJECTIVES (PEOS)

**PEO 1:** To produce graduates and post graduates who will be able to meet the requirements and challenges at national & international levels in the field of formulation, manufacture and application of Leather and allied products.

**PEO 2:** To inculcate in students the fundamental concepts related to Leather Production & applications

to enable them to develop novel technologies to meet the global standards of eco-friendliness & sustainability.

**PEO 3:** To produce technologists with high moral values and professional ethics, who can work with industry

hand-in-hand for mutual benefits and to sensitize them for job creation for the society, specially the rural community.

## IV. PROGRAM OUTCOMES (PO's) OF B.TECH. CHEMICAL TECHNOLOGY - LEATHER TECHNOLOGY PROGRAM

B.Tech. Chemical Technology- Leather Technology Graduates of the program will be able to:

| **Program Outcomes (POs)** | | **Graduate Attributes(GAs)** |
|---|---|---|
| **PO1** | Apply the knowledge of science engineering fundamentals and Technological concepts for the solution of Technological problems such that they meet the industry requirement to serve leather as well as footwear and garment making industry. | Technological/Engineering Knowledge |
| **PO2** | Identify formulate, review literature and analyze complex problems related to Chemical Technology- Leather Technology reaching substantiated conclusions using engineering Tech. sciences | Problem Analysis |
| **PO3** | Solution for industry requirement as per technological changes reforms, latest technique and management requirement of leather industry. | Development of solutions |
| **PO4** | Use research-based knowledge and research methods including project work and seminar work for the latest topics in leather industry, analysis and interpretation of data, and synthesis of the information to provide valid conclusions | Projects works & seminar for professional enhancement |
| **PO5** | Impart knowledge to the students the core concepts of chemical engineering such that they are prepared to face the competitive exams and accentuate higher studies and research | Modern Tool Usage |

| | | |
|---|---|---|
| **PO6** | Apply contextual knowledge with justification to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to engineering and Chemical Technology-Leather Technology professional practice | The Technologist & Society |
| **PO7** | Understand the impact of the professional engineering and Chemical Technology- Leather Technology solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development | Environment and sustainability |
| **PO8** | Apply ethical principles and commit to professional ethics adhering to the norms of the engineering and Chemical Technology- Leather Technology practice | Ethics |
| **PO9** | Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings | Individual and team work |
| **PO10** | Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions. | Communication |
| **PO11** | Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments. | Project management and finance |
| **PO12** | Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change. | Life-long learning |

## V. PROGRAM SPECIFIC OUTCOMES (PSOS) FOR B. TECH. CHEMICAL TECHNOLOGY-LEATHER TECHNOLOGY PROGRAM

**PSO 1:** Students should be able to apply the acquired knowledge in the professional world related to formulation, manufacture and application of Leather and allied products and should be sensitized technocrats towards using indigenous resources and infrastructure to develop novel technologies compatible with the startup mission of India.

**PSO 2:** Graduates should be able to handle research and development assignments in industry and should be welcome candidates for higher studies in high profile national and international institutes/universities with a strong concern for environment and social issues.

**SYLLABUS**

**B. TECH. (CHEMICAL TECHNOLOGY-LEATHER TECHNOLOGY**

**(Applicable for the new entrants from the session 2017-18)**

**TLT – 201: LEATHER MICROSCOPY AND BACTERIOLOGY**

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 6 | 5 |

**OBJE OBJECTIVE:** The objective of this course is to enable the students understand

- The composition of Hide & Skin and their classifications.
- To study Mechanical and optical part of compound microscope.
- To study the fiber structure.
- To study the Bacterial Cell and its Internal Structure.
- To study defects of hide & skin.

**Course Outcome**

On the successful completion of the course, students will be able to

| | | |
|---|---|---|
| **CO1** | Understand the composition Hide & Skin and their classifications | Understand |
| **CO2** | Understand the Working of compound microscopy. | Understand |
| **CO3** | Understand Orientation of fiber. | Understand |
| **CO4** | Understand the fiber structure change in curing soaking, liming and bating | Understand |
| **CO5** | Understand the Chemistry of DNA & RNA | Understand |
| **CO6** | Apply the Working of compound microscopy. | Apply |

| **CO** | **PO 1** | **PO2** | **PO 3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO 9** | **PO1 0** | **PO1 1** | **PO1 2** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | _ | _ | _ | _ | _ | _ | _ | _ | _ | _ | _ |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO2** | 3 | 2 | _ | _ | _ | _ | _ | _ | _ | _ | _ | _ |
| **CO3** | 3 | 2 | 3 | _ | _ | _ | _ | _ | _ | _ | _ | _ |
| **CO4** | 3 | 2 | _ | _ | _ | 1 | _ | _ | _ | _ | _ | _ |
| **CO5** | 3 | 2 | 2 | _ | _ | 1 | _ | 1 | _ | _ | _ | _ |
| **CO6** | 3 | 2 | 3 | 2 | _ | 2 | 1 | _ | 2 | _ | _ | 1 |
| **Average** | 3 | 2 | 2.6 | 2 | _ | 1.3 | 1 | 1 | 2 | _ | _ | 1 |

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) *If there is no correlation, put "-"*

**Course Level Assessment Questions**

**Course Outcome 1(CO1)**

1. Histology of hides and skins-cells.
2. Fibrous & Non Fibrous.
3. Composition of Hide & Skin.

**Course Outcome 2(CO2)**

1. Classification of Microscope.
2. Mechanical and optical part of compound microscope.
3. Image formation.

**Course Outcome 3(CO3)**

1. Orientation of fiber
2. Structure changes in curing, soaking, limping.
3. Optimal conditioning of fiber structure in various types of leather assessment of leather.

**Course Outcome 4(CO4)**

1. Nutrition of bacteria
2. The preparation of culture media.
3. Bacteriology of curing soaking, liming and bating.

**Course Outcome 5(CO5)**

1. identification and classification of fungi associate with leather processing,
2. Defects in Hide & Skin.
3. Classification of enzyme.

**Course Outcome 6(CO6)**

1. Study of optical part of a compound microscope. Setting up of compound microscope
2. Identification of hides and skins of different species from their anatomical structure.
3. Preparation of microscopical slides by paraffin wax and freezing method of different hides and skins.

# SYLLABUS

## Module I

**History**: Histology of hides and skins-cells,, tissues, fibers, muscles, glands, epidermis, dermis etc. histological characteristics of buffalo and cow hides, goat and sheep skins, reptiles skins.

## Module II

**Compound Microscope:** Mechanical and optical part of compound microscope, image formed, defects in eye pieces and their rectification etc. different types of microscopes.

**Microscopical slides**: Preparation of microscopical slides, finishing and hardening, embedding, sectioning, staining and counting the photomicrography.

## Module III

**Fiber Structure and Assessment**: Orientation of fiber, structure in curing, soaking, limping, picking tanning and optimal conditioning of fiber structure in various types of leather assessment of leather.

## Module IV

**The Bacterial Cell and its Internal Structure:** Nutrition of bacteria and the preparation of culture media. Metabolism and respiration of bacteria-sterilization-effect of environment upon bacteria-isolation and identification of bacteria classification of bacteria usually found ion hides and skins-bacterial proteolysis disinfections and disinfectants-bacteriology of curing soaking, liming and bating.

## Module V

**Mycology:** Isolation, identification and classification of fungi associate with leather processing, Morphology and physiology of fungi, Mycological problems of leather industry and their prevention.

**Entomology:** Influence of the following parasite diseases, skin leather quality and their prevention, warbles ticks, mosquito lice, insect damage to dry hides and skin caused by hide beetles and moths and their prevention.

**Leather Biotechnology:** Chemistry of DNA & RNA, structure conformation, classification of enzyme, essentials of biotechnology, restriction of enzyme.

**Module-VI : Laboratory experiments**

**Microscopy**

1.Study of optical part of a compound microscope. Setting up of compound microscope.

2.Identification of hides and skins of different species from their anatomical structure.

3.Identification of hides and skins of different species from their grain pattern.

4.Assessment of sole leather, Leather board etc.

5.Preparation of microscopical slides by paraffin wax and freezing method of different hides and skins.

**Bacteriology**

1Preparation of different culture media.

2.Staining of bacteria.

3.Isolation and identification of pure culture.

4.Culture of anaerobic bacteria.

5.Isolation and identification of fungi in leather.

6.Identification defects caused on hides, skins and leather.

7.Assessment of finished leather, heavy leather and light leather.

**References and suggested readings :**

1.Pelczar, Reid, "Microbiology"

2.Staineer, "Microbiology"

3.Seelay, Demark, Microbes in Action"

4.Reed, R, "Science for Students of Leather Technology"

5. "Histology of Hides and Skins-A Monograph," CLRI Publication

## Course contents and lecture schedule

| Module No. | Topic | No. of Lectures |
|---|---|---|
| 1. | **History** | |
| 1.1 | Histology of hides and skins-cells. | 01 |
| 1.2 | Study of tissues, fibers, muscles. | 01 |
| 1.3 | Study of glands, epidermis, dermis etc. | 02 |
| 1.4 | histological characteristics of buffalo & cow hides. | 01 |
| 1.5 | histological characteristics of goat and sheep skins, | 01 |
| 1.6 | histological characteristics of reptiles skins. | 01 |
| 2. | **Compound Microscope:** | |
| 2.1 | Mechanical and optical part of compound microscope. | 01 |
| 2.2 | Image formed, defects in eye pieces and their rectification etc. | 02 |
| 2.3 | Different types of microscopes. | 02 |
| 2.4 | Preparation of microscopical slides. | 02 |
| 2.5 | Finishing and hardening. | 01 |
| 2.6 | Embedding, sectioning, staining etc. | 02 |
| 2.7 | Counting the photomicrography. | 02 |
| **3.** | **Fiber Structure and Assessment**: | |
| 3.1 | Orientation of fiber, | 02 |
| 3.2 | Structure change in curing, | 01 |
| 3.3 | Structure change in soaking & liming | 02 |
| 3.4 | Structure change in picking & tanning | 01 |
| 3.5 | Optimal conditioning of fiber structure in various types of leather assessment of leather. | 01 |
| **4.** | **The Bacterial Cell and its Internal Structure:** | |

| | | |
|---|---|---|
| 4.1 | Nutrition of bacteria and the preparation of culture media. | 02 |
| 4.2 | Metabolism and respiration of bacteria-sterilization-effect of environment upon bacteria-isolation | 01 |
| 4.3 | Identification of bacteria | 01 |
| 4.4 | Classification of bacteria usually found in hides and skins- | 01 |
| 4.5 | Bacterial proteolysis disinfections and disinfectants-bacteriology of curing soaking, liming and bating. | 02 |
| **5.** | **Mycology, Entomology & Leather Biotechnology:** | |
| 5.1 | Isolation, identification and classification of fungi associate with leather processing, Morphology and physiology of fungi, Mycological problems of leather industry and their prevention. | 02 |
| 5.2 | Influence of the following parasite diseases, skin leather quality | 01 |
| 5.3 | Prevention of warbles ticks, mosquito lice, insect damage to dry hides and skin caused by hide beetles and moths and their prevention. | 02 |
| 5.4 | Chemistry of DNA & RNA, structure conformation, | 01 |
| 5.5 | Classification of enzyme, essentials of biotechnology, restriction of enzyme. | 01 |
| | **Total Hours** | **40** |
| **6.** | **Laboratory experiments** | |
| 6.1 | Study of optical part of a compound microscope. Setting up of compound microscope. | 06 |
| 6.2 | Identification of hides and skins of different species from their anatomical structure. | 03 |
| 6.3 | Identification of hides and skins of different species from their grain pattern. | 03 |
| 6.4 | Assessment of sole leather, Leather board etc. | 03 |
| 6.5 | Preparation of microscopical slides by paraffin wax and freezing method of different hides and skins. | 03 |
| 6.6 | Preparation of different culture media. | 03 |
| 6.7 | Staining of bacteria. | 03 |

| | | |
|---|---|---|
| 6.8 | Isolation and identification of pure culture. | 03 |
| 6.9 | .Culture of anaerobic bacteria. | 03 |
| 6.10 | Isolation and identification of fungi in leather. | 03 |
| 6.11 | Identification defects caused on hides, skins and leather. | 03 |
| 6.12 | Assessment of finished leather, heavy leather and light leather. | 03 |
| **Total hours** | | **39** |
| **Grand total hours:** | | **79** |

**TLT-202: SKIN PROTEINS AND PRETANNAGE**

| **L** | **T** | **P** | **C** |
|---|---|---|---|
| **3** | **0** | **3** | **4** |

**OBJECTIVE:** The objective of this course is to educate the students about

- Chemical Constituents of hides and skins
- General and physical chemistry of proteins
- Structure of collagen
- Effect of enzymes on collagen
- Non proteinous skin components
- Pre-tanning process

**Course Outcome**

On the successful completion of the course, students will be able to

| | | |
|---|---|---|
| **CO1** | Understand the Chemical Constituents of hides and skins | Understand |
| **CO2** | Understand the Structure of collagen | Understand |

| | | |
|---|---|---|
| **CO3** | Understand the Effect of enzymes on collagen | Understand |
| **CO4** | Understand the chemical composition, structure | Understand |
| **CO5** | Understand the Non proteinous skin components & Pre-tanning process | Understand |
| **CO6** | Training in the various unit operations such as curing, beam house tanning. | Apply |

| **CO** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 1 | 2 | 2 | 2 | _ | _ | _ | _ | _ | _ | 1 |
| **CO2** | 3 | _ | _ | _ | _ | 2 | 1 | _ | _ | _ | _ | _ |
| **CO3** | 3 | 2 | _ | _ | _ | _ | 2 | _ | _ | _ | _ | _ |
| **CO4** | 3 | 2 | _ | _ | _ | _ | 2 | _ | _ | _ | _ | _ |
| **CO5** | 3 | 2 | 2 | 2 | _ | _ | 2 | _ | _ | _ | _ | _ |
| **CO6** | 3 | 3 | 3 | 2 | _ | 2 | _ | _ | 2 | _ | _ | 1 |
| **Average** | 3 | 2 | 2.3 | 2 | 2 | 2 | 1.7 | _ | 2 | _ | _ | 1 |

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) *If there is no correlation, put "-*

**Course Level Assessment Questions**

**Course Outcome 1(CO1)**

1. Fibrous and non-fibrous proteins
2. Non-proteinous skin components.
3. Reaction of proteins with acids, base and salts

**Course Outcome 2(CO2)**

1. Primary structure of collagen, amino acid composition
2. X-ray diffraction pattern, the triple helix structure
3. Form of collagen

**Course Outcome 3(CO3)**

1. Mechanism of Denaturation process.
2. Collagen and their relation with amino acid composition
3. Effect of enzymes on collagen

**Course Outcome 4(CO4)**

1. Keratin, Reticulin, elastin.
2. Modification of reactive groups of collagen
3. Non-fibrous skin proteins.

**Course Outcome 5(CO5)**

1. Lipids, carbohydrates vitamins, mineral constituents
2. Flaying, curing, defect of hides and skins
3. Soaking, liming, deliming, bating, degreasing, pickling and depickling process control.

**Course Outcome 6(CO6)**

1. Study of raw hides and skins their identification defects grading and selection.
2. Training in the various unit operations such as curing, beam house tanning
3. Manufacturing of Wet Blue.

## SYLLABUS

### Module I

**Chemical Constituents of hides and skins:** Variation fibrous and non-fibrous proteins, non-proteinous skin components.

**General and physical chemistry of proteins:** with special reference to hide proteins, chemical constituents of hides and skins, reaction of proteins with acids, base and salts.

### Module II

**Structure of collagen:** primary structure of collagen, amino acid composition, molecular conformation amino acid sequence in collagen in relation to molecular conformation- X-ray diffraction pattern, the triple helix structure, electron microscopy of the collagen fiber.

**Aggregation phenomenon of collagen:** precipitated form of collagen, Kinetics of fibril formation, interchain epoug tiunks in collagen.

### Module III

**Thermal transition:** Thermal transition in collagen and their relation with amino acid composition and environmental-temperature, Denaturation temperature, Mechanism of Denaturation process, Renaturation of gelatin solution.

**Effect of enzymes on collagen:** Collagenasis, proteolytic enzymes, selective proteolysis and telopeptides.

**Module IV**

**Reactive groups in collagen:** Modification of reactive groups of collagen modified proteins.

**Other skin properties:** Keratin, Reticulin, elastin- their chemical composition, structure and functions, non-fibrous skin proteins.

**Module V**

**Non proteinous skin components:** Lipids, carbohydrates vitamins, mineral constituents.

**Pre-tanning process:** Flaying, curing, defect of hides and skins, chemistry and principle of different pretanning process- soaking, liming, deliming, bating, degreasing, pickling and depickling process control.

**Module-VI: Laboratory experiments**

1. Study of raw hides and skins their identification defects grading and selection.
2. Training in the various unit operations such as curing, beam house tanning.
3. Practical training in various machines employed in the tannery.
4. Preparation of chrome liquors by different procedures.
5.

**References and suggested readings:**

1. Dutta. S.S., "An Introduction to the Principles of Leather Manufacture".

2. Sarkar K.T., "Theory & Practice of Leather Manufacture".

3. Heidemann, “Fundamentals of Leather Manufacture”.

4. Flaherty, Roddy, Lollar, “The Chemistry and Technology of Leather” Vol. I

5. Technical literature of STAHL

6. I. S. Publications.

7. Technical literature of LANXESS

| Module No. | Topic | No. of Lectures |
|---|---|---|
| **1.** | **Chemical Constituents of hides and skins & General and physical chemistry of proteins:** | |
| 1.1 | Variation fibrous proteins | 01 |
| 1.2 | Non-fibrous proteins, | 01 |
| 1.3 | Non-proteinous skin components. | 01 |
| 1.4 | General and physical chemistry of proteins with special reference to hide proteins, | 02 |
| 1.5 | Chemical constituents of hides and skins, | 02 |
| 1.6 | Reaction of proteins with acids, base and salts | 02 |
| | | |
| **2.** | **Structure of collagen:** | |
| 2.1 | Primary structure of collagen, amino acid composition, molecular conformation amino acid sequence in collagen in relation to molecular conformation- | 02 |
| 2.2 | X-ray diffraction pattern, the triple helix structure | 02 |
| 2.3 | Electron microscopy of the collagen fiber. | 01 |
| 2.4 | Precipitated form of collagen, Kinetics of fibril formation, interchain epoug tiunks in collagen | 02 |
| | | |
| **3.** | **Thermal transition & Effect of enzymes on collagen:** | |
| 3.1 | Thermal transition in collagen and their relation with amino acid composition and environmental-temperature | 01 |
| 3.2 | Denaturation temperature, Mechanism of Denaturation process, | 01 |
| 3.3 | Renaturation of gelatin solution. | 01 |
| 3.4 | Collagenasis, proteolytic enzymes, | 01 |
| 3.5 | Selective proteolysis and telopeptides. | 01 |
| | | |
| **4.** | **Reactive groups in collagen & Other skin properties:** | |
| 4.1 | Modification of reactive groups of collagen modified proteins. | 02 |

| | | |
|---|---|---|
| 4.2 | Keratin, Reticulin, elastin- their chemical composition | 02 |
| 4.3 | Structure and functions of Keratin, Reticulin, elastin | 02 |
| 4.4 | Non-fibrous skin proteins | 02 |
| | | |
| **5.** | **Non proteinous skin components & Pre-tanning process:** | |
| 5.1 | Lipids, carbohydrates vitamins, mineral constituents. | 02 |
| 5.2 | Flaying, curing | 02 |
| 5.3 | Defect of hides and skins,. | 01 |
| 5.4 | Chemistry and principle of soaking, liming, deliming | 02 |
| 5.5 | Chemistry and principle of bating, degreasing, pickling and depickling process control. | 02 |
| | Chemistry and principle of pickling and depickling process control. | 02 |
| **Total hours** | | **40** |
| **6.** | **Laboratory experiments** | |
| 6.1 | Study of raw hides and skins their identification defects grading and selection. | 06 |
| 6.2 | Training in unit operations such as curing | 06 |
| 6.3 | Training Training in unit operations such as Soaking | 06 |
| 6.4 | Training Training in unit operations such as liming | 06 |
| 6.5 | Training Training in unit operations such as Deliming | 06 |
| 6.6 | Training Training in unit operations such as Pickling | 06 |
| 6.7 | Training Training in unit operations such as Tanning | 06 |
| 6.8 | Practical training in various machines employed in the tannery. | 06 |
| 6.9 | Preparation of chrome liquors by different procedures. | 06 |
| | | |
| | **Total hours** | **54** |
| | **Grand total hours** | **94** |

**TLT 301: Inorganic Tannage**

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**OBJECTIVE:** The objective of this course is to enable the students understand:

- Behaviour of group elements, chromium, Aluminium, Zirconium, Iron, Titanium, Difference between salts of these elements
- Mechanism of different tanning processes.
- Theory of neutralization processes & Principle and mechanism of Combination Tannage
- Tanning behaviour of group elements
- Basic concepts of Basicity, Masking, Olation, Polymerization & Oxolation.
- Principles of chemistry applied to transition elements

**Course Outcome:**

On the successful completion of the course, students will be able to

| | | |
|---|---|---|
| **CO1** | Understand behaviour of group elements | Understand |
| **CO2** | Understand Chromium complexes and their structures & mechanism of chrome tanning | Understand |
| **CO3** | Understand mechanism of tanning of Aluminium, Zirconium. | Understand |
| **CO4** | Understand mechanism of tanning of, Iron, Titanium. | Understand |
| **CO5** | Unders Principle and mechanism of semi-chrome, chrome retanned and other<br>combination tannages. | Understand |

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | _ | _ | _ | _ | _ | _ | _ | _ | _ | _ | _ |
| **CO2** | 3 | _ | _ | _ | _ | _ | _ | _ | _ | _ | _ | _ |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO3** | 3 | 2 | _ | _ | _ | _ | _ | _ | _ | _ | _ | _ |
| **CO4** | 2 | 2 | _ | 1 | _ | _ | 2 | _ | _ | _ | _ | _ |
| **CO5** | 1 | _ | 2 | _ | _ | _ | 2 | _ | 2 | _ | _ | 1 |
| **Average** | 2.4 | 2 | 2 | 1 | _ | _ | 2 | _ | 2 | _ | _ | 1 |

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) *If there is no correlation, put "-"*

**Course Level Assessment Questions:**

**Course Outcome 1(CO1)**

1. Werners co-ordination theory,
2. Behaviour of group elements,
3. Difference between salts.

**Course Outcome 2(CO2)**

1. Chromium complexes and their structures
2. Olation, oxolation, polymerisation of chrome complexes
3. Variable parameters of chrome tanning.

**Course Outcome 3(CO3)**

1. Aluminium Tanning
2. Zirconium Tanning
3. Masking principle of masking

**Course Outcome 4(CO4)**

1. Tanning behaviour of salts of Iron and Titanium .
2. Theory of neutralization processes.
3. Affect of neutralization.

**Course Outcome 5(CO5)**

1. Principle and mechanism of semi-chrome
2. Chrome retanning.
3. Other combination tannages.

**SYLLABUS**

**Module- I :**

**Theory & behaviour of group elements:**

Werners co-ordination theory, behaviour of group elements, chromium, Aluminium, Zirconium, Iron, Titanium, Difference between salts of these elements.

**Module-II :**

**Chrome Tanning:** Chromium complexes and their structures, study on the phenomena of hydrolysis, olation, oxolation, polymerisation of chrome complexes, masking principle of masking, affect of masking on chrome tannage, Method of chrome tannage, preparation of chrome liquors and powders, influence of reducing agent on nature of chrome complexes mechanism of chrome tanning, variable parameters of chrome tanning.

**Module-III :**

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

**Zirconium Tanning:**Tanning behaviour of salts of Zirconium, factors affecting Zirconium Tannage, mechanism of zirconium tannage,

**Module-IV:**

Tanning behaviour of salts of Iron and Titanium, Tannages involving the use of Sodium silicate and poly phosphates.

**Neutralization:** Theory of neutralization processes, affect of neutralization.

**Module-V:**

**Combination Tannage:** Principle and mechanism of semi-chrome, chrome retanned and other combination tannages.

**References and other readings:**

1. Sarkar, K.T., "Theory and Practice of Leather Manufacture".
2. Dutta. S.S., "An Introduction to the Principles of Leather Manufacture".

**Course contents and lecture schedule**

| Module No. | Topic | No. of Lectures |
|---|---|---|
| **1.** | **Theory & behaviour of group elements.** | |
| 1.1 | Werners co-ordination theory | 02 |
| 1.2 | Behaviour of group elements, chromium, Aluminium, Zirconium, Iron, Titanium | 04 |
| 1.3 | Difference between salts of these elements. | 03 |
| **2.** | **Chrome Tanning:** | |
| 2.1 | Chromium complexes and their structures | 02 |
| 2.2 | Study on the phenomena of hydrolysis, olation, oxolation, polymerisation of chrome complexes | 02 |
| 2.3 | Masking principle of masking, affect of masking on chrome tannage | 01 |
| 2.4 | Method of chrome tannage, | 02 |
| 2.5 | Preparation of chrome liquors and powders | 02 |
| 2.6 | Influence of reducing agent on nature of chrome complexes | 01 |
| 2.7 | Mechanism of chrome tanning | 02 |
| 2.8 | Variable parameters of chrome tanning. | 02 |
| **3.** | **Aluminium Tanning & Zirconium Tanning:** | |
| 3.1 | Tanning behaviour of salts of aluminium | 01 |
| 3.2 | Study on phenomena of olation, oxolation and masking in aluminium salts, | 01 |
| 3.3 | Tanning behaviour of salts of Zirconium | 01 |
| 3.4 | Factors affecting Zirconium Tannage | 01 |
| 3.5 | Mechanism of zirconium tannage, | 01 |
| **4.** | **Other Tanning & Neutralization:** | |
| 4.1 | Tanning behaviour of salts of Iron and Titanium | 02 |
| 4.2 | Tannages involving the use of Sodium silicate and poly phosphates. | 02 |

| | | |
|---|---|---|
| 4.3 | Theory of neutralization processes | 02 |
| 4.4 | Affect of neutralization. | 02 |
| **5.** | **Combination Tannage:** | |
| 5.1 | Principle and mechanism of semi-chrome | 02 |
| 5.2 | Chrome retanned | 02 |
| 5.3 | Other combination tannages. | 02 |
| | **Total hours** | **40** |

| **L** | **T** | **P** | **C** |
|---|---|---|---|
| **3** | **0** | **6** | **5** |

**TLT-303: ANALYSIS OF MATERIALS OF LEATHER MANUFACTURE**

**OBJECTIVE:** The objective of this course is to enable the students

- To understand principle of analytical method employed in analysis of water.
- To understand Analysis of Various Chemicals and Auxiliaries used in Leather Processing:
- To understand theory of oils, fats, binders & waxes etc.
- To understand Analysis of Tanning Agent.

**Course Outcome**

On the successful completion of the course, students will be able to

| | | |
|---|---|---|
| **CO1** | Understand principle of analytical method employed in analysis of water. | Understand |
| **CO2** | Understand Analysis of Various Chemicals and Auxiliaries used in Leather Processing: | Understand |
| **CO3** | Understand basic principles of titration and standards theory of oils, fats, binders & waxes etc. | Understand |

| | | |
|---|---|---|
| **CO4** | Understand analysis of Liquors of beam House Processes | Understand |
| **CO5** | Understand analysis of Tanning Agent. | Understand |
| **CO6** | Understand analysis of materials of leather manufacture. | Apply |

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 03 | 02 | _ | 01 | 02 | _ | _ | _ | _ | _ | _ | _ |
| **CO2** | 03 | 02 | _ | 01 | 02 | _ | _ | _ | _ | _ | _ | _ |
| **CO3** | 03 | _ | _ | _ | _ | _ | _ | _ | _ | _ | _ | _ |
| **CO4** | 03 | 02 | _ | 01 | 02 | _ | _ | _ | _ | _ | _ | 01 |
| **CO5** | 03 | 02 | _ | _ | _ | _ | _ | _ | _ | _ | _ | _ |
| **CO6** | 03 | 02 | _ | _ | 02 | _ | _ | _ | _ | _ | _ | 01 |
| **Average** | 3 | 2 | _ | 1 | 2 | _ | _ | _ | _ | _ | _ | _ |

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High), *no correlation, "-"*

**Course Level Assessment Questions:**

**Course Outcome 1(CO1)**

1. Analytical method employed in analysis of water
2. Effect of hardness of water on various processes in leather manufacture
3. Softening of water.

**Course Outcome 2(CO2)**

1. Analysis of salt, lime.
2. Analysis of deliming agents.
3. Neutralizing agents.

**Course Outcome 3(CO3)**

1. Oils and Fats
2. Sulfated oils, soap, fat liquors
3. Auxiliaries like resin binders, wax emulsions etc.

**Course Outcome 4(CO4)**

1. Analysis of Soak liquor,

2. Analysis of lime liquor.
3. Analysis of pickle liquor.

**Course Outcome 5(CO5)**

1. Vegetable tanning materials and extracts.
2. Chrome extracts and liquors.
3. Zirconium and Aluminum Tanning agent.

**Course Outcome 6(CO6)**

1. Analysis of water.
2. Analysis of materials of leather manufact

**SYLLABUS**

**Module -I:**

**Analysis of water:** Type of water – principle of analytical method employed in analysis of water effect of hardness of water on various processes in leather manufacture softening of water.

**Module -II:**

**Analysis of Various Chemicals and Auxiliaries used in Leather Processing**: Salt, Lime, Sodiumsulphate, Almmonium salt, Deliming agents, Bates, Neutralizing agents.

**Module -III:**

Oils and Fats, sulfated oils, soap, fat liquors and other auxiliaries like resin binders, wax emulsions etc.

**Module-IV :**

**Analysis of Liquors of beam House Processes**: Soak liquor, lime liquor and pickle liquor.

**Module -V:**

**Analysis of Tanning Agent:** Vegetable tanning materials and extracts, chrome extracts and liquors, zirconium and Aluminum Tanning agent, formaldehyde.

**Module -VI:**

1. Water Analysis: Temporary hardness, Permanent hardness, Total hardness, Chloride content, Sulphate content, Iron content.
2. Analysis of common salt.
3. Analysis of lime-available lime, Total bases.
4. Analysis of sodium sulphide.
5. Analysis of used lime liquors-lime, sodium sulphide, salt content.
6. Analysis of deliming agents-analysis of ammonium salts, analysis of organic acids.
7. Analysis of pickle liquor.

8. Analysis of bate.
9. Analysis of oils, moisture, acid value, saponification value, iodine value, unsaponifiables.
10. Analysis of sulphate oils-moisture, pH, acid value, total alkalinity organically combined $SO_3$, Na groups.

