**DEPARTMENT OF AGRICULTURAL ENGINEERINGASSAM UNIVERSITY: SILCHAR**

**Curriculumof**
**Undergraduate Degree CourseIn**
**Agricultural Engineering**

**General, Course structure & Theme & Semester-wise credit distribution**

## A. Definition of Credit:

| | |
|---|---|
| 1 Hr. Lecture (L) per week | 1 credit |
| 1 Hr. Tutorial (T) per week | 1 credit |
| 1 Hr. Practical (P) per week | 0.5 credit |
| 2 Hours Practical(Lab)/week | 1 credit |

**B. Range of credits -** A range of credits from 150 to 160 for a student to be eligible to get Under Graduate degree in Engineering. A student will be eligible to get Under Graduate degree with Honors or additional Minor Engineering, if he/she completes an additional 20 credits. Thesecould be acquired through MOOCs.

## C. Structure of Undergraduate Engineering program:

| Sl. No. | Category | Credit Breakup |
|---|---|---|
| 1 | Humanities and Social Sciences including Management courses | 13 |
| 2 | Basic Science courses | 22 |
| 3 | Engineering Science courses including workshop, drawing, basics of electrical/mechanical/computer etc. | 24 |
| 4 | Professional core courses | 56 |
| 5 | Professional Elective courses relevant to chosen specialization/branch | 18 |
| 6 | Open subjects – Electives from other technical and /or emerging subjects | 12 |
| 7 | Project work, seminar and internship in industry or elsewhere | 15 |
| 8 | Mandatory Courses [Environmental Sciences, Induction Program, Indian Constitution, Essence of Indian Knowledge Tradition] | (non-credit) |
| | **Total** | **160** |

## D. Credit distribution in the First year of Undergraduate Engineering program:

| | Lecture | Tutorial | Laboratory/ Practical | Total credits |
|---|---|---|---|---|
| Chemistry-I | 3 | 1 | 4 | 6 |
| Physics | 3 | 1 | 4 | 6 |
| Mathematics-I | 3 | 1 | 0 | 4 |
| Mathematics -II | 3 | 1 | 0 | 4 |
| Programming for Problem solving | 3 | 0 | 4 | 5 |
| English | 2 | 0 | 4 | 4 |
| Engineering Graphics & Design | 1 | 0 | 4 | 3 |
| Workshop/ManufacturingPractices | 1 | 0 | 4 | 3 |
| Basic Electrical Engineering | 3 | 1 | 2 | 5 |
| *Basic Electronics Engineering | 3 | 1 | 0 | 4 |
| *Engineering Mechanics | 3 | 1 | 0 | 4 |
| *Mathematics -III | 2 | 0 | 0 | 2 |

***These courses are offered in the 3rd semester& onwards.**

## E. Course code and definition:

| Course code | Definitions |
|---|---|
| BSC | Basic Science Courses |
| ESC | Engineering Science Courses |
| HSMC | Humanities and Social Sciences including Management courses |
| PCC-AE | Professional core courses |
| PEC -AE | Professional Elective courses |
| OEC-AE | Open Elective courses |
| LC | Laboratory course |
| MC | Mandatory courses |
| SI | Summer Industry Internship |
| PROJ-AE | Project |

## HUMANITIES AND SOCIAL SCIENCES INCLUDING MANAGEMENT COURSES [HSMC]

| Sl. No. | Code No. | Course Title | Hours per week | | | Total Credits | Semester |
|---|---|---|---|---|---|---|---|
| | | | Lecture | Tutorial | Practical | | |
| 1 | HSMC 101 | English-I | 1 | 0 | 2 | 2 | 1 |
| 2 | HSMC 201 | English-II | 1 | 0 | 2 | 2 | 2 |
| 3 | HSMC 301 | Humanities-1 (Effective Technical Communication) | 3 | 0 | 0 | 3 | 3 |
| 4 | HSMC 401 | Management-I (Organizational Behavior) | 3 | 0 | 0 | 3 | 4 |
| 5 | HSMC 501 | Operations Research and Industrial Management | 3 | 0 | 0 | 3 | 5 |
| | | | | | **Total Credits:** | **13** | |

## BASIC SCIENCE COURSES [BSC]

| Sl. No. | CodeNo. | Course Title | Hours per week | | | Total Credits | Semester |
|---|---|---|---|---|---|---|---|
| | | | Lecture | Tutorial | Practical | | |
| 1 | BSC101 | Engineering Physics | 3 | 1 | 4 | 6 | 1 |
| 2 | BSC 102 | Mathematics-I | 3 | 1 | 0 | 4 | 1 |
| 3 | BSC 201 | Mathematics-II (Probability and Statistics) | 3 | 1 | 0 | 4 | 2 |
| 4 | BSC 202 | Chemistry-I | 3 | 1 | 4 | 6 | 2 |
| 5 | BSC 301 | Mathematics-III (Ordinary Differential Equation and Complex Variable) | 2 | 0 | 0 | 2 | 3 |
| | | | | | **Total Credits:** | **22** | |

## ENGINEERING SCIENCE COURSES [ESC]

| Sl. No. | CodeNo. | Course Title | Hours per week | | | Total Credits | Semester |
|---|---|---|---|---|---|---|---|
| | | | Lecture | Tutorial | Practical | | |
| 1 | ESC 101 | Engineering Graphics & Design | 1 | 0 | 4 | 3 | 1 |
| 2 | ESC 102 | Workshop/Manufacturing Practices | 1 | 0 | 4 | 3 | 2 |
| 3 | ESC 201 | Programming for Problem Solving | 3 | 0 | 4 | 5 | 2 |
| 4 | ESC 202 | Basic Electrical Engineering | 3 | 1 | 2 | 5 | 1 |
| 5 | ESC 301 | Basic Electronics Engineering | 3 | 1 | 0 | 4 | 2 |
| 6 | ESC 302 | Engineering Mechanics | 3 | 1 | 0 | 4 | 2 |
| | | | | | **Total Credits:** | **24** | |

**PROFESSIONAL CORE COURSES [PCC]**

| Sl. No. | CodeNo. | Course Title | Hours per week | | | Total Credits | Semester |
|---|---|---|---|---|---|---|---|
| | | | Lecture | Tutorial | Practical | | |
| 1 | AE301 | Fluid Mechanics | 2 | 0 | 2 | 3 | 3 |
| 2 | AE302 | Thermodynamics | 2 | 1 | 0 | 3 | 3 |
| 3 | AE303 | Advanced Workshop Technology | 0 | 0 | 4 | 2 | 3 |
| 4 | AE401 | Strength of Materials | 2 | 1 | 0 | 3 | 4 |
| 5 | AE402 | Surveying and Leveling | 2 | 0 | 2 | 3 | 4 |
| 6 | AE403 | Soil Science and Soil Mechanics | 2 | 0 | 2 | 3 | 4 |
| 7 | AE404 | Farm Power | 2 | 0 | 2 | 3 | 4 |
| 8 | AE405 | Post Harvest Operations | 2 | 0 | 2 | 3 | 4 |
| 9 | AE501 | Kinematics and Theory of Machines | 2 | 1 | 0 | 3 | 5 |
| 10 | AE502 | Watershed Hydrology | 2 | 0 | 2 | 3 | 5 |
| 11 | AE503 | Farm Machinery | 2 | 0 | 2 | 3 | 5 |
| 12 | AE504 | Mechanical Operation in Food Processing | 2 | 0 | 2 | 3 | 5 |
| 13 | AE 505 | Renewable Energy Technologies | 2 | 0 | 2 | 3 | 5 |
| 14 | AE 601 | Thermal Operation in Food Processing | 2 | 0 | 2 | 3 | 6 |
| 15 | AE 602 | Machine Design and drawing | 2 | 0 | 2 | 3 | 6 |
| 16 | AE 603 | Soil & Water Conservation Engg. | 2 | 0 | 2 | 3 | 6 |
| 17 | AE 604 | Irrigation & Drainage Engineering | 2 | 0 | 2 | 3 | 6 |
| 18 | AE 701 | Land and Water Resource Management | 3 | 0 | 0 | 3 | 7 |
| 19 | AE 702 | Fruits and Vegetable Processing | 3 | 0 | 0 | 3 | 7 |
| | | | | | | | |
| | | | | | **Total Credits:** | **56** | |

**PROFESSIONAL ELECTIVE COURSES [PEC]**

| Sl. No. | Code No. | Course Title | Hours per week | | | Total Credits | Semester |
|---|---|---|---|---|---|---|---|
| | | | Lecture | Tutorial | Practical | | |
| 1 | AEZXX | Elective - I | 3 | 0 | 0 | 3 | 5 |
| 2 | AEZXX | Elective - II | 3 | 0 | 0 | 3 | 6 |
| 3 | AEZXX | Elective - III | 3 | 0 | 0 | 3 | 6 |
| 4 | AEZXX | Elective -IV | 3 | 0 | 0 | 3 | 7 |
| 5 | AEZXX | Elective -V | 3 | 0 | 0 | 3 | 7 |
| 6 | AEZXX | Elective - VI | 3 | 0 | 0 | 3 | 8 |
| | | | | | **Total Credits:** | **18** | |

## PROFESSIONAL ELECTIVE COURSE TRACKS- AGRICULTURAL ENGINEERING [PEC-AE]

The students will have options of selecting the electives from the different tracks/threads depending on the specialization one wishes to acquire. The following Five Professional Specialized Tracks offer electives in the respective Tracks:

| Track / Threads | Professional Specialized Tracks | Professional Elective Courses (PEC-AE) | |
|---|---|---|---|
| A | Water Resources Development and Management | A01<br>A02<br>A03 | Watershed Planning and Management<br>Environmental Engineering Fundamentals<br>Environmental Microbiological Principles |
| B | Food Process Engineering | B01<br>B02<br>B03<br>B04 | Food Chemistry and MicrobiologyRefrigeration &<br>Air Conditioning Tea Technology<br>Dairy Food Technology |
| C | Farm Machinery and Power Engineering | C01<br>C02<br>C03<br>C04<br>C05<br>C06 | Testing & Evaluation of Tractors & Machines<br>Advanced Farm Power<br>Instrumentation and ControlEarth Moving<br>Machinery Ergonomics and Safety<br>Hydraulic Drives and Controls |
| D | Aquacultural Engineering | D01 | Aquacultural Engineering |
| E | Allied Engineering Applications | E01<br>E02<br>E03 | Agricultural Business Management<br>Building Materials & Structural Design<br>Statistical Methods in Agriculture |

## OPEN ELECTIVE COURSES [OEC]

| Sl. No. | Code No. | Course Title | Hours per week | | | Total Credits | Semester |
|---|---|---|---|---|---|---|---|
| | | | Lecture | Tutorial | Practical | | |
| 1 | OEC ASH27 | Open Elective I (Humanities) Understanding Culture and Society through Literature | 3 | 0 | 0 | 3 | 6 |
| 2 | OEC | Open Elective – II | 3 | 0 | 0 | 3 | 7 |
| 3 | OEC | Open Elective - III | 3 | 0 | 0 | 3 | 8 |
| 4 | OEC | Open Elective – IV | 3 | 0 | 0 | 3 | 8 |
| | | | | | **Total Credits:** | **12** | |

## OPEN ELECTIVE COURSES [OEC]

| Sl. No. | Courses |
|---|---|
| 1 | Soft Skills and Interpersonal CommunicationICT for Development Human Resource |
| 2 | Development and Organizational Behavior |
| 3 | Cyber Law and Ethics |
| 4 | Introduction to Philosophical Thoughts |
| 5 | Comparative Study of Literature |
| 6 | Indian Music System |
| 7 | History of Science & Engineering |
| 8 | Introduction to Art and Aesthetics |
| 9 | Economic Policies in India |

**Note**: There should be at least two electives from the Open Elective Course choices (OEC). The rest two can be taken from the other threads, if intended.

**PROJECT WORK, SEMINAR AND INTERNSHIP IN INDUSTRY OR ELSEWHERE**

| Sl. No. | Code No. | Course Title | Hours per week | | | Total Credits | Semester |
|---|---|---|---|---|---|---|---|
| | | | Lecture | Tutorial | Practical | | |
| 1 | AE 510 | Summer Industry Internship - I | - | - | - | 2 | 5 |
| 2 | AE 703 | Summer Industry Internship - II | - | - | - | 2 | 7 |
| 3 | AE 704 | Project- I | 0 | 0 | 10 | 5 | 7 |
| 4 | AE 801 | Project- II | 0 | 0 | 12 | 6 | 8 |
| | | | | | **Total Credits:** | **15** | |

**MANDATORY COURSES**

| Sl. No. | Code No. | Course Title | Hours per week | | | Total Credits | Semester |
|---|---|---|---|---|---|---|---|
| | | | Lecture | Tutorial | Practical | | |
| 1 | MC -1 | Environmental Sciences | 2 | 0 | 0 | - | 4 |
| 2 | MC-2 | Constitution of India/ Essence of Indian Knowledge Tradition | 2 | 0 | 0 | - | 5 |

**4 year Curriculum structure Undergraduate Degree in Engineering & Technology**
**Branch / course: Agricultural EngineeringTotal credits (4 year course) 160**

**I. Induction Program** (Please refer Appendix-A of Model Curriculum for Undergraduate Degree Courses in Engineering & Technology January 2018 Volume - I published by AICTE for guidelines)

| **Induction program(mandatory)** | 3 weeks duration<br>(Please refer Appendix-A for guidelines & alsodetails available in the curriculum of Mandatory courses) |
|---|---|
| Induction program for students to be Offered right at the start of the first year | ✓ Physical activity<br>✓ Creative Arts<br>✓ Universal Human Values<br>✓ Literary<br>✓ Proficiency Modules<br>✓ Lectures by Eminent People<br>✓ Visits to local Areas<br>✓ Familiarization to Dept./ Branch & Innovations |