**References and suggested readings:**


1. Sarkar, P. K., "Analysis of Materials of Leather Manufactures"
2. Mahadevan, T. S. K., "A Practical Guide for Chemical Analysis and Physical Testing of Leather"
3. Sarkar K.T. "Theory and practices of Leather Manufacture".
4. "I.S. Standards for Chemical Testing".


## Course contents and lecture schedule

| Module No. | Topic | No. of Lectures |
|---|---|---|
| **1.** | **Analysis of water:** | |
| 1.1 | Type of water | 02 |
| 1.2 | principle of analytical method employed in analysis of water | 02 |
| 1.3 | effect of hardness of water on various processes in leather manufacture | 02 |
| 1.4 | softening of water. | 02 |
| **2.** | **Analysis of Various Chemicals and Auxiliaries used in Leather Processing:** | |
| 2.1 | Salt & Lime. | 02 |
| 2.2 | Sodiumsulphate & Almmonium salt. | 02 |
| 2.3 | Deliming agents & Bates, | 02 |
| 2.4 | Neutralizing agents. | 02 |
| **3.** | | |
| 3.1 | Oils and Fats. | 02 |
| 3.2 | Sulfated oils & soap. | 02 |
| 3.3 | Fat liquors and other auxiliaries like resin binders, | 02 |
| 3.4 | Wax emulsions etc. | 02 |
| **4.** | **Analysis of Liquors of beam House Processes** | |
| 4.1 | Soak liquor. | 02 |

| | | |
|---|---|---|
| 4.2 | Lime liquor. | 02 |
| 4.3 | Pickle liquor. | 02 |
| **5.** | **Analysis of Tanning Agent:** | |
| 5.1 | Vegetable tanning materials and extracts | 03 |
| 5.2 | Chrome extracts and liquors. | 03 |
| 5.3 | Zirconium and Aluminum Tanning agent. | 03 |
| 5.4 | Formaldehyde | 01 |
| **Total hours** | | **40** |
| **6.** | **Laboratory experiments** | |
| 6.1 | Water Analysis: Temporary hardness, Permanent hardness, Total hardness, Chloride content, Sulphate content, Iron content. | 06 |
| 6.2 | Analysis of common salt. | 06 |
| 6.3 | Analysis of lime-available lime, Total bases. | 06 |
| 6.4 | Analysis of sodium sulphide. | 06 |
| 6.5 | Analysis of used lime liquors-lime, sodium sulphide, salt content. | 06 |
| 6.6 | Analysis of deliming agents-analysis of ammonium salts, analysis of organic acids. | 06 |
| 6.7 | Analysis of pickle liquor. | 06 |
| 6.8 | Analysis of bate. | 06 |
| 6.9 | Analysis of oils, moisture, acid value, saponification value, iodine value, unsaponifiables. | 06 |
| 6.10 | Analysis of sulphate oils-moisture, pH, acid value, total alkalinity organically combined $SO_3$, Na groups. | 06 |
| **Total hours** | | **60** |
| **Grand total hours** | | **100** |

**TLT-302: POST TANNING AND FINISHING OPERATION**

| L | T | P | C |
|---|---|---|---|
| 3 | 1 | 0 | 4 |

**OBJECTIVE:** The objective of this course is to enable the students understand:

- Chemistry of Bleaching and Mordanting agent
- Theory of Oil, Fat and Fat liquoring.
- Principle of Water Proofing.
- Properties and chemistry of Finishing Materials.
- Properties, Chemistry and methods of preparation of the following finishing materials
- Once the wet blue is ready how to further process it to process to finished leather and its underlying Techniques.

**Course Outcome**

On the successful completion of the course, students will be able to understand:

| | | |
|---|---|---|
| **CO1** | Understand Chemistry of Bleaching and Mordanting agent & dyeing | Understand |
| **CO2** | Understand Theory & mechanism of Oil, Fat and Fat liquoring. | Understand |
| **CO3** | Understand Principle of Water Proofing & film formation. | Understand |
| **CO4** | Understand Properties and chemistry of Finishing Materials. | Understand |
| **CO5** | Understand Properties, Chemistry and methods of preparation of the following finishing materials | Understand |

| **CO** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO 6** | **PO 7** | **PO 8** | **PO9** | **PO10** | **PO1 1** | **PO 12** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | _ | _ | _ | _ | _ | _ | _ | _ | _ | _ | _ |
| **CO2** | 3 | _ | _ | _ | _ | _ | _ | _ | _ | _ | _ | _ |
| **CO3** | 3 | 2 | _ | _ | _ | _ | _ | _ | _ | _ | _ | _ |
| **CO4** | 2 | 2 | _ | 1 | _ | _ | 2 | _ | _ | _ | _ | _ |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO5** | 1 | _ | 2 | _ | _ | _ | 2 | _ | 2 | _ | _ | 1 |
| **Average** | 2.4 | 2 | 2 | 1 | _ | _ | 2 | _ | 2 | _ | _ | 1 |

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) *If there is nocorrelation, put "-"*

**Course Level Assessment Questions**

**Course Outcome 1(CO1)**

1. Classification of leather dyes

2. Theory and mechanism of dyeing

3. Dyeing methods

**Course Outcome 2(CO2)**

1. Types and properties of oils and fats applied in Leather.

2. Principal and methods of sulphation, sulphonation and sulphitation of oils.

3. Chemistry and Preparation of Synthetic fatliquors.

**Course Outcome 3(CO3)**

1. Classification and types of leather finishes

2. Theory of film formation

3. Methods of application finishes

**Course Outcome 4(CO4)**

1. Aqueous pigment pastes

2. Synthetic polymer dispersions

3. Binders.

**Course Outcome 5(CO5)**

1. Nitrocellulose lacquers
2. Wax emulsions,
3. Silicone emulsions.

## SYLLABUS

### Module-I

**Chemistry of Bleaching and Mordanting agent:** Dyeing: Principles of colour chemistry, Classification of leather dyes, Blending of dyes, Principles of cilour matching, Theory and mechanism of dyeing, Dyeing methods, Light fastness of dyeing, Dyeing auxiliaries such as leveling agents, wetting agents, Dispersing agents and Dye fixatives.

### Module-II:

**Oil, Fat and Fat liquoring:** Theory of emulsions, Types and properties of oils and fats applied in Leather, Types of fatliquor, Principal and methods of sulphation, sulphonation and sulphitation of oils, Chemistry and Preparation of Synthetic fatliquors, Fatliquoring methods, Mechanism of fatliquoring

### Module-III:

**Water Proofing:** Classification and types of leather finishes, Cohesion and Adhesion, Theory of film formation, Methods of application finishes, Other mechanical operation involved in finishing

### Module-IV:

**Finishing Materials:** Properties, Chemistry and methods of preparation of the following finishing materials: Aqueous pigment pastes, Synthetic polymer dispersions, binders.

### Module-V

**Properties, Chemistry and methods of preparation of the following finishing materials:** Nitrocellulose lacquers and lacquer emulsions, Wax emulsions, silicone emulsions.

**References and suggested readings**


1. Dutta. S.S., "An Introduction to the Principles of Leather Manufacture".

2. Sarkar K.T., "Theory & Practice of Leather Manufacture".

3. Flaherty, Roddy, Lollar, “The Chemistry and Technology of Leather” Vol. III
4. Heidemann, “Fundamentals of Leather Manufacture”.
5. Sharp house, J.H., “Leather Technician's Handbook”.
6. Reed. R., “Science for student of leather technology”.

**Course contents and lecture schedule**

| Module No. | Topic | No. of Lectures |
|---|---|---|
| **1.** | **Chemistry of Bleaching and Mordanting agent:** | |
| 1.1 | Dyeing: Principles of colour chemistry, | 02 |
| 1.2 | Classification of leather dyes, | 02 |
| 1.3 | Blending of dyes, Principles of cilour matching, | 01 |
| 1.4 | Theory and mechanism of dyeing, | 02 |
| 1.5 | Dyeing methods, | 02 |
| 1.6 | Light fastness of dyeing, | 01 |
| 1.7 | Dyeing auxiliaries such as leveling agents, wetting agents, Dispersing agents and Dye fixatives. | 02 |
| **2.** | **Oil, Fat and Fat liquoring:** | |
| 2.1 | Theory of emulsions, | 01 |
| 2.2 | Types and properties of oils and fats applied in Leather, Types of fatliquor, | 02 |
| 2.3 | Principal and methods of sulphation, sulphonation and sulphitation of oils, | 02 |
| 2.4 | Chemistry and Preparation of Synthetic fatliquors, Fatliquoring methods, | 02 |
| 2.5 | Mechanism of fatliquoring | 01 |
| **3.** | **Water Proofing:** | |
| 3.1 | Classification and types of leather finishes, | 02 |

| | | |
|---|---|---|
| 3.2 | Cohesion and Adhesion,. | 01 |
| 3.3 | Theory of film formation, | 01 |
| 3.4 | Methods of application finishes, | 01 |
| 3.5 | Other mechanical operation involved in finishing | 01 |
| **4.** | **Finishing Materials:** | |
| 4.1 | Properties, Chemistry and methods of preparation of Aqueous pigment pastes, | 02 |
| 4.2 | Properties, Chemistry and methods of preparation of Synthetic polymer dispersions. | 02 |
| 4.3 | Properties, Chemistry and methods of preparation of binders. | 02 |
| **5.** | **Properties, Chemistry and methods of preparation of finishing materials:** | |
| 5.1 | Properties, Chemistry and methods of preparation of Nitrocellulose lacquers | 02 |
| 5.2 | Properties, Chemistry and methods of preparation of lacquer emulsions,. | 01 |
| 5.3 | Properties, Chemistry and methods of preparation of Wax emulsions, | 01 |
| 5.4 | Properties, Chemistry and methods of preparation of silicone emulsions | 01 |
| | **Total hours** | **40** |

**TLT – 304: <u>PROCESSING OF LEATHER-I</u>**

| **L** | **T** | **P** | **C** |
|---|---|---|---|
| **3** | **0** | **6** | **5** |

**OBJECTIVE:** The objective of this course is to enable the students

- To understand the manufacturing of various finished & heavy leather.
- To understand the processing of industrial & sports leather.
- To understand the manufacturing of various light leather.
- To understand the manufacturing of water proof leather.
- To understand the uses of splits.

**Course Outcome**

On the successful completion of the course, students will be able to

| | | |
|---|---|---|
| **CO1** | general practices in vegetable and chrome tanning | Understand |
| **CO2** | Understand the processing of industrial & sports leather | Understand |
| **CO3** | Understand the manufacturing of various light leather. | Understand |
| **CO4** | Understand the manufacturing of water proof leather. | Understand |
| **CO5** | Understand the uses & of splits by manufacturing different leathers. | Understand |
| **CO6** | Processing of chrome leather from different raw materials and tannages. | Apply |

| **CO** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 2 | _ | _ | 1 | _ | _ | _ | _ | _ | _ | _ |
| **CO2** | 3 | 2 | _ | _ | 2 | _ | _ | _ | _ | _ | _ | _ |
| **CO3** | 3 | 2 | _ | _ | 2 | _ | _ | _ | _ | _ | _ | _ |
| **CO4** | 2 | 2 | _ | _ | 2 | _ | _ | _ | _ | _ | _ | _ |
| **CO5** | 3 | 2 | 2 | 2 | 2 | _ | 3 | _ | 2 | _ | _ | 1 |
| **CO6** | 3 | 2 | 1 | _ | _ | _ | _ | _ | _ | _ | _ | 1 |
| **Average** | 2.8 | 2 | 1.5 | 2 | 1.8 | _ | 3 | _ | 2 | _ | _ | 1 |

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) *If there is no correlation, put "-*

**Course Level Assessment Questions**

**Course Outcome 1(CO1)**

1. Finished leathers and composition of finishes

2. Vegetable tanned sole leathers, Bag tanning.

3. Belting leathers

**Course Outcome 2(CO2)**

1. Leather for liquification plants for air, Oil seal, Gas.

2. Sports Goods leather.

3. Hockey ball, Cricket Ball leather.

**Course Outcome 3(CO3)**

1**.** Softies & nappa leather.

2. Printed Leathers.

3. Upholstery leathers.

**Course Outcome 4(CO4)**

1. Water proof and water repellent upper leather.

2. Lining leather.

3. Bag leather.

**Course Outcome 5(CO5)**

1**.** Different types of leathers using chrome splits

2. Formulation and different dyestuffs.

3. Retaining agents.

**Course Outcome 6(CO6)**

1**.** Wet blue hides and skins and their assortment

2. Lining Leathers from different raw materials and tannages.

3. Chrome and Chrome retain upper leathers.

**Syllabus**

**Module-I:**

Finished leathers and composition of finishes, tanned leathers semi finished leathers wet blue-wet white properties, general practices in vegetable and chrome tanning.

**Heavy Leathers:** Vegetable tanned sole leathers, Bag tanning, different types of finished leathers, Belting leathers, Harness and saddlery leathers, Chrome and waxed soles, picking band leathers. Picker and apron leathers, Hydraulic and pneumatic leather such as hand pump leathers.

**Module-II:**

Leather for liquification plants for air, Oil seal, Gas, etc. Sports Goods leathers like Football. Rugby ball, Volley ball, Hockey ball, Cricket Ball etc. Gloves leathers for wicket keepers, Batting, Boxing etc).

**Module-III:**

**Light Leather**: Full chrome retan, hunting suedes, softies, nappa, and burnishable Upper leathers, Printed, Shrunken grain and upholstery leathers

**Module-IV:**

Water proof and water repellent upper leather, Nubuk and white leather. E.I. tanning, dressing of E.I. tanned leathers in to upper, lining, Bag leather, leather for leather goods kattas, bunwar etc.

**Module-V:**

Different types of leathers using chrome splits, Formulation and different dyestuffs, fat liquors, retaining agents.

**Module-VI: Laboratory Experiments**

1. Manufacture of E.I. skins and rips manufacture of vegetable tanned sole leather by rapid tanning method.

2.Manufacture of Chrome and waxed sole leathers manufacture of waterproof sole leathers.

3.Processing of harness and saddlery leather.

4.Wet blue hides and skins and their assortment.

5.Full chrome and Chrome retain upper leathers.

6.Lining Leathers from different raw materials and tannages.

7.Shrunken grain leathers from different raw materials and tannages.

8.Book Binding leather from different raw materials and tannages.

**References and suggested readings:**

**1.**Tuck, D.H., "The Manufacture of Upper Leathers".

2.arkar, K.T., "Theory and Practice of Leather Manufacture".

**Course contents and lecture schedule**

| **Module No.** | **Topic** | **No. of Lectures** |
|---|---|---|
| **1.** | Heavy Leathers: | |
| 1.1 | Finished leathers and composition of finishes, | 01 |
| 1.2 | tanned leathers semi finished leathers wet blue-wet white properties | 01 |
| 1.3 | General practices in vegetable and chrome tanning. | 01 |
| 1.4 | Vegetable tanned sole leathers, Bag tanning, | 01 |
| 1.5 | Different types of finished leathers, Belting leathers, Harness and saddlery leathers | 01 |
| 1.6 | Chrome and waxed soles, picking band leathers | 01 |
| 1.7 | Picker and apron leathers, | 01 |
| 1.8 | Hydraulic and pneumatic leather such as hand pump leathers. | 01 |
| **2.** | | |
| 2.1 | Leather for liquification plants for air, Oil seal, Gas, etc | 02 |
| 2.2 | Sports Goods leathers like Football. Rugby ball, Volley ball, Hockey ball, Cricket Ball etc. | 03 |
| 2.3 | Gloves leathers for wicket keepers, Batting, Boxing etc. | 02 |
| **3.** | **Light Leather**: | |
| 3.1 | Full chrome retan leathers | 01 |
| 3.2 | Hunting suedes leathers | 01 |
| 3.3 | Softies & nappa leathers | 02 |
| 3.4 | Burnishable Upper leathers | 01 |

| | | |
|---|---|---|
| 3.5 | Printed & Shrunken grain leathers | 02 |
| 3.6 | Upholstery leathers | 01 |
| **4.** | | |
| 4.1 | Water proof and water repellent upper leather, | 02 |
| 4.2 | Nubuk and white leather. E.I. tanning, dressing of E.I. tanned leathers in to upper | 02 |
| 4.3 | Lining leather. | 02 |
| 4.4 | Bag leather. | 02 |
| 4.5 | Leather for leather goods kattas, bunwar etc. | 02 |
| **5.** | | |
| 5.1 | Different types of leathers using chrome splits, | 02 |
| 5.2 | Formulation and different dyestuffs. | 02 |
| 5.3 | Fat liquors. | 02 |
| 5.4 | Retainning agents. | 01 |
| | **Total hours** | **40** |
| **6** | **Laboratory experiments** | |
| 6.1 | Manufacture of E.I. skins and rips manufacture of vegetable tanned sole leather by rapid tanning method. | 03 |
| 6.2 | Processing of harness and saddlery leather. | 03 |
| 6.3 | Manufacture of Chrome and waxed sole leathers manufacture of waterproof sole leathers. | 03 |
| 6.4 | Wet blue hides and skins and their assortment. | 06 |
| 6.5 | Full chrome and Chrome retain upper leathers. | 36 |
| 6.6 | Lining Leathers from different raw materials and tannages. | 06 |
| 6.7 | Shrunken grain leathers from different raw materials and tannages. | 06 |
| 6.8 | Book Binding leather from different raw materials and tannages. | 06 |
| | **Total hours** | **69** |
| | **Grand total hours** | **109** |

## TLT-306 : LEATHER ANALYSIS AND QUALITY CONTROL

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 6 | 5 |

**OBJECTIVE:** The objective of this course is to enable the students understand

- Principles and methods of analysis of limed and pickled pelt
- chemical testing of vegetable tanned/chrome tanned
- Physical Testing of Leather
- Quality control in leather processing
- Instrument Analysis.

**Course Outcome**

On the successful completion of the course, students will be able to

| | | |
|---|---|---|
| **CO1** | Understand the Chemical analysis of pelts and Leathers | Understand |
| **CO2** | Understand the Physical Testing of Leather | Understand |
| **CO3** | Principle involved in Static and Dynamic methods of non destructive testing of leathers | Understand |
| **CO4** | Understand the Standards and quality Control | Understand |
| **CO5** | Understand the Instrument Analysis | Understand |
| **CO6** | Analysis of chrome tanning agents & Physical testing of heavy and light leather. | Apply |

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | – | – | – | – | – | – | – | – | – | – | – |
| **CO2** | 3 | 2 | 2 | – | – | – | – | – | – | – | – | – |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO3** | 3 | 2 | 2 | _ | _ | _ | _ | _ | _ | _ | _ | _ |
| **CO4** | 3 | 2 | _ | _ | _ | _ | _ | _ | _ | _ | _ | _ |
| **CO5** | 3 | 2 | 2 | _ | _ | 1 | _ | 1 | _ | _ | _ | _ |
| **CO6** | 3 | 2 | 3 | 2 | _ | 2 | 1 | | 2 | _ | _ | 1 |
| **Average** | 3 | 2 | 2.2 | 2 | _ | 1.5 | 1 | 1 | 2 | _ | _ | _ |

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) *If there is no correlation, put "-*

**Course Level Assessment Questions**

**Course Outcome 1(CO1)**

1**.** Principles and methods of analysis of limed and pickled pelt,
2. Chemical testing of vegetable tanned, chrome tanned etc.
3. Chemical testing of combination tanned leathers.

**Course Outcome 2(CO2)**

1. Sampling position.
2. Physical testing of leather.
3. Different methods employ for physical testing of leather

**Course Outcome 3(CO3)**

1. Principle involved in Static methods of non destructive testing of leathers.
2. Principle involved in Dynamic methods of non destructive testing of leathers.
3. Different methods in testing of colour fastness of leathers.

**Course Outcome 4(CO4)**

1**.** Quality control in leather processing
2. Rectification of defects in hides, Skin and Leathers
3. Physical and chemical characteristics of various types of leathers.

**Course Outcome 5(CO5)**

1**.** Potentiometry.
2. Non-aqueous titrations.
3. Spectrophotometry and colorimertry.

**Course Outcome 6(CO6)**

1**.** Testing of chrome tanning agents.
2 Chemical analysis of vegetable tanned/chrome tanned

3. Physical testing of heavy and light leather.

**SYLLABUS**

**Module-I:**

**Chemical analysis of pelts and Leathers:** Principles and methods of analysis of limed and pickled pelt, chemical testing of vegetable tanned/chrome tanned/aluminum tanned/zirconium tanned/ formaldehyde tanned, combination tanned leathers.

**Module-II**

**Physical Testing of Leather:** Sampling position for physical testing of leather. Different methods employ for physical testing of leather**.**

**Module-III:**

Principle involved in Static and Dynamic methods of non destructive testing of leathers. Different methods in testing of colour fastness of leathers.

**Module-IV:**

**Standards and quality Control**: Quality control in leather processing, Rectification of defects in hides, Skin and Leathers, control of yield, colour and finish of leather etc. Physical and chemical characteristics (standard specifications) of various types of leathers.

**Module-V :**

**Instrument Analysis:** Potentiometry, non-aqueous titrations, conductometry chromatography, spectrophotometry and colorimertry, ion-exchange resins, electrophoresis. Principles and their application analysis.

**Module-VI :**

**Laboratory Experiments**

Analysis of chrome tanning agents- Moisture, $Cr_2O_3$ content, basicity, Degree of olation. Analysis of Alum tanning agents.Analysis of formaldehyde.Chemical analysis of vegetable tanned/chrome tanned/combination tanned leathers.Physical testing of heavy and light leather.Spectrophotometery, chromatography and electrophoresis.

**References and suggested readings:**


1. Mahadevan, T. S. K., "A Practical Guide for Chemical Analysis and Physical Testing of Leather".
2. Sarkar, P. K., "Analysis of Materials of Leather Manufactures"
3. "I.S. Standards for Chemical Testing.


**Course contents and lecture schedule**

| Module No. | Topic | No. of Lectures |
|---|---|---|
| 1. | **Chemical analysis of pelts and Leathers:** | |
| 1.1 | Principles and methods of analysis of limed. | 02 |
| 1.2 | Principles and methods of analysis of pickled pelt. | 02 |
| 1.3 | Principles and methods of analysis of chemical testing of vegetable tanned leather. | 02 |
| 1.4 | Principles and methods of analysis of chrome tanned leather. | 02 |
| 1.5 | Principles and methods of analysis of aluminum tanned leathers | 01 |
| 1.6 | Principles and methods of analysis of zirconium tanned leather. | 01 |
| 1.7 | Principles and methods of analysis of formaldehyde tanned leather. | 01 |
| 1.8 | Principles and methods of analysis of combination tanned leather. | 01 |
| **2.** | **Physical Testing of Leather:** | |
| 2.1 | Sampling position for physical testing of leather. | 03 |
| 2.2 | Different methods employ for physical testing of leather | 03 |
| **3** | | |
| 3.1 | Principle involved in Static non destructive testing of leathers. | 03 |
| 3.2 | Dynamic methods of non destructive testing of leathers. | 03 |
| 3.3 | Different methods in testing of colour fastness of leathers | 02 |
| 4 | **Standards and quality Control**: | |
| 4.1 | Quality control in leather processing. | 02 |

| | | |
|---|---|---|
| 4.2 | Rectification of defects in hides, Skin and Leathers. | 02 |
| 4.3 | Control of yield, colour and finish of leather etc. | 02 |
| 4.4 | Physical characteristics (standard specifications) of various types of leathers. | 02 |
| 4.5 | Chemical characteristics (standard specifications) of various types of leathers. | 02 |
| **5** | **Instrument Analysis:** | |
| 5.1 | Potentiometry principles and their application analysis. | 01 |
| 5.2 | Non-aqueous titrations principles and their application analysis | 01 |
| 5.3 | Conductometry chromatography principles and their application analysis | 01 |
| 5.4 | Spectrophotometry and colorimertry principles and their application analysis | 01 |
| 5.5 | Ion-exchange resins principles and their application analysis | 01 |
| 5.6 | Electrophoresis principles and their application analysis | 01 |
| | **Total hours** | **40** |
| | | |
| 6 | **Laboratory Experiments** | |
| 6.1 | Analysis of Moisture,. | 3 |
| 6.2 | Analysis $Cr_2O_3$ content, | 6 |
| 6.3 | Analysis basicity. | 6 |
| 6.4 | Analysis Degree of olation | 3 |
| 6.5 | Analysis of Alum tanning agents. | 3 |
| 6.6 | Chemical analysis of vegetable tanned leather. | 6 |
| 6.7 | Chemical analysis chrome tanned | 15 |
| 6.8 | Chemical analysis combination tanned leathers. | 3 |
| 6.9 | Physical testing of light leather. | 9 |
| 6.10 | Physical testing of heavy leather. | 9 |
| 6.11 | Spectrophotometery, chromatography and electrophoresis | 3 |

| | | |
|---|---|---|
| | **Total hours** | **66** |
| | **Grand total hours** | **106** |

**TLT-401 : PROCESSING OF LEATHER-II**

| **L** | **T** | **P** | **C** |
|---|---|---|---|
| **3** | **0** | **3** | **4** |

**OBJECTIVE:** The objective of this course is to enable the students understand

- Manufacturing of Different types of goat upper leather.
- Manufacturing of Different types of goat dressing leather.
- Manufacturing of Different types of sheep leather.
- Manufacturing of Different types of fur leather.
- Up gradation of leather.
- Processing of light leather & fashionable leather

**Course Outcome**

On the successful completion of the course, students will be able to

| | | |
|---|---|---|
| **CO1** | Understand the Manufacturing of Different types of goat upper leather. | Understand |
| **CO2** | Understand the Manufacturing of Different types of goat dressing leather | Understand |
| **CO3** | Understand Manufacturing of Different types of sheep leather | Understand |
| **CO4** | Understand the processing of hair on tanning. | Understand |
| **CO5** | Up gradation of leather by different finishing technique. | Understand |
| **CO6** | Apply knowledge of processing of leather. | Apply |

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | | | | | | | | | | | |
| **CO2** | 3 | 2 | 2 | | | | | | | | | |
| **CO3** | 3 | 2 | 2 | | | | | | | | | |
| **CO4** | 3 | 2 | | | | | | | | | | |
| **CO5** | 3 | 2 | 2 | | | 1 | | 1 | | | | |
| **CO6** | 3 | 2 | 3 | 2 | | 2 | 1 | | 2 | | | 1 |
| **Average** | 3 | 2 | 2.2 | 2 | | 1.5 | 1 | 1 | 2 | | | 1 |

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) *If there is no correlation, put "-"*

**Course Level Assessment Questions**

**Course Outcome 1(CO1)**

1. Glazed kid.
2. Glazed uppers, shoe suede.
3. Garment suede, Lining leathers

**Course Outcome 2(CO2)**

1. Chamois leathers
2. Printed leathers
3. Dressing into different types of leathers

**Course Outcome 3(CO3)**

1. Vegetable tanning and chrome tanning of sheep skins
2. Conversion into different types of finished leathers-sheep nappa garment.
3. Lining leathers, glove leathers.

**Course Outcome 4(CO4)**

1. Reptile leathers
2. hair on tanning
3. Dressing of fur skins

**Course Outcome 5(CO5)**

1. Special finishing effects for up gradation of leather.

2. Embossing, screen printing block printing.
3. Roller coating and other modern equipments.

**Course Outcome 6(CO6)**

1. Preparation of Different types of leathers using wet Blue Cow and Buffalo hides, calf skins.
2. Preparation of Different types of leathers using wet Blue of Goat and Sheep skins.
3. Application of Different types of leathers.

**SYLLABUS**

**Module-I : Goat skins:**

Glazed kid, resin uppers, glazed uppers, shoe suede, garment suede, Lining leathers.

**Module-II :**

Chamois leathers, printed leathers, morocco and book binding leathers, E.I. Goat skins and their dressing into different types of leathers.

**Module-III : Sheep Skins:**

Vegetable tanning and chrome tanning of sheep skins, conversion into different types of finished leathers-sheep nappa, garment, suede, uppers. Lining leathers, glove leathers, diaphragm leathers..

**Module-IV : Exotics and others:**

Reptile leathers, hair on tanning and dressing of fur skins.

**Module-V : Upgrading of leathers:**

Retanning special finishing effects for up gradation of lower ends like Embossing, screen printing block printing, transfer film finishing, seal and Sink finish, popcorn effect, punching etc. Roller coating and other modern equipments, Burnishable and oil pull up leathers.

**Module-VI : Laboratory experiments**

Different types of leathers using Raw / wet Blue/ E.I. of Cow and Buffalo hides, calf skins.Different types of leathers using Raw / wet Blue of Goat and Sheep skins.vegetable tanned sole leather**,**Chrome tanned sole

leather**,**Belting leather**,**Cycle saddle leathers**,** Picking band leathers**,**Picker**,** Apron leather**,** Foot ball leather**,**Cricket ball leathers**,**Volley ball leathers**,**Upholstery leathers**,**E.I. Kips , Upper leathers from different raw materials and tannages.

**References :**


**1.** Dey, J.M. Practical Aspects of the manufacture of upper leathers.

2.Tuck, D.H. "The Manufacture of upper leathers".