**II. Semester-wise structure of curriculum**
**[L= Lecture, T = Tutorials, P = Practical & C = Credits]**

**Semester I [First year]**
**Branch/Course: Agricultural Engineering**

| Sl. No. | CourseCode | Course Title | Hours per week | | | Total Contact hours | Credits |
|---|---|---|---|---|---|---|---|
| | | | Lecture | Tutorial | Practical | | |
| 1 | ASH 101 | Engineering Physics | 3 | 1 | 4 | 8 | 6 |
| 2 | ASH 102 | Mathematics-I | 3 | 1 | 0 | 4 | 4 |
| 3 | ASH 104 | English-I | 1 | 0 | 2 | 3 | 2 |
| 4 | ASH 105 | Workshop / Manufacturing Practices | 1 | 0 | 4 | 5 | 3 |
| 5 | ASH 106 | Engineering Graphics | 1 | 0 | 4 | 5 | 3 |
| | | | | | | **Total Credits:** | **18** |

## Semester II [First year]
## Branch/Course: Agricultural Engineering

| Sl. No. | CourseCode | Course Title | Hours per week | | | Total Contact hours | Credits |
|---|---|---|---|---|---|---|---|
| | | | Lecture | Tutorial | Practical | | |
| 1 | ASH 201 | Mathematics-II (Probability and Statistics) | 3 | 1 | 0 | 4 | 4 |
| 2 | ASH 202 | Chemistry-I | 3 | 1 | 4 | 8 | 6 |
| 3 | ASH 203 | Programming for Problem Solving | 3 | 0 | 4 | 7 | 5 |
| 4 | ASH 204 | Basic Electrical Engineering | 3 | 1 | 2 | 6 | 5 |
| 5 | ASH 205 | English-II | 1 | 0 | 2 | 3 | 2 |
| | | | | | | **Total Credits:** | **22** |

## Semester III [Second year]
## Branch/Course: Agricultural Engineering

| Sl. No. | Course Code | Course Title | Hours per week | | | Total Contact hours | Credits |
|---|---|---|---|---|---|---|---|
| | | | Lecture | Tutorial | Practical | | |
| 1 | ASH 301 | Mathematics-III (OrdinaryDifferential Equation and Complex Variable) | 2 | 0 | 0 | 2 | 2 |
| 2 | ASH 302 | Basic Electronics Engineering | 3 | 1 | 0 | 4 | 4 |
| 3 | ASH 303 | Engineering Mechanics | 3 | 1 | 0 | 4 | 4 |
| 4 | ASH 304 | Humanities-1 (Effective Technical communication) | 3 | 0 | 0 | 3 | 3 |
| 5 | AE 301 | Fluid Mechanics | 2 | 0 | 0 | 2 | 2 |
| 6 | AE 302 | Thermodynamics | 2 | 1 | 0 | 3 | 3 |
| 7 | AE 303 | Fluid Mechanics Lab | 0 | 0 | 2 | 2 | 1 |
| 8 | AE 304 | Advanced Workshop Technology | 0 | 0 | 4 | 4 | 2 |
| | | | | | | **Total Credits:** | **21** |

## Semester IV [Second year]
## Branch/Course: Agricultural Engineering

| Sl. No. | Course Code | Course Title | Hours per week | | | Total Contact hours | Credits |
|---|---|---|---|---|---|---|---|
| | | | Lecture | Tutorial | Practical | | |
| 1 | ASH 401 | Management-I (Organizational Behavior) | 3 | 0 | 0 | 3 | 3 |
| 2 | AE 401 | Strength of Materials | 2 | 1 | 0 | 3 | 3 |
| 3 | AE 402 | Surveying and Leveling | 2 | 0 | 0 | 2 | 2 |
| 4 | AE 403 | Soil Science and Soil Mechanics | 2 | 0 | 0 | 2 | 2 |
| 5 | AE 404 | Farm Power | 2 | 0 | 0 | 2 | 2 |
| 6 | AE 405 | Post Harvest Operations | 2 | 0 | 0 | 2 | 2 |
| 7 | AE 406 | Surveying and Leveling Lab | 0 | 0 | 2 | 2 | 1 |
| 8 | AE 407 | Soil Science and Soil Mechanics Lab | 0 | 0 | 2 | 2 | 1 |
| 9 | AE 408 | Farm Power Lab | 0 | 0 | 2 | 2 | 1 |
| 10 | AE 409 | Post-Harvest Operations Lab | 0 | 0 | 2 | 2 | 1 |
| 11 | MC -1 | Environmental Sciences | 2 | 0 | 0 | 2 | 0 |
| | | | | | | **Total Credits:** | **18** |

## Semester V [Third year]
## Branch/Course: Agricultural Engineering

| Sl. No. | Course Code | Course Title | Hours per week | | | Total Contact hours | Credits |
|---|---|---|---|---|---|---|---|
| | | | Lecture | Tutorial | Practical | | |
| 1 | ASH 501 | Operations Research and Industrial Management | 3 | 0 | 0 | 3 | 3 |
| 2 | AE 501 | Kinematics and Theory of Machines | 2 | 1 | 0 | 3 | 3 |
| 3 | AE 502 | Watershed Hydrology | 2 | 0 | 0 | 2 | 2 |
| 4 | AE 503 | Farm Machinery | 2 | 0 | 2 | 2 | 2 |
| 5 | AE 504 | Mechanical Operation in Food Processing | 2 | 0 | 0 | 2 | 2 |
| 6 | AE 505 | Renewable Energy Technologies | 2 | 0 | 2 | 2 | 2 |
| 7 | AE ZXX | Elective - I | 3 | 0 | 0 | 3 | 3 |
| 8 | AE 506 | Watershed Hydrology Lab | 0 | 0 | 2 | 2 | 1 |
| 9 | AE 507 | Farm Machinery Lab | 0 | 0 | 2 | 2 | 1 |
| 10 | AE 508 | Mechanical Operation in Food Processing Lab. | 0 | 0 | 2 | 2 | 1 |
| 11 | AE 509 | Renewable Energy Technologies Lab | 0 | 0 | 2 | 2 | 1 |
| 12 | AE 510 | Summer Industry Internship - I | - | - | - | - | 2 |
| 13 | MC-2 | Constitution of India | - | - | - | - | 0 |
| | | **Total Credits:** | | | | | **23** |

## Semester VI [Third year]
## Branch/Course: Agricultural Engineering

| Sl. No. | Course Code | Course Title | Hours per week | | | Total Contact hours | Credits |
|---|---|---|---|---|---|---|---|
| | | | Lecture | Tutorial | Practical | | |
| 1 | AE 601 | Thermal Operation in Food Processing | 2 | 0 | 0 | 2 | 2 |
| 2 | AE 602 | Machine Design and Drawing | 2 | 0 | 0 | 2 | 2 |
| 3 | AE 603 | Soil & Water Conservation Engineering | 2 | 0 | 0 | 2 | 2 |
| 4 | AE 604 | Irrigation & Drainage Engineering | 2 | 0 | 2 | 2 | 2 |
| 5 | AE ZXX | Elective - II | 3 | 0 | 0 | 3 | 3 |
| 6 | AE ZXX | Elective - III | 3 | 0 | 0 | 3 | 3 |
| 7 | OEC 27 | Open Elective – I (Humanities) | 3 | 0 | 0 | 3 | 3 |
| 8 | AE 605 | Thermal Operation in Food Processing Lab | 0 | 0 | 2 | 2 | 1 |
| 9 | AE 606 | Machine Design and drawing Lab | 0 | 0 | 2 | 2 | 1 |
| 10 | AE 607 | Soil & Water Conservation Engineering Lab | 0 | 0 | 2 | 2 | 1 |
| 11 | AE 608 | Irrigation & Drainage Engineering Lab | 0 | 0 | 2 | 2 | 1 |
| | | | | | | **Total Credits:** | **21** |

## Semester VII [Fourth year]
## Branch/Course: Agricultural Engineering

| Sl. No. | Course Code | Course Title | Hours per week | | | Total Contact hours | Credits |
|---|---|---|---|---|---|---|---|
| | | | Lecture | Tutorial | Practical | | |
| 1 | AE 701 | Land and Water Resource Management | 3 | 0 | 0 | 3 | 3 |
| 2 | AE 702 | Fruits and Vegetable Processing | 2 | 1 | 0 | 3 | 3 |
| 3 | AE ZXX | Elective - IV | 3 | 0 | 0 | 3 | 3 |
| 4 | AE ZXX | Elective -V | 3 | 0 | 0 | 3 | 3 |
| 5 | OEC | Open Elective – II | 3 | 0 | 0 | 3 | 3 |
| 6 | AE 703 | Summer Industry Internship - II | - | - | - | - | 2 |
| 7 | AE 704 | Project- I | 0 | 0 | 10 | 10 | 5 |
| | | | | | | **Total Credits:** | **22** |

## Semester VIII [Fourth year]
## Branch/Course: Agricultural Engineering

| Sl. No. | Course Code | Course Title | Hours per week | | | Total Contact hours | Credits |
|---|---|---|---|---|---|---|---|
| | | | Lecture | Tutorial | Practical | | |
| 1 | AE ZXX | Elective - VI | 3 | 0 | 0 | 3 | 3 |
| 2 | OEC | Open Elective – III | 3 | 0 | 0 | 3 | 3 |
| 3 | OEC | Open Elective – IV | 3 | 0 | 0 | 3 | 3 |
| 4 | AE 801 | Project- II | 0 | 0 | 12 | 12 | 6 |
| | | | | | | **Total Credits:** | **15** |

**DETAILED 4-YEAR CURRICULUM CONTENTS**
**Undergraduate Degree in Engineering & Technology**
**Branch/Course: AGRICULTURAL ENGINEERING**

**HUMANITIES AND SOCIAL SCIENCES INCLUDING MANAGEMENT COURSES [HSMC]**

| | | | |
|---|---|---|---|
| **HSMC 101** | **English** | **1L:0T:2P** | **2 Credits** |
| **HSMC 201** | **English** | **1L:0T:2P** | **2 Credits** |

**Teaching Scheme:** Lectures - 1 hours/week; Laboratory –2 hours/week

**Course Outcomes**

The student will acquire basic proficiency in English including reading and listening comprehension, writing and speaking skills.

**Syllabus Contents**

**Unit 1: Vocabulary Building**

1.1 The concept of Word Formation
1.2 Root words from foreign languages and their use in English
1.3 Acquaintance with prefixes and suffixes from foreign languages in English to form derivatives.
1.4 Synonyms, antonyms, and standard abbreviations.

**Unit 2: Basic Writing Skills**

2.1 Sentence Structures
2.2 Use of phrases and clauses in sentences
2.3 Importance of proper punctuation
2.4 Creating coherence
2.5 Organizing principles of paragraphs in documents
2.6 Techniques for writing precisely

**Unit 3: Identifying Common Errors in Writing**

3.1 Subject-verb agreement
3.2 Noun-pronoun agreement
3.3 Misplaced modifiers
3.4 Articles
3.5 Prepositions
3.6 Redundancies
3.7 Clichés

**Unit 4: Nature and Style of sensible Writing**

4.1 Describing
4.2 Defining
4.3 Classifying
4.4 Providing examples or evidence
4.5 Writing introduction and conclusion

**Unit 5: Writing Practices**

5.1 Comprehension
5.2 Précis Writing
5.3 Essay Writing

**Unit 6: Oral Communication**

(This unit involves interactive practice sessions in Language Lab)

- Listening Comprehension
- Pronunciation, Intonation, Stress and Rhythm
- Common Everyday Situations: Conversations and Dialogues
- Communication at Workplace
- Interviews
- Formal Presentations

**Suggested Readings**


1. Practical English Usage. Michael Swan. OUP. 1995.
2. Remedial English Grammar. F.T. Wood. Macmillan. 2007
3. On Writing Well. William Zinsser. Harper Resource Book. 2001
4. Study Writing. Liz Hamp-Lyons and Ben Heasly. Cambridge University Press. 2006
5. Communication Skills. Sanjay Kumar and Pushp Lata. Oxford University Press. 2011.
6. Exercises in Spoken English. Parts. I-III. CIEFL, Hyderabad. Oxford University Press.


| HSMC 301 | Humanities-1 (Effective Technical Communication) | 3L:0T:0P | 3 Credits |
|---|---|---|---|

**Teaching Scheme:** Lectures - 3 hours/week

**Syllabus Contents**

**Module 1:** Information Design and Development- Different kinds of technical documents, Information development life cycle, Organization structures, factors affecting information and document design, Strategies for organization, Information design and writing for print and for online media.

**Module 2:** Technical Writing, Grammar and Editing- Technical writing process, forms of discourse, Writing drafts and revising, Collaborative writing, creating indexes, technical writing style and language. Basics of grammar, study of advanced grammar, editing strategies to achieve appropriate technical style. Introduction to advanced technical communication, Usability, Hunan factors, Managing technical communication projects, time estimation, Single sourcing, Localization.

**Module 3:** Self Development and Assessment- Self assessment, Awareness, Perception and Attitudes, Values and belief, Personal goal setting, career planning, Self-esteem. Managing Time; Personal memory, Rapid reading, Taking notes; Complex problem solving; Creativity

**Module 4:** Communication and Technical Writing- Public speaking, Group discussion, Oral; presentation, Interviews, Graphic presentation, Presentation aids, Personality Development. Writing reports, project proposals, brochures, newsletters, technical articles, manuals, official notes, business letters, memos, progress reports, minutes of meetings, event report.

**Module 5:** Ethics- Business ethics, Etiquettes in social and office settings, Email etiquettes, Telephone Etiquettes, Engineering ethics, Managing time, Role and responsibility of engineer, Work culture in jobs, Personal memory, Rapid reading, Taking notes, Complex problem solving, Creativity.

**References**


1. David F. Beer and David Mc Murrey, Guide to writing as an Engineer, John Willey. NewYork, 2004
2. Diane Hacker, Pocket Style Manual, Bedford Publication, New York, 2003. (ISBN 0312406843)
3. Shiv Khera, You Can Win, Macmillan Books, New York, 2003.
4. Raman Sharma, Technical Communications, Oxford Publication, London, 2004.
5. Dale Jungk, Applied Writing for Technicians, McGraw Hill, New York, 2004. (ISBN: 07828357-4)
6. Sharma, R. and Mohan, K. Business Correspondence and Report Writing, TMH New Delhi2002.
7. Xebec, Presentation Book, TMH New Delhi, 2000. (ISBN 0402213)


| HSMC 401 | Management-I: (Organizational Behaviour) | 3L:0T:0P | 3 Credits |
|---|---|---|---|

**Teaching Scheme:** Lectures - 3 hours/week

**Objectives**

To understand the various facets of individual, group and organizational behavior which have an impact on personal and organizational effectiveness.