3. CLRI Publication.

4. Dutta. S.S., "An Introduction to the Principles of Leather Manufacture".

5. Sarkar K.T., "Theory & Practice of Leather Manufacture".


**Course Content and lecture Schedule**

| Module No. | Topic | No. of Lectures |
|---|---|---|
| **1** | **Goat skins:** | |
| 1.1 | Process for manufacturing of Glazed kid leather. | 01 |
| 1.2 | Process for manufacturing of resin uppers leather. | 01 |
| 1.3 | Process for manufacturing of glazed uppers leather. | 01 |
| 1.4 | Process for manufacturing of shoe suede leather. | 01 |
| 1.5 | Process for manufacturing of garment suede leather. | 01 |
| 1.6 | Process for manufacturing of Lining leathers. | 01 |
| | | |
| **2** | | |
| 2.1 | Process for manufacturing of Chamois leathers. | 02 |
| 2.2 | Process for manufacturing of printed leathers. | 01 |

| | | |
|---|---|---|
| 2.3 | Process for manufacturing of Morocco and book binding leathers | 01 |
| 2.4 | Process for manufacturing of E.I. Goat skins and their dressing into different types of leathers. | 01 |
| | | |
| **3** | **Sheep Skins:** | |
| 3.1 | Vegetable tanning and chrome tanning of sheep skins conversion into different types of finished leathers. | 02 |
| 3.2 | Process for manufacturing of sheep nappa, garment. | 02 |
| 3.3 | Process for manufacturing of suede uppers. | 01 |
| 3.4 | Process for manufacturing of Lining leathers. | 01 |
| 3.5 | Process for manufacturing of glove leathers. | 01 |
| 3.6 | Process for manufacturing of diaphragm leathers. | 01 |
| 3.7 | Process for manufacturing of garment suede. | 01 |
| | | |
| **4** | **Exotics and others:** | |
| 4.1 | Reptile leathers | 02 |
| 4.2 | hair on tanning | 02 |
| 4.3 | dressing of fur skins. | 02 |
| **5** | **Upgrading of leathers:** | |
| 5.1 | Retanning special finishing effects for up gradation of lower ends like Embossing. | 01 |
| 5.2 | Special finishing effects for up gradation of lower ends like screen printing | 01 |
| 5.3 | Special finishing effects for up gradation of lower ends like block printing, | 01 |
| 5.4 | Special finishing effects for up gradation of lower ends like transfer film finishing, | 01 |
| 5.5 | Special finishing effects for up gradation of lower ends like seal and Sink finish. | 01 |
| 5.6 | Special finishing effects for up gradation of lower ends like popcorn effect, punching etc. | 01 |
| 5.7 | Roller coating and other modern equipments. | 02 |
| 5.8 | Burnishable and oil pull up leathers | 02 |

| | | |
|---|---|---|
| | **Total hours** | **30** |
| **6** | **Laboratory experiments** | |
| 6.1 | Preparation of Different types of leathers using Raw / wet Blue/ E.I. of Cow and Buffalo hides, calf skins. | 9 |
| 6.2 | Preparation of Different types of leathers using Raw / wet Blue of Goat and Sheep skins. | 9 |
| 6.3 | vegetable tanned sole leather | 3 |
| 6.4 | Chrome tanned sole leather | 3 |
| 6.5 | Belting leather | 3 |
| 6.6 | Cycle saddle leathers | 3 |
| 6.7 | Picking band leathers & Picker | 3 |
| 6.8 | Apron leather | 3 |
| 6.9 | Foot ball leather, Cricket ball leathers & Volley ball leathers | 3 |
| 6.10 | Upholstery leathers | 3 |
| 6.11 | E.I. Kips , Upper leathers from different raw materials and tannages. | 3 |
| | **Total hours** | **45** |
| | **Grand hours** | **75** |

**TLT – 403 : LEATHER AUXIALARIES TECHNOLOGY**

| L | T | P | C |
|---|---|---|---|
| 3 | 1 | 0 | 3 |

**OBJECTIVE:** The objective of this course is to enable the students understand

- The role of leather auxiliaries in up gradation of leather.
- To analyze of tanning agents & evaluation and quality control
- To know Chemistry and technology of organic and inorganic pigments
- To understand the preparation and properties of various types of binders.
- Lacquers emulsions and Thinners
- Use and application of auxiliaries & how it help in leather processing manufacturing

**Course Outcome**

On the successful completion of the course, students will be able to

| | | |
|---|---|---|
| **CO1** | Understand the role of leather auxiliaries in up gradation of leather. | Understand |
| **CO2** | To analyze of tanning agents & evaluation and quality control | Understand |
| **CO3** | Understand the Chemistry and technology of organic and inorganic pigments | Understand |
| **CO4** | Understand the preparation and properties of various types of binders | Understand |
| **CO5** | Production of lacquers from various source-Nitrocellulose | Understand |

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO 6 | PO 7 | PO 8 | PO9 | PO10 | PO1 1 | PO 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | _ | _ | _ | _ | _ | _ | _ | _ | _ | _ | _ |
| **CO2** | 3 | _ | _ | _ | _ | _ | _ | _ | _ | _ | _ | _ |
| **CO3** | 3 | 2 | _ | _ | _ | _ | _ | _ | _ | _ | _ | _ |
| **CO4** | 2 | 2 | _ | 1 | _ | _ | 2 | _ | _ | _ | _ | _ |
| **CO5** | 1 | _ | 2 | _ | _ | _ | 2 | _ | 2 | _ | _ | 1 |
| **Average** | 2.4 | 2 | 2 | 1 | _ | _ | 2 | _ | 2 | _ | _ | 1 |

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) *If there is nocorrelation, put "-"*

**Course Level Assessment Questions**

**Course Outcome 1(CO1)**

1. An overview of Indian leather auxiliaries industry development
2. Important aspects of auxiliaries production
3. Instrumentation and quality control**.**

**Course Outcome 2(CO2)**

1. Fatliquoring Chemicals
2. Sulphation, Sulphonation, Sulphitation.
3. Chemistry and technology of dyes.

**Course Outcome 3(CO3)**

1. Chemistry and technology of organic and inorganic pigments.
2. Factors controlling brilliancy, transparency, opacity, solvent, thermal and light resistances
3. Evaluation and quality control.

**Course Outcome 4(CO4)**

1. preparation and properties of various types of binders.
2. Protein and resin binders.
3. Evaluation and quality control

**Course Outcome 5(CO5)**

1. Lacquers emulsions and Thinners.
2. Nitrocellulose, PVC,Cellulose acctate butyrate & PU.
3. Thinner formation**.**

**Syllabus:**

**Module-I** The role of leather auxiliaries in up gradation of leather, an overview of Indian leather auxiliaries industry development, important aspects of auxiliaries production such as plant and equipment design, unit operations and unit process, Instrumentation and quality control**.**

**Module- II**

**Fatliquaring agents:** Vegetable tanning agents and systems manufacturers unit processes involved, evaluation and quality control. Fatliquoring Chemicals, Oils, and Fats-extration, fatliquor preparations, Sulphation, Sulphonation, Sulphitation synthetic fatliquors-quality control, Dyes: Chemistry and technology of acid, basic, direct, premetalised, Reactive and solvent dyes.

**Module-III**

**Pigments:** Chemistry and technology of organic and inorganic pigments, Products mixture and machinery requirements for pigment dispersions with or without binders for leather finishing, Factors controlling brilliancy, transparency, opacity, solvent, thermal and light resistances, Evaluation and quality control.

**Module-IV**

**Binders:** Protein and resin binders- preparation and properties of various types of binders with special reference of their resistance to water, Solvent, rubbing, cold track, oxidation etc. Evaluation and quality control.

**Module-V**

**Lacquers**: Lacquers emulsions and Thinners-Production of lacquers from various source-Nitrocellulose, PVC, Cellulose acctate butyrate, PU Etc., Thinner formation, lacquer emulsions, quality control.Global policies and regulations. Social and environmental challenges of Leather waste in India. Leather and environment. Salient features of the Leather waste management (PWM) rules. Waste treatment of various Leather plants, estimation of power requirement and efficiency of size reduction operation of Leathers

**References :**


1. Flaherty, Roddy, Lollar, “The Chemistry and Technology of Leather” Vol. III
2. Dutta. S.S., "An Introduction to the Principles of Leather Manufacture".


**Course contents and lecture schedule**

| Module No. | Topic | No. of lectures |
|---|---|---|
| **1.** | **The role of leather auxiliaries in up gradation of leather** | |
| 1.1 | The roll of leather auxiliaries in up gradation of leather | 02 |
| 1.2 | an overview of Indian leather auxiliaries industry development, | 01 |
| 1.3 | Important aspects of auxiliaries production such as plant and equipment design. | 01 |
| 1.4 | Unit operations and unit process & Instrumentation. | 02 |
| 1.5 | quality control | 01 |
| **2.** | **Fatliquaring agents & Dyes:** | |
| 2.1 | Fatliquaring agents | 01 |
| 2.2 | Vegetable tanning agents and systems manufacturers unit processes involved, evaluation and quality control. Fatliquoring Chemicals | 02 |
| 2.3 | Oils, and Fats-extration, fatliquor preparations. | 02 |
| 2.4 | Sulphation, Sulphonation, Sulphitation synthetic fatliquors-quality control. | 02 |
| 2.5 | Chemistry and technology of Dyes. | 01 |
| 2.6 | acid, basic, direct, premetalised dyes etc. | 02 |
| 2.7 | Reactive and solvent dyes. | 02 |
| **3.** | **Pigments:** | |
| 3.1 | Chemistry and technology of organic and inorganic pigments, | 02 |
| 3.2 | Products mixture and machinery requirements for pigment dispersions with or without binders for leather finishing, | 02 |

| | | |
|---|---|---|
| 3.3 | Factors controlling brilliancy, transparency, opacity, solvent, thermal and light resistances | 02 |
| 3.5 | Evaluation and quality control. | 01 |
| **4.** | **Binders:** | |
| 4.1 | Protein and resin binders | 02 |
| 4.2 | preparation and properties of various types of binders with special reference of their resistance to water, Solvent, rubbing, cold track, oxidation etc. | 04 |
| 4.3 | Evaluation and quality control | 01 |
| **5.** | **Lacquers**: | |
| 5.1 | Lacquers emulsions and Thinners | 02 |
| 5.2 | Production of lacquers from various source-Nitrocellulose, PVC, Cellulose acctate butyrate, PU Etc., | 02 |
| 5.3 | Thinner formation, lacquer emulsions,. | 02 |
| 5.4 | quality control | 01 |
| | **Total hours** | **40** |

**TLT-405 : ORGANIC TANNAGES**

| L | T | P | C |
|---|---|---|---|
| 2 | 0 | 0 | 2 |

**OBJECTIVE:** The objective of this course is to enable the students understand

- Concept of tanning.
- Hydrolysable & Condensed tannins.
- Synthetic tannins.
- Resin and Polymeric Tannages.
- Aldehyde tannage.
- The principles and process of vegetable tannage & synthetic tanningin leather processing.

**Course Outcome**

On the successful completion of the course, students will be able to

| | | |
|---|---|---|
| **CO1** | Understand the classification & properties of tannins. | Understand |
| **CO2** | Understand the concept of Hydrolysable & Condensed tannins. | Understand |
| **CO3** | Understand the mechanism of tanning with syntans. | Understand |
| **CO4** | Understand the vegetable tanning & synthetic tannins. | Understand |
| **CO5** | Understand the Different aldehydes used for tanning | Understand |

| **CO** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 1 | 3 | 1 | 1 | | 1 | | | | | |
| **CO2** | 3 | 1 | 3 | 1 | 1 | | 1 | | | | | |
| **CO3** | 3 | 1 | 3 | 2 | 2 | | 2 | | | | | |
| **CO4** | 3 | 1 | 3 | 1 | 1 | | 3 | | | | | |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO5** | 3 | 1 | 3 | 2 | 2 | | 2 | 1 | | | | |
| **Average** | 3 | 1 | 3 | 1.4 | 1.4 | | 1.8 | 1 | | | | |

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) *If there is no correlation, put "-"*

**Course Level Assessment Questions**

**Course Outcome 1(CO1)**

1. Process of vegetable tanning

2. Properties and use of different types of syntans in leather manufacture

3. General chemistry of syntans.

**Course Outcome 2(CO2)**

1. Hydrolysable tannins.

2. Condensed tannins.

3. Biosynthesis of plant polyphenols.

**Course Outcome 3(CO3)**

1. Mechanism of vegetable tanning.
2. General chemistry of syntans.
3. Properties and use of different types of syntans.

**Course Outcome 4(CO4)**

1. Study different methylol compounds of nitrogen basis.
2. Properties of oil tanned leather.
3. Synthetic oil tannge.

**Course Outcome 5(CO5)**

1. Different aldehydes used for tanning.
2. Mechanism of tanning with formaldehyde glutaraldehyde.
3. Properties of leather tanned with different aldehydes.

## SYLLABUS

**Module-I :**

**Collagen Tanning**: Concept of tanning, leather properties of dependent on tanning.

**Vegetable tannins**: classification of vegetable tannins, physico-chemical properties of vegetable tannin, vegetable tanning materials and their properties, leaching of vegetable tanning and general methods of tannin extract preparation.

**Module-II :**

**Hydrolysable tannins**: chemistry of poly phenolic tannins present in major hydrolysable tanning material methods of separation of poly phenolic substance from tanning extracts, structure of galotannins an ellagitannins.

**Condensed tannins**: Chemistry of flavonoid tannins present in major condensed tanning materials, methods of separation of monomeric flavonoid compounds from tanning extracts, structure of leucoanthocynaidin catchins and polymeric flavonoid tannins.

**Biosynthesis of plant polyphenols**: path ways for biosynthesis of gallotannins and ellagitannins in plant biosynthesis of flavonoids and condensed tannins.

**Module-III :**

**Vegetable tanning**: Mechanism of vegetable tanning, factors affecting vegetable tannage, process of vegetable tanning.

**Synthetic tannins**: General chemistry of syntans; their classification, general methods of manufacture properties and use of different types of syntans in leather manufacture, mechanism of tanning with syntans.

**Module-IV :**

**Resin and Polymeric Tannages**: study different methylol compounds of nitrogen basis and polymeric compounds used in leather manufacture.

**Module-V :**

**Aldehyde tannage**: Different aldehydes used for tanning, mechanism of tanning with formaldehyde glutaraldehyde and starch dialdehydes, factors involved in tannages, properties of leather tanned with different aldehydes.

**Reference Book**


1. Sarkar, K.T., "Theory and Practice of Leather Manufacture".
2. Dutta. S.S., "An Introduction to the Principles of Leather Manufacture"
3. Wilson, J. A., “The chemistry of Leather Manufactures” Vol. II
4. Gustavson, K. H., “ The Chemistry of Tanning Process”

5. Flaherty, Roddy, Lollar, "The Chemistry and Technology of Leather" Vol. II

**Course content and lecture Schedule**

| Module No. | Topic | No. of Lectures |
|---|---|---|
| **1** | **Collagen Tanning & Vegetable Tannins:** | |
| 1.1 | Concept of tanning, leather properties of dependent on tanning. | 01 |
| 1.2 | classification of vegetable tannins | 01 |
| 1.3 | classification of vegetable tannins | 01 |
| 1.4 | tanning materials and their properties | 01 |
| 1.5 | leaching of vegetable tanning and general methods of tannin extract preparation. | 01 |
| **2** | **Hydrolysable tannins** , **Condensed tannins** & **Biosynthesis of plant polyphenols**: | |
| 2.1 | chemistry of poly phenolic tannins present in major hydrolysable tanning material methods of separation of poly phenolic substance from tanning extracts | 03 |
| 2.2 | structure of galotannins an ellagitannins. | 01 |
| 2.3 | Chemistry of flavonoid tannins present in major condensed tanning materials, methods of separation of monomeric flavonoid compounds from tanning extracts | 02 |
| 2.4 | structure of galotannins an ellagitannins. | 01 |
| 2.5 | path ways for biosynthesis of gallotannins and ellagitannins in plant biosynthesis of flavonoids and condensed tannins | 02 |
| **3** | **Vegetable tanning & Synthetic tannins**: | |
| 3.1 | Mechanism of vegetable tanning, factors affecting vegetable tannage, process of vegetable tanning. | 02 |
| 3.2 | General chemistry of syntans; their classification, general methods of manufacture properties and use of different types of syntans in leather manufacture, mechanism of tanning with syntans. | 03 |
| **4** | **Resin and Polymeric Tannages** & **Oil Tanning**: | |
| 4.1 | study different methylol compounds of nitrogen basis and polymeric compounds used in leather manufacture | 02 |
| 4.2 | Methods of oil tannage, properties of oil tanned leather, | 02 |

| | | |
|---|---|---|
| | mechanism of oil tannage, factor involved in oil tannage, synthetic oil tannge | |
| **5** | **Aldehyde tannage**: | |
| 5.1 | Different aldehydes used for tanning | 02 |
| 5.2 | Mechanism of tanning with formaldehyde glutaraldehyde and starch dialdehydes | 02 |
| 5.3 | Factors involved in tannages | 02 |
| 5.4 | Properties of leather tanned with different aldehydes. | 01 |
| | **Total hours** | **30** |

**TLT – 407 : FOOTWEAR TECHNOLOGY**

| **L** | **T** | **P** | **C** |
|---|---|---|---|
| **2** | **0** | **0** | **2** |

**OBJECTIVE:** The objective of this course is to enable the students understand:

- Different types of upper and lining leathers.
- History of shoe.
- Principles of cutting.
- Principles and methods of pre-lasting and lasting.
- Various methods of shoe construction.

**Course Outcome**

On the successful completion of the course, students will be able to

| | | |
|---|---|---|
| **CO1** | Understand the Different types of upper and lining leathers. | Understand |
| **CO2** | Understand the History of shoe. | Understand |
| **CO3** | Understand the Principles of cutting. | Understand |
| **CO4** | Understand the Principles and methods of pre-lasting and lasting. | Understand |
| **CO5** | Understand the Various methods of shoe construction. | Understand |

| CO | PO1 | PO 2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO1 0 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | | | | | | | | | | | |
| **CO2** | 3 | 2 | 1 | | | | | | | | | |
| **CO3** | 3 | 2 | 3 | 2 | 3 | | | | | | | |
| **CO4** | 3 | 2 | | | 1 | 1 | | | | | | |
| **CO5** | 3 | 2 | 2 | 3 | 3 | 1 | 2 | 2 | | | | |
| **Aver age** | 3 | 2 | 2 | 2.5 | 2.3 | 1 | 2 | 2 | | | | |

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) *If there is no correlation, put "-"*

**Course level assessment questions**

**Course Outcome 1(CO1)**

1. Different types of soling materials.
2. Different types of adhesives used in footwear industry.
3. Shoe dressing materials etc.

## Course Outcome 2(CO2)

1. History of shoe.
2. Fashion & designs.
3. Preparation of standards and section for men, ladies & children.

## Course Outcome 3(CO3)

1. Principles of cutting.
2. skiving, punching and gimping
3. Top line and other edge treatments.

## Course Outcome 4(CO4)

1. Sole attaching.

2. Upper preparation.
3. Quality control and fault finding problems- solving.

## Course Outcome 5(CO5)

1. Various methods of shoe construction.
2. Shoe room techniques.

**SYLLABUS**

**Module-I :**

**FOOTWEAR MATERIALS AND COMPONENTS**

Different types of upper and lining leathers; Different types of soling materials; Different types of adhesives used in footwear industry; Kinds of insole boards, Grinderies; Fasteners; Shoe dressing materials etc.

**Module-II :**

**DESIGN AND PATTERN DEVELOPMENT**

History of shoe; Purposes and styles; Fashion & designs; Preparation of standards and section

for men, ladies & children; Classic and other types of shoes and boots.

**Module-III :**

**CUTTING, PRE-CLOSING AND CLOSING**

Principles of cutting – Hand, machine; Clicking room design and management. Checking

incoming work, stitchmaking, skiving, punching and gimping, heat embossing, flow moulding, toe puff attachment, attaching linings and scrims, trimming linings, finishing off closed seams. Top line and other edge treatments, local reinforcements, attaching fastners and trims

**Module-IV:**

**PRELASTING AND LASTING**

Principles and methods of pre-lasting and lasting for different types of construction; Sole

attaching; Lasted margin; Upper preparation; Sole preparation; Sole cementing; Upper

76 cementing; Bottom fillers and shanks; Adhesive drying, Heat activation, Spotting, Pressing, Last slipping, Health and safety, Quality control and fault finding problems- solving.

**Module-V:**

**METHODS OF SHOE CONSTRUCTION**

Various methods of shoe construction; shoe room techniques

**Recommended Books:**

1. Cott, N.F., "American Shoe Making", Shoe Trades Publishing Co., Cambridge.1993.

2. "Apparel International" Published by P.F collier and sons, U.K, 1961.

3. "Shoes and Leather News",Published by bureau of foreign and domestic commerce, Dept of commerce, US, 1940.

**Course contents and lecture schedule**

| Module No. | Topic | No. of Lectures |
|---|---|---|
| **1.** | **FOOTWEAR MATERIALS AND COMPONENTS** | |
| 1.1 | Different types of upper and lining leathers. | 01 |
| 1.2 | Different types of soling materials. | 01 |
| 1.3 | Different types of adhesives used in footwear industry. | 01 |
| 1.4 | Kinds of insole boards. | 01 |
| 1.5 | Grinderies; Fasteners; Shoe dressing materials etc. | 01 |
| **2.** | **DESIGN AND PATTERN DEVELOPMENT** | |
| 2.1 | History of shoe. | 01 |
| 2.2 | Purposes and styles; Fashion & designs. | 01 |
| 2.3 | Preparation of standards and section for men, ladies & children; | 02 |

| | | |
|---|---|---|
| 2.4 | Classic and other types of shoes and boots. | 02 |
| **3.** | **CUTTING, PRE-CLOSING AND CLOSING** | |
| 3.1 | Principles of cutting – Hand, machine; Clicking room design and management. | 02 |
| 3.2 | Checkingi ncoming work, stitchmaking, skiving, punching and gimping, heat embossing, flow moulding. | 02 |
| 3.3 | toe puff attachment, attaching linings and scrims. | 02 |
| 3.4 | Trimming linings, finishing off closed seams.. | 02 |
| 3.5 | Top line and other edge treatments, local reinforcements, attaching fastners and trims. | 01 |
| **4.** | **PRELASTING AND LASTING** | |
| 4.1 | Principles and methods of pre-lasting and lasting for different types of construction; Sole attaching. | 02 |
| 4.2 | Lasted margin; Upper preparation; Sole preparation; Sole cementing; Upper 76 cementing. | 02 |
| 4.3 | Bottom fillers and shanks; Adhesive drying, Heat activation, Spotting. | 01 |
| 4.4 | Pressing, Last slipping. | 01 |
| 4.5 | Health and safety, Quality control and fault finding problems- solving. | 01 |
| **5.** | **METHODS OF SHOE CONSTRUCTION** | |
| 5.1 | Various methods of shoe construction. | 02 |
| 5.2 | Shoe room techniques. | 01 |
| | **Total hours** | **30** |

**TLT –409: INTRODUCTION TO LEATHER TECHNOLOGY**

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**OBJECTIVE:** The objective of this course is to enable the students

- To understand General physical and chemistry of proteins.
- To understand pretanning process.
- To understand concept of tanning.
- To understand principle of dyes, oils, binders etc.
- To understand effluent disposal, machine in leather processing and footwear making.

**Course Outcome**

On the successful completion of the course, students will be able to

| | | |
|---|---|---|
| **CO1** | To understand General physical and chemistry of proteins. | Understand |
| **CO2** | To understand pretanning process. | Understand |
| **CO3** | To understand concept of tanning. | Understand |
| **CO4** | To understand principle of dyes, oils, binders etc. | Understand |
| **CO5** | To understand effluent disposal, machine in leather processing and footwear making. | Understand |

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | | | | | | | | | | | |
| **CO2** | 3 | | | | | 2 | | | | | | |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO3** | 3 | 2 | 3 | 2 | | | | | | | | 2 |
| **CO4** | 3 | 2 | 3 | 2 | | | | | | | | 2 |
| **CO5** | 3 | 2 | | 2 | | 2 | | | | | | 2 |
| **Average** | 3 | 2 | 3 | 2 | | 2 | | | | | | 2 |

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) *If there is no correlation, put "-"*

**Course Level Assessment Questions**

**Course Outcome 1(CO1)**

1. Various fibrous and non fibrous proteins, Non proteinous skin 84omponents
2. General physical and chemistry of proteins.
3. Primary structure of collagen

**Course Outcome 2(CO2)**

1. Keratin, Reticulin, Elastin
2. Pretanning process

**Course Outcome 3(CO3)**

1. Concept of tanning
2. Theory of neturalisation
3. combination tannages.

**Course Outcome 4(CO4)**

1. Classification of leather dyes.
2. oils & fats.
3. Classification and types of leather finishes.

**Course Outcome 5(CO5)**

1. Tannery effluents
2. different machine used in leather processing.
3. Making of footwear

**SYLLABUS**

**Module-I :** Various fibrous and non fibrous proteins, Non proteinous skin 85omponents. General physical and chemistry of proteins. Chemical constitution of hides and skins. Reaction of proteins with acids, bases and salts. Primary structure of collagen, effect of enzymes on collagen.

**Module-II :**

Keratin, Reticulin, Elastin, histology of hides and skins-cell, tissue, fibers, muscels, glands, epidermics, pretanning process-soaking, liming, deliming, bating, degreasing, pickling & depickling).

**Module-III :**

Concept of tanning and leather, leather properties dependent on tanning, Vegetable tannins and vegetable tanning, classification of vegetable tannins, vegetable tanning materials and their properties, hydrolyable and condensed tannins, Mechanism of vegetable tanning, process of vegetable tanning, synthetic tannins, chrome complexes and their structures, method of chrome tanning, preparation of chrome liquors & Powders, mechanism of chrome tannage. Study of Aluminium, Zirconium, iron, Titanium, Sodium silicate & polyphosphates. Theory of neturalisation, combination tannages

**Module-IV :**

Principle of color chemistry, classification of leather dyes, color matching, theory and mechanism of dyeing, oils, fats, classification and types of leather finishes, pigments, binders, intro cellulose lacquers, wax emulsions, silicon emulsion.

**Module-V**

Tannery effluents, effluent disposal, leather machinery-different machine used in leather processing. Anatomy of human foot, closing, making of footwear, classification of leather goods, method and material for construction.

**References :**


1. Dutta. S.S., “An Introduction to the Principles of Leather Manufacture”.
2. Sarkar K.T., “Theory & Practice of Leather Manufacture”.


**Course content and lecture Schedule**

| Module No. | Topic | No.of lectures |
|---|---|---|
| **1** | | |
| **1.1** | Various fibrous and non fibrous proteins, Non proteinous skin 86omponents. | **02** |
| **1.2** | General physical and chemistry of proteins. Chemical constitution of hides and skins. Reaction of proteins with acids, bases and salts. | **02** |
| **1.3** | Primary structure of collagen, effect of enzymes on collagen. | **02** |
| **2** | | |
| **2.1** | Keratin, Reticulin, Elastin, histology of hides and skins-cell, tissue, fibers, muscels, glands, epidermics, | **02** |
| **2.2** | pretanning process-soaking, liming, deliming, | **02** |
| **2.3** | bating, degreasing, pickling & depickling | **02** |
| **3** | | |
| **3.1** | Concept of tanning and leather, leather properties dependent on tanning, Vegetable tannins and vegetable tanning, classification of vegetable tannins, vegetable tanning materials and their properties, hydrolyable and condensed tannins, | **02** |
| **3.2** | Mechanism of vegetable tanning, process of vegetable tanning, synthetic tannins, chrome complexes and their structures, method of chrome tanning, preparation of chrome liquors & Powders, mechanism of chrome tannage. Study of Aluminium, Zirconium, iron, Titanium, Sodium silicate & polyphosphates. | **02** |
| **3.3** | Theory of neturalisation, combination tannages. | **02** |
| **4** | | |
| **4.1** | Principle of color chemistry, classification of leather dyes, color matching, theory and mechanism of dyeing, | **02** |
| **4.2** | oils, fats, classification and types of leather finishes, | **02** |
| **4.3** | pigments, binders, intro cellulose lacquers, wax emulsions, silicon emulsion, | **02** |
| **5** | | |
| **5.1** | Tannery effluents, effluent disposal, | **02** |
| **5.2** | Leather machinery-different machine used in leather processing. | **01** |
| **5.3** | Anatomy of human foot. | **01** |
| **5.4** | closing, making of footwear, classification of leather goods, method and material for construction | **02** |

| | | |
|---|---|---|
| | **Total hours** | **30** |

**TLT –402 : TANNERY EFFLUENT TREATMENT**

| **L** | **T** | **P** | **C** |
|---|---|---|---|
| **3** | **0** | **0** | **3** |

**OBJECTIVE:** The objective of this course is to enable the students

- To understand types of water pollution.
- To know Types of tannery effluents, characteristics of effluents.
- To know primary & secondary treatments.
- To know effluent disposal and specification for industrial effluent discharge.
- To understand solid waste management.

**Course Outcome**

On the successful completion of the course, students will be able to

| | | |
|---|---|---|
| **CO1** | Understand types of water pollution. | Understand |
| **CO2** | Understand Types of tannery effluents, characteristics of effluents. | Understand |
| **CO3** | Understand primary & secondary treatment systems. | Understand |
| **CO4** | Understand effluent disposal and specification for industrial effluent discharge | Understand |
| **CO5** | Understand recovery and reuse of water in tanning Industry. | Understand |

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | | | | | | 1 | | | | | |
| **CO2** | 3 | | | | | | 2 | | | | | |
| **CO3** | 3 | 1 | | | | 1 | 1 | | | | | |
| **CO4** | 3 | 1 | 2 | 2 | | 2 | 2 | | | | | |
| **CO5** | 3 | 2 | 2 | 3 | 3 | 2 | 2 | 2 | 1 | | | 3 |
| **Average** | 3 | 1.3 | 2 | 2.5 | 3 | 1.6 | 1.6 | 2 | 1 | | | 3 |

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) *If there is no correlation, put "-"*

**Course Level Assessment Questions**

**Course Outcome 1 (CO1)**

1. Types of water pollution
2. physical, chemical, physiological and biological pollutants,
3. pollution effects

**Course Outcome 2(CO2)**

1. characteristics of effluents from Beam House Process,
2. characteristics of effluents from tan yard process and finishing yard process.
3. Estimation of OD. BOD, COD,

**Course Outcome 3 (CO3)**

1. Waste water drainage and collection system in tanneries
2. Primary treatment unit.
3. Trickling filter, design criteria.

**Course Outcome 4 (CO4)**

1. Types of effluent disposal.
2. Indian Standards.
3. Specification for industrial effluent discharge.

**Course Outcome 5(CO5)**

1. Recovery and reuse of water in tanning Industr
2. Utilization of treated effluents
3. Solid wastes from tanneries origin and disposal.

**SYLLABUS**

**Module-I: Pollution:** Types of water pollution, physical, chemical, physiological and biological pollutants, pollution effects of land ground after, surface water, aquatic life and sea.

**Module-II**: **Tannery Effluents:** Types of tannery effluents,characteristics of effluents from Beam House Process, tan yard process and finishing yard process- Estimation of OD. BOD, COD, heavy metals(Ca, Cr, Pb and Hg) and total dissolved solids in waste water.

**Module-III:**

**Primary treatments:** Waste water drainage and collection system in tanneries, screens, equalisation of waste water, primary treatment unit.

**Secondary Treatment Systems:** Lagoon treatment, aeration systems, trickling filter, design criteria, Biotechnology in effluent and disposals.

**Module-IV:**

**Effluent Disposal:** Types of effluent disposal, standards and specification Indian Standards, specification for industrial effluent discharge.

**Module-V: Water for Tanning:** Water for tanning process, recovery and reuse of water in tanning Industry, utilization of treated effluents.

**Solid Waste Management:** Solid wastes from tanneries origin and disposal, utilization sludge disposal from treatment system.

**Reference Books and Suggested Readings :**

**1.** Metcalf and Eddy,"Wastewater Enginnering (treatment Disposal Reuse)".

2.Steel, E.W. & Meghee J.T.," Water Supply and Sewerage".

3.Hardenbergh, W.A. & Rodie, E.R.," Water Supply and Waste Disposal". 4.Chambolle, " Environment & Tannery".

5.Dutta. S.S., "An Introduction to the Principles of Leather Manufacture".