**Syllabus Contents**

**Unit 1: Behavioral Concepts**: Nature and Concepts of OB, Models of Organizational Behavior, Relationship with Other Fields, Contemporary challenges. Learning: Nature and Significance of

Learning, Process of Learning, Theories of Learning

**Unit 2 :Motivation Concepts**: Nature of Motivation, Classification of Motives, Motivation Process, Theories of Motivation: Early Theories: Hierarchy of Needs, Two-Factor Theory, McClelland's Theory of Needs; Contemporary Theories: Goal Setting Theories, Reinforcement Theory, Equity Theory, Expectancy Theory Attitudes: Nature & Dimensions of Attitude, Components of Attitude, Types of Attitude, Cognitive Dissonance Theory.

**Unit 3 : Perception**: Perceptual Process Model, Social Identity Theory, Attribution Theory: Attribution Errors, Perceptual Errors in Organizational Setting, Improving Perceptions Personality: Meaning of Personality, Determinants of Personality, Five–Factor Model of Personality, Myers-Briggs Type Indicator (MBTI); Theories of Personality: Freudian Theory (Psychoanalytic Theory of Personality), Erik Erikson Stages of Personality Development, Trait Theory, Jungian Theory given by Carl Jung .

**Unit 4 : Group Dynamics**: Nature of Group Dynamics, Types, Stages of Group Formation: The Five Stage Model; Group Structure: Group Tasks, Team Development: Nature, Significance, Comparing Work Groups and Work Teams, Types of Work-Teams, Team-Effectiveness Model, Team Process, Contemporary Issues in Managing Teams, Concept of Conflict.

**Unit 5: Organizational Change**: Meaning and approaches to managing organizational change, creating a culture for change implementing the change Kurt Lewn Model of change.

**Unit 6: Leadership**: Nature, Components, Leadership Styles, Traits of Effective Leader, Myths, Models and Theories of Leadership, Leadership Skills.

**References**


1. Luthans Fred, "Organizational Behaviour", Tata McGraw Hill.
2. Rao V S P., "Organizational Behaviour", Excel Books.
3. Robbins Stephen P & Judge and Sanghi, "Organizational Behaviour", Pearson Education.
4. Aswathapa K., "Organisational Behaviour", Himalaya Publishing House.
5. Prasad L.M., Organisational Behaviour", Sultan Chand & Sons.


| HSMC 501 | Operations Research and Industrial Management | 3L:0T:0P | 3 Credits |
|---|---|---|---|

**Teaching Scheme:** Lectures - 3 hours/week

**Course Outcomes**

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

- Apply the dynamic programming to solve problems of discreet and continuous variables.
- Apply the concept of non-linear programming.
- Carry out sensitivity analysis.
- Model the real world problem and simulate it.

**Syllabus Contents**

**Unit 1:** Optimization Techniques, Model Formulation, models, General L.R Formulation, Simplex Techniques, Sensitivity Analysis, Inventory Control Models

**Unit 2:** Formulation of a LPP - Graphical solution revised simplex method - duality theory - dualsimplex method - sensitivity analysis - parametric programming

**Unit 3:** Nonlinear programming problem - Kuhn-Tucker conditions min cost flow problem -max flow problem - CPM/PERT

**Unit 4:** Scheduling and sequencing - single server and multiple server models - deterministicinventory models - Probabilistic inventory control models - Geometric Programming.

**Unit 5:** Competitive Models, Single and Multi-channel Problems, Sequencing Models, Dynamic Programming, Flow in Networks, Elementary Graph Theory, Game Theory Simulation.

**References**


1. H.A. Taha, Operations Research, An Introduction, PHI, 2008
2. H.M. Wagner, Principles of Operations Research, PHI, Delhi, 1982.
3. J.C. Pant, Introduction to Optimisation: Operations Research, Jain Brothers, Delhi, 2008

4. Hitler Libermann Operations Research: McGraw Hill Pub., 2009
5. Pannerselvam, Operations Research: Prentice Hall of India, 2010
6. Harvey M Wagner, Principles of Operations Research: Prentice Hall of India, 2010

**BASIC SCIENCE COURSES [BSC]**

| BSC 101 | Physics (Mechanics & Mechanics of Solids) | 3L:1T:4P | 6 Credits |
|---|---|---|---|

**Teaching Scheme:** Lectures - 3 hours/week; Tutorial – 1 hour/week; Laboratory – 4 hours/week

**Syllabus Contents**

**Module 1: Vector mechanics of particles (6 lectures)**

Transformation of scalars and vectors under Rotation transformation; Forces in Nature; Newton's laws and its completeness in describing particle motion; Form invariance of Newton's Second Law; Solving Newton's equations of motion in polar coordinates; Problems including constraints and friction; Extension to cylindrical and spherical coordinates; Potential energy function; F = - Grad V; Conservative and non-conservative forces; Central forces; Conservation of Angular Momentum

**Module 2: Planar rigid body mechanics (4 lectures)**

Definition and motion of a rigid body in the plane; Rotation in the plane; Kinematics in a coordinate system rotating and translating in the plane; Angular momentum about a point of a rigid body in planar motion; Euler's laws of motion, their independence from Newton's laws, and their necessity in describing rigid body motion; Examples.

**Module 3: Statics (10 lectures)**

Free body diagrams with examples on modelling of typical supports and joints; Condition forequilibrium in three- and two- dimensions; Friction: limiting and non-limiting cases; Force displacement relationship; Geometric compatibility for small deformations; Illustrations through simple problems on axially loaded members like trusses.

**Module 4: Mechanics of solids (10 lectures)**

Concept of stress at a point; Planet stress: transformation of stresses at a point, principal stresses and Mohr's circle; Concepts of elasticity, plasticity, strain hardening, failure (fracture /yielding); Idealization of one-dimensional stress-strain curve; Generalized Hooke's law with and without thermal strains for isotropic materials; Complete equations of elasticity; Force analysis — axial force, shear force. Torsion of circular shafts and thin-walled tubes (plastic analysis and rectangular shafts not to be discussed); Bending stress; Shear stress; Cases of combined stresses; Concept of strain energy

**References**

1. Engineering Mechanics, 2nd ed. — MK Harbola
2. Introduction to Mechanics — MK Verma
3. An Introduction to Mechanics — D Kleppner& R Kolenkow
4. Principles of Mechanics — JL Synge & BA Griffiths
5. Mechanics — JP Den Hartog
6. Engineering Mechanics — Dynamics, 7th ed. - JL Meriam
7. Mechanical Vibrations — JP Den Hartog
8. Theory of Vibrations with Applications — WT Thomson
9. An Introduction to the Mechanics of Solids, 2nd ed. with SI Units — SH Crandall, NC Dahl& TJ Lardner
10. Engineering Mechanics: Statics, 7th ed. — JL Meriam
11. Engineering Mechanics of Solids — EP Popov

| BSC 102 | Mathematics-I (Calculus & Linear Algebra) | 3L:1T:0P | 4 Credits |
|---|---|---|---|

**Teaching Scheme:** Lectures - 3 hours/week; Tutorial – 1 hour/week

**Syllabus Contents**

**Module 1: Calculus (4 lectures)**

Evolutes and involutes; Evaluation of definite and improper integrals; Beta and Gamma functions and their properties; Applications of definite integrals to evaluate surface areas and

volumes of revolutions.

**Module 2: Calculus: (4 lectures)**

Rolle's Theorem, Mean value theorems, Taylor's and Maclaurin theorems with remainders; indeterminate forms and L'Hospital's rule; Maxima and minima.

**Module 3: Sequences and series: (8 lectures)**

Convergence of sequence and series, tests for convergence; Power series, Taylor's series, seriesfor exponential, trigonometric and logarithm functions; Fourier series: Half range sine and cosine series, Parseval's theorem.

**Module 4: Multivariable Calculus (Differentiation): (6 lectures)**

Limit, continuity and partial derivatives, directional derivatives, total derivative; Tangent plane and normal line; Maxima, minima and saddle points; Method of Lagrange multipliers; Gradient, curl and divergence.

**Module 5: Matrices (8 lectures)**

Inverse and rank of a matrix, rank-nullity theorem; System of linear equations; Symmetric, skew symmetric and orthogonal matrices; Determinants; Eigenvalues and eigenvectors; Diagonalization of matrices; Cayley-Hamilton Theorem, and Orthogonal transformation.

**References**


1. G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9th Edition, Pearson, Reprint, 2002.
2. Erwin kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
3. Veerarajan T., Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi, 2008.
4. Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11th Reprint, 2010.
5. D. Poole, Linear Algebra: A Modern Introduction, 2nd Edition, Brooks/Cole, 2005.
6. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications,Reprint, 2008.
7. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010.


| BSC 201 | Mathematics-II (Probability and Statistics) | 3L:1T:0P | 4 Credits |
|---|---|---|---|

**Teaching Scheme:** Lectures - 3 hours/week; Tutorial – 1 hour/week

**Syllabus Contents**

**Module 1: Basic Probability (12 hours)**

Probability spaces, conditional probability, independence; Discrete random variables, Independent random variables, the multinomial distribution, Poisson approximation to the binomial distribution, infinite sequences of Bernoulli trials, sums of independent random variables; Expectation of Discrete Random Variables, Moments, Variance of a sum, Correlation coefficient, Chebyshev's Inequality.

**Module 2: Continuous Probability Distributions (4 hours)**

Continuous random variables and their properties, distribution functions and densities, normal, exponential and gamma densities.

**Module 3: Bivariate Distributions (4 hours)**

Bivariate distributions and their properties, distribution of sums and quotients, conditional densities, Bayes' rule.

**Module 4: Basic Statistics (8 hours)**

Measures of Central tendency: Moments, skewness and Kurtosis - Probability distributions: Binomial, Poisson and Normal - evaluation of statistical parameters for these three distributions, Correlation and regression – Rank correlation.

**Module 5: Applied Statistics (8 hours)**

Curve fitting by the method of least squares- fitting of straight lines, second degree parabolas and more general curves. Test of significance: Large sample test for single proportion, difference of proportions, single mean, difference of means, and difference of standard deviations.

**Module 6: Small samples (4 hours)**
Test for single mean, difference of means and correlation coefficients, test for ratio of variances - Chi-square test for goodness of fit and independence of attributes.

**References**

1. E. Kreyszig, "Advanced Engineering Mathematics", John Wiley & Sons, 2006.
2. P. G. Hoel, S. C. Port and C. J. Stone, "Introduction to Probability Theory", Universal BookStall, 2003.
3. S. Ross, "A First Course in Probability", Pearson Education India, 2002.
4. W. Feller, "An Introduction to Probability Theory and its Applications", Vol. 1, Wiley, 1968.
5. N.P. Bali and M. Goyal, "A text book of Engineering Mathematics", Laxmi Publications,2010.
6. B.S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, 2000.
7. T. Veerarajan, "Engineering Mathematics", Tata McGraw-Hill, New Delhi, 2010.


| BSC 202 | Chemistry-I | 3L:1T:4P | 6 Credits |
|---|---|---|---|

**Teaching Scheme:** Lectures - 3 hours/week; Tutorial – 1 hour/week; Laboratory –4 hours/week

**Course Outcomes**
The concepts developed in this course will aid in quantification of several concepts in chemistry that have been introduced at the 10+2 levels in schools. Technology is being increasingly based on the electronic, atomic and molecular level modifications. Quantum theory is more than 100 years old and to understand phenomena at nanometer levels, one has to base the description of all chemical processes at molecular levels. The course will enable the student to:

- Analyse microscopic chemistry in terms of atomic and molecular orbitals and intermolecularforces.
- Rationalise bulk properties and processes using thermodynamic considerations.
- Distinguish the ranges of the electromagnetic spectrum used for exciting different molecularenergy levels in various spectroscopic techniques
- Rationalise periodic properties such as ionization potential, electronegativity, oxidation states and electronegativity.
- List major chemical reactions that are used in the synthesis of molecules.

**Syllabus Contents**
**Unit 1: Atomic and molecular structure (12 lectures)**
Schrodinger equation. Particle in a box solutions and their applications for conjugated molecules and nanoparticles. Forms of the hydrogen atom wave functions and the plots of these functions to explore their spatial variations. Molecular orbitals of diatomic molecules and plots of the multicenter orbitals. Equations for atomic and molecular orbitals. Energy level diagrams of diatomics. Pimolecular orbitals of butadiene and benzene and aromaticity. Crystal field theory and the energy level diagrams for transition metal ions and their magnetic properties. Band structure of solids and the role of doping on band structures.
**Unit 2: Spectroscopic techniques and applications (8 lectures)**
Principles of spectroscopy and selection rules. Electronic spectroscopy. Fluorescence and its applications in medicine. Vibrational and rotational spectroscopy of diatomic molecules. Applications. Nuclear magnetic resonance and magnetic resonance imaging, surface characterization techniques. Diffraction and scattering.
**Unit 3: Intermolecular forces and potential energy surfaces (4 lectures)**
Ionic, dipolar and van Der Waals interactions. Equations of state of real gases and critical phenomena. Potential energy surfaces of H3, H2F and HCN and trajectories on these surfaces.
**Unit 4: Use of free energy in chemical equilibria (6 lectures)**
Thermodynamic functions: energy, entropy and free energy. Estimations of entropy and free energies. Free energy and emf. Cell potentials, the Nernst equation and applications. Acid base, oxidation reduction and solubility equilibria. Waterchemistry. Corrosion. Use of free energy

considerations in metallurgy through Ellingham diagrams.

**Unit 5: Periodic properties (4 Lectures)**

Effective nuclear charge, penetration of orbitals, variations of s, p, d and f orbital energies of atoms in the periodic table, electronic configurations, atomic and ionic sizes, ionization energies, electron affinity and electronegativity, polarizability, oxidation states, coordination numbers and geometries, hard soft acids and bases, molecular geometries

**Unit 6: Stereochemistry (4 lectures)**

Representations of 3 dimensional structures, structural isomers and stereoisomers, configurations and symmetry and chirality, enantiomers, diastereomers, optical activity, absolute configurations and conformational analysis. Isomerism in transitional metal compounds

**Unit 7: Organic reactions and synthesis of a drug molecule (4 lectures)**

Introduction to reactions involving substitution, addition, elimination, oxidation, reduction, cyclization and ring openings. Synthesis of a commonly used drug molecule.

**Laboratory**

Choice of 10-12 experiments from the following

- Determination of surface tension and viscosity
- Thin layer chromatography
- Ion exchange column for removal of hardness of water
- Determination of chloride content of water
- Colligative properties using freezing point depression
- Determination of the rate constant of a reaction
- Determination of cell constant and conductance of solutions
- Potentiometry - determination of redox potentials and emfs
- Synthesis of a polymer/drug
- Saponification/acid value of an oil
- Chemical analysis of a salt
- Lattice structures and packing of spheres
- Models of potential energy surfaces
- Chemical oscillations- Iodine clock reaction
- Determination of the partition coefficient of a substance between two immiscible liquids
- Adsorption of acetic acid by charcoal
- Use of the capillary viscometers to the demonstrate of the isoelectric point as the pH of minimum viscosity for gelatin sols and/or coagulation of the white part of egg.

**Laboratory 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:

- Estimate rate constants of reactions from concentration of reactants/products as a function oftime
- Measure molecular/system properties such as surface tension, viscosity, conductance of solutions, redox potentials, chloride content of water, etc.
- Synthesize a small drug molecule and analyze a salt sample

**References**


1. University chemistry, by B. H. Mahan
2. Chemistry: Principles and Applications, by M. J. Sienkoand R. A. Plane
3. Fundamentals of Molecular Spectroscopy, by C. N. Banwell
4. Engineering Chemistry (NPTEL Web-book), by B. L. Tembe, Kamaluddin and M. S. Krishnan
5. Physical Chemistry, by P. W. Atkins
6. Organic Chemistry: Structure and Function by K. P. C. Volhardt and N. E. Schore, 5th Editionhttp://bcs.whfreeman.com/vollhardtschore5e/default.asp

| BSC 301 | Mathematics-III (Ordinary Differential Equationand Complex Variable) | 2L:0T:0P | 2 Credits |
|---|---|---|---|

**Teaching Scheme :** Lectures - 2 hours/week

**Course Outcomes**

The objective of this course is to familiarize the prospective engineers with techniques in ordinary and partial differential equations and complex variables. It aims to equip the students to deal with advanced level of mathematics and applications that would be essential for their disciplines. The students will learn:

- The effective mathematical tools for the solutions of differential equations that model physical processes.
- The tools of differentiation and integration of functions of a complex variable that are used in various techniques dealing engineering problems.

**Syllabus Contents**

**Module 1: First order ordinary differential equations (6 lectures)**

Exact, linear and Bernoulli's equations, Euler's equations, Equations not of first degree: equations solvable for p, equations solvable for y, equations solvable for x and Clairaut's type.

**Module 2: Ordinary differential equations of higher orders (8 lectures)**

Second order linear differential equations with variable coefficients, method of variation of parameters, Cauchy-Euler equation; Power series solutions; Legendre polynomials, Bessel functions of the first kind and their properties.

**Module 3: Complex Variable – Differentiation and Integration (6 lectures)**

Differentiation, Cauchy-Riemann equations, analytic functions, harmonic functions, finding harmonic conjugate; elementary analytic functions (exponential, trigonometric, logarithm) and their properties; Contour integrals, Taylor's series, zeros of analytic functions, singularities, Evaluation of definite integral involving sine and cosine.

**References**


1. G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9th Edition, Pearson, Reprint,2002.
2. Erwin kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
3. W. E. Boyce and R. C. DiPrima, Elementary Differential Equations and Boundary ValueProblems, 9thEdn., Wiley India, 2009.
4. S. L. Ross, Differential Equations, 3rd Ed., Wiley India, 1984.
5. E. A. Coddington, An Introduction to Ordinary Differential Equations, Prentice Hall India,1995.
6. E. L. Ince, Ordinary Differential Equations, Dover Publications, 1958.
7. J. W. Brown and R. V. Churchill, Complex Variables and Applications, 7th Ed., Mc-GrawHill, 2004.
8. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications,Reprint, 2008.
9. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010.


**ENGINEERING SCIENCE COURSES [ESC]**

| ESC 101 | Programming for Problem Solving | 3L:0T:4P | 5 Credits |
|---|---|---|---|

**Teaching Scheme:** Lectures - 3 hours/week; Laboratory – 4 hour/week

**Course Outcomes**

The student will learn

- To formulate simple algorithms for arithmetic and logical problems.
- To translate the algorithms to programs (in C language).
- To test and execute the programs and correct syntax and logical errors.
- To implement conditional branching, iteration and recursion.

- To decompose a problem into functions and synthesize a complete program using divide andconquer approach.
- To use arrays, pointers and structures to formulate algorithms and programs.
- To apply programming to solve matrix addition and multiplication problems and searchingand sorting problems.
- To apply programming to solve simple numerical method problems, namely rot finding offunction, differentiation of function and simple integration.

**Unit 1*:* Introduction to Programming (4 lectures)**
Introduction to components of a computer system (disks, memory, processor, where a program is stored and executed, operating system, compilers etc.). (1 lecture).
Idea of Algorithm: steps to solve logical and numerical problems. Representation of Algorithm: Flowchart / Pseudocode with examples. (1 lecture)
From algorithms to programs; source code, variables (with data types) variables and memory locations, Syntax and Logical Errors in compilation, object and executable code. (2 lectures)
**Unit 2*:* Arithmetic expressions and precedence (12 lectures)**
Conditional Branching and Loops (6 lectures)
Writing and evaluation of conditionals and consequent branching (3 lectures) Iteration and loops (3 lectures)
**Unit 3*:* Arrays (6 lectures)**
Arrays (1-D, 2-D), Character arrays and Strings
**Unit 4*:* Basic Algorithms (6 lectures)**
Searching, Basic Sorting Algorithms (Bubble, Insertion and Selection), Finding roots of equations, notion of order of complexity through example programs (no formal definition required)
**Unit 5*:* Function (5 lectures)**
Functions (including using built in libraries), Parameter passing in functions, call by value, passing arrays to functions: idea of call by reference
**Unit 6*:* Recursion (4 -5 lectures)**
Recursion, as a different way of solving problems. Example programs, such as Finding Factorial, Fibonacci series, Ackerman function etc. Quick sort or Merge sort.
**Unit 7: Structure (4 lectures)**
Structures, Defining structures and Array of Structures
**Unit 8: Pointers (2 lectures)**
Idea of pointers, Defining pointers, Use of Pointers in self-referential structures, notion of linkedlist (no implementation)
**Unit 9:** File handling (only if time is available, otherwise should be done as part of the lab)

**Laboratory Outcomes**
- To formulate the algorithms for simple problems
- To translate given algorithms to a working and correct program
- To be able to correct syntax errors as reported by the compilers
- To be able to identify and correct logical errors encountered at run time
- To be able to write iterative as well as recursive programs
- To be able to represent data in arrays, strings and structures and manipulate them through a program
- To be able to declare pointers of different types and use them in defining self-referential structures.
- To be able to create, read and write to and from simple text files.

**Laboratory** - The laboratory should be preceded or followed by a tutorial to explain the approach or algorithm to be implemented for the problem given.

**Tutorial 1:** Problem solving using computers.
**Lab1:** Familiarization with programming environment
**Tutorial 2:** Variable types and type conversions:
**Lab 2:** Simple computational problems using arithmetic expressions.
**Tutorial 3:** Branching and logical expressions.
**Lab 3**: Problems involving if-then-else structures.
**Tutorial 4:** Loops, while and for loops.
**Lab 4:** Iterative problems e.g., sum of series.
**Tutorial 5:** 1D Arrays: searching, sorting
**Lab 5:** 1D Array manipulation.
**Tutorial 6:** 2D arrays and Strings.
**Lab 6:** Matrix problems, String operations.
**Tutorial 7:** Functions, call by value.
**Lab 7:** Simple functions.
**Tutorial 8 and 9:** Numerical methods (Root finding, numerical differentiation, numerical integration).
**Lab 8 and 9:** Programming for solving Numerical methods problems.
**Tutorial 10:** Recursion, structure of recursive calls.
**Lab 10:** Recursive functions.
**Tutorial 11:** Pointers, structures and dynamic memory allocation.
**Lab 11:** Pointers and structures.
**Tutorial 12:** File handling.
**Lab 12:** File operations.

**References**


1. Byron Gottfried, Schaum's Outline of Programming with C, McGraw-Hill
2. E. Balaguruswamy, Programming in ANSI C, Tata McGraw-Hill
3. Brian W. Kernighan and Dennis M. Ritchie, The C Programming Language, Prentice Hall of India


| ESC 102 | Engineering Graphics & Design | 1L:0T:4P | 3 Credits |
|---|---|---|---|

**Teaching Scheme:** Lectures - 1 hours/week; Laboratory – 4 hour/week

**Course Outcomes**

All phases of manufacturing or construction require the conversion of new ideas and design concepts into the basic line language of graphics. Therefore, there are many areas (civil, mechanical, electrical, architectural and industrial) in which the skills of the CAD technicians play major roles in the design and development of new products or construction. Students prepare for actual work situations through practical training in a new state-of-the-art computer designed CAD laboratory using engineering software. This course is designed to address:

- to prepare you to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
- to prepare you to communicate effectively
- to prepare you to use the techniques, skills, and modern engineering tools necessary for engineering practice

The student will learn:

- Introduction to engineering design and its place in society
- Exposure to the visual aspects of engineering design
- Exposure to engineering graphics standards
- Exposure to solid modelling
- Exposure to computer-aided geometric design
- Exposure to creating working drawings

- Exposure to engineering communication

**Syllabus Contents**

**Traditional Engineering Graphics**:

Principles of Engineering Graphics; Orthographic Projection; Descriptive Geometry; Drawing Principles; Isometric Projection; Surface Development; Perspective; Reading a Drawing; Sectional Views; Dimensioning & Tolerances; True Length, Angle; intersection, Shortest Distance.

***Computer Graphics***:

Engineering Graphics Software; -Spatial Transformations; Orthographic Projections; Model Viewing; Co-ordinate Systems; Multi-view Projection; Exploded Assembly; Model Viewing; Animation; Spatial Manipulation; Surface Modelling; Solid Modelling; Introduction to Building Information Modelling (BIM)

***(Except the basic essential concepts, most of the teaching part can happen concurrently in the laboratory)***

**Module 1: Introduction to Engineering Drawing**

Principles of Engineering Graphics and their significance, usage of Drawing instruments, lettering, Conic sections including the Rectangular Hyperbola (General method only); Cycloid, Epicycloid, Hypocycloid and Involute; Scales – Plain, Diagonal and Vernier Scales.

**Module 2: Orthographic Projections**

Principles of Orthographic Projections-Conventions - Projections of Points and lines inclined to both planes; Projections of planes inclined Planes - Auxiliary Planes.

**Module 3: Projections of Regular Solids**

Solids inclined to both the Planes- Auxiliary Views; Draw simple annotation, dimensioning and scale. Floor plans that include: windows, doors, and fixtures such as WC, bath, sink, shower, etc.

**Module 4: Sections and Sectional Views of Right Angular Solids**

Prism, Cylinder, Pyramid, Cone – Auxiliary Views; Development of surfaces of Right Regular Solids - Prism, Pyramid, Cylinder and Cone; Draw the sectional orthographic views of geometrical solids, objects from industry and dwellings (foundation to slab only)

**Module 5: Isometric Projections**

Principles of Isometric projection – Isometric Scale, Isometric Views, Conventions; Isometric Views of lines, Planes, Simple and compound Solids; Conversion of Isometric Views to Orthographic Views and Vice-versa, Conventions

**Module 6: Overview of Computer Graphics**

Listing the computer technologies that impact on graphical communication, Demonstrating knowledge of the theory of CAD software [such as: The Menu System, Toolbars (Standard, Object Properties, Draw, Modify and Dimension), Drawing Area (Background, Crosshairs, Coordinate System), Dialog boxes and windows, Shortcut menus (Button Bars), The Command Line (where applicable), The Status Bar, Different methods of zoom as used in CAD, Select and erase objects; Isometric Views of lines, Planes, Simple and compound Solids].

**Module 7: Customization & CAD Drawing**

Set up of the drawing page and the printer, including scale settings, Setting up of units and drawing limits; ISO and ANSI standards for coordinate dimensioning and tolerancing; Orthographic constraints, Snap to objects manually and automatically; Producing drawings by using various coordinate input entry methods to draw straight lines, Applying various ways of drawing circles.

**Module 8: Annotations, layering & other Functions**

Applying dimensions to objects, applying annotations to drawings; Setting up and use of Layers, layers to create drawings, Create, edit and use customized layers; Changing line lengths through modifying existing lines (extend/lengthen); Printing documents to paper using the print command; orthographic projection techniques; Drawing sectional views of composite right regular geometric solids and project the true shape of the sectioned surface; Drawing annotation, Computer-aided design (CAD) software modeling of parts and assemblies. Parametric and non-parametric solid, surface, and wireframe models. Part editing and two-dimensional

documentation of models. Planar projection theory, including sketching of perspective, isometric, multiview, auxiliary, and section views. Spatial visualization exercises. Dimensioning guidelines, tolerancing techniques; dimensioning and scale multi views of dwelling.

**Module 9: Demonstration of a Simple Team Design Project**

Geometry and topology of engineered components: creation of engineering models and their presentation in standard 2D blueprint form and as 3D wire-frame and shaded solids; meshed topologies for engineering analysis and tool-path generation for component manufacture; geometric dimensioning and tolerancing; Use of solid-modeling software for creating associative models at the component and assembly levels; floor plans that include: windows, doors, and fixtures such as WC, bath, sink, shower, etc. Applying colour coding according to building drawing practice; Drawing sectional elevation showing foundation to ceiling; Introduction to Building Information Modelling (BIM).