**Course contents and lecture schedule**

| Module No. | Topic | No. of lectures |
|---|---|---|
| **1.** | **Pollution:** | |
| 1.1 | Types of water pollution | 01 |
| 1.2 | Physical & chemical pollutants | 02 |
| 1.3 | Physiological and biological pollutants | 02 |
| 1.4 | Pollution effects of land ground after, surface water, aquatic life and sea.. | 02 |
| **2.** | **Tannery Effluents:** | |
| 2.1 | Types of tannery effluents | 02 |
| 2.2 | Characteristics of effluents from Beam House Process, | 03 |
| 2.3 | Characteristics of effluents from tan yard process. | 02 |
| 2.4 | Characteristics of effluents from finishing yard process. | 02 |
| 2.5 | Estimation of OD. BOD, COD, heavy metals(Ca, Cr, Pb and Hg) and total dissolved solids in waste water | 03 |
| **3.** | **Primary & secondary treatment systems:** | |
| 3.1 | Waste water drainage and collection system in tanneries, screens. | 02 |
| 3.2 | Equalization of waste water, primary treatment unit. | 02 |
| 3.3 | Lagoon treatment, aeration systems, | 02 |
| 3.4 | Trickling filter, design criteria, | 02 |
| 3.5 | Biotechnology in effluent and disposals | 02 |
| **4.** | **Effluent Disposal:** | |
| 4.1 | Types of effluent disposal | 03 |
| 4.2 | standards and specification Indian Standards | 02 |
| 4.3 | specification for industrial effluent discharge | 02 |

| | | |
|---|---|---|
| **5.** | **Water for Tanning & Solid Waste Management:** | |
| 5.1 | Water for tanning process, recovery and reuse of water in tanning Industry. | 02 |
| 5.2 | Utilization of treated effluents. | 02 |
| 5.3 | Solid wastes from tanneries origin and disposal. | 02 |
| 5.4 | Utilization sludge disposal from treatment system. | 02 |
| | **Total hours** | **40** |

**TLT – 404 LEATHER PRODUCTS TECHNOLOGY**

| **L** | **T** | **P** | **C** |
|---|---|---|---|
| **3** | **0** | **0** | **3** |

**OBJECTIVE:** The objective of this course is to enable the students

- To understand the Classification of leather Goods & Garments.
- To understand assembly Techniques.
- To understand the Machinery needs for Leather Goods Manufacture.
- To understand the Classification of Leather Based Sports Goods.
- To understand Total Quality management.

**Course Outcome**

On the successful completion of the course, students will be able to

| | | |
|---|---|---|
| **CO1** | Understand the Classification of leather Goods & | Understand |

| | | |
|---|---|---|
| **CO2** | Understand assembly Techniques | Understand |
| **CO3** | Understand the Machinery needs for Leather Goods Manufacture. | Understand |
| **CO4** | Understand the Classification of Leather Based Sports Goods. | Understand |
| **CO5** | Understand Total Quality management. | Understand |

| **CO** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | | | | | | | | | | | |
| **CO2** | 3 | | | | | 2 | | | | | | |
| **CO3** | 3 | 2 | | | | | | | | | | |
| **CO4** | 3 | 2 | | | | | | | | | | |
| **CO5** | 3 | 2 | 2 | 2 | | 2 | | | | | | |
| **Average** | 3 | 2 | 2 | 2 | | 2 | | | | | | |

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High), *if there is no correlation, put "-"*

**Course Level Assessment Questions**

**Course Outcome 1(CO1)**

1. Classification of leather Goods & Garments
2. Property Requirement for Leather and Lining materials,
3. Accessories for leather Goods and garments

**Course Outcome 2(CO2)**

1. Hand and Machine Cutting
2. various types of assembly Techniques
3. Quality Control measures in Leather products manufacture.

**Course Outcome 3(CO3)**

1. Machinery needs for Leather Goods Manufacture
2. Various types of Sewing machines.
3. Embossing.

**Course Outcome 4(CO4)**

1. General information about Sports Goods
2. Classification of Leather Based Sports
3. Harness and Saddlery.

**Course Outcome 5(CO5)**

1. Project feasibility Reports.
2. Costing and pricing.
3. Analysis of International market trends.

## SYLLABUS

### Module I

**Overview:** Classification of leather Goods & Garments. Selection of materials Grading and assorting of Leathers for Leather Goods & Garments. Property Requirement for Leather and Lining materials, Accessories for leather Goods and garments

### Module II

**Cutting:** Hand and Machine Cutting, Pattern interlocking, various types of assembly Techniques, skiving, splitting, folding, Sewing Quality Control measures in Leather products manufacture.

### Module III

Machinery needs for Leather Goods Manufacture, Various types of Sewing machines-FlatBed, Post Bed, Clicking, Splitting, Skiving, folding, embossing.

### Module IV

General information about Sports Goods, Harness & Saddlery Industry. Classification of Leather Based Sports Goods like Football, Hockey Ball, Cricket Ball, Sports Gloves, Wicket keeping Gloves, Sports Goods Bags. Harness and Saddlery such as jumping, riding, racing, reins, Halters, Bridles Stirrups, Noseband, Martingales. Special types of leathers manufactured for sports goods, Harness and Saddlery and their Characteristics.

**Module V**

**Organisation & Management:** Project feasibility Reports, costing and pricing for leather goods& garments. Total Quality management. Analysis of International market trends.

**Recommended Books:**


1. Clarks, "Manual on shoe Making".
2. CLRI, SATRA, FDDI, Publication


**Course content and lecture schedule**

| Module No. | Topic | No. of Lectures |
|---|---|---|
| **1.** | **Overview:** | |
| 1.1 | Classification of leather Goods & Garments. | 02 |
| 1.2 | Selection of materials<br>Grading and assorting of Leathers for Leather Goods & Garments. | 03 |
| 1.3 | Property Requirement for Leather and Lining materials | 02 |
| 1.4 | Accessories for leather Goods and garments | 02 |
| **2** | **Cutting:** | 01 |
| 2.1 | Hand and Machine Cutting, | 02 |
| 2.2 | Pattern interlocking, various types of assembly Techniques, | 03 |
| 2.3 | Skiving, splitting, folding, Sewing Quality Control measures in Leather products manufacture | 03 |
| **3** | | |
| 3.1 | Machinery needs for Leather Goods Manufacture. | 03 |
| 3.3 | Various types of Sewing machines-FlatBed, Post Bed, Clicking, Splitting, Skiving, folding, embossing. | 03 |
| **4** | | |
| 4.1 | General information about Sports Goods, Harness & Saddlery Industry. | 02 |
| 4.2 | Classification of Leather Based Sports Goods like Football, Hockey Ball, Cricket Ball, Sports Gloves, Wicket keeping Gloves, Sports Goods Bags. | 03 |

| | | |
|---|---|---|
| 4.3 | Harness and Saddlery such as jumping, riding, racing, reins, Halters, Bridles<br><br>Stirrups, Noseband, Martingales. Special types of leathers manufactured for sports goods, Harness and Saddlery and their Characteristics | 03 |
| **5** | **Organization & Management:** | |
| 5.2 | Project feasibility Reports. | 02 |
| 5.3 | costing and pricing for leather goods& garments. | 02 |
| 5.4 | Total Quality management. | 02 |
| 5.5 | Analysis of International market trends | 01 |
| | **Total hours** | **40** |

**TLT – 406 : LEATHER TRADES ENGINEERING**

| **L** | **T** | **P** | **C** |
|---|---|---|---|
| **2** | **0** | **0** | **2** |

**OBJECTIVE:** The objective of this course is to enable the students understand:

- mechanism and development of tannery machines
- The fundamental concepts of development of hydraulic and pneumatic steering mechanisms accessories and control applied to tannery machines.
- Detailed study of Beam-house, tanning and finishing machines
- Drainage and disposal in tanneries.
- Maintenance of tannery buildings.

**Course Outcome**

On the successful completion of the course, students will be able to

| | | |
|---|---|---|
| **CO1** | Understand mechanism and development of tannery machines | Understand |
| **CO2** | Understand hydraulic and pneumatic steering mechanisms accessories | Understand |
| **CO3** | Understand working of Beam-house, tanning and finishing machines. | Understand |
| **CO4** | Understand internal transport & Drainage and disposal in tanneries | Understand |

| | | |
|---|---|---|
| **CO5** | Understand maintenance of tannery buildings. | Understand |

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | | | | | | 2 | | | | | 2 |
| **CO2** | 3 | | | | | | 3 | 2 | | | | |
| **CO3** | 3 | | | | | | | | | | | 2 |
| **CO4** | 2 | | | | | | 2 | 2 | | | | |
| **CO5** | 1 | | | | | | | | | | | |
| **Average** | 2.4 | | | | | | 2.3 | 2 | | | | 2 |

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) *If there is no correlation, put "-*

**Course Level Assessment Questions**

**Course Outcome 1(CO1)**

1. Clutch mechanism
2. Balancing and Vibration
3. Helically bladed cylinders, Bush, ball, roller and ring oil bearings, cam, springs and their application.

**Course Outcome 2(CO2)**

1. Air compressors, dust control equipment, blowers.
2. Automatic controls and their application.
3. Drying mechanisms and different types of dryers.

**Course Outcome 3(CO3)**

1. study of machines used in a tannery.
2. Foundation and Erection of machinery.
3. Latest development of leather processing vessels.

**Course Outcome 4(CO4)**

1. Internal transport
2. Safety precautions.

3. Drainage and disposal in tanneries.

**Course Outcome 5(CO5)**

1. Maintenance of tannery buildings.
2. Tanning machinery maintenance.
3. Automatic and mechanization of tanneries.

**SYLLABUS**

**Module- I :**

Clutch mechanism, crank-slede and straight motion and lever mechanism and development of tannery machines, Balancing and Vibration - their application in high speed slicking action for helically bladed cylinders, Bush, ball, roller and ring oil bearings, cam, springs and their application and function in tannery machines

**Module-II :**

Development of hydraulic and pneumatic steering mechanisms accessories and control applied to tannery machines, air compressors, dust control equipment, blowers, etc. Automatic controls and their application in all Instruments, drying mechanisms and different types of dryers.

**Module-III :** Detailed study of Beam-house, tanning and finishing machines, their description, construction with sketch, selection, Foundation and Erection of machinery. Latest development of leather processing vessels

**Module-IV:** Internal transport, safety precautions, power, water and steam distribution, drainage and disposal in tanneries.

,

**Module-V:** Maintenance of tannery buildings: Electrical, steam and water lines, tanning machinery, routing prevent maintenance, automatic and mechanization of tanneries.

**References and suggestive readings :**

**1**. Sharp house, J.H., “Leather Technician's Handbook”.

2. Mechanical Engineering Text Book.

**Course content and lecture schedule**

| Module No. | Topic | No. of Lectures |
|---|---|---|
| **1.** | | |
| 1.1 | Clutch mechanism, crank-slede and straight motion and lever mechanism and development of tannery machines, | 02 |
| 1.2 | Balancing and Vibration - their application in high speed slicking action for helically bladed cylinders, Bush, ball, roller and ring oil bearings, cam, springs and their application and function in tannery machines. | 03 |
| **2.** | | |
| 2.1 | Development of hydraulic and pneumatic steering mechanisms accessories and control applied to tannery machines, air compressors, dust control equipment, blowers, etc. | 03 |
| 2.2 | Automatic controls and their application in all Instruments, drying mechanisms and different types of dryers. | 02 |
| **3.** | | |
| 3.1 | Detailed study of Beam-house, tanning and finishing machines, their description, construction with sketch, selection, | 03 |
| 3.2 | Foundation and Erection of machinery | 01 |
| 3.3 | Latest development of leather processing vessels. | 01 |
| **4.** | | |
| 4.1 | Internal transport. | 01 |
| 4.2 | Safety precautions. | 01 |
| 4.3 | Power, water and steam distribution. | 01 |
| 4.4 | Drainage and disposal in tanneries. | 02 |
| **5.** | | |
| 5.1 | Maintenance of tannery buildings: Electrical, steam and water lines, | 03 |

| | | |
|---|---|---|
| | tanning machinery. | |
| 5.2 | Routing prevent maintenance. | 01 |
| 5.3 | Automatic and mechanization of tanneries. | 01 |
| | **Total hours** | **25** |

**TLT – 408 : COMPUTER AIDED LEATHER PRODUCT DESIGN**

| **L** | **T** | **P** | **C** |
|---|---|---|---|
| **2** | **0** | **0** | **2** |

**OBJECTIVE:** The objective of this course is to enable the students understand:

- The Anatomy of human foot.
- Different types of footwear
- Basic methods of cutting different components
- Different method of footwear construction
- Role of Computer aided design .

**Course Outcome**

On the successful completion of the course, students will be able to

| | | |
|---|---|---|
| **CO1** | Understand the Anatomy of human foot | Understand |
| **CO2** | Understand the Different types of footwear & their components. | Understand |
| **CO3** | Understand Basic methods of cutting different components | Understand |
| **CO4** | Understand the Different method of footwear construction. | Understand |
| **CO5** | Understand the Role of Computer aided design . | Understand |

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | | | | | | | | | | | |
| **CO2** | 3 | 2 | 1 | | | | | | | | | |
| **CO3** | 3 | 2 | 3 | 2 | 2 | | | | | | | |
| **CO4** | 3 | 2 | | | 1 | 1 | | | | | | |
| **CO5** | 3 | 2 | 2 | 3 | 2 | 1 | 2 | 2 | | | | |
| **Average** | 3 | 2 | 2 | 2.5 | 1.6 | 1 | 2 | 2 | | | | |

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) *If there is no correlation, put "-"*

**Course Level Assessment Questions**

**Course Outcome 1(CO1)**

1. Anatomy of human
2. Function of the foot, Foot comfort and Common foot abnormalities.
3. Shoe sizing system and fittings.

**Course Outcome 2(CO2)**

1. Different types of footwear
2. Basics concepts of design and pattern cutting.
3. leather materials for different components of footwear

**Course Outcome 3(CO3)**

1. Basic methods of cutting different components
2. Tools and equipment for footwear making.
3. Closing of simple uppers.

**Course Outcome 4(CO4)**

1. Different method of footwear construction.
2. Classification of Leather goods.
3. Material selection criteria for leather garments.

**Course Outcome 5(CO5)**

1. CAD, CPU, Data storage, Input/output devices.
2. Operating system.
3. Application of software for Footwear.

## SYLLABUS

### Unit I

Anatomy of human foot, Function of the foot, Foot comfort and Common foot abnormalities, Foot and Last measurement, Shoe sizing system and fittings.

### Unit II

Designing and pattern making, Different types of footwear, Various components of footwear, Basics concepts of design and pattern cutting, Grading methods, Various allowances, Applications of computer aid designing, Materials of leather products- Selection of leather and non-leather materials for different components of footwear and garments.

### Unit III

Basic methods of cutting different components, Tools and equipment for clicking, marking, skiving, edge treatments, fitting, stitching and types of stitches, closing of simple uppers.

### Unit IV

Different method of footwear construction, Cemented, Direct vulcanized, Injection-moulded, Veldschoen, Machine welted, Slip and sting Lasted, Finishing and Treening operation, , Classification of Leather goods, Type and selection of materials, Methods of construction, Tools and Machinery. Classification of leather, Material selection criteria for leather garments. Lining materials, Factors such as light weight, Porosity, Water absorption, Accessories metal fittings for garments, Designing methods, Various components, Preparation of Standards & pattern of Garment/Material.

### Unit V

Computer aided design, CAD, CPU, Data storage, Input/output devices, Function of CPU, Main memory and backup storage devices, Selection of Input/output devices, Operating system, Application of software for Footwear.

**Recommended Books**

1. Clarks,"Manual on shoe Making".

2. "Tips for shoe Making"

3.CLRI, SATRA, FDDI, Publication.

**Course contents and lecture schedule**

| Module No. | Topic | No. of lectures |
|---|---|---|
| **1.** | | |
| 1.1 | Anatomy of human foot. | 02 |
| 1.2 | Function of the foot, Foot comfort and Common foot abnormalities, | 01 |
| 1.3 | Foot and Last measurement. | 01 |
| 1.4 | Shoe sizing system and fittings. | 01 |
| **2.** | **Designing and pattern making:** | |
| 2.1 | Different types of footwear | 01 |
| 2.2 | Various components of footwear | 01 |
| 2.3 | Basics concepts of design and pattern cutting, Grading methods, Various allowances,. | 01 |
| 2.4 | Applications of computer aid designing, | 01 |
| 2.5 | Materials of leather products- Selection of leather and non-leather materials for different components of footwear and garments | 01 |
| **3.** | | |
| 3.1 | Basic methods of cutting different components | 01 |
| 3.2 | Tools and equipment for clicking, marking, skiving, edge treatments, fitting, stitching. | 02 |
| 3.3 | types of stitches. | 01 |
| 3.4 | Closing of simple uppers. | 01 |

| | | |
|---|---|---|
| **4.** | | |
| 4.1 | Different method of footwear construction, Cemented, Direct vulcanized Injectionmoulded, Veldschoen, Machine welted, Slip and sting Lasted, | 02 |
| 4.2 | Finishing and Treening operation. | 02 |
| 4.3 | Classification of Leather goods. | 01 |
| 4.4 | Type and selection of materials. | 01 |
| | Methods of construction, Tools and Machinery, Classification of leather, Material selection criteria for leather garments | 02 |
| | .Lining materials, Factors such as light weight, Porosity, Water absorption, | 01 |
| | Accessories metal fittings for garments, Designing methods, Various components,Preparation of Standards & pattern of Garment/Material | 01 |
| **5.** | **Bulk nano structured materials** | |
| 5.1 | Computer aided design, CAD, CPU, Data storage, Input/output devices, Function of CPU, Main memory and backup storage devices, | 02 |
| 5.2 | Selection of Input/output devices, Operating system, | 02 |
| 5.3 | Application of software for Footwear. | 01 |
| | **Total Hours** | **30** |

| | **L** | **T** | **P** | **C** |
|---|---|---|---|---|
| **TLT – 417: EDUCATIONAL TOUR** | **0** | **0** | **0** | **0** |

Students will be taken to the visit of industries/research organization, in their field of Leather manufacturing and application during the vacation period and they will give presentation.

**OBJECTIVE:** The objective of this course is to enable the students

- To understand industrial atmosphere
- To have knowledge of product formulation and manufacturing processes in

industries.

- To learn professional ethics.

**Course Outcome**

On the successful completion of the course, students will be able to

| | | |
|---|---|---|
| **CO1** | Understand the industrial working atmosphere | Understand and apply |
| **CO2** | To develop product formulation and manufacturing processes at their own end | Apply |
| **CO3** | To learn professional ethics. | Ethics |
| **CO4** | Improve the communication skill of the students. | Communication |
| **CO5** | Analyze environment and sustainability of related technology. | Analyze<br>Environment & Sustainability |

| **CO** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | | | | | 3 | | | 1 | | | |
| **CO2** | 2 | 2 | 2 | | | 2 | 2 | | 2 | | | 3 |
| **CO3** | | | | | | | | 3 | | | | |
| **CO4** | | | | | | | | | | 3 | | 2 |
| **CO5** | | | | | | 2 | 3 | | 2 | | | 2 |
| **Average** | 2.5 | 2 | 2 | | | 2.3 | 2.5 | 3 | 1.6 | 3 | | 2.3 |

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) *If there is no correlation, put "-"*

**TLT – 461: INDUSTRIAL TRAINING**

| L | T | P | C |
|---|---|---|---|
| 0 | 0 | 4 | 2 |

The students after summer internship of 6 to 8 weeks would be giving presentation on the work they performed or learned during training

**OBJECTIVE:** The objective of this course is to enable the students

- To expose to industrial environment
- To acquaint with the various machines for the manufacturing of Leathers
- For testing of raw materials and finished products
- Handle the research project.
- To improve professional attitude

**Course Outcome**

On the successful completion of the course, students will be able to

| | | |
|---|---|---|
| **CO1** | Understand the work culture and human relationship. | Understand |
| **CO2** | Apply the theoretical knowledge in understanding the working of various machines | Apply |
| **CO3** | Understand the process sequence and optimization of process parameters. | Understand |
| **CO4** | To get exposure to various conventional and model tools and equipments for testing of raw materials and finished products | Apply |
| **CO5** | To analyze the research problem and devise methodology/ steps to solve it | Analyze |

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 1 | 3 | 2 | | | | | | | | | |
| **CO2** | 2 | 2 | 2 | | 2 | 2 | | | | | | |
| **CO3** | 2 | 3 | | 2 | 3 | | | | | | | |
| **CO4** | | 3 | 2 | 3 | 3 | | | | | | | |
| **CO5** | | 3 | 3 | 3 | 3 | | | | | | | |
| **Average** | 1.6 | 2.8 | 2.5 | 2.6 | 2.7 | 2 | | | | | | |

**TLT - 471 : SEMINAR**

| L | T | P | C |
|---|---|---|---|
| 0 | 0 | 4 | 2 |

**OBJECTIVE:** The objective of this course is to enable the students

- Study a topic of latest developments/innovative technology on their own and to prepare a dissertation report on this topic.
- Present a lecture on the topic on power point format.
- Improve the communication skill of the students.

**Course Outcome**

On the successful completion of the course, students will be able to

| | | |
|---|---|---|
| **CO1** | Understand a topic of latest developments/innovative technology. | Understand |
| **CO2** | Apply the knowledge to prepare a dissertation report on this topic. | Apply |
| **CO3** | Deliver a lecture on the topic on power point format. | Apply |
| **CO4** | Improve the communication skill of the students. | Communication |

| | | |
|---|---|---|
| **CO5** | Analyze environment and sustainability of related technology | Analyze<br><br>Environment& Sustainability |

| **CO** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | | | 1 | | 2 | 1 | | 1 | | | |
| **CO2** | 2 | 2 | 2 | 1 | 1 | 2 | 3 | | 2 | 3 | 1 | 2 |
| **CO3** | | | | | | | | | | 3 | | 1 |
| **CO4** | | | | | | | | | | 3 | | 1 |
| **CO5** | | | | | | 2 | 3 | | 2 | | | 2 |
| **Average** | 2.5 | 2 | 2 | 1 | 1 | 2 | 2.3 | | 1.6 | 3 | 1 | 1.5 |

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) *If there is no correlation, put "-*

**TLT – 497: PROJECT**

| **L** | **T** | **P** | **C** |
|---|---|---|---|
| **0** | **0** | **8** | **4** |

**OBJECTIVE:** The objective of this course is to enable the students

- To identify a Leather product that can be manufactured in India or a research problem and conduct experiment.
- To prepare a feasibility report for a project based on manufacturing of product.
- To present a lecture on the topic on power point format.
- To improve the communication skill of the students.

**Course Outcome**

On the successful completion of the course, students will be able to

| | | |
|---|---|---|
| **CO1** | Understand a topic of latest developments/innovative technology. | Understand |
| **CO2** | Apply the knowledge to prepare a feasibility/dissertation report on this topic. | Apply |
| **CO3** | Deliver a lecture on the topic on power point format. | Apply |
| **CO4** | Improve the communication skill of the students. | Communication |
| **CO5** | Analyze environment and sustainability of related technology | Analyze |

| **CO** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | | | 1 | | 2 | 1 | | 1 | | | |
| **CO2** | 2 | 2 | 2 | 1 | 1 | 2 | 3 | | 2 | 3 | 3 | 2 |
| **CO3** | | | | | | | | | | 3 | | 2 |
| **CO4** | | | | | | | | | | 3 | | 2 |
| **CO5** | | | | | | 2 | 3 | | 2 | | | 2 |
| **Average** | 2.5 | 2 | 2 | 1 | 1 | 2 | 2.3 | | 1.6 | 3 | 3 | 2 |

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) *If there is no correlation, put "-"*

**TLT – 498 : PROJECT**

| L | T | P | C |
|---|---|---|---|
| 0 | 0 | 20 | 10 |

**OBJECTIVE:** The objective of this course is to enable the students

- To identify the project, product ideas may emerge mainly from survey of raw materials
- To prepare a detailed project report on fabrication of a product/equipment/process of a plant for production of Leathers product with complete lay-out or a research problem and conduct experiment.
- To assess the economic analysis and to prepare a feasibility report for a project based on manufacturing of product/equipment/process.
- To prepare the students for entrepreneurship. .
- To develop marketing skill in the students.

**Course Outcome**

On the successful completion of the course, students will be able to

| | | |
|---|---|---|
| **CO1** | Understand a topic of latest developments/innovative technology | Understand |
| **CO2** | Apply the knowledge to prepare a feasibility/dissertation report on this topic. | Apply |
| **CO3** | Deliver a lecture on the topic on power point format. | Apply |
| **CO4** | Improve the communication skill of the students. | Communication |
| **CO5** | Analyze environment and sustainability of related technology | Analyze |

| **CO** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 2 | | 1 | | 2 | 1 | | 3 | | 2 | |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO2** | 2 | 2 | 2 | 1 | 1 | 2 | 3 | | 2 | 3 | 3 | 2 |
| **CO3** | | | | | | | | | | 3 | | 2 |
| **CO4** | | | | | | | | | | 3 | | 2 |
| **CO5** | | | | | | 2 | 3 | | 2 | | | 2 |
| **Average** | 2.5 | 2 | 2 | 1 | 1 | 2 | 2.3 | | 2.3 | 3 | 2.5 | 2 |

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) *If there is no correlation, put "-"*

# *Year 1st semester 1 & 2*

# *Syllabus of*

# *other Departments*

**Department of Chemistry**

**School of Basic &Applied Sciences,**

**Harcourt Butler Technical University, Kanpur**

<table>
<tr><td rowspan="2">Course code</td><td colspan="4">Existing code</td><td>New code</td></tr>
<tr><td colspan="4">ICY-101/201</td><td>BCY-101/102</td></tr>
<tr><td>Category</td><td colspan="5">Basic Science Course</td></tr>
<tr><td>Course Title</td><td colspan="5">Engineering Chemistry (Theory & Lab)</td></tr>
<tr><td rowspan="2">Scheme and Credits</td><td>L</td><td>T</td><td>P</td><td>Credits</td><td rowspan="2">Semester I/II<br>Branches to whom offered<br>(CHE/LT /BE/FT/OT/PT/IT/PL)/<br>(CE/EE/CS/ET/ME)</td></tr>
<tr><td>3</td><td>0</td><td>2</td><td>4</td></tr>
<tr><td>Pre-requisites</td><td colspan="5">Basic knowledge of Maths (12th Level)</td></tr>
</table>

**Course Content:**

**Engineering Chemistry (Theory & Lab):**

**BCY-101/102**

**Detailed content:**

**Module I**

**(i) *Bonding*:** CFT, Electronic Spectra and Ligands (strong and weak field), Phosphorescence and Fluorescence, Jablonski diagram, hydrogen bonding and their effect on physical properties, Metallic bonds, Classification and Applications of Liquid crystals, Band Theory of Solids and superconductors.

(Lectures: 7-8)

**(ii) *Spectroscopy***: Basic Principles, Instrumentation and Applications of UV-VIS and IR Spectroscopy.

(Lectures: 5-6)

**Module II**

**(i) *Chemical Kinetics***: Second order reactions. Determination of order, Fast and slow reaction, steady state approximation, Temperature effect, Concept of Activated Complex/Transition State: Energy of activation, Potential energy surface, Theories of reaction rate: Collision and Transition State theories in terms of enzyme catalysis. (Lectures: 4-5)

**Module III**

**(i) *Electrochemistry***: Dry and fuel cells, electrochemical cell, Solar cells, Disensitized cell, Photovoltaic cell.

(Lectures: 3-4)

**(ii) *Environmental Chemistry*:** Air and Water Pollution, analysis of gaseous effluents oxides of Nitrogen, oxides of Sulphur and $H_2S$, chemical analysis of effluents liquid streams, BOD, COD, control of pollution, Depletion of ozone layer.
(Lectures: 5-6)

**Module IV**

**(ii) *Stereochemistry*:** Stereoisomerism of organic compounds containing one & two chiral centers. Enantiomers & Diastereomers, E-Z nomenclature, R-S configuration, Atropisomerism, and Optical isomerism in Allenes, biphenyl and Spiranes, Circular Dichroism.
(Lectures: 5-6)

**(i) *Reaction Mechanism***: Inductive, Electromeric and Mesomeric effects. Study of reaction intermediates (Carbanion, carbocation, carbene, nitrene and benzyne). Mechanism of nucleophilic and electrophilic substitution reactions. Mechanism and application of following reactions:

a) Suzuki-Miyaura Cross coupling reaction
b) Fries and Photo-Fries Rearrangement
c) Wagner- Meerweir Rearrangement
d) Umpolung Reactions
e) Reaction of vision

**(**Lectures: 4-5)

**Module V**

**(i) *Polymers***: Introduction and their classifications, types of polymerization, Free radical, anionic and cationic polymerization, Preparation, Rheological properties and uses of some common polymers. Synthetic Polymers (carbon framework, silicon framework, fluorinated polymer), Conducting and Biodegradable polymers.

(Lectures: 4-5)

**(ii) *Water Analysis*:** Introduction; Hardness of Water- cause, types, units, Disadvantages of using hard water for domestic and industrial purposes, Softening of hard water, Chemical analysis of Water- estimation of free chlorine, total alkalinity, hardness, Numerical based on determination of hardness.

(Lectures: 4-5)

**List of Experiments:**

1. Determination of alkalinity in given water sample.
   a. Sodium Carbonate & Sodium Bicarbonate
   b. Sodium Carbonate & Sodium Hydroxide
2. Determination of temporary and permanent hardness in water sample using EDTA as standard solution.
3. Determination of Chloride content of water by Mohr's Method.
4. Determination of Chlorine content in Bleaching powder.
5. Determination of strength of supplied Ferrous Ammonium Sulphate (FAS) solution in using external, internal indicators.
6. Determination of viscosity of a given liquid by Ostwald's viscometer.
7. Determination of surface tension of a given liquid by Stalagmometer.
8. pH determination of given sample.
9. Determination of iron content of water by Mohr's Method.
10. Determination of Dissociation constant of weak acids by conductometric Titration.

**Reference Books:**

Advance Organic Chemistry by Jerry March, Third Edition Wiley Eastern Limited, New Delhi.

1. Organic Chemistry by Morrision & Boyd, Allyn and Bacon, Inc. Boston.
2. Physical Chemistry by Puri, Sharma & Pathania, Peter Atkins & Julio de Paula, Arun Bahl, B.S. Bahl & G.D.Tuli.

3. Textbook of Physical Chemistry by S. Glasstone, Macmillan and Co. Ltd., London.
4. Chemical Kinetics and Reaction Dynamics by Puri, Sharma & Pathania.
5. Principles of Polymerization by George Odian.
6. Polymer Science by V. R. Gowarikar, N. V. Vishwanathan and J. Shridhar, Wiley Eastern Ltd., New Delhi.
7. Principles of Instrumental Analysis by Douglas and Skoog, Saunder College Publishing Co., New York.
8. Engineering Chemistry by Jain & Jain, Dhanpat Rai Publication Co., New Delhi.
9. Application of Absorption Spectroscopy of Organic Compounds by John R. Dyer, Prentice Hall of India Pvt. Ltd., New Delhi.
10. Spectroscopy of Organic Compounds by P.S. Kalsi, Y.R. Sharma.

**Course Outcome:**

After studying the course, the student will be able to:

- Interpret UV-Visible and IR–Spectra.
- Describe a reaction rate having various reaction orders.
- Understand different aspects of corrosion (Chemical and electrochemical corrosion, mechanism, factors affecting, protection and practical problems, prevention methods). Thermodynamic overview of electrochemical processes. Reversible and irreversible cells.
- Gain hands-on experience in making different polymers, distinguish between different polymeric structures, classify polymers and analyze the polymerization mechanism. The uses of polymers in different walks of life.
- Knowledge of conductivity polymers, bio-degradable polymers and fiber reinforced plastics.
- Acquire knowledge about water and treatment of municipal water.

**Experimental Outcome:**

The chemistry laboratory course will consist of experiments illustrating the principles of chemistry relevant to the study of science and engineering. The students will learn to:

.

- Design and carry out scientific experiments as well as accurately record and analyze the results of such experiments
- Communicate the results of scientific work.
- Measure molecular/system properties such as surface tension, viscosity, conductance of solution.
- Chemical analysis of water-hardness, alkalinity, pH and chloride content.

**Expected Experimental Learning Outcomes**

The chemistry laboratory course will consist of experiments illustrating the principles of chemistry relevant to the study of science and engineering. The students will learn to:

.

- Students will be able to design and carry out scientific experiments as well as accurately record and analyze the results of such experiments.
- Students will be skilled in problem solving, critical thinking and analytical reasoning as applied to scientific problems.
- Students will be able to clearly communicate the results of scientific work in oral, written and electronic formats to both scientists and the public at large.
- Students will be able to explore new areas of research in both chemistry and allied fields of science and technology.
- Students will appreciate the central role of chemistry in our society and use this as a basis for ethical behavior in issues facing chemists including an understanding of safe handling of chemicals, environmental issues and key issues facing our society in energy, health and medicine.
- Design and carry out scientific experiments as well as accurately record and analyze the results of such experiments
- Communicate the results of scientific work.
- Measure molecular/system properties such as surface tension, viscosity, conductance of solution.
- Chemical analysis of water-hardness, alkalinity, pH and chloride content.

***Evaluation Scheme***

**B.Tech- I Year**

**SEMESTER I/II**

| **Course Code** | **Subject** | **Credit** | **CT** | **AT** | **TA** | **Lab** | **Total** | **Semester Final Exam** | **Grand Total** |
|---|---|---|---|---|---|---|---|---|---|
| BCY-101/102 | Engineering Chemistry | 4[3-0-2] | 15 | 10(5T+5P) | 10(5T+5P) | 15 | 50 | 50 | 100 |

**Engineering Chemistry**

**BMA-101: MATHEMATICS-1**

**(I-B.Tech, I Semester)**

**All Branches**

**(Effective from Session 2017-18)**

**L T P**

**3 1 0**

**Unit I- Functions of One Real Variable:**

Successive differentiation, Leibnitz theorem, Mean value theorems, sequences and series, Expansion of functions, Improper integrals and their convergence.

**Unit II- Functions of Several Real Variables:**

Limit, Continuity, Partial differentiation, Total differential and approximations, Jacobian, Euler's theorem Expansion of functions, Beta and Gamma Functions, Multiple integral, Change of order, Change of variables, Applications to area, volume, mass, surface area etc. Dirichlet's Integral & applications.

**Unit III- Vector Calculus:**

Point functions, differentiation, Gradient, Directional derivative, Divergence and Curl of a vector and their physical interpretations, Solenoidal & irrotational fields, Integration, Line, Surface and Volume integrals Green's. Stoke's and Gauss Divergence theorems (without proof) and applications.

**IV- Matrices and Linear Algebra:**

Vector space and subspace, linear dependence, dimensions and basis, Linear transformation and its matrix representation, Elementary transformations, Echelon form, rank & nullity, Consistency of linear system of equations and their solutions, characteristic equation, Cayley Hamilton theorem, Real and complex eigenvalues and eigenvectors, diagonalisation, quadratic forms, complex, orthogonal, and unitary matrices, Application to Cryptography, discrete, Compartmental models and system stability.

**Unit V- Optimization:**

Engineering applications of optimization, statement and classification of optimization problems, Optimization techniques, single variable optimization, multi variable optimization with no constraint, with equality and inequality constraints, Linear Programming Problems, Graphical method and Simplex method.

**Books Recommended:**


**1.** R.K. Jain & S. R. K. lyengar; Advanced Engineering Mathematics, Narosa Publishing House 2002.

**2.** Erwin Kreyszig: Advanced Engineering Mathematics. John Wiley & Sons 8th Edition.

**3.** Dennis G. Zill & Michael R Cullen; Advanced Engineering Mathematics, Jones & Bartlett Publishers, 2nd Edition.

**4.** S.S. Rao; Optimization: Theory & application Wiley Eastern Limited.

**5.** T.M. Apostol, calculus, Vol. I, 2nd ed., Wiley 1967.

**6.** T.M. Apostol, Calculus, Vol. II, 2nd ed**.,** Wiley 1969.

**7.** Gilbert Strang, Linear Algebra & its applications, Nelson Engineering 2007.

8. Calculus & Analytic Geometry, Thomas and Finny.


**Objective / Outcomes, Mathematics-I**

Calculus is one of the most intellectual achievement in the field of mathematics. It is a collection of fascinating and exciting ideas rather than a technical tool. In particular differential calculus i.e. derivative is useful to solve a variety of problems that arise in engineering, technology, science and fields including social sciences. The study of convergence of the infinite series as well as improper integral has vital importance in engineering & Technology.

The Study of partial differentiation and its applications be needful to solve such engineering problems improving quantity (functions ) depends on more than one parametric (variable).

Some special functions are represented by improper integrals such as beta & gamma functions. Which are very useful to solve concern engineering. Problem. Multiple integrals have been found to be basic application in engineering such as to find areas and volume of various bodies, this is applicable in various fields like, while preparing a machine, or the parts to be fitted in any machine its size and volume etc. are very important.

Matrices have been found to be of great utility in many branches of applied mathematics such as algebraic and differential equations , mechanics theory, electrical circuits, nuclear physics, aerodynamics and astronomy. With the advent of computers, the usage of matrix methods has been greatly facilitated.

The Vector calculus extends the basic concepts of (ordinary) differential calculus to vector function, by introducing derivative of a vector function and the new concepts of gradient, divergence and curl.

Vector integral calculus extends the concepts of (ordinary) integral calculus to vector functions. It has applications in fluid flow design of under water transmission cables, study of satellites. Line integral is useful in the calculation of work done by variable forces along paths in space and the rates at which fluid flow along curve (circulation) and across boundaries (flux).

Optimization theory and methods have been applied in many fields to handle various practical problems. In light of advances in computing systems, optimization techniques have become increasingly important and popular in different engineering applications.

An important application of multivariable differential calculus is finding the maximum and minimum values of functions of several variables. Such as in the study of stability of the equilibrium states of mechanical and physical systems, determination of extrema is of greatest importance.

# PROGRAM CORE COURSES

| EET 101/102 | Electronics & Instrumentation Engineering | 3L:0T:0P | 3credits |
|---|---|---|---|

P-N Junction Diode, V-I Characteristics, Diode Application as Rectifier (Half Wave & Full Wave), Zener Diode and its Applications.

Introduction to Bipolar Junction Transistor, Operational Amplifier, FET: Applications, demo, explanation,its Applications

Boolean Algebra, Logic Gates, Concept of Universal Gate, Minimization using K map, Number system
Basic Combinational Circuits: Adder, Subtractor.
Sequential Circuits: Flip-Flops, Registers.

Functional Elements of Instruments, Classification & Characteristics, Types of Errors,
Active and Passive Transducers and their Characteristics,
Display Devices: Seven Segment Display, Alphanumeric Display, LCD, LED, Plasma.
Electronic Ammeter and Voltmeter, Digital Multi-meter, Digital Storage Oscillcope(DSO) Projectors.

**Text Books:**

1. Malvino, A.P. / "Electronics Principles" / Tata McGraw-Hill / 6th Ed.
2. Boylestad, Robert & Nashelsky, Louis / "Electronic Devices & Circuit Theory" / Prentice Hall of India / 8th Ed.
3. H.S. Kalsi / "Electronic Instrumentation" / Tata McGraw-Hill
4. Malvino & Leach / "Digital Principles & Applications" / Tata McGraw-Hill / 5th Edition

**Reference Books:**

1. Sedra, Adel S., Smith, Kenneth C. / "Microelectronic Circuits"/ Oxford University Press / 5th Edition
2. Sawhney AK/ "Electrical and electronic Measurement and Instrumentation"/ Dhanpat Rai & sons.
3. Lectures of NPTEL

**OUTCOMES:**

The students will have basic knowledge of Electronics and instrumentation engineering related to Diode, BJT, FET, digital electronics, transducers, CRO etc. and they will apply fundamental principles of the related electronics circuit to solve practical problems related to engineering applications.

# ENGINEERING GRAPHICS (ECE-101/102)

L T P C : 0 0 6 3

**Syllabus**

**Unit-I**

Lettering and Dimensioning

Introduction, lettering practice, Elements of dimensioning - systems of dimensioning.

Geometric Constructions

Free hand sketching, Conic sections, Special curves.

Engineering Scales

**Unit-II**

Projection of Points and Projection of Lines

Projection of Points: First and Third Angle Projections; Projection of points. Projection of Lines: Projection of straight lines (First angle projection only); Projection of lines inclined to one plane and both planes, true length and true inclinations.

**Unit-III**

Projection of Solids and Section of Solids

Projection of solids: Classification of solids, Projection of solids in simple position, Projection of solids inclined to one plane. Sections of Solids: Right regular solids and auxiliary views for the true shape of the sections.

**Unit-IV**

Development of Surfaces

Development of surfaces for various regular solids.

Isometric Projection and Perspective Projection

Isometric Projection: Isometric scales, Isometric projections of simple and combination of solids; Perspective Projection: Orthographic representation of a perspective views – Plane figures and simple solids - Visual ray method.

**Unit-V**

Orthographic Projection

Conversion of pictorial view into orthographic Projection.

Introduction to auto CAD

**Text Book(s)**

1. Venugopal K and Prabhu Raja V, "Engineering Graphics", New AGE International Publishers, 2015.

**Reference Books**

1. N. D. Bhatt, Engineering Drawing, Charotar publishing House,
2. Natarajan, K. V., A Text book of Engineering Graphics, Dhanalakshmi Publishers, 2012.
3. K.L.Narayana, P. Kannaiah&K.VenkataReddy New Age International publishers

**Course Objectives:**

- To follow basic drawing standards and conventions.
- To develop skills in three-dimensional visualization of engineering components.
- To prepare sectional views of solids.
- To draw the development of surfaces and estimate the sheet metal requirement.
- To develop an understanding of solid modelling using CAD software.

**Expected Course Outcome:**

- Prepare drawings as per standards.
- Solve specific geometrical problems in plane geometry involving lines, plane figures and special Curves.
- Prepare sectional views of solids.
- Draw isometric drawings of combined solids and simple components.
- Produce orthographic projection of engineering components working from pictorial drawings.
- Prepare solid modelling of machine components using CAD software

**CONCEPTS OF COMPUTER & 'C' PROGRAMMING (ECS-101/102)**

| Type | LTP | Credits |
|---|---|---|
| ESC | 302 | 4 |

**Prerequisite: NIL**

**Course Content:**

**Unit-1:**

Introduction to Computers:Computer hardware Components, peripherals and their functions, Number Systems and conversion methods, Concept of an algorithm; termination and correctness. Algorithms to programs: specification, top-down development and stepwise refinement, Introduction to programming environment, use of high level programming language for the systematic developmentof programs. Introduction to the design and implementation of correct, efficient and maintainable programs, Structured Programming, Trace an algorithm to depict the logic.

**Unit-2:**

Basic operating System Concepts: Introduction of MS-DOS, WINDOWS, and LINUX Operating Systems, Functional Knowledge of these operating systems, Introduction of basic commands of LINUX and Editors, Managing Files and Directories in LINUX, Programming Environment in LINUX, Writing and executing programs in LINUX.

**Unit-3:**

Programming in C: History, Introduction to C Programming Languages, Structure of C programs, compilation and execution of C programs, Debugging Techniques, Data Types and Sizes, Declaration of variables, Modifiers, Identifiers and keywords, Symbolic constants, Storage classes (automatic, external, register and static), Enumerations, command line parameters, Macros, The C Preprocessor.

**Unit-4:**

Operators: Unary operators, Arithmetic & logical operators, Bit wise operators, Assignment operators and expressions, Conditional expressions, Precedence and order of evaluation. Control statements: if-else, switch, break, and continue, the comma operator, goto statement. Loops: for, while, do-while. Functions: built-in and user-defined, function declaration, definition and function call, and parameter passing: call by value, call by reference, recursive functions, Multi-file programs. Arrays: linear arrays, multidimensional arrays, passing arrays to functions, Arrays and strings.

**Unit-5:**

Structure and Union: definition and differences, self-referential structure. Pointers: value at (*) and address of (&) operator, pointer to pointer, Dynamic Memory Allocation, calloc and malloc functions, array of pointers, function of pointers, structures and pointers. File Handling in C: opening and closing a data file, creating a data file, read and write functions, unformatted data files.

**Lab Work:**

1. Write C program to find largest of three integers.

2. Write C program to check whether the given string is palindrome or not.

3. Write C program to find whether the given integer is

   (i). a prime number

   (ii). an Armstrong number.

4. Write C program for Pascal triangle.

5. Write C program to find sum and average of n integer using linear array.

6. Write C program to perform addition, multiplication, transpose on matrices.

7. Write C program to find Fibonacci series of iterative method using user-defined function.

8. Write C program to find factorial of n by recursion using user-defined functions.

9. Write C program to perform following operations by using user defined functions:

(i) Concatenation

(ii) Reverse

(iii) String Matching

10. Write C program to find sum of n terms of series: n – n*2/2! + n*3/3! - n*4/4! + .....

11. Write C program to interchange two values using

(i). Call by value.

(ii). Call by reference.

12. Write C program to sort the list of integers using dynamic memory allocation.

13. Write C program to display the mark sheet of a student using structure.

14. Write C program to perform following operations on data files:

(i) Read from data file.

(ii) Write to data file.

15. Write C program to copy the content of one file to another file using command line argument.

**Text and References Books:**

1. Kernighan, Ritchie, “The C Programming Language”, PHI

2. V. Rajaraman, “Fundamentals of Computers”, PHI

3. Peter Norton’s, “Introduction to Computers”, TMH

4. Gottfried, “Programming in C”, Schaum’s Series, Tata McGraw Hill

5. YashwantKanitkar, “Working with C”, BPB

6. E. Balagurusamy, “Programming in ANSI C”, TMH

**Course Outcomes:**

1. Identify the parts of the computer system and explain the functioning of its componentsalongwith the process of problem solving. (Remember, Understand)
2. Design an algorithmic solution for a given problem and translate it into a program. (Design)
3. Understand different operating systems, related concepts and their functions. (Understand)
4. Use the appropriate control statements to solve the given problem. (Apply)

| CO | Statement | PO1 | PO 2 | PO 3 | PO 4 | PO 5 | PO6 | PO 7 | PO 8 | PO 9 | PO1 0 | PO1 1 | PO1 2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **ECS-102: Computer Concepts and ‘C’ Programming** | | | | | | | | | | | | | |
| ECS-102 CO1 | | S | S | S | | | | | | M | | | M |
| ECS-102 CO2 | | S | S | S | | | | | | M | | | M |
| ECS-102 CO3 | | S | S | L | | | | | | M | | | M |
| ECS-102 | | S | S | S | | | | | | M | | | M |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO4 | | | | | | | | | | | | | |
| ECS-102 CO5 | | S | S | S | | | | | | M | | | M |
| ECS-102 CO6 | | S | S | S | | | | | | M | | | M |

5. Implement different Operations on arrays and use functions to solve the given problem. (Apply)
6. Understand pointers, structures and unions &Implement file Operations in C programming. (Understand, Apply)

**SYLLABUS**

**WORKSHOP PRACTICE : EWS - 101 / 102**

**{ L : T : P : C = 0 : 0 : 4 : 2 }**
**Common to I st B. Tech.**

**all branches of Engg. & Tech.**

**NAME OF DIFFERENT SHOPS :**

- **Carpentry Shop :**

**Practice ( I )** : To prepare half lap corner joint from given pieces of mango wood.

**Practice ( II )** : To prepare mortise and tenon joint from given pieces of mango wood.

**Instructions** : Description and demonstration of different tools, joints along with advanced Carpentry joints, classification and definition of timber, wood seasoning, demonstration of wood working lathe and advanced power tools used in carpentry work, safety precaution during actual working.

- **Fitting and Bench working Shop :**

**Practice ( I )** : To prepare male-female joint from given pieces of mild steel.

**Practice ( II )** : To prepare practice work piece involving marking , measuring , sawing, drilling and tapping operations.

**Instruction** : Classification and description of different tools used in fitting shop e.g. marking and measuring tools , holding and supporting tools, striking tools and cutting tools etc , safety precaution during actual working.

- **Black Smithy Shop :**

**Practice ( I )** : To prepare ‘ L ’ shape job from given piece of mild steel rod by hand forging.

**Practice ( II )** : To prepare a ‘ Ring ’ from given piece of mild steel rod by hand forging.

**Instructions** : Description of various forging processes done in black-smithy work e.g upsetting, drawing down, punching, bending, fullering etc, classification and description of different tools, equipments used in black smithy shop,

safety precaution during actual working.

- **Welding Shop :**

**Practice ( I )** : To prepare simple butt joint and lap joint by electric arc welding from given pieces of mild steel.

**Practice ( II )** : To prepare simple lap joint by oxy-acetylene gas welding and gas flame cutting practice.

**Instructions** : Concept of welding, classification and explanation of various types of welding with the help of flow chart, description of different tools. Equipments required for arc welding and gas welding, demonstration of various types oflames in Oxy-acetylene gas welding, setting of current and selection of electrodes along with different welding joints, safety precaution during actual working.

- **Sheet Metal Shop :**

**Practice ( I )** : To prepare a funnel complete with soldering from given G.I. sheet.

**Practice ( II )** : To fabricate tray / tool box or electric panel box from given G.I. sheet.

**Instructions** : Classification and description of different types of tools, equipments used in sheet metal work, different types of metals used in sheet metal shop e.g Galvanized iron, black iron, copper ,aluminum etc, concept of development

of surfaces along with different types of joints in sheet metal work, safety precaution during actual working.

- Machine Shop :

**Practice ( I )** : To prepare a job by plain turning, facing, step turning and chamfering operation from given mild steel rod.

**Practice ( II )** : To prepare a job by taper turning, threading, knurling operations from given mild steel rod.

**Instructions** : Classification of lathe machines, different parts of lathe machine, tools and equipments used, explanation and demonstration of various operations on lathe machine, tool geometry of single point cutting tool, cutting speed, feed and depth of cut in turning, safety precaution during actual working.

- Foundry Shop :

**Practice ( I )** : To prepare a mould of given pattern in Green Sand

**Practice ( II )** : To prepare a mould with two step pulley with runner and riser

**Course Outcomes :**

Students will be able to :

1.Apply basic principal of mechanical and its application in engineering problems .
2.Determine resultants and apply condition of static equilibrium to plan force system .
3.Identify and quantify all forces associated with a static framework
4.Generate and sketch shear and bending moment diagrams
5.Derive and apply stress and strain relations in single and compound members subject to axial force, bending moment and torsion.
6.Stress analysis for two dimensional stress system.

**Course Outcome**

- Acquire skills in basic engineering practice
- Identify the hand tools and instruments.
- Obtain practical skills in the trades.
- Gain measuring skills.

| **Course Outcome ( CO )** | | **Bloom's Knowledge Level (KL)** |
|---|---|---|
| At the end of the course the student should be able to : | | |
| CO 1 | Study and practice on machine tools and their operations | K2 |
| CO 2 | Practice on manufacturing of components using workshop trades including fitting, carpentry, foundry, black - smithy and welding work | K3 |
| CO 3 | Identify and apply suitable tools for machining processes including plain turning, step turning, taper turning, facing, thread cutting operations | K4 |
| CO 4 | Understand and practice welding and forging operations | K3 |

| | | |
|---|---|---|
| CO 5 | Select the appropriate tools required for specific operation | K2 , K3 |
| CO 6 | Comprehend the proper safety measures required to be taken while using different tools. | K1 , K2 |

Note : K1 - Remember, K2 - Understand, K3 - Apply, K4 - Analyze, K5 - Evaluate, K6 - Create

**Text and References :**


- A course in Workshop Technology - By R. S. Khurmi & J. K. Gupta
- Manufacturing Processes - By B. S. Raghuwanshi
- Elements of Workshop Technology ( Vo I - I ) - By S. K. Hajra Chudhury , Nirjhar Roy &

## ENVIRONMENTAL AND ECOLOGY (ECE 103)/104

### Unit-I

Definition, Scope and importance, Need for Public awareness, Environment definition, Ecosystem, Concept of ecosystem, Structure and function of an ecosystem, Energy flow in ecosystem, Ecological succession, Balanced ecosystem, Human activities, Food shelter, Economic and Social Security.

Effects of Human Activities on Environment : Agriculture, Housing Industry, Mining and Transportation Activities, Basic of Environmental Impact Assessment, Sustainable Development.

### Unit-II

Natural Resources : Water Resources – Availability and Quality Aspects, Conservation of water, Water Borne Diseases, Water induced Diseases, Fluoride problems in Drinking Water, Mineral Resources, Forest Wealth, Material Cycles-Carbon, Nitrogen and Sulphur Cycles.

Energy-Different Types of Energy, Electro-magnetic Radiation, Conventional and Non-Conventional Sources, Hydro Electric Fossil Fuel Based, Nuclear, Solar, Biomass, Bio-gas, Hydrogen as an Alternative Future Sources of energy.

### Unit-III

Environmental Pollution : Water Pollution, Land Pollution, Noise Pollution, Public Health aspects, Air Pollution, Soil Pollution, Marine Pollution, Thermal Pollution, Nuclear Hazards.

Solid Waste Management : Cause , effects and control measures of urban and industrial wastes, Role of an Individual in prevention of pollution, Pollution case studies, Disaster management : Floods, earthquake, cyclone and landslides.

### Unit-IV

Current Environmental Issue of Importance, Population Growth, Variation among nations, Population explosion, Family welfare Programme, Climate Change and Global Warming-Effects, Urbanization, Automobile Pollution, Acid Rain, Ozone Layer Depletion.

Environmental Protection-Role of Government, Legal Aspects, Initiatives by Non-Government Organizations (NGO), Environmental Education, Value Education, Human Rights, HIV/AIDS, Women and Child Welfare, Case Studies.

### Course Objective

1. To make students understand and appreciate the unity of life in all its forms, the implications of the life style on the environment.
2. To understand the various causes for environmental degradation.
3. To understand individual contribution in the environmental pollution.
4. To understand the impact of pollution at the global level and also in the local environment.
5. To understand the concept of sustainable development.

**Expected Course Outcome :**

Student will be able to

1. Understand the need for eco-balance.
2. Acquire basic knowledge about global climate change with a particular reference to the Indian context.
3. Find ways to protect the environment and play pro-active roles.
4. Involve themselves in activities for environment protection.

**Department of Physics**

**School of Basic & Applied Sciences**

**Harcourt Butler Technical University, Kanpur**

# Proposed Curriculum

**For**

**First Year Undergraduate Degree Courses**

**In**

**Engineering & Technology**

**Physics (Theory & Lab.)**

**Course Code: BPH-101/201**

**Course Objective, Structure, Credits & Assessment Scheme**

**Course Objective:** To understand the fundamentals of Physics and to apply these in solving engineering problems.

<table>
<tr><td>Course Code</td><td colspan="5">BPH – 101 / 201</td></tr>
<tr><td>Category</td><td colspan="5">Basic Science Course</td></tr>
<tr><td>Course Title</td><td colspan="5">Physics (Theory & Lab.)</td></tr>
<tr><td rowspan="2">Scheme and Credits</td><td>L</td><td>T</td><td>P</td><td>Credits</td><td rowspan="2">Semester- I / II</td></tr>
<tr><td>3</td><td>0</td><td>2</td><td>4</td></tr>
<tr><td>Assessment Scheme</td><td colspan="5">Sessional : 50 Marks<br>End Semester Exam : 50 Marks</td></tr>
<tr><td>Course Content</td><td colspan="5">Given from Page 4 to 7</td></tr>
</table>

**Course Content: Physics (Theory & Lab)**

**Code: BPH – 101/201**

| | |
|---|---|
| **Pre-requisites** | Basic knowledge of Maths ($12^{th}$ level) and preliminary idea of Vector calculus |

**MODULE- 1 (Lectures: 08)**

**Introductory Mechanics & Theory of Relativity:**

Potential energy function $F = -\text{grad}\ (V)$, equipotential surfaces, meaning of gradient, divergence, curl and their physical significance, Conservative and Non-Conservative forces, Curl of a force, Central forces, Examples of Central forces, Conservation of Angular Momentum,.

Inertial and Non- Inertial Frames of reference, Galilean transformation, Michelson Morley Experiment, Lorentz Transformation, Length contraction, Time dilation and Evidences for time dilation, Relativistic velocity addition formula, Relativistic variation of mass with velocity, Evidence of mass variation with velocity, Einstein's Mass energy equivalence, Examples from nuclear physics, Relativistic energy momentum relation.

**MODULE -2 (Lectures: 08)**

**Quantum Mechanics-Schrodinger Equation and its Applications:**

Dual Nature of matter & Radiation, Heisenberg's uncertainty Principle and their applications, wave group concept, Davisson Germer experiment, Postulates of quantum mechanics, Significance of wave function, Derivation of Schrodinger equation for time independent and time dependent cases.

Application of Schrodinger wave equation for a free particle, Particle in a box (one dimensional and three dimensional), Simple harmonic oscillator (one dimensional).

**MODULE – 3 (Lectures: 08)**

**Electromagnetic Theory:**

Ampere's law and Faraday's law of electromagnetic induction, Maxwell's equations, Correction of Ampere's law by Maxwell (concept of displacement current), transformation from integral to differential form, Physical significance of each equation, Poynting theorem, Maxwell's equations in free space, velocity of electromagnetic wave, Transverse character of the wave and orthogonality of **E**, **H** and **v** vectors, Maxwell's equation in dielectric medium and velocity of e.m. wave, Comparison with free space, Maxwell's equations in conducting media, Solution of differential equation in this case,penetration depth, its significance.

**MODULE – 4 (Lectures: 09)**

**Materials of Technological Importance:**

**Dielectric Materials:** Electric field in presence of dielectric medium,concept of electric polarization, different types of polarizations, dielectric in a.c. field,concept of dielectric loss and loss energy.

**Semiconducting Materials:** Concept of energy bands in solids, carrier concentration and conductivity in intrinsic semiconductors and their temperature dependence, carrier concentration and conductivity in extrinsic semiconductors and their temperature dependence, Hall effect in semiconductors, compound semiconductors.

**Nano Materials:** Basic principles of nanoscience and technology, preparation, structure and properties of fullerene and carbon nanotubes, applications of nanotechnology.

**MODULE: 5 (Lectures: 09)**

**Statistical Mechanics & Lasers:**

Phase space, the probability of distribution, most probable distribution, Maxwell-Boltzmann Statistics, Applicationsof Maxwell-Boltzmann Statistics, derivation of average velocity, RMS velocity and most probable velocity in the above case, Bose-Einstein Statistics, application to black body radiation, distribution law of energy, Planck's radiation formula and Stefan's law. Fermi – Dirac statics, application in case of free electrons in metals, energy distribution, Fermi energy.

**Lasers:** Spontaneous and stimulated emission of radiations, Einstein's theory of matter-radiation interaction, Einstein's coefficients and relation between them, Population inversion, components of a laser, different kinds of lasers, Ruby laser, He-Ne laser, properties of laser beams, mono-chromaticity, coherence, directionality, and brightness, applications of lasers

**References:**


1. Physics, Marcelo Alonso, J. Finn Edwards, Addison Wesley
2. Perspectives of Modern Physics, Arthur Beiser, McGraw Hill
3. Engineering Physics, R. K.Shukla, Pearson Education
4. Electrical Engineering Materials, R.K.Shukla, McGraw Hill
5. Introduction to Electrodynamics, David Griffiths, Cambridge University Press
6. Principles of Engineering Physics, R.K.Shukla, Ira Books
7. Introduction to Solid State Physics, Charles Kittel, Willey

**List of Experiments:(Any ten experiments)**

1. To determine the energy of band gap of a N-type Ge-semiconductor using four probe method
2. Verification of Stefan's fourth power law for black body radiation, determination of the exponent of the temperature
3. Study of thermoelectricity: Determination of thermo-power of Copper-constantan thermo-couple
4. To study the variation of magnetic field with distance along the axis of current carrying coil and then to estimate the radius of the coil
5. Study of Carrey Foster's bridge: determination of resistance per unit length of the bridge wire and of a given unknown resistance
6. Determination of specific charge (charge to mass ratio; e/m) for electron
7. Study of tangent galvanometer: determination of reduction factor and horizontal component of earth's magnetic field
8. Determination of the wavelength of sodium light using Newton Rings' method
9. To determine the concentration of sugar solution using half shade polarimeter
10. Determination of wavelength of spectral lines of mercury (for violet, green, yellow-1 and yellow-2) using plane transmission grating
11. Determination of charge sensitivity and ballistic constant of a ballistic galvanometer
12. To determine the wavelength of spectral lines of hydrogen & hence to determine the value of Rydberg Constant
13. Draw the V-I characteristic of Light Emitting Diode (LED) and determine the value of Planck's constant

**Course Outcome**

**Module -1** To understand and to apply principle of conservation of momentum. e.g. in rocket propulsion and in many other space applications.

To understand the theory of relativity and to analyse how the physical quantities undergo drastic changes in their original value at very high velocities and also to see how its principles are applicable in particle accelerators, nuclear devices as an alternative sources of energy and for defence purpose.

**Module-2** To understand the basics of quantum mechanics, and to apply its principles to learn the phenomena that occur at subatomic dimensions.

**Module–3** To understand and to apply Maxwell's equations which forms the basis of electromagnetic theory. This has a wide application in communication systems. All the information propagating in the universe utilises the principle of electromagnetic theory.