**References**

1. Bhatt N.D., Panchal V.M. & Ingle P.R., (2014), Engineering Drawing, Charotar PublishingHouse
2. Shah, M.B. &Rana B.C. (2008), Engineering Drawing and Computer Graphics, Pearson Education
3. Agrawal B. &Agrawal C. M. (2012), Engineering Graphics, TMH Publication
4. Narayana, K.L. & P Kannaiah (2008), Text book on Engineering Drawing, Scitech Publishers
5. (Corresponding set of) CAD Software Theory and User Manuals.

| ESC 201 | Basic Electrical Engineering | 3L:1T:2P | 5 Credits |
|---|---|---|---|

**Teaching Scheme:** Lectures - 3 hours/week; Tutorial – 1 hour/week; Laboratory –2 hours/week

**Course Outcomes**

- To understand and analyze basic electric and magnetic circuits
- To study the working principles of electrical machines and power converters.
- To introduce the components of low voltage electrical installations

**Syllabus Contents**

**Module 1 : DC Circuits (8 hours)**

Electrical circuit elements (R, L and C), voltage and current sources, Kirchoff current and voltage laws, analysis of simple circuits with dc excitation. Superposition, Thevenin and Norton Theorems. Time-domain analysis of first-order RL and RC circuits.

**Module 2: AC Circuits (8 hours)**

Representation of sinusoidal waveforms, peak and rms values, phasor representation, real power, reactive power, apparent power, power factor. Analysis of single-phase ac circuits consisting of R, L, C, RL, RC, RLC combinations (series and parallel), resonance. Three-phase balanced circuits, voltage and current relations in star and delta connections.

**Module 3: Transformers (6 hours)**

Magnetic materials, BH characteristics, ideal and practical transformer, equivalent circuit, losses in transformers, regulation and efficiency. Auto-transformer and three-phase transformer connections.

**Module 4: Electrical Machines (8 hours)**

Generation of rotating magnetic fields, Construction and working of a three-phase induction motor, Significance of torque-slip characteristic. Loss components and efficiency, starting and speed control of induction motor. Single-phase induction motor. Construction, working, torque-speed characteristic and speed control of separately excited dc motor. Construction and working of synchronous generators.

**Module 5: Power Converters (6 hours)**

DC-DC buck and boost converters, duty ratio control. Single-phase and three-phase voltage source inverters; sinusoidal modulation.

**Module 6: Electrical Installations (6 hours)**

Components of LT Switchgear: Switch Fuse Unit (SFU), MCB, ELCB, MCCB, Types of Wires and Cables, Earthing. Types of Batteries, Important Characteristics for Batteries. Elementary calculations for energy consumption, power factor improvement and battery backup.

**Laboratory Outcomes**

- Get an exposure to common electrical components and their ratings.
- Make electrical connections by wires of appropriate ratings.
- Understand the usage of common electrical measuring instruments.
- Understand the basic characteristics of transformers and electrical machines.
- Get an exposure to the working of power electronic converters

**Laboratory**

List of experiments/demonstrations

- Basic safety precautions. Introduction and use of measuring instruments–voltmeter, ammeter, multi-meter, oscilloscope. Real-life resistors, capacitors and inductors.
- Measuring the steady-state and transient time-response of R-L, R-C, and R-L-C circuits to a step change in voltage (transient may be observed on a storage oscilloscope). Sinusoidal steady state response of R-L, and R-C circuits – impedance calculation and verification. Observation of phase differences between current and voltage. Resonance in R-L-C circuits.
- Transformers: Observation of the no-load current waveform on an oscilloscope (nonsinusoidal wave-shape due to B-H curve nonlinearity should be shown along with a discussion about harmonics). Loading of a transformer: measurement of primary and secondary voltages and currents, and power.
- Three-phase transformers: Star and Delta connections. Voltage and Current relationships (line-line voltage, phase-to-neutral voltage, line and phase currents). Phase-shifts between the primary and secondary side. Cumulative three-phase power in balanced three-phase circuits.
- Demonstration of cut-out sections of machines: dc machine (commutator-brush arrangement), induction machine (squirrel cage rotor), synchronous machine (field winging - slip ring arrangement) and single-phase induction machine.
- Torque Speed Characteristic of separately excited dc motor.
- Synchronous speed of two and four-pole, three-phase induction motors. Direction reversal by change of phase-sequence of connections. Torque-Slip Characteristic of an induction motor. Generator operation of an induction machine driven at super-synchronous speed.
- Synchronous Machine operating as a generator: stand-alone operation with a load. Control of voltage through field excitation.
- Demonstration of (a) dc-dc converters (b) dc-ac converters – PWM waveform (c) the use of dc-ac converter for speed control of an induction motor and (d) Components of LT switchgear.

**References**


1. D.P. Kothari and I. J. Nagrath, “Basic Electrical Engineering”, Tata McGraw Hill, 2010.
2. D.C. Kulshreshtha, “Basic Electrical Engineering”, McGraw Hill, 2009.
3. L.S. Bobrow, “Fundamentals of Electrical Engineering”, Oxford University Press, 2011.
4. E. Hughes, “Electrical and Electronics Technology”, Pearson, 2010.
5. V.D. Toro, “Electrical Engineering Fundamentals”, Prentice Hall India, 1989.


| ESC 202 | Workshop/Manufacturing Practices | 1L:0T:4P | 3 Credits |
|---|---|---|---|

**Teaching Scheme:** Lectures - 1 hours/week; Laboratory –4 hours/week

Manufacturing is fundamental to the development of any engineering product. The course on Engineering Workshop Practice is intended to expose engineering students to different types of manufacturing/ fabrication processes, dealing with different materials such as metals, ceramics, plastics, wood, glass etc. While the actual practice of fabrication techniques is given more weightage, some lectures and video clips available on different methods of manufacturing are also included.

**Course Outcomes:**

At the end of this course, students will demonstrate the ability to

- Understanding different manufacturing techniques and their relative advantages/ disadvantages with respect to different applications.
- Selection of a suitable technique for meeting a specific fabrication need.
- Acquire a minimum practical skill with respect to the different manufacturing methods and develop the confidence to design & fabricate small components for their project work and also to participate in various national and international technical competitions.
- Introduction to different manufacturing methods in different fields of engineering
- Practical exposure to different fabrication techniques.
- Creation of simple components using different materials.
- Exposure to some of the advanced and latest manufacturing techniques being employed in the industry.

**Syllabus Contents Lectures & videos: (10 hours)**

1. Manufacturing Methods-casting, forming, machining, joining, advanced manufacturing methods (3 lectures)
2. CNC machining, Additive manufacturing (1 lecture)
3. Fitting operations & power tools (1 lecture)
4. Electrical & Electronics (1 lecture)
5. Carpentry (1 lecture)
6. Plastic moulding, glass cutting (1 lecture)
7. Metal casting (1 lecture)
8. Welding (arc welding & gas welding), brazing (1 lecture)

**Workshop Practice: (60 hours)**

1. Machine shop - 10 hours
2. Fitting shop - 8 hours
3. Carpentry - 6 hours
4. Electrical & Electronics - 8 hours
5. Welding shop - 8 hours (Arc welding 4 hours + gas welding 4 hours)
6. Casting - 8 hours
7. Smithy - 6 hours
8. Plastic moulding & Glass Cutting - 6 hours

Examinations could involve the actual fabrication of simple components, utilizing one or more ofthe techniques covered above.

**References**

1. HajraChoudhury S.K., HajraChoudhury A.K. and Nirjhar Roy S.K., "Elements of Workshop Technology", Vol. I 2008 and Vol. II 2010, Media promoters and publishers private limited, Mumbai.
2. Kalpakjian S. And Steven S. Schmid, "Manufacturing Engineering and Technology", 4th edition, Pearson Education India Edition, 2002.
3. Gowri P. Hariharan and A. Suresh Babu,"Manufacturing Technology – I" Pearson Education, 2008.
4. Roy A. Lindberg, "Processes and Materials of Manufacture", 4th edition, Prentice Hall India
5. 1998.
6. Rao P.N., "Manufacturing Technology", Vol. I and Vol. II, Tata McGrawHill House, 2017.

| ESC 301 | Basic Electronics Engineering | 3L:1T:0P | 4 Credits |
|---|---|---|---|

**Teaching Scheme:** Lectures - 3 hours/week; Tutorial – 1 hour/week

**Objectives**

To provide an overview of electronic device components to Mechanical engineering students

**Course Outcomes**

At the end of this course students will demonstrate the ability to

- Understand the principles of semiconductor devices and their applications.
- Design an application using Operational amplifier.
- Understand the working of timing circuits and oscillators.
- Understand logic gates, flip flop as a building block of digital systems.
- Learn the basics of Electronic communication system.

**Syllabus Contents**

**Semiconductor Devices and Applications**: Introduction to P-N junction Diode and V-I characteristics, Half wave and Full-wave rectifiers, capacitor filter. Zener diode and its characteristics, Zener diode as voltage regulator. Regulated power supply IC based on 78XX and 79XX series, Introduction to BJT, it's input-output and transfer characteristics, BJT as a single stage CE amplifier, frequency response and bandwidth.

**Operational amplifier and its applications:** Introduction to operational amplifiers, Op-amp input modes and parameters, Op-amp in open loop configuration, op-amp with negative feedback, study of practical op-amp IC 741, inverting and non-inverting amplifier applications: summing and difference amplifier, unity gain buffer, comparator, integrator and differentiator.

**Timing Circuits and Oscillators:** RC-timing circuits, IC 555 and its applications as astable and mono-stable multi-vibrators, positive feedback, Barkhausen's criteria for oscillation, R-C phaseshift and Wein bridge oscillator.

**Digital Electronics Fundamentals** :Difference between analog and digital signals, Boolean algebra, Basic and Universal Gates, Symbols, Truth tables, logic expressions, Logic simplification using Kmap, Logic ICs, half and full adder/subtractor, multiplexers, de-multiplexers, flip-flops, shift registers, counters, Block diagram of microprocessor/microcontroller and their applications.

**Electronic Communication Systems**: The elements of communication system, IEEE frequency spectrum, Transmission media: wired and wireless, need of modulation, AM and FM modulation schemes, Mobile communication systems: cellular concept and block diagram of GSM system.

**References**

1.Floyd ," Electronic Devices" Pearson Education 9th edition, 2012.
2.R.P. Jain, "Modern Digital Electronics", Tata McGraw Hill, 3rd Edition, 2007.
3.Frenzel, "Communication Electronics: Principles and Applications", Tata McGraw Hill, 3rd Edition, 2001.

| ESC 302 | Engineering Mechanics | 3L:1T:0P | 4 Credits |
|---|---|---|---|

**Teaching Scheme:** Lectures - 3 hours/week; Tutorial – 1 hour/week

**Objectives**

The objective of this Course is to provide an introductory treatment of Engineering Mechanics to all the students of engineering, with a view to prepare a good foundation for taking up advanced courses in the area in the subsequent semesters. A working knowledge of statics with emphasison force equilibrium and free body diagrams. Provides an understanding of the kinds of stress and deformation and how to determine them in a wide range of simple, practical structural problems, and an understanding of the mechanical behavior of materials under various load conditions. Lab should be taken concurrently.

What Will I Learn?

a) Confidently tackle equilibrium equations, moments and inertia problems
b) Master calculator/computing basic skills to use to advantage in solving mechanics problems.
c) Gain a firm foundation in Engineering Mechanics for furthering the career in Engineering

**Course Outcomes**

Upon successful completion of the course, student should be able to:

- Use scalar and vector analytical techniques for analyzing forces in statically determinate structures
- Apply fundamental concepts of kinematics and kinetics of particles to the analysis of simple,practical problems
- Apply basic knowledge of maths and physics to solve real-world problems
- Understand measurement error, and propagation of error in processed data
- Understand basic kinematics concepts – displacement, velocity and acceleration (and theirangular counterparts);
- Understand basic dynamics concepts – force, momentum, work and energy;
- Understand and be able to apply Newton's laws of motion;
- Understand and be able to apply other basic dynamics concepts - the Work-Energy principle, Impulse-Momentum principle and the coefficient of restitution;
- Extend all of concepts of linear kinetics to systems in general plane motion (applying Euler's Equation and considering energy of a system in general plane motion, and the work of couples and moments of forces)
- Learn to solve dynamics problems. Appraise given information and determine which concepts apply, and choose an appropriate solution strategy; and
- Attain an introduction to basic machine parts such as pulleys and mass-spring systems.

**Syllabus Contents**

**Module 1:** *Introduction to Engineering Mechanics covering*, Force Systems Basic concepts, Particle equilibrium in 2-D & 3-D; Rigid Body equilibrium; System of Forces, Coplanar Concurrent Forces, Components in Space – Resultant- Moment of Forces and its Application; Couples and Resultant of Force System, Equilibrium of System of Forces, Free body diagrams, Equations of Equilibrium of Coplanar Systems and Spatial Systems; Static Indeterminacy.

**Module 2:***Friction covering*, Types of friction, Limiting friction, Laws of Friction, Static and Dynamic Friction; Motion of Bodies, wedge friction, screw jack & differential screw jack.

**Module 3:***Basic Structural Analysis covering*, Equilibrium in three dimensions; Method of Sections; Method of Joints; How to determine if a member is in tension or compression; Simple Trusses; Zero force members; Beams & types of beams; Frames & Machines.

**Module 4:** *Centroid and Centre of Gravity covering*, Centroid of simple figures from first principle, centroid of composite sections; Centre of Gravity and its implications; Area moment of inertia- Definition, Moment of inertia of plane sections from first principles, Theorems of moment of inertia, Moment of inertia of standard sections and composite sections; Mass moment inertia of circular plate, Cylinder, Cone, Sphere, Hook.

**Module 5:** *Virtual Work and Energy Method*- Virtual displacements, principle of virtual work for particle and ideal system of rigid bodies, degrees of freedom. Active force diagram, systems with friction, mechanical efficiency. Conservative forces and potential energy (elastic and gravitational), energy equation for equilibrium. Applications of energy method for equilibrium. Stability of equilibrium.

**Module 6:** *Review of particle dynamics*- Rectilinear motion; Plane curvilinear motion (rectangular, path, and polar coordinates). 3-D curvilinear motion; Relative and constrained motion; Newton's $2^{nd}$ law (rectangular, path, and polar coordinates). Work-kinetic energy, power, potential energy. Impulse-momentum (linear, angular); Impact (Direct and oblique).

**Module 7:** *Introduction to Kinetics of Rigid Bodies covering*, Basic terms, general principles in dynamics; Types of motion, Instantaneous centre of rotation in plane motion and simple problems; D'Alembert's principle and its applications in plane motion and connected bodies;Work energy principle and its application in plane motion of connected bodies; Kinetics of rigidbody rotation.