**Module–4** To study the fundamentals of material science especially dielectric materials, semiconducting materials and nanomaterial and to apply the knowledge to use how dielectrics are used for the storage of charge. infrared detectors, crystal oscillators, manufacture of microphones, headsets loudspeakers, transducers, ultrasound applications, gas ignitors, accelerometers etc.

Semiconductor material technology which has completely changed the scenario by replacing the older vacuum tube technology, are another technologically important materials which are widely used in LEDs, miniaturisation of electronic devices and to develop materials with improved efficiency and economy.

Nanotechnology is the most emerging field at present and is extremely important. It has got various applications in many areas including information technology, biomedical, energy-storage, automotive industry, electronics industry, textiles and chemical industries.

**Model – 5** To understand the statistical behaviour of the constituent particles which give rise to form a material, and to apply the principles of statistical mechanics and to understand the basics of Laser.

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**BMA-102: MATHEMATICS-II**

**(I-B.Tech, II SEMESTER)**

**All Branches**

**(Effective from Session 2017-18)**

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**Unit- I: Ordinary Differential Equations:**

First order ordinary differential equations, Existence and uniqueness of solutions of initial value problems, Solution of higher order linear differential equation with constant coefficients, Solution of second order differential equations by changing dependent and independent variables, Cauchy- Euler equations, Methods of diagonalization, undetermined coefficients and variation of parameters: Nonlinear equations, Linear and nonlinear models, Initial value and boundary value problems, Systems of equations. Application of differential equations as mathematical models, Models from population dynamics, Newton's Law of cooling, electric circuit, Oscillation of spring.

**Unit-II: Series Solutions of Ordinary Differential Equations & Special Fuctions**

Ordinary and singular points of an equation, Power series solutions, Frobenius method, Bessel's and Legendre's equations and their series solutions, Properties of Legendre's polynomials and Bessel's functions, Generating functions, Fourier- Bessel series and Fourier-Legendre series expansions, sturm- Liouville Problem and related theorems.

**Unit-III: Laplace Transform:**

Laplace transform, Existence conditions and ROC, Inverse Laplace transform, Operational properties, Convolution, Unit step function, Dirac-Delta function, Periodic functions, Applications to solve IVP and BVP: Linear ordinary differential equations, Transfer function and control system analysis.

**Unit-IV: Fourier Series and Partial Differential Equations:**

Orthogonal functions, Fourier series, existence conditions, Fourier series of even and odd functions, convergence of Fourier series, Fourier half range series, Harmonic analysis, Complex Fourier series and frequency spectrum.

Development of partial differential equations and Solutions, Solution of first order partial differential equations, Solutions of linear higher order partial differential equations with constant coefficients.

**Unit-V: Boundary-Value Problems:**

Classification of second order partial differential equations, Derivation of heat and wave equations, solutions in rectangular coordinates by separation variable method, solution of Laplace equation, D'Alemberts solution of wave equation, Non-homogeneous equations and boundary conditions, Orthogonal series expansions, Fourier series in two dimensions, Boundary value problems in polar, cylindrical and spherical coordinate systems and their solutions.

**Books Recommended:**

**1**. E.A. Coddington, An Introduction to Ordinary Differential Equations, Practice Hall, 1995.

**2.** I.N. Sneddon, Elements of Partial Differential equations, McGraw-Hill 1957.

3. Dennis G, Zill & Michael R. Cullen; Advanced Engineering Mathematics, Jones & Bartlett Publishers. 2nd Edition.

4. R.K. Jain & S.R.K. Iyengar; Advanced Engineering Mathematics, Narosa Publishing House, 2002.

5. Erwin Kreyszig; Advaced Engineering Mathematics, John Wiley & Sons 8th Edition.

**Objective / Outcomes, Mathematics II**

All the physical & engineering problems related to rate of change and many practical laws, used in engineering, are expressed mathematically in the form of differential equations so the primary use of differential equations is to serve as a tool for the study of problems regarding change in almost all the branches of engineering & technology.

The solutions of many differential equations arises from physical problems and important differential equations such as Bessel's equation and Legendre equation cannot be expressed in terms of elementary functions in closed form so in such cases, it is easier to find an approximate solutions in the form of the

convergent infinite series. The series solutions many reveal important information's about the nature of solution such as passing through the origin even or odd, increasing & decreasing on a given interval and so on.

Laplace transform is a very powerful technique it replaces operations of calculus by operations of algebra. Laplace transform is useful since particular solution can be obtained without first determining the general solution of differential equation. Non-homogeneous equation also can be solved. Solution of mechanical and electrical problems involving discontinuous force function of periodic function are obtained easily.

Fourier series is the simple representation of a complicated periodic functions associated as the periodic phenomenon which occur frequently in many physical and engineering problems.

It is very useful in the study of heat conduction, mechanics, concentration of chemical and pollutants, electrostatics. The Fourier Transform and series and their analytic properties are very commonly used in telecommunications, digital signal processing, electronic design and more.

Several problems in fluid mechanics, solid mechanics, heat transfer, electromagnetic theory and other areas of physics & engineering are modeled as boundary value problems i.e. partial differential equations with boundary value conditions in the different coordinate systems.

# EEE 102: ELECTRICAL ENGINEERING

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Unit I

1. DC Circuit Analysis and Network Theorems:

Circuit Concepts: Concepts of Network, Active and Passive elements, voltage and current sources, concept of linearity and linear network, unilateral and bilateral elements. R L and C as linear elements. Source Transformation.

Kirchhoff's Law; loop and nodal methods of analysis; star – delta transformation; Network Theorems: Superposition Theorem, Thevenin's Theorem, Norton's Theorem, Maximum Power Transfer Theorem. (Simple Numerical Problems) 9

Unit II

2. Steady – State Analysis of Single Phase AC Circuits:

AC Fundamentals: Sinusoidal, Square and Triangular waveforms – average and effective values, form and peak factors, concept of phasors, phasor representation of sinusoidally varying voltage and current. Analysis of series, parallel, and series – parallel RLC Circuits: Apparent, Active & Reactive Powers, Power factor, causes and problems of low power factor, power factor improvement. Resonance in Series and Parallel Circuits, Bandwidth and Quality Factor. (Simple Numerical Problems) 8

Unit III

3. Three Phase AC Circuits:

Three Phase System – its necessity and advantages, meaning of phase sequence and star and delta connections, balanced supply and balanced load, line and phase voltage / current relations, three phase power and its measurement. (Simple Numerical Problems) 3

Unit IV

4. Measuring Instruments:

Types of instruments: Construction and Working Principles of PMMC and Moving Iron type Voltmeter & Ammeters, Single Phase Dynamometer Wattmeter and Induction Type Energy Meter, use of Shunts and Multipliers. (Simple Numerical Problems on Energy Meter, Shunts and Multipliers) 4

Unit V

5. Introduction To Power System:

General layout of Electrical Power system and functions of its elements, standard transmission and distribution voltages, concept of grid. 2

**EME-102** **ENGINEERING MECHANICS** **3[3-0-0]**

**Unit I**

**Two Dimensional Force Systems:** Basic concepts, Laws of motion, Principle of Transmissibility of forces, Transfer of a force to parallel position, Resultant of a force system, Simplest Resultant of Two dimensional concurrent and Non-concurrent Force systems, Distributed force system, Free body diagrams, Equilibrium and Equations of Equilibrium, Applications.

**Friction**: Introduction, Laws of Coulomb Friction, Equilibrium of Bodies involving Dry-friction, Belt friction, Applications.

**Unit II**

**Beam**: Introduction, Shear force and Bending Moment, Differential Equations for Equilibrium, Shear force and Bending Moment Diagrams for Statically Determinate Beams.

**Trusses:** Introduction, Simple Truss and Solution of Simple truss, Method of Joints and Method of Sections.

**Unit III**

**Centroid and Moment of Inertia:** Centroid of plane, curve, area, volume and composite bodies, Moment of inertia of plane area, Parallel Axes Theorem, Perpendicular axes theorems, Principal Moment Inertia, Mass Moment of Inertia of Circular Ring, Disc, Cylinder, Sphere and Cone about their Axis of Symmetry.

**Unit IV**

**Simple Stress and Strain:** Introduction, Normal and Shear stresses, Stress- Strain Diagrams for ductile and brittle material, Elastic Constants, One Dimensional Loading of members of varying cross-sections, Strain energy.

**Compound stress and strains:** Introduction, state of plane stress, Principal stress and strain, Mohr's stress circle. Theories of Failure.

**Unit V**

**Pure Bending of Beams:** Introduction, Simple Bending Theory, Stress in beams of different cross sections.

**Torsion:** Introduction to Torsion of circular shaft, combined bending & torsion of solid & hollow shafts.

**Textbooks:**

1. Engineering Mechanics by R.K.Bansal
2. Strength of Materials by R.K. Rajput

**Reference books:**

1. Engineering Mechanics by Irving H. Shames, Prentice-Hall
2. Mechanics of Materials by E.P.Popov, PHI
3. Strength of Materials by Ryder
4. Mechanics of Material by Gere & Timoshenko
5. Engineering Mechanics by A. Nelson
6. Engineering Mechanics by U.C. Jindal
7. Engineering Mechanics Statics by J.L. Meriam & L.G.Kraige

**HHS-101/102: ENGLISH LANGUAGE AND COMPOSITION**

| | | |
|---|---|---|
| **Course: B. Tech** | **Branch: All** | **Year / Semester: Ist Year** |
| **Sessional Marks:** | **50** | **Credit: 2** |
| **End Semester Exam:** | **50** | **LTP: 2 0 0** |

**UNIT I Basic Applied Grammar and Usage:**

Sentence structure-1: constituent of a sentence- noun, verb, adjective, preposition, etc.; use of articles, adjectival forms, prepositions, adverbs; verb forms; finite and non-finite verbs, gerund and participles, auxiliary verbs. Tense and mood, Subject- verb concord, pronoun concord

**UNIT II Sentence Structure-2:**

(i) adverb clause, adjective clause, noun-clause; (ii) negation and interrogation; (iii) passive; (iv) exclamatory; (v) transformations; (vi) tense forms; (vii) varieties of sentences; (viii) placement of modifiers

**UNIT III Paragraph Writing:**

Structure of Paragraph, Topic Sentence, Construction of Paragraph, Technique of Paragraph writing, Unity, Coherence, Emphasis

**UNIT IV Comprehension and Précis Writing**

Reading and listening comprehension, improving comprehension skills, précis writing

**UNIT V Short Essay Writing**

Dimension of essay writing- literary, Scientific, Comparison and Contrast, Narrative, Descriptive, Reflective, Expository, Argumentative and Imaginative

**********

**References:**


1. Das, B K and A David, 'A Remedial Course in English for Colleges', (Book -1,2,3) Oxford University Press, New Delhi.
2. Sinha, R P, 'Current English Grammar and Usage with Composition', Oxford University Press, New Delhi.
3. Wren, P C & Martin, 'English Grammar and Composition', S Chand & Co Ltd. New Delhi.
4. A. S. Horne, Guide to Pattern and usage in English, Oxford University Press, N.D.
5. M.L. Tickoo & A. E. Subramanian, Intermediate Grammar, usage & composition, Orient Longman


**Course Objectives (COs)**

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

1. Write professional statements & organizational communications.
2. Develop writing skills by applying different strategies on organisation system.
3. Develop the project reports, their relevance and significance.

**HHS-103/104, HHS-401: PROFESSIONAL COMMUNICATION**

| | | |
|---|---|---|
| **Course: B. Tech & MCA** | **Branch: All** | **Year / Semester: Ist Year** |
| **Sessional Marks:** | **50** | **Credit: 4** |
| **End Semester Exam:** | **50** | **LTP: 3 1 2** |

**UNIT I Fundamentals of Technical Communication**:

Process of communication, language as a tool of communication, levels of communication , flow of communication, barriers to communication, communication across cultures; Technical Communication: meaning, significance, characteristics, difference between technical and general communication.

**UNIT II Elements of Written Communication**:

Words and phrases, word formation, synonyms and antonyms, homophones, one word substitution, sentence construction, paragraph construction,

**UNIT III Forms of Technical Communication**:

(A) business letters, job application letter and resume, business letters: sales & credit letters, letters of enquiry, letters of quotation, order, claim and adjustment letters, official letters: D.O. letters, government letters, letters to authorities, etc. ,

(B) Technical Reports: general format of a report, formal and informal reports, memo report, progress report, status report, survey report, trip report, complaint report, , Joining Report ,laboratory report, research papers, dissertations and theses. E-mail writing

Technical Proposals: purpose, characteristics, types, structure

**UNIT IV Presentation Strategies**:

Defining the subject, scope and purpose, analysing audience & locale, collecting materials, preparing outlines, organising the contents, visual aids, nuances of delivery, extemporaneous, manuscripts, impromptu, non- verbal strategies.

**<u>UNIT V</u> Value-based Text Reading**:

(A) Study of the following essays from the text book with emphasis on writing skills:

1. Man and Nature by J. Bronowski
2. The Language of Literature and Science by Aldous Huxley
3. The Aims of Science & The Humanities by Moody E Prior
4. Gods in this Godless Universe by Bertrand Russell
5. Science and Survival by Barry Commoner

(B) Readings of selected short stories:

1. The Renunciation by Rabindranath Tagore
2. The Lament by Anton P. Chekhov
3. The Barber's Trade Union by Mulk Raj Anand
4. The Eyes Are Not Here by Ruskin Bond

**Text Books:**

1. 'Improve Your Writing' ed. By V N Arora and Laxmi Chandra, Oxford University Press, New Delhi
2. 'An Anthology of English Short Stories', edited by R P Singh, Oxford University Press.
3. 'Technical Communication- Principles and Practices' by Meenakshi Raman & Sangeeta Sharma, Oxford University Press, New Delhi.

**Reference Books:**

1. Effective Technical Communication, by Barun K Mitra, Oxford University Press
2. Business Correspondence & Report Writing by R.C. Sharma & Krishna Mohan, Tata McGraw Hill, N.D.
3. Developing Communication Skills by Krishna Mohan & Meera Banerjee, Macmillan India
4. 'Technical Communication- Principles and Practices' by M R S Sharma, Oxford University Press, New Delhi

**Course Objectives (COs)**

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

1. Effectively communicate their ideas in the contemporary global competitive environment.
2. Convey their messages through constructive writing.
3. Draft potent E-Mails, letters, proposals and reports.
4. Present their presentations along with using all nuances of delivery with clarity and thoroughness.
5. Solve problems based on real time situations and articulate them eventually

**PROFESSIONAL COMMUNICATION LABORATORY**

Interactive practical sessions with emphasis on oral presentations/ spoken communication:

Practical Sessions on:

1. Group Discussions: selected topical issues to be discussed in groups.

2. Mock interviews
3. Communication skills for seminars/conferences/workshops with emphasis on non-verbal skills.
4. Presentation skills for technical papers/project reports/professional reports.
5. Theme presentation/ key note presentation based on correct argumentation methodologies.
6. Argumentative skills
7. Role play
8. Comprehension skills based on reading and listening practice, asking questions.
9. Introduction to International Phonetics Alphabets
10. Audio Visual demonstration of effective communicative strategies & TED Talks

**References:**


**1.** Sethi and Dhamija, 'A Course in Phonetics and Spoken English', Prentice Hall of India, New Delhi.
**2.** Joans Daniel, 'English Pronouncing Dictionary', Cambridge University Press.


**Additional Reference Books**


1. R. K. Bansal & J.B. Harrison, Spoken English for India, Orient Longman
**2.** Excellence in Business Communication, Boeuve & Thill and Courtland

# *Year 2nd semester 3 & 4*

# *Syllabus of*

# *other Departments*

**BMA-201, MATHEMATICS-III**
**(II-B.Tech)**

**(Effective from Session 2018-19)**

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**Unit – I: Transform Methods:**

Fourier integral, conditions of convergence, Fourier sine and cosine integrals, complex form, applications, Fourier transform pairs, existence conditions, operational properties. Applications of Laplace transform and Fourier transform to solve boundary value problems, Discrete and Fast Fourier transforms and its applications.

Development of difference equations as models, operator method, method of undetermined coefficients, Z-transform pairs, ROC. Operational properties, limiting- value theorems, its applications to solve difference equations and BVP, systems of difference equations.

**Unit- II: Functions of a Complex Variable and Conformal mapping:**

Limit, continuity, differentiability and analyticity, Cauchy-Riemann equations, harmonic functions, complex functions as mappings, liner transformation, inverse transformation, bilinear transformations, conformal mapping, applications.

**Unit- III: Integration of Complex Functions:**

Contour integrals and evaluations, Cauchy- integral theorem, Cauchy's integral formulae, Liouville's theorem, convergence of power series, Taylor series, Laurent series, zeros and singularities of a complex function, residues and residue theorem, Fundamental theorem of algebra Rouche's theorem, Argument Principle and maximum modules theorem, evaluation of definite and improper integrals.

**Unit- IV: Curve- Fitting, Correlation, Regression and Probability:**

Curve-fitting, method of least- squares, fitting of straight lines, polynomials, non-linear and exponential curves etc., correlation analysis, linear, non-linear and multi-regression analysis, probability, random variables and probability distributions, expectation, moments and transform methods, Binomial, Poisson and Normal distributions.

**Unit- V: Statistical Methods:**

Sampling theory (small and large), parameter estimation, confidence intervals, tests of hypotheses and significance; Overview of t-distribution, F-distributions and $\chi^2$-distribution. Z-, t-, F-, and $\chi^2$ tests, goodness of fit test- $\chi^2$ test, analysis of variance, non-parametric tests (Simple application). time series analysis, index numbers, quality control charts.

**Books Recommended:**


1. Dennis G, Zill & Michael R. Cullen; Advanced Engineering Mathematics, Jones & Bartlett Publishers. 2nd Edition.

2. R.K. Jain & S.R.K. Iyengar; advanced Engineering Mathematics, Narosa Publishing House, 2002.

3 Erwin Kreyszig; Advanced Engineering Mathematics, John Wiley & Sons 8th Edition.

4. R.V. Churchill and J.L. Brown, Complex Variables and Applications, McGraw Hill, 1990.

5. J.N. Kapur and H.C. Saxena, Mathematical Statistics, S.Chand. & Co., 2001.

6. H.C. Saxena, Practical Mathematical Statistics, S. chand & Co., 2000.

7. J.H. Mathews and R.W. Howell, Complex analysis for Mathematics and Engineering, 3rd Ed. Narosa, 1998.


**Objective / Outcomes, Mathematics-III**

Fourier transform is useful in study of frequency response of filter, In the theories of communication engineering, wave propagation, transmission lines and solution of boundary value problems. Discrete and fast fourier transform are used in signal analysis. Fourier transform is also used in electromagnetic field, medical application and in error control coding.

Solution of a discrete system, expressed as a difference equation is obtained using z-transform. Discrete analysis played important role in the development of communication engineering. Basic theory of z-transform help us to obtain the response of output sequence for a discrete system. This will involve the concept of the transfer function.

Complex Analysis is the study of analytic functions. It is an elegant and powerful method useful in the study of heat flow, fluid dynamics and electrostatics. Two-dimensional potential problem can be solved using analytic functions. The other important applications of this theory is to evaluate many real integrals which can not be evaluated by usual methods.

In many engineering problems to establish a linear, quadratic, cubic or exponential relationship between two quantities, it is required two or more unknowns in such a way that these follow whole data, such situations occur in the problems of curve fitting etc. Correlation and regression are the most commonly used techniques for investigating the relationship between two quantitative variables. The theory of probability is the study of such random phenomenon, which are not deterministic. In analyzing and interpreting data that involves an element of "chance" or uncertainty, probability theory plays a vital role in the theory and application of statistics.

probability distribution is the theoretical counterpart of frequency distribution and plays an important role in the theoretical study of populations.

Statistical methods are useful in engineering, medical sciences, industries, banking, and economics. These methods are used to present the data effectively, help in critical analysis of information and summarizing the large data into a simple form using the frequency distribution and graph. In many situations, assumptions are made about the population parameters involved in order to arrive at decisions related to population on the basis of sample information. Quality control and process control use statistics as a tool to manage conformance to specifications of manufacturing processes and their products.

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**TCH – 201 : MATERIALS AND ENERGY BALANCE**

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|---|
| **OBJECTIVE**: The objective of this course is to enable the students<br>To understand the basic calculations related to material and energy flow in the chemical processes.<br>To apply the basic calculations related to material and energy flow in the chemical processes. |

**Course Outcome**

On the successful completion of the course, students will be able to

| | | |
|---|---|---|
| **CO1** | understand material and energy balance equations for open and closed systems. | Understand |
| **CO2** | select appropriate basis and conduct degree of freedom analysis before solving material and energy balance problems. | Understand |
| **CO3** | make elementary flow-sheets and perform material and energy balance calculations without and with chemical reactions, and involving concepts like recycle, bypass and purge. | Apply |
| **CO4** | perform process calculations utilizing psychometric charts and steam tables. | Analyze |
| **CO5** | apply simultaneous material and energy balance calculations for steady state continuous flow systems and unsteady state systems. | Apply |

**Syllabus**

**Module-I: Elements of Materials and Energy Balance**

Dimensions, system of units and their conversions, Mass and volume relations, Basic stoichiometric principles, limiting and excess reactants, Degree of completion, Conversion, selectivity, yield. Ideal gas law, Dalton's Law, Amagat's Law, Introduction to degrees of freedom analysis.

**Module-II: Vapor Pressure of Liquids and Solids**

Concept of vapor pressure of liquids and solids, Vapor pressure plot (Cox chart), Vapor pressures of miscible and immiscible liquids and solutions, Raoult's Law and Henry's Law. Humidity and saturation use of humidity charts for engineering calculations.

**Module-III: Material Balance without and with Chemical Reactions**

Material balance without chemical reactions and its application to unit operations like distillation, absorption etc. Material balance with chemical reaction. Recycle, bypass and purging.

**Module-IV: Concept and Applications of Heat Phenomenon**

Heat capacity of gases, liquids and solutions. Heat of fusion and vaporization. Steady state energy balance for systems with and without chemical reactions. Calculations and application of heat of reaction combustion, formation, neutralization and solution. Enthalpy-concentration charts. Orsat analysis. Calculation of theoretical and actual flame temperatures.

**Module-V: Simultaneous Material and Energy Balance**

Simultaneous material and energy balance. Introduction to Unsteady state material and energy balance.

## Reference Books and Suggested Readings :


1. Hougen, O.A., Watson, K.M and Ragatz, R.A., " Chemical Process Principles Part-I ",John Wiley and Asia Publishing, 1970.
2. Himmelblau, D.M., "Basic Principles and Calculations in Chemical Engineering" ,sixth Edition, Prentice Hall Inc., 1996.
3. Felder, R.M. & Rousseau, R.W. "Elementary Principles of Chemical Processes ", 3rd edition. JohnWiley. (1999)
4. Bhatt, B.L., VORA, S.M., "Stoichiomentry ", Tata McGraw-Hill, 1976.
5. Venkataramani, V., Anantharaman, N., Begum, K. M. Meera Sheriffa, "Process Calculations" , Second Edition, Prentice Hall of India.

6. Sikdar, D. C., "Chemical Process Calculations", Prentice Hall of India.

**TCH – 203 : FLUID FLOW AND UNIT OPERATION**

| |
|---|
| **OBJECTIVE**: The objective of this course is to enable the students<br><br>To introduce the mechanics of fluids (fluid statics and fluid dynamics), relevant to chemical engineering operations.<br>To apply mathematical equations to understand the forces on fluids.<br>To appy industrial operations dealing with the particulate solids, their handling in various unit operations, and those in which particle fluid interactions are important. |

**Course Outcome**

On the successful completion of the course, students will be able to

| | | |
|---|---|---|
| **CO1** | Understand basic concepts pertaining to fluids and fluid flow, relation between flow variables. | Understand |
| **CO2** | Apply mathematical equations to calculate boundary layer thicknesses, friction factor, pressure drop, power requirements in single phase flow in pipes for fully developed laminar and turbulent flows. | Apply |
| **CO3** | Understand pump type and pump size to meet the specific pumping requirements, flow meters and to analyze drag force and terminal settling velocity for single particles. | Understand |
| **CO4** | Understand the significance and usage of different particulate characterization parameters, and equipment to estimate them, size reduction, energy requirements and design of filtration unit. | Understand |
| **CO5** | Apply mathematical equations for designing a continuous thickener using results of a batch settling test, pressure drop in fixed and fluidized beds, and power consumption and mixing time in a given mixing or agitation process. | Apply |
| **CO6** | Apply the concepts of fluid flow and unit operations through laboratory experiments. | Apply |

**Syllabus**

**Module – I: Introduction to Fluid and Fluid Flow**

Fluid and Types of fluids, Properties of fluids, Fluid statics: Pascal's law for pressure at a point in a fluid, Variation of pressure in a Static fluid, Pressure Measurement-Manometers, Buoyancy Fluid flow: Stream line, Stream tube, Steady & Uniform flows, One-dimensional & multidimensional flow, Equation of continuity, Energy equation - Bernoulli's equation, Momentum equation, Navier stokes equation, Two dimensional flow: Velocity potential, Potential function & Irrotational flow.

**Module-II: Fluid Flow - I**

Development of boundary layer for flow over a flat plate Development of boundary layer for flow through circular pipe, Entry length, Fully developed flow Boundary layer separation Flow of incompressible fluid in pipes: Laminar flow, Hagen Poiseuille equation Friction factor Pressure drop in turbulent flow Velocity Distribution for turbulent flow Surface roughness Flow through non-circular pipes Flow through curved pipes Expansion losses, Contraction losses, Losses for flow through fittings, Equivalent length of pipe fittings.

**Module – III: Fluid Flow - II**

Closed channel flow measurement: Venturimeter, Orifice meter, Venturi - Orifice Comparison, Pitot tube, Rotameter, Flow measurement based on Doppler effect, Hot wire and hot film anemometer, Magnetic flow meter, Open channel flow measurement: Elementary theory of weirs and notches. Transportation of fluids: Pump classifications: Suction, discharge, net pressure heads, specific speed and power calculations, NPSH Characteristics, and constructional details of centrifugal pumps, Cavitation, Priming, Positive displacement pumps, Compressors, Fans and Blowers.

**Module-IV: Fluid Flow - III**

Particle shape, particle size, different ways of expression of particle size, shape factor, sphericity, mixed particles size analysis, screens – ideal and actual screens, differential and cumulative size analysis, effectiveness of screen, Size Reduction: Introduction – types of forces used for communition, laws of size reduction, work index, Equipments of size reduction. Flow of Fluid Past Immersed Bodies: Drag, drag coefficient, pressure drop – Kozeny – Carman equation, Blake- Plummer, Ergun equation, fluidization, conditions for fluidization, minimum fluidization velocity, types of fluidization, application of fluidization, slurry transport, pneumatic conveying.

**Module-V: Motion of Particles Through Fluids**

Motion of Particles Through Fluids: Mechanics of particle motion, equation for one dimensional motion of particles through a fluid in gravitational and centrifugal field, terminal velocity, drag coefficient, motion of spherical particles in Stoke’s region, Newton’s region and intermediate region, criterion for settling regime, hindered settling, modification of equation for hindered settling, centrifugal separators, cyclones and hydro

cyclones. Sedimentation: thickener design, determination of thickener area. Filtration: Agitation And Mixing: Agitation equipment, Power calculation, Mixing of solids, Types of mixers and Conveyors.

**Module-VI: Laboratory Experiments**

Determination and verification of type of flow using Reynolds apparatus, Bernoulli's apparatus, etc., friction losses in a straight pipe, pipe fittings and valves & bend pipe, pressure drop in a packed bed by Ergun's equation, determination and verification of discharge coefficient of an orifice meter, Rotameter, V-notch in open channel, study the principle of a hydro-cyclone and find out the efficiency of separation, determination of average particle size of a mixture of particles by sieve analysis, determination and experimentally verification of Ritinger's constant of Jaw crusher, determination of reduction ratio, maximum feed size and theoretical capacity of crushing rolls, determination of the effect of no. of balls on grinding in a Ball mill and comparison of its critical speed with the operating speed, enrichment of the coal sample using a froth flotation cell, reduction ratio using Pulverizer, determination of reduction ratio & experimentally verification reduction ratio of a Gyratory Crusher.

**Reference Books and Suggested Readings :**


McCabe and Smith, Unit Operations of Chemical Engineering: McGraw Hill.

1. Coulson & Richardson , Chemical Engineering Vol. I: Pergamon, 1979 McGraw Hill.
2. Gupta, Vijay and S. K. Gupta, "Fluid Mechanics and its Applications", Wiley Eastern, New Delhi (1984). 4. Rajput, R. K., "Text Book of Fluid Mechanics", S. Chand and Co., New Delhi (1998).
3. R. W. Fox, P. J. Pritchard and A. T. McDonald, Introduction to Fluid Mechanics, 7th Edition, Wiley-India 2010.
4. R. B. Bird, W. E. Stewart and E. N. Lightfoot, Transport Phenomena, 2nd Edition, Wiley India 2002.
5. Rhodes, M. J., Introduction to Particle Technology, 2nd edition, John Wiley, Chichester ; New York, 2008.
6. Allen, T., Powder Sampling and Particle Size Determination, Elsevier, 2003.
7. Masuda, H., Higashitani, K., Yoshida, H., Powder Technology Handbook, CRC, Taylor and Francis, 2006.


**HHS-203/204: ORGANIZATIONAL BEHAVIOR**

| **Course: IIIrd B. Tech** | **Branch: CS/IT** | **Year / Semester: IIIrd Year** |
|---|---|---|
| **Sessional Marks:** | **50** | **Credit: 3** |
| **End Semester Exam:** | **50** | **LTP: 3 1 0** |

**Unit 1: Introduction to organizations**

What is an organization, components of organization, nature and variety of organizations (in terms of objectives, structure etc.), models of analyzing organizational phenomena, organizational and business variables, organizations in the Indian context, institutions and structures.

**Unit 2: Dimensions of Individual Behavior**

Individual Behavior, Dimensions of individual behavior: Perceptions, Learning, Motivation, Personality, Commitment, Attitudes, Values & Ethics, Stress Management

**Unit 3: Dimensions of Interpersonal Behavior**

Transactional Analysis, Interpersonal communication, Listening, Feedback, Counseling,

**Unit 4: Group Behavior**

Leadership, Communication, Group: Formal Vs Informal Groups, Group Decision making, Team: Team building, team problem solving.