**Module 8:** *Mechanical Vibrations covering*, Basic terminology, free and forced vibrations,

resonance and its effects; Degree of freedom; Derivation for frequency and amplitude of free vibrations without damping and single degree of freedom system, simple problems, types of pendulum, use of simple, compound and torsion pendulums;

**Tutorials** *from the above modules covering*, To find the various forces and angles including resultants in various parts of wall crane, roof truss, pipes, etc.; To verify the line of polygon on various forces; To find coefficient of friction between various materials on inclined plan; Free body diagrams various systems including block-pulley; To verify the principle of moment in the disc apparatus; Helical block; To draw a load efficiency curve for a screw jack.

**References**


1. Irving H. Shames (2006), Engineering Mechanics, 4th Edition, Prentice Hall
2. F. P. Beer and E. R. Johnston (2011), Vector Mechanics for Engineers, Vol I - Statics, VolII, –Dynamics, 9th Ed, Tata McGraw Hill
3. R.C. Hibbler (2006), Engineering Mechanics: Principles of Statics and Dynamics, PearsonPress.
4. Andy Ruina and RudraPratap (2011), Introduction to Statics and Dynamics, Oxford UniversityPress
5. Shanes and Rao (2006), Engineering Mechanics, Pearson Education,
6. Hibler and Gupta (2010),Engineering Mechanics (Statics, Dynamics) by Pearson Education
7. Reddy Vijaykumar K. and K. Suresh Kumar (2010), Singer's Engineering Mechanics
8. Bansal R.K.(2010), A Text Book of Engineering Mechanics, Laxmi Publications
9. Khurmi R.S. (2010), Engineering Mechanics, S. Chand & Co.
10. Tayal A.K. (2010), Engineering Mechanics, Umesh Publication


## PROFESSIONAL CORE COURSES [PCC]

| | | | |
|---|---|---|---|
| **AE 301** | **Fluid Mechanics** | **2L:0T:0P** | **2 Credits** |
| **AE 303** | **Fluid Mechanics Lab.** | **0L:0T:2P** | **1 Credit** |

**Teaching Scheme:** Lectures - 2 hours/week; Laboratory – 2 hours/week

**Objectives**

The objective of this course is to introduce the concepts of fluid mechanics useful in Agricultural Engineering applications. The course provides a first level exposure to the students to fluid statics, kinematics and dynamics. Measurement of pressure, computations of hydrostatic forces on structural components and the concepts of Buoyancy all find useful applications in many engineering problems. A training to analyze engineering problems involving fluids – such as those dealing with pipe flow, open channel flow, jets, turbines and pumps, dams and spillways, culverts, river and groundwater flow - with a mechanistic perspective is essential for the civil engineering students. The topics included in this course are aimed to prepare a student to build a good fundamental background useful in the application-intensive courses covering hydraulics, hydraulic machinery and hydrology in later semesters.

**Course Outcomes**

At the end of the course, the student will be able to:

- Understand the broad principles of fluid statics, kinematics and dynamics
- Understand definitions of the basic terms used in fluid mechanics
- Understand classifications of fluid flow
- Be able to apply the continuity, momentum and energy principles
- Be able to apply dimensional analysis

**Syllabus Contents**

**Module 1:** Basic Concepts and Definitions – Distinction between a fluid and a solid; Density, Specific weight, Specific gravity, Kinematic and dynamic viscosity; variation of viscosity with temperature, Newton law of viscosity; vapour pressure, boiling point, cavitation; surface tension,

capillarity, Bulk modulus of elasticity, compressibility.

**Module 2:** Fluid Statics - Fluid Pressure: Pressure at a point, Pascals law, pressure variation with temperature, density and altitude. Piezometer, U-Tube Manometer, Single Column Manometer, U Tube Differential Manometer, Micromanometers. pressure gauges, Hydrostatic pressure and force: horizontal, vertical and inclined surfaces. Buoyancy and stability of floating bodies.

**Module 3:** Fluid Kinematics-Classification of fluid flow : steady and unsteady flow; uniform and non-uniform flow; laminar and turbulent flow; rotational and irrotational flow; compressible and incompressible flow; ideal and real fluid flow; one, two and three dimensional flows; Stream line, path line, streak line and stream tube; stream function, velocity potential function. One-,two- and three -dimensional continuity equations in Cartesian coordinates

**Module 4:** Fluid Dynamics- Surface and body forces; Equations of motion - Euler's equation; Bernoulli's equation – derivation; Energy Principle; Practical applications of Bernoulli's equation: venturimeter, orifice meter and pitot tube; Momentum principle; Forces exerted by fluid flow on pipe bend; Vortex Flow – Free and Forced; Dimensional Analysis and Dynamic Similitude – Definitions of Reynolds Number, Froude Number, Mach Number, Weber Number and Euler Number; Buckingham's π-Theorem.

**Lab Experiments**

- Measurement of viscosity
- Study of Pressure Measuring Devices
- Stability of Floating Body
- Hydrostatics Force on Flat Surfaces/Curved Surfaces
- Verification of Bernoulli's Theorem
- Venturi meter
- Orifice meter
- Impacts of jets
- Flow Visualisation -Ideal Flow
- Length of establishment of flow
- Velocity distribution in pipes
- Laminar Flow

**References**

1. Fluid Mechanics and Machinery, C.S.P.Ojha, R. Berndtsson and P. N. Chadramouli, Oxford University Press, 2010.
2. Hydraulics and Fluid Mechanics, P M Modi and S M Seth, Standard Book House
3. Theory and Applications of Fluid Mechanics, K. Subramanya, Tata McGraw Hill
4. Fluid Mechanics with Engineering Applications, R.L. Daugherty, J.B. Franzini and E.J. Finnemore, International Student Edition, McGraw Hill.

| AE 302 | Thermodynamics | 2L:1T:0P | 3 Credits |
|---|---|---|---|

**Teaching Scheme:** Lectures - 2 hours/week; Tutorial – 1 hour/week

**Objectives**

- To learn about work and heat interactions, and balance of energy between system and its surroundings
- To learn about application of I law to various energy conversion devices
- To evaluate the changes in properties of substances in various processes
- To understand the difference between high grade and low grade energies and $2^{nd}$ law limitations on energy conversion

**Course Outcomes**

1. After completing this course, the students will be able to apply energy balance to systems andcontrol volumes, in situations involving heat and work interactions
2. Students can evaluate changes in thermodynamic properties of substances

3. The students will be able to evaluate the performance of energy conversion devices
4. The students will be able to differentiate between high grade and low grade energies.

**Syllabus Contents**

Fundamentals - System & Control volume; Property, State & Process; Exact & Inexact differentials; Work-Thermodynamic definition of work; examples; Displacement work; Path dependence of displacement work and illustrations for simple processes; electrical, magnetic, gravitational, spring and shaft work. (5 lectures)

Temperature, Definition of thermal equilibrium and Zeroth law; Temperature scales; Various Thermometers- Definition of heat; examples of heat/work interaction in systems- First Law for Cyclic & Non-cyclic processes; Concept of total energy E ; Demonstration that E is a property; Various modes of energy, Internal energy and Enthalpy. (5 lectures)

Definition of Pure substance, Ideal Gases and ideal gas mixtures, Real gases and real gas mixtures, Compressibility charts- Properties of two phase systems - Const. temperature and Const. pressure heating of water; Definitions of saturated states; P-v-T surface; Use of steam tables and R134a tables; Saturation tables; Superheated tables; Identification of states & determination of properties, Mollier's chart. (8 lectures)

First Law for Flow Processes - Derivation of general energy equation for a control volume; Steady state steady flow processes including throttling; Examples of steady flow devices; Unsteady processes; examples of steady and unsteady I law applications for system and control volume. (5 lectures)

Second law - Definitions of direct and reverse heat engines; Definitions of thermal efficiency and COP; Kelvin-Planck and Clausius statements; Definition of reversible process; Internal and external irreversibility; Carnot cycle; Absolute temperature scale. (5 lectures) Clausius inequality; Definition of entropy S ; Demonstration that entropy S is a property; Evaluation of S for solids, liquids, ideal gases and ideal gas mixtures undergoing various processes; Determination of s from steam tables- Principle of increase of entropy; Illustration of processes in Ts coordinates; Definition of Isentropic efficiency for compressors, turbines and nozzles- Irreversibility and Availability, Availability function for systems and Control volumes undergoing different processes, Lost work. Second law analysis for a control volume. Exergy balance equation and Exergy analysis. (8 lectures)

Thermodynamic cycles - Basic Rankine cycle; Basic Brayton cycle; Basic vapor compression cycle and comparison with Carnot cycle. (4 lectures)

**References**

1. Sonntag, R. E, Borgnakke, C. and Van Wylen, G. J., 2003, 6th Edition, Fundamentals ofThermodynamics, John Wiley and Sons.
2. Jones, J. B. and Duggan, R. E., 1996, Engineering Thermodynamics, Prentice-Hall of India
3. Moran, M. J. and Shapiro, H. N., 1999, Fundamentals of Engineering Thermodynamics, JohnWiley and Sons.
4. Nag, P.K, 1995, Engineering Thermodynamics, Tata McGraw-Hill Publishing Co. Ltd.

| AE 304 | Advanced Workshop Technology | 0L:0T:4P | 2 Credits |
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**Teaching Scheme:** Laboratory – 4 hours/week

**Objectives**

To motivate and challenge students to understand and develop an appreciation of the processes in correlation with material properties which change the shape, size and form of the raw materialsinto the desirable product by conventional or unconventional manufacturing methods.

**Course Outcomes**

Upon completion of this course, students will be able to understand the different conventional and unconventional manufacturing methods employed for making different products.

**Syllabus Contents**

**Conventional Manufacturing processes:**

Casting and moulding: Metal casting processes and equipment, Heat transfer and solidification, shrinkage, riser design, casting defects and residual stresses.

Introduction to bulk and sheet metal forming, plastic deformation and yield criteria; fundamentals of hot and cold working processes; load estimation for bulk forming(forging, rolling, extrusion, drawing) and sheet forming (shearing, deep drawing, bending) principles of powder metallurgy.

Metal cutting: Single and multi-point cutting; Orthogonal cutting, various force components: Chip formation, Tool wear and tool life, Surface finish and integrity, Machinability, Cutting tool materials, Cutting fluids, Coating; Turning, Drilling, Milling and finishing processes, Introduction to CNC machining.

Additive manufacturing: Rapid prototyping and rapid tooling**.**

Joining/fastening processes: Physics of welding, brazing and soldering; design considerations in welding, Solid and liquid state joining processes; Adhesive bonding.

**Unconventional Machining Processes:**

Abrasive Jet Machining, Water Jet Machining, Abrasive Water Jet Machining, Ultrasonic Machining, principles and process parameters, Electrical Discharge Machining, principle and processes parameters, MRR, surface finish, tool wear, dielectric, power and control circuits, wire EDM; Electro-chemical machining (ECM), etchant & maskant, process parameters, MRR and surface finish, Laser Beam Machining (LBM), Plasma Arc Machining (PAM) and Electron Beam Machining.

**References**

1. Kalpakjian and Schmid, Manufacturing processes for engineering materials (5th Edition)- Pearson India, 2014
2. Mikell P. Groover, Fundamentals of Modern Manufacturing: Materials, Processes, and Systems
3. Degarmo, Black &Kohser, Materials and Processes in Manufacturing

| **AE 401** | **Strength of Materials** | **2L:1T:0P** | **3 Credits** |
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**Teaching Scheme:** Lectures - 2 hours/week; Tutorial – 1 hour/week

**Objectives**

- To understand the nature of stresses developed in simple geometries such as bars, cantilevers, beams, shafts, cylinders and spheres for various types of simple loads.
- To calculate the elastic deformation occurring in various simple geometries for different typesof loading.

**Course Outcomes**

- After completing this course, the students should be able to recognise various types loads applied on machine components of simple geometry and understand the nature of internal stresses that will develop within the components.
- The students will be able to evaluate the strains and deformation that will result due to the elastic stresses developed within the materials for simple types of loading.

**Syllabus Contents**

Deformation in solids- Hooke’s law, stress and strain- tension, compression and shear stresses elastic constants and their relations- volumetric, linear and shear strains- principal stresses and principal planes- Mohr’s circle. (8 lectures)

Beams and types transverse loading on beams- shear force and bend moment diagrams- Types of beam supports, simply supported and over-hanging beams, cantilevers. Theory of bending of beams, bending stress distribution and neutral axis, shear stress distribution, point and distributed loads. (8 lectures)

Moment of inertia about an axis and polar moment of inertia, deflection of a beam using double

integration method, computation of slopes and deflection in beams, Maxwell's reciprocal theorems.(8 lectures)
Torsion, stresses and deformation in circular and hollow shafts, stepped shafts, deflection of shafts fixed at ends, stresses and deflection of helical springs. (8 lectures)
Axial and hoop stresses in cylinders subjected to internal pressure, deformation of thick and thin cylinders, deformation in spherical shells subjected to internal pressure (8 lectures)

**References**


1. Egor P. Popov, Engineering Mechanics of Solids, Prentice Hall of India, New Delhi, 2001.
2. R. Subramanian, Strength of Materials, Oxford University Press, 2007.
3. Ferdinand P. Been, Russel Johnson Jr and John J. Dewole, Mechanics of Materials, TataMcGraw Hill Publishing Co. Ltd., New Delhi 2005.


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|---|---|---|---|
| **AE 402** | **Surveying and Leveling** | **2L:0T:0P** | **2 Credits** |
| **AE406** | **Surveying and Leveling Lab.** | **0L:0T:2P** | **1 Credit** |

**Teaching Scheme :** Lectures - 2 hours/week; Laboratory – 2 hours/week

**Course Outcomes**

Upon completion of this course,

- Students will be able to understand and apply the concept of surveying and levelling on the practical field.
- Students will get familiarized with the equipment's/instruments/tools used in surveying and levelling
- Students will be able to find the errors in levelling and methods to correct them.

**Syllabus Contents**

**Unit 1**: **Introduction to Surveying**

Definition, principles and basic concepts of surveying, classification, basic measurements, units of measurements, plans and maps, types of scales, surveying measurement and errors, scale corrections, accuracy and precision, stages of survey operation.