**Unit 5: Organizational Dimensions**

Organizational Structure: Elements of Organizational Structure, Dimensions of Organizational Structure, Organizational change, Organizational Development, Power, Authority, Politics

***Note:*** *Integrating cases (s). Case method and lectures should be supplemented with a variety of other methodologies such as feedback on questionnaires and tests, role plays, and behavior simulation exercise.*

**References:**


1. Luthans Fred., "Organizational Behavior", McGraw Hill, 1998
2. Pareek, Udai, "Understanding Organizational Behavior, Oxford university press


**Additional Reference Books**


1. Robbins (4th ed.), "Essentials of organizational behavior", Prentice Hall of India Pv1. Ltd., New Delhi, 1995
2. Keith Davis, "Organisational Behaviour,
3. Hersey and Blanchard (6th ed.). "Management of organizational behavior L utilising human resources", Prentice Hall of India Pv1. Ltd., New Delhi, 1996.
4. Nancy J. Adler, ‘International Organisational Behaviour’, Cengage Learning
5. Nelson Quick, ‘Organizational Behaviour Function Learning’Fifth Edition


**Course Objectives (COs)**

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

1. Apply organizational objectives, components and models in Indian context for better results for attaining organizational goals.
2. Demonstrate individual behavioural dimensions, learning theories, perceptual process, values & ethics with motivational techniques in stressed situations.
3. Identify mechanism for, conducive survival of individual in an organization with interpersonal understanding.
4. Ascertain group, group behaviour, Team & Team building with its key role in organization.
5. Demonstrate organisational structure, organisational change, organisational development for achieving higher productivity and accomplishing goals of organisation.

**CYBER SECURITY (ECS-205/206)**

| Type | L | T | P | Credits |
|---|---|---|---|---|
| MDC | 2 | 0 | | 0 |

**Prerequisite:**

**Course Content:**

**Unit-1:** Introduction to information systems, Types of information systems, Development of Information systems, Introduction to information security, Need for Information security, Threats of Information Systems, Information Assurance, Cyber Security and Security Risk Analysis.

**Unit-2** Application security (Database, E-mail and Internet), Data Security Considerations-Backups, Archival Storage and Disposal of Data, Security Technology- Firewall and VPNs, Intrusion Detection, Access Control, Security Threats- Viruses, Worms, Trojan Horse, Bombs, Trapdoors, Spoofs, E-mail viruses, Macro viruses, Malicious Software, Network and Denial of Services Attack, Security Threats to E-Commerce – Electronic Payment System, e-Cash, Credit/Debit Cards, Digital Signature, public Key Cryptography.

**Unit-3** Developing Secure Information Systems, Application Development Security, Information Security Governance & Risk Management, Security Architecture & Design, Security Issues in Hardware, Data Storage & Downloadable devices, Physical Security of IT Assets, Access Control, CCTV and intrusion Detection Systems, Backup Security Measures.

**Unit-4** Security Policies, why Policies should be developed, WWW Policies, Email Security Policies, Policy Review Process- Corporate policies- Sample Security Policies, Publishing and Notification requirement of the Policies.Information Security Standards- ISO, IT Act, Copyright Act, Patent Law, IPR. Cyber Laws in India: IT Act 2000 Provisions, Intellectual Property Law: Copy Right Law, Software License, Semiconductor Law and Pattern Law.

**Text and Reference Books:**


1. Charles, P., and Shari Lawrence Pfleeger, "*Analyzing Computer Security"*. Pearson Education India.
2. V.K. Pachghare, "*Cryptography and information security",* PHI Learning Pvt. Ltd., Delhi India.
3. Dr Surya PrakashTripathi, RitendraGoyal, and Praveen Kumar Shukla, "Introduction to Information Security and Cyber Law", Willey Dreamtech Press.
4. Schou, Shoemaker, "Information Assurance for the Enterprise", Tata McGraw Hill.
5. Chander Harish, "Cyber Laws and their Protection", PHI Learning Private Limited, Delhi, India.

6.

**Course Outcomes:**

1. Understand information, information systems, information security, Cyber Security and Security Risk Analysis. (Understand)
2. Understand and apply application security,data security,security technology, security threats from malicious software. (Understand, Apply)
3. Understand the concepts of security threats to e-commerce applications such as electronic payment system, e-Cash, Credit/Debit Cards etc. (Understand)
4. Understand and apply Information Security Governance & Risk Management, Security of IT Assets and Intrusion Detection Systems. (Understand, Apply)
5. Understand various types of Security Policies, Cyber Ethics, IT Act, IPR and Cyber Laws in India. (Understand)

   Since Cyber Security is an Audit Course CO – PO matrix is not made for it.

**Department of Chemistry**

*School of Basic & Applied Sciences,*

**Harcourt Butler Technical University, Kanpur**

***Curriculum for Second Year Undergraduate***

***Degree Courses***

***In***

***Engineering & Technology***

***Modern Analytical Techniques (Theory & Lab.)***

***IV Semester***

***Course Code (BCY-202)***

**Department of Chemistry**

**School of Basic &Applied Sciences,**

**Harcourt Butler Technical University, Kanpur**

| Course code | Existing code | | | | New code |
|---|---|---|---|---|---|
| | ICY-301/351 | | | | BCY-202 |
| Category | Basic Science Course | | | | |
| Course Title | MODERN ANALYTICAL TECHNIQUIES (Theory & Lab) | | | | |
| Scheme and Credits | L | T | P | Credits | Semester IV |
| | 3 | 0 | 3 | 4 | Branches to whom offered (CHE/BE/FT/OT/PT/PL/LT) |

**Course Content**

**Chemistry (Theory & Lab)**

**BCY- 202**

**MODERN ANALYTICAL TECHNIQUIES**

**II B.Tech. IV Semester**

**Detailed content:**

**Module I**

**(i)** ***Infrared Spectroscopy*****:** Introduction, Principle, Instrumentation, mechanics of measurements, Selection rules, fundamental vibration modes, Factors influencing the Band Position and intensities, some characteristics frequencies and co-relation of IR spectra with molecular structures, effect of Hydrogen Bonding on vibrational frequencies.

(Lectures: 6-7)

**(ii)** ***Raman Spectroscopy*****:** Introduction theory of Raman Spectroscopy, Mechanism of Raman and Rayleigh scattering, Rule of Mutual Exclusion, correlation with the molecular structure, difference between Raman and IR spectra, Resonance Raman effect, Application of Raman Spectroscopy.

(Lectures:4-5)

**Module II**

**(i)** ***Nuclear Magnetic Resonance Spectroscopy*****:** Introduction, basic principles, mechanics of measurements, chemical shift, band multiplets, spin-spin splitting, shielding and deshielding effect, spin-spin coupling and coupling constant (J), some characteristics of NMR positions, Application in elucidation of molecular structure, , Elementary idea of NOE, DEPT NMR, $C^{13}$ NMR, $P^{31}$NMR, $F^{19}$NMR.

(Lectures: 4-5)

**(ii) *Mass Spectroscopy*:** Introduction, basic principles, instrumentation, fragmentation patterns, nitrogen rule, Mc Lafferty Rearrangement, interpretation of mass spectra and applications.

(Lectures: 3-4)

**(iii) *ESR* (*Electron Spin Resonance*) -** Basic Principles and Magnetic Interactions, Instrumentation and Applications.

(Lectures: 2-3)

**Module III**

**(i) *Potentiometry and Conductometry*:** General principles, reference and indicator electrodes, potentiometric and conductometitrations.

(Lectures: 3-4)

***Polarography*:** Basic principle, dropping mercury electrode (DME), half wave potential, polarographic currents and applications.

(Lectures: 3-4)

**Module IV**

**(i) *Chromatographic methods***: Introduction to Chromatographic methods: TLC, Column and Gas chromatography, Principles, Instrumentation, GC column, Detectors and stationary phases and applications, hyphenated techniques (GC-MS).

(Lectures: 4-5)

Liquid Chromatography LC/HPLC, Column efficiency in LC, Detectors, Instrumentation, Partition/Adsorption/Ion Exchange Chromatography

(Lectures: 4-5)

**Module V**

**(i) *Thermal Methods of Analysis*:** Thermogravimetric analysis, differential thermal analysis and differential scanning calorimetry and applications.

(Lectures: 4-5)

**CHEMISTRY LAB**

**List of Experiments:**

1. Estimation of vitamin C in commercial soft drink / Glucon D.
2. Determine the strength of oxalic acid conductometrically using sodium hydroxide solution.
3. Separation of amino acids by thin layer chromatography.
4. Determination of Rf value of Methyl Orange and Phenolphthalein using paper/ thin layer chromatography.
5. Separation of metal ions by paper/thin layer chromatography.
6. Determine the adsorption isotherm of oxalic acid/acetic acid on activated charcoal and verify the Freundlich adsorption isotherm.
7. Determine the rate constant (K) of hydrolysis of ethyl acetate catalyzed by HCL.
8. Prepare p-nitro acetanilide from acetanilide and find its percentage yield.
9. Determine the viscosity and percentage composition of the given liquid using Ostwald's viscometer.
10. Determine the strength of given glucose solution by titration against Fehling's solution.
11. Evaluation of Dissociation Constant k for a weak acid using conductometry.
12. Elution of chemicals by Column Chromatography.
13. Elution of genomic DNA from plants suspension.
14. Estimation of Phosphoric acid from coca cola.

**Reference Books:**


1. Instrumental Analysis, Douglas A. Skoog, F. James Holler & Stanley R. Crouch.
2. Instrumental Methods of Analysis, Willard, Merit and Dean.
3. Handbook of Instrumental Techniques for Analytical Chemistry Ronald A. Hites, Indian University, School of Public and Environmental Affairs and Department of Chemistry.
4. Applications of absorption spectroscopy of organic compounds, John R. Dyer.
5. Instrumental Methods Analysis, B. K. Sharma.
6. Text book of Quantitative Inorganic Analysis, A. I. Vogel.
7. Spectroscopy of Organic Compounds by P.S. Kalsi, Y.R. Sharma, Robert M. Silverstein & Francis X.Webster.


**Course Outcome:**

After studying the course, the student will be able to:

- Interpret UV-Visible, NMR, Raman, Mass and IR–Spectra.

- Elucidation of the Thermal Stability of different molecules and their Characterization on the basis of their thermal stability and Glass Transition Temperature of Polymers.
- Analytical separation carried out by Chromatography in a multicomponent system.polymeric structures, classify polymers and analyze the polymerization mechanism. The uses of polymers in different walks of life.
- Determine stability of a substance at elevated temperature, identification, purity and decomposition mechanism of polymers.
- Determine the specific heat, heat of reaction, Melting point & boiling point.
- Check the purity of drugs, crystallization and fusion of polymeric materials.

**Experimental Outcome:**

The chemistry laboratory course will consist of experiments illustrating the principles of chemistry relevant to the study of science and engineering. The students will learn to:

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- Design and carry out scientific experiments as well as accurately record and analyze the results of such experiments
- Communicate the results of scientific work..
- Measure molecular/system properties such as viscosity, conductance of solution.
- Single step synthesis of small molecules.
- Applies the principle of chemical kinetics to know chemical reactions, determining the order and rate constant.
- Understand the adsorption phenomenon based on Freundlich and Langmuir phenomenon.

***Evaluation Scheme***

**B. Tech II-BCY- 202**

**SEMESTER IV**

**MODERN ANALYTICAL TECHNIQUIES**

| Course Code | Subject | Credit | CT | AT | TA | Lab | Total | Semester Final Exam | Grand Total |
|---|---|---|---|---|---|---|---|---|---|
| BCY-202 | Modern Analytical Techniques | 4[3-0-3] | 15 | 10(5T+5P) | 10(5T+5P) | 15 | 50 | 50 | 100 |

**BMA-206, COMPUTER ORIENTED NUMERICAL METHODS**

**(II-B.Tech, CHE,CE, ME, BE, FT, OT, PT, PL, LT)**

**(Effective from Session 2018-19)** **L T P**

**3 1 0**

**UNIT I: Nonlinear Equations and Simultaneous Linear Equations:**
Roots of nonlinear equation, Methods of solution, Order of convergence of iterative methods, Simple roots: Bisection, False position, secant, Newton-Raphson, Chebyshev, Iteration and multi point iteration methods, Multiple roots: Newton-Raphson and Chebyshev, Complex roots: Newton-Raphson and Muller's method, a system of nonlinear equations: Newton-Raphson and Iteration methods, Polynomial equations: Bairstow's method, convergence analysis of above methods.
Linear systems: Introduction, Direct methods, Operation count, Pivoting, III conditioned linear systems & condition number, Iteration methods: Jacobi, Gauss-Seidel, SOR methods, convergence conditions. Special system of equations: Thomas algorithm. Eigen value problems: Given's and Power methods.

**UNIT II: Interpolation, Differentiation and Integration:**
Curve fitting: Polynomial interpolation, error, Existence and Uniqueness, Truncation error bounds, difference operators, Newton forward and backward difference interpolations, Lagrange, Newton divided difference and Iterated interpolations, stirling and Bessel's interpolations, Spline interpolation, Least squares and Chebyshev approximations. Numerical Differentiation: Methods based on interpolation, Error analysis. Numerical Integration: Methods based on interpolations (Trapezoidal, Simpson's 1/3, simpson's 3/8 rule), Gauss quadrature methods, Romberg integration, Error bounds and estimates.

**UNIT III: Numerical Solution of Ordinary Differential Equations:**
Initial-value problems, Single step methods: Taylor's, Picard's, Euler's, Modified Euler's method and Runge-Kutta method (fourth Order), Error estimates, Multi-step methods: Adam's-Bashforth and Milne's methods, convergence and stability analysis, Simultaneous and Higher order equations: RK Fourth order method.

**UNIT IV: Initial & Boundary Value Problems and Iterative Solvers:**
BVP: Shooting method and Finite difference methods for Ordinary Differential Equations, Solution of Partial differential equation; solution of Laplace, Poisson equations: Standard 5- point and diagonal 5- point formulae, Jacobi method, Gauss Seidel method (Liebmann's iterative method) Relaxation method. Solution of heat equation: Crank – Nicolson method, Solution of wave equation.

**UNIT V: Finite Element Method:**
Basic concepts, variational formulation and functional, base functions, approximations weighted residual methods: Ritz method, Galerkin method, Least squares method, collocation method, Finite element and solution of simple problems and time dependent problems.

**Books Recommended:**

1. M.K.Jain, S.R.K. Iyengar & R.K.Jain, Numerical methods for Scientific and Engineering Computation, N age International Publication.
2. S.S Sastry, Intoductory Methods of Numerical Analysis, Eastern Economy Edition.
3. S. Rajasekaran, Numerical Method in Science and Engineering, Wheeler Publishing House.
4. B.S. Grewal, Numerical Method in Engineering & Science, Khanna Publishers.

**Objective / Outcomes, CONM**

Using Mathematical Modeling, most of the problems in Engineering, physical and Economical sciences canbe formulated in terms of systems of linear or non-linear equations, ordinary or partial differential equations or integral equations. In majority of the cases, the solutions to these problems in analytical form are difficult or not amenable for direct interpretation. In all such problems, Numerical Analysis provides approximate solutions to the desired degree of accuracy.

Numerical Methods provide easier computational process to solve various mathematical problems like Interpolation, Differentiation, Integration, ODE & PDE and Initial & Boundary value problems.

Analytical solutions can be obtained only for selected class of ODE and PDE. For certain problems, analytical solutions cannot be obtained. However numerical solutions can be obtained to the desired degree of accuracy using computers.

In civil engineering, numerical methods are used routinely in structural analysis to determine the member forces and moments in structural systems, prior to design. They are most useful in analyzing civil engineering problems with complicated geometries, material properties and loading conditions.

Finite element method has been extensively used in the field of structural mechanics, it has been successfully applied to solve several other types of engineering problems like heat conduction, fluid dynamics, electric and magnetic field. The general applicability of the method is to find the solution of complicated boundary value and other problems.

## BMA-251: NUMERICAL TECHNIQUES LAB
## (II-B.Tech. CHE,CE, ME, BE, FT, OT, PT, PL, LT,; IV Semester)

**L T P**
**0 0 3**

Develop Programs of the following techniques in C/C++ Language:

1. To implement iterative methods to solve a nonlinear equation.
2. To implement iterative methods to solve a system of linear equations.
3. To implement Forward, Backward and Central difference interpolation formulae.
4. To implement Newton’s divided difference and Lagrange’s interpolation formulae.

5. To implement Numerical differentiation.
6. To implement Numerical integration using Trapezoidal, Simpson 1/3 and Simpson 3/8 rules.
7. To implement single step methods to solve initial value problems.
8. To implement multi step methods to solve initial value problems.
9. Solution of Heat equations (Parabolic equations) by finite difference method.
10. Solution of Laplace equations (elliptic equations) by finite difference method.
11. Solution of wave equations (Hyperbolic equations) by finite difference method.

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**TCH – 202 : HEAT TRANSFER OPERATIONS**

| |
|---|
| **OBJECTIVE:** The objective of this course is to enable the students<br>to understand the fundamentals of heat transfer mechanisms in fluids and solids<br>to understand the applications of heat transfer mechanisms in various heat transfer equipments in process industries. |

**Course Outcome**

On the successful completion of the course, students will be able to

| | | |
|---|---|---|
| **CO1** | understand different modes of heat transfer. | Understand |
| **CO2** | apply calculation of heat transfer by free convection using dimensionless Grashoff number and heat transfer for one-dimensional and multi-dimensional : steady and unsteady state conduction in solids using analytical and graphical methods. | Apply |
| **CO3** | evaluate heat-transfer by forced convection for laminar and turbulent flows in internal and external configurations by employing basics of the boundary layer concept and empirical correlations. Heat transfer by radiation. | Apply |
| **CO4** | understand phase-change phenomena and latent heat of vaporization, including free convective, nucleate and film boiling, as well as dropwise and film condensation. | Understand |

| | | |
|---|---|---|
| **CO5** | Analyze design of heat exchangers using the log-mean temperature difference, over-all heat transfer coefficient and the effectiveness-NTU methods and to analyze the design of single and multiple effect evaporators. | Analyze |

**Syllabus**

**Module-I: Modes of Heat Transfer - I**

Basic Concepts: Modes of heat transfer, conduction, convection and radiation, analogy between heat flow and electrical flow. Conduction: One dimensional steady state heat conduction, the Fourier heat conduction equation, conduction through plane wall, conduction through cylindrical wall, spherical wall, variable thermal conductivity, combined mechanism of heat transfer (conduction-convection-radiation systems), conduction through composite slab, cylinder and sphere, thermal contact resistance, critical radius of insulation, Extended surfaces: heat transfer from a fin, fin effectiveness and efficiency, Introduction to unsteady state heat conduction.

**Module-II: Modes of Heat Transfer - II**

The convective heat transfer coefficient, thermal boundary layers for the cases of flow of fluid over a flat plate and flow through pipe, dimensionless numbers in heat transfer and their significance, dimensional analysis, Buckingham's pi theorem, application of dimensional analysis to forced convection and natural convection. Forced Convection: Correlation equations for heat transfer in laminar and turbulent flows in a Circular tube and duct, Reynolds and Colburn analogies between momentum and heat transfer, heat transfer to liquid metals and heat transfer to tubes in cross flow. Natural Convection: Natural convection from vertical and horizontal surfaces, Grashof and Rayleigh numbers.

**Module-III: Modes of Heat Transfer - III**

Heat transfer by radiation: Basic Concepts of radiation from surface : black body radiation, Planks law, Wien's displacement law , Stefan Boltzmann's law, Kirchhoff's law, grey body, Radiation intensity of black body, View factor , emissivity, radiation between black surfaces and grey surfaces. Solar radiations, combined heat transfer coefficients by convection and radiation.

**Module-IV: Boiling and Condensation**

Pool boiling, pool boiling curve for water, maximum and minimum heat fluxes, correlations for nucleate and film pool boiling, drop wise and film wise condensation, Nusselt analysis for laminar film wise condensation on a vertical plate, film wise condensation on a horizontal tube, effect of non-condensable gases on rate of condensation. Evaporation: Types of evaporators, boiling point elevation and Duhring's rule, material and

energy balances for single effect evaporator, multiple effect evaporators: forward, mixed and backward feeds, capacity and economy of evaporators.

**Module-V: Heat Exchangers**

Types of heat exchangers, Principal Components of a Concentric tube & Shell-andTube Heat Exchanger, Baffles, Tubes and Tube Distribution ,Tubes to Tube sheets Joint, Heat Exchangers with Multiple Shell & tube Passes, Fixed-Tube sheet and Removable-Bundle Heat Exchangers, log-mean temperature difference, overall heat transfer coefficient, fouling factors, Design of double pipe and shell and tube heat exchangers.

**Reference Books and Suggested Readings:**


1. ”Heat transfer principles and applications” Dutta, B.K., PHI
2. “Heat Transfer” Holman J.P., 9th Ed., McGraw Hill.
3. “Chemical Engineering:Vol-1”, Coulson, J. M. & Richardson, J. F., 6th ed. Butterworth Heinemann
4. “Principles of Heat Transfer”, Kreith F. and Bohn M., 6th Ed., Brooks Cole
5. “Process Heat Transfer”, Kern, D. Q McGraw Hill Book. 6. “Fundamentals of Heat and Mass Transfer”, Incropera F.P. and Dewitt D.P 5th Ed., John Wiley.
6. , “Process Calculations” , Second Edition, Prentice Hall of India.
7. Sikdar, D. C., “Chemical Process Calculations”, Prentice Hall of India.


**TCH – 204 : CHEMICAL ENGINEERING THERMODYNAMICS**

**OBJECTIVE:** The objective of this course is to enable the students

to understand the principles and application of first and second law of thermodynamics and equation of state

to introduce the concepts of fugacity, activity coefficient, vapour-liquid equilibrium and reaction equilibrium.

**Course Outcome**

On the successful completion of the course, students will be able to

| | | |
|---|---|---|
| **CO1** | understand basic concepts of thermodynamics and laws of thermodynamics. | Understand |
| **CO2** | apply mathematical equations to analyze the changes in system properties. | Apply |
| **CO3** | understand the properties of non ideal gases, thermodynamic properties using residual properties. | Understand |
| **CO4** | apply mathematical equations to estimate the thermodynamic properties of substances in gas or liquid state of ideal and real mixture. | Apply |
| **CO5** | analyze the effect of change in temperature, pressure and composition on equilibrium conversions for chemical reactions | Analyze |

**Syllabus**

**Module-I: Basic Concepts & First Law of Thermodynamics**Basic Concepts & First Law of Thermodynamics : Scope of thermodynamics, System & Surroundings, Properties -Force, Temperature & pressure, Equilibrium, Processes- Reversible & Irreversible, Work, Heat, Energy, Phase rule, Joule's Experiment, Internal energy, Enthalpy, Heat capacities, Application of first law to closed & open systems. Volumetric properties of pure fluids: PVT behavior of pure substances, Virial equation of state and its application, ideal gas and cubic equation of state, Generalized correlations for gases and liquids.

**Module-II: Basic Concepts & Second Law of Thermodynamics**

Second Law of Thermodynamics: Heat engine and its efficiency, Heat pump, Refrigerator, COP, Second law of Thermodynamics, Kelvin–Planck statement & Clausius Statement, Carnot's cycle and Carnot theorems, Clausius inequality, Entropy balance for open systems, ideal work and lost work, Principle of entropy increase. Thermodynamic properties of fluids: property relations for homogenous phases, Maxwell relations, various equations of enthalpy, entropy and internal energy. Thermodynamic analysis of steam power plants. Heat pumps. Liquefaction processes. Dew point and bubble point.

**Module-III: Residual Properties, Two-phase Systems and Solution Thermodynamics**

Residual properties, two phase systems: Clapeyron equation, Estimation of thermodynamic properties by using graphs and tables. Solution thermodynamics Theory: Fundamental property relation, Chemical potential and phase equilibria, Partial properties, Ideal gas mixture model, fugacity and fugacity coefficient for pure species and in solution, Ideal solution model and excess properties.

**Module-IV: Applications of Solution Thermodynamics**

Solution thermodynamics Application: Liquid phase properties from VLE data, Models for the excess Gibbs energy, Property changes of mixing. Phase Equilibria: Nature of equilibrium, phase rule, VLE qualitative

behavior, Simple Models for VLE, VLE by Modified Raoults law and VLE from K-value charts, Equilibrium and stability, Osmotic Equilibrium and osmotic pressure, liquid- liquid equilibrium and solid liquid equilibrium.

**Module-V: Thermodyanamic Equilibrium**

The reaction coordinates, Application of the criteria for equilibrium to chemical reactions, the standard Gibbs free energy change and the equilibrium constant, effect temperature on equilibrium constant, evaluation of the equilibrium constants, Relation of equilibrium constants to composition, equilibrium conversions for reactions, phase rule for reacting systems.

**Reference Books and Suggested Readings:**

"Introduction to Chemical Engineering Thermodynamics" by J.M. Smith and H.C. Van Ness, McGraw Hill International Ltd, 2005.

1. "Chemical Engineering Thermodynamics" by Y.V.C. Rao, Universities Press (India) Ltd. Hyderabad
2. "Chemical and Process Thermodynamics", Kyle B.G., 3rd ed., Prentice Hall. 1999.
3. Chemical, Biochemical & Engineering Thermodynamics by S. Sandler. 4th Ed., John Wiley & sons, 2006.
4. "Chemical Engineering Thermodynamics", by Narayanan, K.V., Prentice Hall. 2007.

**HHS-202: ENGINEERING ECONOMICS AND MANAGEMENT**

| | | |
|---|---|---|
| **Course: B.Tech** | **Branch:** CS/IT/EE/ET,<br>All Chemical technology Branches | **Year / Semester: IIIrd , Final** |
| **Sessional Marks:** | **50** | **Credit: 3** |
| **End Semester Exam:** | **50** | **LTP: 3 1 0** |

**UNIT I Introduction to Economics**:

Overview: production possibility curve, choices-what, how and for whom, micro- and macro economics, inflation, unemployment, GDP and business cycle; demand and supply, elasticity of demand, consumer surplus and its applications, utility theory.

**UNIT II Production and Cost**:

Factors of production, production function, law of variable proportion, isoquant analysis, return to scale, economies of scale;

Types of costs: direct and indirect costs, explicit and implicit costs, opportunity cost, economic cost, fixed cost and variable costs, average and marginal costs, short-run and long-run costs, optimal combination of factor-inputs.

**UNIT III Market Structure:**

Perfectly Competitive Market, Imperfect market: Monopoly, Oligopoly, Monopolistic Market

**UNIT IV Fundamentals of Management**:

Development of Management Thoughts, Objectives, Functions of Management: Planning, Organising, Directing, Controlling and Coordination.

**UNIT V Business Enterprises**-

Business Ownership: Sole Proprietorship, Partnership, Company: Promotion, Formation & Development, Cooperative Firms.

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**Text books:**


1. **Koutsoyiannis, A**., 'Modern Microeconomics', English Language Book Society, Macmillan.
2. **Joseph, L Massod,** "Essential of Management", Prentice Hall, India.


**Additional Reference Books**:


1. **Armstrong, Michel**, "A Handbook of Management Techniques", Kogan Page Limited
2. **Babcock, D L and Lucy C Morse**, "Managing Engineering and Technology", third edition, Pearson Education, 2006
3. **Pindyck, R S, Rubinfeld, D L & Mehta** , 'Microeconomics', 6 th Edition, Pearson Education India.
4. **Barthwal, R R , Microeconomic Analysis**
5. **Samuelson, Paul A** , 'Economics', 5th edition, McGraw Hill New York.
6. **Henderson, J M and Quadnt, R E** , 'Microeconomic Theory: A Mathematical Approach.', Tata MacGraw Hill, New Delhi,2003

7. **H. Varian,** 'Intermediate Micro Economics'
8. **G. Mankiw,''**Principles of Micro Economics

**Additional references will be provided in class

**Course Objectives (COs)**

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

1. This course is important for B.Tech students to understand essential economic principles for solving economic problems with suitable policy alternatives.
2. It is helpful to know how rational consumers can maximize their satisfaction with limited incomes and to make best use of their resources. This knowledge is useful to Engg & technical students in their professional carrier particularly in corporate and manufacturing sector.
3. The knowledge of production principles and cost analysis are useful for engg & technical students when they will deal with cost and production management as managers.
4. Market knowledge is important for engg. & technical students, to study the contemporary market situations, market strategy to manage the industries.
5. It gives basic knowledge of management techniques.
6. Topic Business Enterprises will provide to develop Entrepreneurship skills towards formation of partnership, companies their functions, collection of capital from various sources and their proper utilisation.

**HHS:205/206 INDIAN CONSTITUTION**

| | | |
|---|---|---|
| **Course: MCA** | **Branch:** | **Year / Semester:** |
| **Sessional Marks:** | **50** | **Credit: 2** |
| **End Semester Exam:** | **50** | **LTP: 2 0 0** |

**UNIT – I- Indian Constitution**

Sources and Features, Preamble, Fundamental Rights, Fundamental Duties and Directive Principles of State Policy

**UNIT-II- Union Executive**

President, Vice President, Prime Minister, Council of Ministers, State Executives- Governor, Chief Minister and Council of Ministers

**UNIT- III- Union Legislature**

Parliament- Composition and Functions, Speaker of Lok Sabha, Amendment Process, State Legislature- Vidhaan Sabha, Panchaayati Raj, Institutions- History, Basic Features and 73rd Amendment

**UNIT- IV- Judiciary**

Supreme Court, High Courts, Judicial Review and Judicial Activism

**UNIT-V- Election Commission**

Election Commission: Role and Functioning, Chief Election Commissioner and Election Commissioners, State Election Commission: Role and Functioning, Institute and Bodies for the Welfare of SC/ST/OBC and Women.

**Reference Books:**


1. Indian Constitution : D.D Basu
2. Indian Administration: Avasthi and Avasti


**Additional Reference Books**


1. The Indian Constitution: Corner Stone of a Nation, G. Austin, Oxford University Press.
2. Indian Politics: Contemporary Issues and Concerns, M. P. Singh and Rekha Saxena, Prentice Hall of India, Delhi

**Course Objectives (COs)**

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

1. Configure the preambles & fundamental rights.
2. Actuate the governance & functioning of constitutional functionaries.
3. Describe the functions of legislative bodies.
4. Decipher the judiciary system & its role in governance.
   Develop a democratic process through electoral me

# *Year 3rd semester 5 & 6*

# *Syllabus of*

# *other Departments*

**TCH – 301 : MASS TRANSFER OPERATIONS**

| L | T | P | C |
|---|---|---|---|
| 3 | 1 | 0 | 4 |

**OBJECTIVE:** The objective of this course is to enable the students

to understand different separation techniques such as distillation, adsorption, and extraction.
to understand the laws of diffusion and unit operations such as absorption, drying, crystallization and humidification and dehumidification.