**Unit 2 Principles of chain surveying**

Definition, selection of survey station and lines, types of ranging and chaining, types of chains, recording the measurements, offset measurements, cross staff, optical square, prism square, obstacles in chaining and ranging chain and tape corrections.

**Unit 3: Traversing**

Methods of traversing, prismatic and surveyors compass, angle and bearings, quadrantal systems, local attraction, magnetic declination, dip-traversing, plotting, Bowditch rule, transit rule, errors in compass survey, limits of accuracy.

**Unit 4: Plane tabling**

Instruments and accessories, methods and principles, two point, three point problems, errors in plane tabling, minor instruments – hand level, abbey level, clinometers, sextant, planimeter, pentameter, computation of areas – methods.

**Unit 5**: **Levelling**

Definition, benchmarks types of levels, optical principles, lenses, telescopes, sensitivity of bubble tubes, levelling staves, basic principles of levelling, temporary adjustments, field book entries, reduction of levels, missing entries, types of levelling, simple, differential and profile levelling, cross sectioning.

**References**


1. R. E. Davis. Elementary Plane Surveying. McGraw Hill
2. A. L. Higgins. Elementary Surveying. McGraw Hill.
3. T.P. Kanetkar & S.V. Kulkarni. Surveying and Levelling. (Part I & II). Griha Prakashan
4. B. C. Punmia. Surveying Vol 1&2. Firewall Media.

| AE 403 | Soil Science and Soil Mechanics | 2L:0T:0P | 2 Credits |
|---|---|---|---|
| AE407 | Soil Science and Soil Mechanics Lab. | 0L:0T:2P | 1 Credit |

**Teaching Scheme :** Lectures - 2 hours/week; Laboratory – 2 hours/week

**Course Outcomes**

Upon completion of this course,

• Students will get an overview of origin of soil, an understanding of soil identification and classification

• Students will have knowledge about the composition of soil air, nature of soil aeration, movement of soil water, measurement of soil temperature

• Students will understand soil behaviour during compression, compaction and shear

**Syllabus Contents**

**Unit-1: Introduction**

Function of soils in our ecosystem, medium for plant growth, engineering medium, soil as a natural body, the soil profile and its layers (horizons), mineral constituents of soil, soil organic matter, weathering of rocks and minerals, physical and chemical weathering, factors influencing soil formation, parental materials, topography, soil formation in action.

**Unit 2: Soil Classification, Architecture and its Physical Properties**

Concept of individual soils, soil taxonomy, soil orders, entisols, inceptisols, andisols, gelisols, histosols, vertisols, mollisols, oxisols. Lower level categories in soil taxonomy, Soil colour, soil texture, structure, densities, pore spaces of mineral soils, soil properties relevant to engineering uses: preliminary definitions and relationship, determination of index properties, clay mineralogy.

**Unit-3: Soil Air, Water, Temperature and Colloid**

Soil air: Composition of soil air, air capacity the nature of soil aeration, soil aeration in the field, oxidation-reduction potential, factors affecting soil aeration, wetlands and their poorly aerated soils.

Soil water: Forms of soil water, soil moisture constants, soil water movement, saturated and unsaturated flow, measurement of soil water

Soil temperature: Sources of heat to soil, factors affecting soil temperature, processes affected by soil temperature, thermal properties of soils, measurement of soil temperature, soil temperature control

Soil colloid: General properties of soil colloids, types of soil colloids, adsorbed cations, fundamentals of layer silicate clay structure, genesis of soil colloids, geographic distribution of clays, sources of charges on soil colloids, soil organism and their role in soil fertility.

**Unit-4: Soil Hydraulics and Elasticity Applied to Soil**

Permeability, seepage analysis, soil hydraulics, seepage below hydraulic structures, Elements of elasticity, stress distribution

**Unit-5: Compressibility, Strength and Stability**

Compression and compressibility, one- and three-dimensional consolidation, compaction Shear strength, Mohr's circle of stresses, active and passive earth pressures, retaining walls, stability analysis of earthen slopes, bearing capacity of soils, foundations.

**References**

1. N. C. Brady and R. W. Ray. The Nature and Properties of Soils. Macmillan
2. T. D. Biswas and S. K. Mukherjee. Text book of Soil Science. McGraw Hill.
3. H. D. Foth. Fundamental of Soil Science. Wiley Eastern.
4. B. C. Punmia., Soil Mechanics and Foundations, Laxmi Publication Pvt. Ltd., NewDelhi
5. S. G. Bowell. Soil Mechanics. Wiley Eastern.
6. Gopalrajan and A. S. R. Rao. Basic and Applied Soil Mechanics.

| AE 404 | Farm Power | 2L:0T:0P | 2 Credits |
|---|---|---|---|

**Teaching Scheme:** Lectures - 2 hours/week; Laboratory – 2 hours/week

**Course Outcomes**

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

- Understand the working principle and working of tractor and automobile engine
- Demonstrate the transmission power from engine to the rear wheels of tractor and automobiles
- Carry out maintenance and adjustment of tractor systems.

**Syllabus Contents**

**Unit 1:** Sources of farm power -conventional & non-conventional energy sources. Classification of tractors and IC engines. Review of thermodynamic principles of IC (CI & SI) engines and deviation from ideal cycle.

**Unit 2:** Study of engine components their construction, operating principles and functions.

**Unit 3:** Engine systems: valves & valve mechanism. Fuel & air supply, cooling, lubricating, ignition, starting and electrical systems. Engine governing systems.

**Unit 4:** Study of transmission system: Clutch: single and multi-plate clutches and their functions, gear box: sliding and constant mesh, differential, final drive mechanism and wheels.

**Unit 5: B**rake mechanism: Mechanical and hydraulic. Steering: Ackerman and hydraulic., Front axle and wheel alignment, Hydraulic system of tractor: Automatic position and draft control.

**Unit 6:** Tractor power outlets: P.T.O., belt pulley, drawbar. Introduction to traction mechanics.

**Unit 7:** Tractor chassis mechanics: C.G. determination and weight transfer. Tractor stability: Grade and non-parallel pull, turning at high speed, Ergonomic considerations and operational safety.

| AE408 | Farm Power Lab. | 0L:0T:2P | 1 Credit |
|---|---|---|---|

**Syllabus Contents**

- Introduction to different systems of an CI engine; Engine parts and functions, working principles etc.
- Valve system – study, construction and adjustments
- Oil & Fuel - determination of physical properties
- Air cleaning system
- Fuel supply system of SI engine; Diesel injection system & timing
- Cooling system, and fan performance, thermostat and radiator performance evaluation
- Part load efficiencies & governing
- Lubricating system & adjustments
- Starting and electrical system
- Ignition system
- Tractor engine heat balance and engine performance curves
- Mechanical power transmission in agricultural tractors, clutch, gear box, differential and finaldrive,
- Wheels and wheel tread adjustment
- Brake and its adjustment.
- Steering system
- Hydraulic lift and hitch system.

**References**

1. Liljedahl, J.B., Turnquist, P.K., Smith, D.W. and Hoki, M. 2004. Tractors and their PowerUnits, 4th Edition. CBS Publishers & Distributors, New Delhi.
2. Mathur, M.L. and Sharma, R.P. 2014. Internal Combustion Engines. Dhanpat Rai Publications
(P) Lrd., New Delhi.
3. Goering, C.E. and Hansen, A.C. 2013.Engine and Tractor Power. ASABE, USA.
4. Domkundwar A.V. 1999. A course in internal combustion engines. DhanpatRai& Co. (P)Ltd., Educational and Technical Publishers, Delhi.
5. Jain, S.C. and Rai, C.R. 2012. Farm Tractor: Maintenance and Repair, Standard

Publishersand Distributors, New Delhi.

| AE405 | Post Harvest Operations | 2L:0T:0P | 2 Credits |
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**Teaching Scheme :** Lectures - 2 hours/week

**Course Outcomes:**

Post-harvest technologies constitute an inter-disciplinary science and techniques applied to agricultural commodities after harvest for the purpose of preservation, conservation, quality control/enhancement, processing, packaging, storage, distribution, marketing, and utilization to meet the food and nutritional requirements of consumers in relation to their needs.

**Syllabus Contents:**

**Unit 1**: Measurement and analysis of quality of different grains, Optimum harvesting conditions for different crops, principles, selection, operation, maintenance and testing of grains processing equipment and plants, fluidization and mechanical operations in cereal processing.

**Unit 2**: Hydrothermal treatment & conditioning of grains, Modern paddy and heat parboiling systems, equipment, Advances in heat transfer and fluid flow in grain processing operations. Humidification and dehumidification operations applied to post harvest engineering.

**Unit 3**: Crop drying principles, moisture migration theories, advances in crop drying theories & mathematical modeling, Crop drying methods/systems and crop dryers-selection, design and testing.

**Unit 4**: Processes and machines for operations involving cleaning, conditioning, milling, sizing, grading and packaging of cereals (paddy, wheat, maize and millets) and pulses.

**Unit 5**: Principles and practices of storage - storage losses and their estimation, factors affecting the grain quality in insects, pests and rodents-control, Flow characteristics of granular materials. Types and functional requirements of storage structures-village level and improved structures, godowns and silos, Design of silos, bunkers and godowns - R.C.C. and steel structures, Aeration system for various storage structures, Grain handling equipment and their design and operational features, Management and maintenance of grain storage.

**References**


1. Brennam, J. G., Butters, J. R., Cowell, N. D and Lilly, A. E. I. (1990). Food Engineering Operations. Elsevier Science Pub. Co., Inc.
2. Geankoplis, C. J. (2002). Transport Processes and Unit Operations. Prentice Hall of India, New Delhi
3. Heldman, D. R. and Hartel, R. W. (1999). Principles of Food Processing. An Aspen Publications, USA
4. McCabe, W.L., Smith, J. C. and Harriott, P. (1985). Unit operations of chemical Engineering. 4th Ed. McGraw -Hill Book Company, Inc.
5. Sahay, K. M. and Singh, K. K. (2001). Unit Operations of Agricultural Processing. Vikash Publishing House Pvt. Ltd., 2nd Ed., India.


| AE409 | Post Harvest Operations Lab. | 0L:0T:2P | 1 Credits |
|---|---|---|---|

**Teaching Scheme:** Laboratory – 2 hours/week

**Course Outcomes:**

- To understand and analyze basic application of post harvest operations.
- To study the working principles of various post harvest and food processing machines.
- Post harvest operations lab constitutes to maintain quality (appearance, texture, flavor and nutritive value), protect food safety, and reduce losses between harvest and consumption.

**Syllabus Contents:**

1. Measurement of physical properties of food grains.
2. Particle size analysis and energy requirement in communition.
3. Milling of rice, wheat and pulses and estimation of milling yield and performance characteristics of equipment used.

4. Colour measurement of foods.
5. Sorption and desorption of grains/bio-materials.
6. Expression/extraction of oils and testing of different rice bran stabilization methods and preparation of valuable products from husk.

**References**

1. Brennam, J. G., Butters, J. R., Cowell, N. D and Lilly, A. E. I. (1990). Food Engineering Operations. Elsevier Science Pub. Co., Inc.
2. Geankoplis, C. J. (2002). Transport Processes and Unit Operations. Prentice Hall of India, New Delhi
3. Heldman, D. R. and Hartel, R. W. (1999). Principles of Food Processing. An Aspen Publications, USA
4. McCabe, W.L., Smith, J. C. and Harriott, P. (1985). Unit operations of chemical Engineering. 4th Ed. McGraw -Hill Book Company, Inc.
5. Sahay, K. M. and Singh, K. K. (2001). Unit Operations of Agricultural Processing. Vikash Publishing House Pvt. Ltd., 2nd Ed., India.

| AE 501 | Kinematics and Theory of Machines | 2L:1T:0P | 3 Credits |
|---|---|---|---|

**Teaching Scheme:** Lectures - 2 hours/week; Tutorial – 1 hour/week

**Objectives**

1. To understand the kinematics and rigid- body dynamics of kinematically driven machine components
2. To understand the motion of linked mechanisms in terms of the displacement, velocity andacceleration at any point in a rigid link
3. To be able to design some linkage mechanisms and cam systems to generate specified outputmotion
4. To understand the kinematics of gear trains

**Syllabus Contents**

Classification of mechanisms-Basic kinematic concepts and definitions-Degree of freedom, mobility-Grashof's law, Kinematic inversions of four bar chain and slider crank chains-Limit positions- Mechanical advantage-Transmission angle-Description of some commonmechanisms-Quick return mechanism, straight line generators-Universal Joint-Rocker mechanisms (8 lectures)

Displacement, velocity and acceleration analysis of simple mechanisms, graphical velocity analysis using instantaneous centers, velocity and acceleration analysis using loop closure equations kinematic analysis of simple mechanisms- slider crank mechanism dynamics-Coincident points- Coriolis component of acceleration- introduction to linkage synthesis- three position graphical synthesis for motion and path generation (8 lectures)

Classification of cams and followers-Terminology and definitions-Displacement diagrams-Uniform velocity, parabolic, simple harmonic and cycloidal motions- derivatives of follower motions specified contour cams- circular and tangent cams- pressure angle and undercutting, sizing of cams, graphical and analytical disc cam profile synthesis for roller and flat face followers (8 lectures)

Involute and cycloidal gear profiles, gear parameters, fundamental law of gearing and conjugate action, spur gear contact ratio and interference/undercutting- helical, bevel, worm, rack & pinion gears, epicyclic and regular gear train kinematics (8 lectures)

Surface contacts- sliding and rolling friction- friction drives- bearings and lubrication- friction clutches- belt and rope drives- friction in brakes (8 lectures)

**Course Outcomes**

After completing this course, the students can design various types of linkage mechanisms for obtaining specific motion and analyse them for optimal functioning

**References**

1. Thomas Bevan, Theory of Machines, 3rd edition, CBS Publishers & Distributors,

2005.
2. CleghornW.L. , Mechanisms of Machines, Oxford University Press, 2005.
3. Robert L. Norton, Kinematics and Dynamics of Machinery, Tata McGrawHill, 2009.
4. Ghosh A. and Mallick A.K., Theory of Mechanisms and Machines, Affiliated East-West Pvt.Ltd, New Delhi, 1988.

| AE 502 | Watershed Hydrology | 2L:0T:0P | 2 Credits |
|---|---|---|---|

**Teaching Scheme :** Lectures - 2 hours/week; Laboratory – 2 hours/week

**Course Outcomes**

- To comprehend basic concepts of the hydrologic cycle.
- To analyse precipitation data in detail, including assessment and instruments of precipitation data.
- To understand the concept of hydrograph and unit hydrograph.
- To understand methods to calculate runoff using empirical formulae and concept of flood routing.