**Course Outcome**

On the successful completion of the course, students will be able to

| | | |
|---|---|---|
| **CO1** | understand the extent of separation achieved for a binary or multicomponent system undergoing flash, steam, batch or fractional distillation. | Understand |
| **CO2** | apply mathematical equations to calculate number of theoretical stages required for a given extent of separation by liquid-liquid or solid-liquid extraction for cross current and countercurrent flows. | Apply |
| **CO3** | apply mathematical equations to calculate the extent of adsorption for adsorption operations, mass transfer rates and diffusion coefficients for liquid. | Apply |
| **CO4** | analyze the similarity of mass, heat and momentum transfer – Analogy and to perform the calculations by psychrometric chart. | Analyze |
| **CO5** | analyze to design contactors for gas absorption system, constant rate drying systems and crystallizers | Analyze |

**Syllabus**

**Module-I: Mass Transfer and Diffusion** Mass Transfer and Diffusion: Steady-state ordinary molecular diffusion: Fick's law of diffusion; Equimolar counter diffusion; Stagnant film diffusion, Diffusion coefficients: Diffusivity in gas mixtures, diffusivity in liquid mixtures, Mass transfer in turbulent flow: Reynolds analogy; Chilton-Colburn analogy; Other analogies, Models for mass transfer at a fluid-fluid interface: Film theory; Penetration theory; surface-renewal theory; film-penetration theory, Two-film theory and overall mass transfer coefficients Absorption and Stripping: Equipments, Gas-liquid equilibrium, Henry's law, Selection of solvent, Absorption in tray column, Graphical and analytical methods.

**Module-II: Distillation** Distillation: Pressure-composition, Temperature-composition, Enthalpy-composition diagrams for ideal and non-ideal solutions; Raoult's law and its application; Maximum and minimum boiling mixtures; Concept of relative volatility; Single Stage Distillation-Differential distillation, Flash vaporization; Vacuum, molecular and steam distillations. Continuous Distillation of Binary Mixtures: Multistage contact operations, Characteristics of multistage tower, McCabe-Thiele method, Ponchon-Savarit method, Concept of theoretical or ideal stage; Reflux ratio-maximum, minimum and optimum reflux ratio, Use of open steam, Tray efficiency, Principles of azeotropic and extractive distillation, Introduction to multicomponent distillation system.

**Module-III: Extraction** Liquid-Liquid Extraction: Applications; Ternary liquid-liquid equilibria; Triangular graphical representation; Equipment used for single stage and multistage continuous operation; Analytical and graphical solution of single and multistage operation. Solid-Liquid Extraction: Applications; Solid-liquid equilibrium; Equipment used in solid liquid extraction; Single and multistage crosscurrent contact and countercurrent operations; Overall stage efficiency; Determination of number of stages.

**Module-IV: Humidification and Drying** Humidification and Dehumidification: Vapor-liquid equilibrium and enthalpy for a pure substance, vapor pressure temperature curve, Vapour gas mixtures, Definition and derivations of relationships related with humidity, Fundamental concept of humidification, Dehumidification and Water cooling, Wet bulb temperature, Adiabatic and non-adiabatic operations, Evaporative cooling ,Classification and design of cooling towers. Drying: Solid-gas equilibrium, Different modes of drying operations, Definitions of moisture contents, Types of batch and continuous dryers, Rate of batch drying, Time of drying, Mechanism of batch drying, Continuous drying.

**Module-V: Crystallization and Adsorption** Crystallization: Crystal geometry-Crystal-size distribution; Thermodynamic considerations, Solubility and material balances, Enthalpy balance; Super saturation, Nucleation, Crystal growth; Equipment for solution crystallization. Adsorption: Description of adsorption processes and their application, Types of adsorption, Nature of adsorbents; Adsorption isotherms and adsorption hysteresis; Stage wise and continuous contact adsorption operations, Determination of number of stages.

## Reference Books and Suggested Readings:


1. Treybal, R.E. "Mass Transfer Operations", 3rd ed. New York: McGraw-Hill, (1980).
2. Seader, J.D. and Henley, E.J., "Separation Process Principles", 2nd ed., Wiley India Pvt. Ltd., New Delhi (2013).
3. Sherwood, T. K., Pigford, R. L. and Wilke, C.R. "Mass Transfer" McGraw Hill (1975).
4. Geankoplis, C.J. "Transport Processes and Separation Process Principles", 4th ed., PHI Learning Private Limited, New Delhi (2012)

**TCH – 303 : CHEMICAL REACTION ENGINEERING**

| L | T | P | C |
|---|---|---|---|
| 3 | 1 | 0 | 4 |

**OBJECTIVE**: The objective of this course is to enable the students

To apply the basic knowledge of calculus, differential equations, thermodynamics, general chemistry, and material and energy balances to solve reactor design problems.
To examine reaction rate data to determine rate laws, and to use them to design chemical reactors with associated cooling/heating equipment and simulation.
To analyse Non-ideal flow behaviour in reactors.

**Course Outcome**

On the successful completion of the course, students will be able to

| | | |
|---|---|---|
| **CO1** | Understand the basic concepts involved in using reaction rate equations and kinetic constants and development of rate laws for homogenous reactions. | Understand |
| **CO2** | Apply the knowledge to design ideal reactors for single and complex reactions, non isothermal reactors and the heat exchange equipment. | Apply |
| **CO3** | Understand optimal reactor configurations and operating policies for systems involving multiple reactions. | Understand |
| **CO4** | Understand to represent flow in real vessels for scale up using dispersion model and tanks in series models. | Understand |
| **CO5** | Analyze reactors involving non-ideal flow based on residence time distribution theory | Analyze |

**Syllabus**

**Module-I: Elements of Reaction Engineering**

Rate of Reaction, Elementary and non-elementary homogeneous reactions, Molecularity and order of reaction, Mechanism of reaction, temperature dependency from thermodynamics, collision and activated complex theories. Integral and differential methods for analyzing kinetic data, interpretation of constant volume reactor, zero, first, second and third order reactions, half life period, irreversible reaction in parallel and series, catalytic reaction, auto catalytic reaction, reversible reactions.

**Module-II: Reaction Engineering I**

Interpretation of variable volume batch reactions for zero, first and second order reactions, Space-time and state-velocity, design equation for ideal batch, steady-state continuous stirred tank, steady-state plug flow reactors for isothermal reaction.

**Module-III: Reaction Engineering II**

Design for single reactions, Size comparison of single reactors, Multiple reactor systems, plug flow/mixed flow reactors in series and parallel, reactors of different types in series, optimum reactor size, recycle reactor, autocatalytic reactions.

**Module-IV: Reaction Engineering III**

Introduction to multiple reactions, qualitative discussion about product distribution, quantitative treatment of product distribution and of reactor size, selectivity, the side entry reactor, irreversible first-order reactions in series, Quantitative treatment: plug flow or batch reactor, Quantitative treatment: mixed flow reactor, Successive irreversible reactions of different orders, reversible reactions, irreversible series-parallel reactions, the Denbigh reactions and their special cases.

**Module-V: Reaction Thermodynamics and Engineering**

Heat of reaction from thermodynamics, equilibrium constants from thermodynamics, General graphical design procedure for non-isothermal reactors, Optimum temperature progression, Heat effects: Adiabatic operations and non-adiabatic operations, Exothermic reactions in mixed flow reactors. Residence time distribution of fluids in vessels, State of aggregation of the flowing systems, Earliness of mixing, Role of RTD, State of Aggregation and earliness of mixing in determining reactor behavior, E, F and C curves, Conversion in Non-ideal flow reactors.

## Reference Books and Suggested Readings:


1. Levenspiel, O., “Chemical Reaction Engineering”, 3rd edition, John Wiley, (1998).
2. Smith, J, M,“Chemical Engineering Kinetics”, 3rd edition, McGraw-Hill (1990).

3. Chemical and Catalytic Reaction Engineering, Carberry, J. J., Dover Books on Chemistry, 2001.
4. Chemical Reactor Analysis and Design Gilbert F. Froment, Kenneth B. Bischoff, Juray De Wilde, John Wiley & Sons, Incorporated, 2010.

## EME-325 ENERGY CONVERSION SYSTEMS & DEVICES 4[3-1-0]

## For III B. Tech. [BE/FT/OT/PT/PL/LT to be offered in V Semester]

**Unit I**

**Properties of steam**

Pure substance, Property of steam, Triple point, Critical point, Sub-cooled liquid, Saturation states, Superheated states, Phase transformation process of water, Graphical representation of pressure, volume and temperature, P-T & P-V diagrams, T-S and H-S diagrams, use of property diagram, Steam- Tables & Mollier charts, Dryness factor and it's measurement, Simple Rankine cycle.

**Unit II**

Zeroth Law, First Law and Second Law of Thermodynamics, Entropy, Enthalpy.

Boilers: Steam generators-classifications. Working of fire-tube and water-tube boilers, boiler mountings & accessories, Draught & its calculations, air pre heater, feed water heater, super heater. Boiler efficiency, Equivalent evaporation. Boiler trial and heat balance.

Condenser: Classification of condenser, Air leakage, Condenser performance parameters

**Unit III**

Classifications of centrifugal pumps, Vector diagram, Work done by impellor, Efficiencies of centrifugal pumps, Specific speed, Model testing, Cavitation, Separation and their control, Performance characteristics.

Positive Displacement Pumps: Reciprocating pump theory, Slip and coefficient of discharges, Indicator diagram, Effect and acceleration, Work saved by fitting air vessels, Comparison of centrifugal and reciprocating pumps, Positive rotary pumps, Gear and Vane pumps, Performance characteristics. Hydraulic accumulator, Special duty pumps, Intensifier, Hydraulic press, Air lift pumps.

**Unit IV**

Compressors, their classification, Atomizers, Centrifuges, Steam ejectors, homogenizers, chillers Design of pressure vessels - thick and thin cylinders, pipe and joints, flanges and valves.

**Unit V**

Internal Combustion Systems, Introduction: Otto Diesel cycles, 2/4 stroke engines, thermal efficiency. Knocking and detonation.

**Textbooks:**

1. Thermodynamics : An Engineering Approach by Cengel & Boles, Mc Graw Hill
2. Hydraulic Machines: Theory & Design, V.P.Vasandhani, Khanna Pub

**Reference Books:**

1. Hydraulic Machines by Jagdish Lal, Metropolitan book co. pvt ltd.
2. Thermodynamics by J.P. Holman, McGraw Hill.

**HHS-341: ENTREPRENEURSHIP DEVELOPMENT**

| | | |
|---|---|---|
| **Course: B.Tech** | **Branch: All** | **Year / Semester: Final Year** |
| **Sessional Marks:** | **50** | **Credit: 3** |
| **End Semester Exam:** | **50** | **LTP: 3 1 0** |

**UNIT I Entrepreneurship**:

Definition, requirements to be an entrepreneur, entrepreneur and intrapreneur, entrepreneur and manager, growth of entrepreneurship in India, women entrepreneurship, rural and urban entrepreneurship.

**Entrepreneurial Motivation:** motivating factors, motivation theories-Maslow's Need Hierarchy Theory, McClelland's Acquired Need Theory, government's policy actions towards entrepreneurial motivation, entrepreneurship development programmes.

**UNIT II Business Enterprises and Ownership Structure**:

Small scale, medium scale and large scale enterprises, role of small enterprises in economic development; proprietorship, partnership, companies and co-operatives firms: their formation, capital structure and source of finance.

**UNIT III Project Management**:

Identification and selection of projects; project report: contents and formulation, concept of project evaluation, methods of project evaluation: internal rate of return method and net present value method.

**UNIT IV Management of Enterprises**:

Strategy & policy, introduction to human resource management, marketing strategies, financial management & strategies: raising and managing capital, shares, debentures and bonds, cost of capital; break- even analysis.

**UNIT V Institutional Support and Policies**:

Institutional support towards the development of entrepreneurship in India: Institutional framework, venture capitalist; technical consultancy organizations (TCOs), government policies for small scale enterprises

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**References:**


1. **Khanka, S S**. 'Entrepreneurial Development', S Chand & Company Ltd. New Delhi
2. **Desai, Vasant**, ' Project Management and Entrepreneurship', Himalayan Publishing House, Mumbai, 2002.


**Additional Reference Books**


1. **Gupta and Srinivasan**, 'Entrepreneurial Development', S Chand & Sons, New Delhi.
2. **Ram Chandran**, 'Entrepreneurial Development', Tata McGraw Hill, New Delhi
3. **Saini, J. S**. 'Entrepreneurial Development Programmes and Practices', Deep & Deep Publications (P), Ltd
4. **Holt, Davis, '**Entrepreneurship : New Venture Creations, PHI
5.


**Course Objectives (COs)**

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

1. Describe what it takes an Entrepreneur; describe multiple ways to become an entrepreneur; including, intrapreneur, manager, woman entrepreneur rural & urban: highlights motives to become entrepreneur.
2. Apply the beginner concept, ownership and various forms with focus on small scale enterprises.
3. Identify opportunities using identification; project conceptualisation, formulation & evaluation.
4. Identify potential contribution of human resources, marketing, financial and strategic management with fund, opportunities
5. Decipher the role of Institution support and policy framework of Government for enterprises in India.

**TCH – 302 : INSTRUMENTATION AND PROCESS CONTROL**

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**OBJECTIVE:** The objective of this course is to enable the students

To understand the fundamentals of process control with applications using P, PI, and PID controllers.
To apply the mathematical models based on transfer function approach for single loop systems and to obtain dynamic response of closed loop systems.
To understand stability analysis in transient and frequency domains, and controller tuning methods.

**Course Outcome**

On the successful completion of the course, students will be able to

| | | |
|---|---|---|
| **CO1** | Understand and interpret control diagrams. | Understand |
| **CO2** | Apply to design and tuning of controllers for specific applications. | Apply |
| **CO3** | Apply mathematical equations to calculate the dynamic response of closed loop systems. | Apply |
| **CO4** | Analyze to check the stability of systems using Bode and Nyquist stability criterion. | Analyze |
| **CO5** | Apply techniques for solving problems of process control at lab scale. | Apply |

**Syllabus**

**Module-I: Introduction to Process Control** Introduction to Process control systems, Use of Laplace & Inverse Laplace Transformation in study of Process Dynamics & Control . Dynamic Modeling of a Process, Dynamic behavior of First order system, First order systems in series & second & higher order systems for various kind of inputs, Linearization of nonlinear systems, Transportation & Transfer Lag.

**Module-II: Classification of Control Systems** Classification of control systems, Regulator & Servo control, Feed Forward & Feed backward control, Negative & Positive Feed back Control, Modes of control action, Controllers & Final control Elements, Reduction of Block & Signal Flow Diagrams.

**Module-III: Response and Stability** Closed loop transfer function, Response of closed loop control system for various type of control actions. Concept of stability, Stability Criterion, Routh test for stability, Frequency response analysis and its applications.

**Module-IV: Process Control Instruments** Principles of measurements and classification of process control instruments, Functional elements of an instrument, Static & Dynamic Characteristics of instruments,

Transducers, Error analysis, Measurement of temperature: expansion thermometers, Resistance Thermometers, thermocouples, Thermistors, Pyrometers.

**Module-V: Measurement of Pressure** Measurement of pressure: Manometers, Elastic pressure transducers, Measurement of Vacuum, flow, measurement: Inferential flow measurements, Quantity flowmeters, Mass flowmeters, Liquid level, measurements: Direct methods, indirect methods, electrical methods, and viscosity.

**Module-VI: Laboratory Experiments** Transient response to single tank system with storage & Flow to (a) step change (b) impulse change in put, Transient response of interacting and non-interacting systems in series, Study the operation of ON-OFF electronic temperature controller & determination of its performance to control the temperature of a system having capacity to store thermal energy, Transient response of a CSTR System to step change, Study the dynamics of parallel & counter flow shell & tube heat exchanger, Controlling of Parallel Flow & counter flow STHE using digital PI controller to have desired output, Dynamics characteristics of mercury & water manometers, Study of control value characteristics, Study the performance of cascade control system & to maintain desired level in a tank, with flow.

## Reference Books and Suggested Readings:


1. Coughnour and Koppel, " Process Systems Analysis and Control ", McGraw-Hill, New York, 1986.
2. S. K. Singh, " Industrial Instrumentation and Control ", Tata McGraw-Hill, 2008.
3. George Stephanopolous, " Chemical Process Control ", Prentice-Hall of India Pvt-Ltd., New Delhi, 1990.
4. Nakra and Chaudhary, " Instumentation Measurement and Analysis", Tata McGraw Hill, 1978.
5. P. K. Sarkar, " Process Dynamics and Control", Prentice Hall India, 2014.
6. D. N. Considine, "Process Instrumentation and Controls Handbook", Considine, McGraw Hill


**BMA-302, OPERATIONS RESEARCH**

**(III-B.Tech, CSE/IT)**

**(Effective from Session 2019-20)**

**L T P**

**3 1 0**

**UNIT I: Linear Programming Problems (LPP)**

OR model, Formulation of LPP. model, Graphical LPP solution and sensitivity analysis, simplex method, M-method, Two-phase method, Special cases in simplex method application, Duality theory, Dual simplex method, Revised simplex method, Degeneracy, Sensitivity analysis, Various industrial application of LP.

**UNIT II: Transportation Models, Assignment Models and Integer Programming:**

Formulation and Optimal solution of transportation models, Assignment models, Transshipment models, Degeneracy in TP model, Industrial application, Formulation and Solution of integer linear programming problems; Cutting-plane algorithm, Branch and Bound algorithm, 0-1 ILPP, applications, Knapsack problem, facility-location problem.

**UNIT III: Sequencing and Scheduling Model:**

Sequencing problems- Travelling salesman problem, Machine-scheduling problem (Job shop), Network based planning models, Objectives of CPM and PERT, Characteristics of CPM/PERT projects, Network diagram, Terminology, Critical path, Project duration, PERT Network, Activity time, Probabilities of project completion, Optimal crashing of project activities.

**UNIT IV: Replacement and Inventory models:**

**Replacement Problems:** Optimal age of equipment replacement, capital equipment discounting cost, Replacement of items that fail, Individual and group replacement policies.
**Inventory Models:** Deterministic inventory models, Classic EOQ model, EOQ with price breaks, Multiterm, stochastic inventory models under probabilistic demand and lead times.

**UNIT V: Dynamic Programming and Genetic Algorithms:**

**Dynamic programming:** Bellman's principle of optimality, computations in DP, Forward and Backward recursions, Dynamic Programming formulations, Investment problem, General allocation problem, Storage coach problem, Production scheduling.
**Genetic Algorithms:** Working principles, similarities and differences between Gas and Traditional methods, Gas for constrained optimization, Applications of Gas to solve simple problems.

**Text Books Recommended:**
**1.** S.S. Rao, "Optimization: Theory and Applications" Willey Eastern Limited.
2. H.A. Taha, " Operations Research- AN Introduction", Macmillan.
3. Hiller, F.S., G.J. Lieberman, "Introduction to Operations Research", Hoiden-Day.
4. Kalyanmoy Deb, "Optimizaton for Engineering Design: Algorithms & Examples " Prentice- Hall of India.

5. B.E. Gillet, Introduction Operations Research- A Computer Oriented Algorithmic Approach, McGraw Hill 1989.

**Objective / Outcomes, Operations Research**

Operation Research is the application of modern methods of mathematical science to complex problems involving management of large systems of men, machines, materials and money in industry, business, government and defence. Operations research has wide scope and has been successfully applied in the following areas:

- Financial Management
- Inventory Control
- Simulation Technique
- Capital Budgeting
- Decision Making

Linear programming has been used to solve problems involving assignment of jobs to machines, blending, product mix, advertising media selection, least cost diet, distribution, transportation, investment portfolio selection and many others.

Transportation problem is the most useful model of L.P.P. which simplify calculation to find solution of L.P.P. containing more number of variables and constraints. It deals with the transportation of a product available at several sources to a number of different destination. Transportation model can be used for a wide variety of situations such as scheduling, production, investment, plant location, inventory control, employment scheduling, personnel assignment, product mix problems and many others.

Sequencing and Scheduling Model has been helpful to solve problems of appropriate selection of the number of jobs (operations) which are assigned to a finite number of service facilities (machines or equipments) so as to optimize the output in items of time, cost or profit. Network techniques of PERT and CPM have been used in planning, scheduling and controlling construction of dams, bridges, roads, highways and development and production of aircrafts, ships, computers, etc.

Inventory control models have been used to determine economic order quantities, safety stocks, reorder levels, minimum and maximum stock levels.

Replacement theory has been extensively employed to determine the optimum replacement interval for three types of replacement problems.

Dynamic programming has been applied to capital budgeting, selection of advertising media, employment smoothening, cargo loading and optimal routing problems.

# *Year 4th semester 7 & 8*

# *Syllabus of*

# *other Departments*

**TCH – 402 : TRANSPORT PHENOMENON**

**OBJECTIVE:** The objective of this course is **t**o enable the students

Understand coupling between three transport phenomena with applications in various disciplines in engineering and science.
Understand to demonstrate the common mathematical structure of transport problems.
Apply mathematical equations in solving flow problems involving newtonian and non-newtonian fluids, solid-state heat conduction, forced and free convection, binary diffusion with or without chemical reaction.

**Course Outcome**

On the successful completion of the course, students will be able to

| | | |
|---|---|---|
| **CO1** | Understand to perform basic vector and tensor analysis. | Understand |
| **CO2** | Apply mathematical equations to solve transport problems using shell balances. | Apply |
| **CO3** | Apply mathematical equations to formulate and to solve one-dimensional transport problems by using the conservation equations. | Apply |
| **CO4** | Apply mathematical equations to formulate simple multi-dimensional transport problems. | Apply |
| **CO5** | Analyze transport phenomenon equations for diffusion. | Analyze |

**Syllabus**

**Module-I: Solution of Transport Problems - I**

Newton's law of viscosity, non–Newtonian fluids, pressure & temperature dependence of viscosity, estimation of viscosity from critical properties. Shell momentum balances, boundary conditions, flow of a falling film, flow through a circular tube, flow through annular, creeping flow along a solid sphere.

**Module-II: Solution of Transport Problems - II**

Time derivatives, The equation of continuity, the equation of motion, the equations of change in curvilinear, co-ordinates, use of the equations of change to set up steady flow problems.

**Module-III: Solution of Transport Problems - III**

Unsteady viscous flow, flow near a wall suddenly set in motion, Boundary layer theory.

**Module-IV: Transport Problems using Shell Energy Balances**

Shell energy balances, temperature profiles, average temperature, energy fluxes at surfaces, Equations of change (non-isothermal), equation of continuity, equation of motion for forced and free convection, equation of energy (non-isothermal).

**Module-V: Transport Problems on Diffusion**

Definitions of concentrations, velocities & mass fluxes, Fick's law of diffusion, Temperature & pressure dependence of mass diffusivity, Maxwell's law of diffusion. Shell mass balance, boundary conditions, diffusion through a stagnant gas film. Diffusion with heterogeneous chemical reaction, Diffusion with homogeneous chemical reaction, Diffusion in to a falling liquid film.

## Reference Books and Suggested Readings:


1. Bird, R. B., Stewart, W. E. and Lightfoot, E. N., "Transport Phenomena", 2nd edition John Wiley (1960).
2. Bannet, C. O. and Myers J. E., "Momentum Heat and Mass Transfer" Tata McGraw Hill, (1973).
3. RS Brodkey and HC Hersey, "Transport Phenomena: AUnified approach", McGraw-Hill Book,(1988).

**PROGRAMME ELECTIVE COURSE IV**

| | L | T | P | C |
|---|---|---|---|---|
| **TCH-404 : PROCESS MODELING AND SIMULATION** | **3** | **0** | **0** | **3** |

**OBJECTIVE:** The objective of this course is to enable the students

Understand to explore the basic concepts and steady state equations of simple systems in chemical process industries.
To deal with the techniques for derivation of system model equations, data analysis and visualization.
To develop the tools to analyze the system and to visualize the effect of various process inputs on system performance and state variables.
To present the basic idea and concept on process model with detailed analysis and solution of model equations for steady and unsteady operations.

**Course Outcome**

On the successful completion of the course, students will be able to

| | | |
|---|---|---|
| **CO1** | Apply knowledge of mathematics for developing model deterministic systems and differentiate between nonlinear and linear models. | Apply |
| **CO2** | Analyze numerically to simulate linear and non linear ordinary differential equations for deterministic systems. | Analyze |
| **CO3** | Apply mathematical equations to estimate and to validate a model based upon input and output data. | Apply |
| **CO4** | Apply mathematical equations to create a model prediction based upon new input and validate the output data. | Apply |
| **CO5** | Analyze for developing steady state models for flash vessels, equilibrium staged processes, distillation columns, absorbers, strippers, CSTR, heat exchangers and packed bed reactors. | Analyze |
| **CO6** | Apply knowledge to demonstrate on various simulation packages and available numerical software libraries. | Apply |

**Syllabus**

**Module-I: Introduction to Mathematical Modeling**

Introduction to mathematical modeling; Advantages and limitations of models and applications of process models of stand-alone unit operations and unit processes; Classification of models: Linear vs. Non linear, Lumped parameter vs. Distributed parameter; Static vs. Dynamic, Continuous vs. Discrete; Numerical Methods: Iterative convergence methods, Numerical integration of ODE- IVP and ODE-BVP.

**Module-II: Process Models I**

Concept of degree of freedom analysis: System and its subsystem, System interaction, Degree of freedom in a system e.g. Heat exchanger, Equilibrium still, Reversal of information flow, Design variable selection algorithm, Information flow through subsystems, Structural effects of design variable selection, Persistent Recycle.

**Module-III: Process Models II**

Simple examples of process models; Models giving rise to nonlinear algebraic equation (NAE) systems, - steady state models of flash vessels, equilibrium staged processes distillation columns, absorbers, strippers, CSTR, heat exchangers, etc.; Review of solution procedures and available numerical software libraries.

**Module-IV: Process Models III**

Steady state models giving rise to differential algebraic equation (DAE) systems; Rate based approaches for staged processes; Modeling of differential contactors – distributed parameter models of packed beds; Packed bed reactors; Modeling of reactive separation processes; Review of solution strategies for Differential Algebraic Equations (DAEs), Partial Differential Equations (PDEs), and available numerical software libraries. Introduction to unsteady state models and their applications.

**Module-V: Simulation and Their Approaches**

Simulation and their approaches, Modular, Sequential, Simultaneous and Equation solving approach, Simulation softwares and their applications, Review of solution techniques and available numerical software libraries. Review of thermodynamic procedures and physical property data banks.

### Reference Books and Suggested Readings:


1. Luyben W.L., "Process Modeling, Simulation, and Control for Chemical Engineering", Mc Graw Hill.
2. D. F. Rudd and C. C. Watson, " Strategy of Process Engineering", Wiley international.
3. M.M. Denn, "Process Modelling", Wiley, New York, (1990).
4. A. K. Jana, "Chemical Process Modelling and Computer Simulation", PHI,(2011).
5. C.D. Holland, "Fundamentals of Modelling Separation Processes", Prentice Hall, (1975).
6. Hussain Asghar, "Chemical Process Simulation", Wiley Eastern Ltd., New Delhi, (1986).


## ELECTIVE COURSE IV

| | L | T | P | C |
|---|---|---|---|---|
| **TCH-406 : PROCESS EQUIPMENT DESIGN** | **3** | **0** | **0** | **3** |

**OBJECTIVE:** The objective of this course is to enable the students

To understand the basic knowledge of design parameters, design procedures for commonly used process equipment and their attachments and different types of equipment testing methods.

**Course Outcome**

On the successful completion of the course, students will be able to

| | | |
|---|---|---|
| **CO1** | Understand the basics of process equipment design and important parameters of equipment design | Understand |
| **CO2** | Apply knowledge to design pressure vessels, tall vessels, and self supporting | Apply |

| | | |
|---|---|---|
| | vessels, and skirt, etc. | |
| **CO3** | Apply knowledge to design liquid and gas storage tanks with and without floating roof. | Apply |
| **CO4** | Apply knowledge to select standard piping, flanges, gaskets and bolts associated with the vessels and storage tanks. | Apply |

**Syllabus**

**Module-I: Introduction to Equipment Design**

Introduction: Classification of engineering materials, properties of Ferrous metals, Non ferrous metals, alloys & Ceramic materials Structure-Property relationship in materials. Deformation of Materials Fracture: Elastic deformation, Plastic deformation, Creep, Visco-elastic deformation, Different types of fracture, Corrosion And Prevention: Direct Corrosion, electro-chemical corrosion, Galvanic cells, High temperature corrosion, Passivity, factor influencing corrosion rate, Control and of corrosion-modification of corrosive environment, Inhibitors, Cathodic protection, protective coatings. Corrosion charts, Metal forming techniques (bending, Rolling, Forming) & Metal joining techniques – welding (Gas of Arc & Electric) for various types such as Butt, Lap, fillet, corner. Inspection of vessel by radiography.

**Module-II: Design of Pressure Vessels**

Pressure Vessels: Type of pressure vessels, Thin cylinder theory for internal pressure. Code & standard for pressure vessels (IS:2825: 1969), Design considerations, classification of pressure vessels as per codes, design of cylindrical and spherical shells under internal and external pressure, selection and design of closures and heads such as Flat, hemispherical, tori-spherical, elliptical & conical.; Introduction to compensation for opening such as nozzles & manholes etc.

**Module-III: Design of Flanges and Piping**

Flanges: Selection of gaskets, selection of standard flanges, optimum selection of bolts for flanges, design of flanges. Inspection and testing of vessels, heads and flanges as per code specifications. Piping: Pipe thickness calculation under internal and external pressure, introduction to flexibility analysis of piping system.

**Module-IV: Design of Tall Tower and Supports**

Tall Tower Design: Design of shell, skirt, bearing plate and anchor bolts for tall tower used at high wind and seismic conditions. Supports: Design of lug support and saddle support including bearing plates and anchor bolts.

**Module-I: Design of Storage Tanks**

Storage Tanks: Introduction to Indian standards, filling and breathing losses; classification of storage tanks; Design of liquid and gas storage tanks with and without floating roof. High-pressure vessels, Fundamental equations, Compound vessels, Liquid storage tanks, Mechanical design of centrifuges, Centrifugal pressure, Bowl and spindle motion: critical speed.

## Reference Books and Suggested Readings:


1. Brownell L. E. and Young H. E., "Process Equipment Design", John Wiley and Sons.2004
2. Bhattacharya B. C., "Introduction of Chemical Equipment Design", CBS Publisher.2003
3. I.S.:2825-1969, "Code for Unfired Pressure Vessels", Bureau of Indian Standards.1969
4. I.S.:803-1962, "Code of Practice for Design, Fabrication and Erection of Vertical Mild Steel Cylindrical Welded Oil Storage Tanks", Bureau of Indian Standards.1962
5. Moss D. R., "Pressure Vessel Design Manual", 3rd Ed., Gulf Publishers.2004
6. Annartone D., "Pressure Vessel Design", Springer-Verlag2007
7. M.V.Joshi and V.V.Mahajani, "Process Equipment Design "Macmillan India
8. J.M.Coulson, J.F.Richardson and R.H.Sinnott," Chemical Engineering Volume