**Syllabus Contents**

**Unit 1:** Definition, hydrologic cycle and its component, meteorological parameters and their measurement

**Unit 2:** Types, measurement and analysis, missing data, aerial precipitation, consistency of rainfall records and frequency analysis

**Unit 3:** Factors affecting runoff, measurement, methods for estimation of runoff volume and peak runoff, rating curve, and rainfall-runoff relations

**Unit 4:** Components of a hydrograph, factors affecting hydrographs, and base flow separation

**Unit 5:** Theory and assumptions of unit hydrographs, unit hydrographs of different durations, dimensionless hydrograph, synthetic unit hydrograph, and instantaneous unit hydrograph

**References**

1. K. Subramanyam. Engineering Hydrology, Tata McGraw Hill Publication Co., New Delhi
2. R. K. Sharma. Hydrology and Water Resources Engineering, Dhanpat Rai and Sons,
3. V. T. Chow. Handbook of Applied Hydrology. McGraw Hill Book Co., USA
4. S.K. Garg. Hydrology and Water Resources Engineering, Khanna Publishers, ND.
5. Ghanashyam Das. Hydrology and Soil Conservation Engineering, Prentice Hall of India, Pvt. Ltd, New Delhi

| AE 506 | Watershed Hydrology Lab | 0L:0T:2P | 1 Credit |
|---|---|---|---|

**Teaching Scheme :** Lectures - 3 hours/week

**Course Outcomes**

Under the completion of the course, students will be able to

- Identify hydrology and open channel related problems practically
- Understand and practice basic measurement and data analysis techniques in hydrology

**Syllabus Contents**

1. Study and use of rain gauge, evaporimeters, anemometer, hygrometer, sunshine recorder instruments
2. Analysis of rainfall data and estimation of average rainfall
3. Study of stream gauging instruments and measurement
4. Ranging out survey line and plotting chain survey.
5. Plotting of the field book, reading for preparation of map-acquaintance with symbols of different objects used in maps and scale of map.

**References**

1. K. Subramanyam. Engineering Hydrology, Tata McGraw Hill Publication Co., New Delhi
2. R. K. Sharma. Hydrology and Water Resources Engineering, Dhanpat Rai and Sons,

3. V. T. Chow. Handbook of Applied Hydrology. McGraw Hill Book Co., USA
4. S.K. Garg. Hydrology and Water Resources Engineering, Khanna Publishers, ND.
5. Ghanashyam Das. Hydrology and Soil Conservation Engineering, Prentice Hall of India, Pvt. Ltd, New Delhi

| AE 503 | Farm Machinery | 2L:0T:0P | 2 Credits |
|---|---|---|---|

**Teaching Scheme:** Lectures - 2 hours/week; Laboratory – 2 hours/week

**Course Outcomes**

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

- Select the appropriate farm machinery and matching power source for various farm operations
- Demonstrate the operation and maintenance of farm machines
- Generate idea for developing suitable machines for the farm operations for specific tasks.

**Syllabus Contents**

**Unit 1:** Objectives of farm mechanization. Classification of farm machines. Materials of construction & heat treatment. Principles of operation and selection of machines used for production of crops. Field capacities & economics. Performance evaluation, selection and cost analysis.

**Unit 2:** Tillage; primary and secondary tillage equipment. Forces acting on tillage tools. Hitching systems and controls. Draft measurement of tillage equipment

**Unit 3:** Sowing, planting & transplanting equipment – their calibration and adjustments. Fertilizer application equipment.

**Unit 4:** Weed control, intercultural implement and Plant protection equipment - sprayers and dusters, their calibration, selection, constructional features of different components and adjustments

**Unit 5:** Principles & types of cutting mechanisms. Construction & adjustments of shear & impact-type cutting mechanisms. Crop harvesting machinery : mowers, windrowers, reapers, reaper binders and forage harvesters. Forage chopping & handling equipment.

**Unit 6:** Threshing mechanics & various types of threshers. Threshers, straw combines & grain combines, maize harvesting & shelling equipment,

**Unit 7:** Testing of farm machine. Test codes & procedure. Interpretation of test results. Selection and management of farm machines for optimum performance.

| AE507 | Farm Machinery Lab. | 0L:0T:2P | 1 Credit |
|---|---|---|---|

**Syllabus Contents**

- Construction details, adjustments and working of M.B. plow, disc plow and disc harrow andsecondary tillage tools.
- Construction and working of rotavators and other rotary tillers.
- Constructional and functional study of different types of seed-drill and planters
- Calibration of seed drills
- Study of sprayers and dusters
- Study of Self-propelled rice transplanter
- Weeding equipments and their use
- Study of sprayers and dusters, measurement of nozzle discharge, field capacity etc.
- Study of different types of power operated reapers and threshers
- Measurement of speed and working width
- Field capacity and field efficiency measurement of machines/implements
- Draft and fuel consumption measurement for different implements under different soil conditions

**References**

1. Srivastava, A.K., Goering, C.E., Rohrbach, R.P. and Buckmaster, D.R. 2013. Engineering

Principles of Agricultural Machines, 2nd Edition. ASABE, St. Joseph, USA.
2. Kepner, R.A., Bainer, R. and Berger, E.L. 1978. Principles of Farm Machinery. John Wileyand Sons, New York.
3. Singh, T.P. 2017. Farm Machinery. PHI Learning Pvt. Ltd., Delhi.
4. Singh, S. 2007. Farm Machinery Principles and Applications. ICAR, New Delhi.
5. Michael, A.M. and Ojha, T.P. 2005. Principles of Agricultural Engineering, Vol. I. Jain Brothers, New Delhi

| AE504 | Mechanical Operation in Food Processing | 2L:0T:0P | 2 Credits |
|---|---|---|---|

**Teaching Scheme :** Lectures - 2 hours/week

**Course Outcomes:**

- Mechanical operations carried out in food processing: Particle size analysis and energy requirement in size reduction of solid foods;
- Homogenization of milk fat in high pressure homogenizer; milling of grains and recovery of various products; drag forces on a particle moving in fluid, pneumatic conveying, pressure drop in fixed and fluidized beds of granular materials; flow rate and pressure drop in single screw extruder.
- Mechanical separation of solids, liquids and gases: sieving, pressure filtration, centrifugal separation in centrifuges and cyclones; agitation and mixing of liquids and solids.

**Syllabus Contents:**

**Unit 1**: Physical characteristics, rheological properties, texture evaluation, mechanical damage, aero and hydro-dynamic characteristics, fractional characteristics, thermal, electrical and optical properties of bio-materials and their application to processing, storage and handling.
**Unit 2**: Filtration of food; slurry - filter medium and cake resistances; filtration equipments
**Unit 3**: Size separation through sieving; particle movement in sediment and centrifugal settling tank; solid bowl and disc bowl centrifuges; Agitation and mixing of liquid foods, powders and pastes.
**Unit 4**: Material handling system and device in food processing plants; drag and pressure flow mechanisms in screw press and extruder.
**Unit 5**: Design of machine elements and their selection, Design of grains and other crops processing machine components, food processing systems design involving, conveying, elevating, cleaning, separation, conditioning/parboiling, milling and mixing, Design, laying and drawing of food processing machines and plants, screw, bucket, belt, oscillating vibratory conveyors.

**References**

1. Brennam, J. G., Butters, J. R., Cowell, N. D and Lilly, A. E. I. (1990). Food Engineering Operations. Elsevier Science Pub. Co., Inc.
2. Earle, R. L. (1983). Unit operations in Food Processing. Pergamon Press.
3. Henderson, S. and Perry, S. M. (1976) Agricultural Process Engineering. 5th ed. AVI Publishing Co. Inc.
4. McCabe, W.L., Smith, J. C. and Harriott, P. (1985). Unit operations of chemical Engineering. 4th Ed. McGraw -Hill Book Company, Inc

| AE 505 | Renewable Energy Technologies | 2L:0T:0P | 2 Credits |
|---|---|---|---|

**Teaching Scheme:** Lectures - 2 hours/week; Laboratory – 2 hours/week

**Course Outcomes**

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

- Understand the working principle and working of various appliances based on renewable energy sources
- Carry out the task of operation and maintenance of biogas plant, gasifier, solar water heatersolar cooker etc.

- Apply the working principle of renewable energy for development of appropriate technologies

**Syllabus Contents**

**Unit 1:** Solar Energy; Heat transfer processes, radiation estimation and physical conversion, Instruments for measurement. Energy collection and thermal analysis; FPC, ETC, concentrating collectors. Solar thermal energy technology application; direct and indirect heating/cooling, refrigeration solar cooker and Water heater, Solar dryers, Solar green house, Active/passive heating, stills and solar pond. Solar photovoltaic technology; Conversion, Systems components and integrations, Balance of systems, applications and utilization in agriculture and agro based industries.

**Unit 2:** Energy from biomass and wastes; Production, distribution, Sources, characterization and properties of waste, composition, treatments, recycling. Biomass conversion technologies; Thermo-chemical, bio-chemical and agro-chemical technology- briquetting, gasification, Producer gas engines applications, Anaerobic digestion; crop residues and animal waste digestion, biogas engine system for power generation, Liquid fuels; aerobic and aerobic fermentation, ethanol, methanol production process and technologies.

**Unit 3:** Wind energy; Resource estimation, technologies, performance curves, wind farms design and considerations, wind mill parameters, power and torque characteristics; design and performance of rotors, wind mill structure design.

**Unit 4:** Other Renewable Energy Technologies; Ocean Thermal Energy Conversion, Geothermal, Tidal and Hydro Energy conversion systems

**Unit 5:** Resources, systems integrations and analysis, applications and utilization. Energy storage; Sensible and latent heat storage, thermos-chemical storage, Phase Change Material (PCM), characteristics and utilization.

| AE509 | Renewable Energy Technologies Lab | 0L:0T:2P | 1 Credit |
|---|---|---|---|

**Syllabus contents**

- Evaluation of solar thermal devices; Solar cooker, water heater, dryer, still, solar pond, solargreen house.
- Solar Photovoltaic cell characteristics
- Analysis of SPV system for home lighting, remote electrification
- SPV pumping system.
- Characterization of biomass; Proximate and Ultimate
- Calorific value estimation of biomass
- Biogas and producer gas
- Design and benefit analysis of community biogas plant
- Simulated anaerobic studies
- Solid state fermentation
- Study of ethanol and methanol plants.
- Design and efficiency testing of wind energy conversion devices; water pumping, electricitygeneration
- Study of solar- wind hybrid systems

**References**

1. Culp, A.W. 1991. Principles of Energy Conversion, McGraw Hill Pub. Co Inc.
2. Odum. H.T. and Odum, E.C. 1976. Energy Basis For Man and Nature. McGraw, Hill Pub. Co.Inc.
3. Garg, H.P. and Praksh J. 1976. Solar Energy- Fundamentals and Applications. Tata McGraw,Hill Pub. Co. Inc.
4. Sukhatmes, S.P. 1997. Solar Energy- Principles of Thermal Collection and Storage, 2nd Edition. Tata McGraw Hill. Pub. Co. Ltd., New Delhi.
5. Duffie, J.A. and Beckman W.A. 1991. Solar Engineering of Thermal Processes. John

Willey,New York.
6. Twidell, J.W. and Weir, A.D. 1986. Renewable Energy Sources, E & FN Spon Ltd., London.
7. Rai, G.D. 2001. Non-Conventional Energy Sources, Khanna Publishers, Delhi.

| AE510 | Mechanical Operation in Food Processing Lab | 0L:0T:2P | 1 Credits |
|---|---|---|---|

**Teaching Scheme :** Laboratory – 2 hours/week

**Course Outcomes:**

The Mechanical Operations in Food Processing laboratory course will consist of experiments illustrating the principles of food operations relevant to the study of science and engineering. The students will learn to:

- Estimate drying rate constants of food grains from concentration of reactants/products as a function of time
- Measure molecular/system properties such as flow rate, viscosity, texture, etc.
- Analyzed the homogenization of milk fat in high pressure homogenizer; milling of grains and recovery of various products
- To study the conveyance of food grain and powder in screw and vibratory conveyors.

**Syllabus Contents:**

**1.** Mixing of solids
**2.** Drying of food grains
**3.** Textural analysis of foods Estimation and measurement of flow rate
**4.** Power requirement and pressure developed in single screw
**5.** Homogenization of milk
**6.** Viscosity measurement of liquid foods
**7.** Measurement of flow properties of powders
**8.** Estimation and measurement of flow rate

**References**

1. Brennam, J. G., Butters, J. R., Cowell, N. D and Lilly, A. E. I. (1990). Food Engineering Operations. Elsevier Science Pub. Co., Inc.
2. Earle, R. L. (1983). Unit operations in Food Processing. Pergamon Press.
3. Henderson, S. and Perry, S. M. (1976) Agricultural Process Engineering. 5th ed. AVI Publishing Co. Inc.
4. McCabe, W.L., Smith, J. C. and Harriott, P. (1985). Unit operations of chemical Engineering. 4th Ed. McGraw -Hill Book Company, Inc

| AE601 | Thermal Operation in Food Processing | 2L:0T:0P | 2 Credits |
|---|---|---|---|

**Teaching Scheme :** Lectures - 2 hours/week

**Course Outcomes:**

- Overview of thermal operations carried out in dairy and food processing. Pasteurization and Sterilization: microbial destruction in batch and continuous sterilization; kinetics of loss of nutrients in sterilization;
- UHT processing; action of chemicals on death kinetics of microbes; aseptic packaging; irradiation and microwave processing of foods; Effects of heat, acid and short wave electromagnetic radiation on kinetics of enzyme inactivation.
- Crystallization and Freezing: Planks law and estimation of freezing time of foods; equipment used for freezing water in food for production of crystalline foods

**Syllabus Contents:**

**Unit 1:** Fourier's law, heat conduction through composite walls, optimum thickness of insulation, general equation under unsteady sate, Free and forced convection, Newton's law of cooling, film coefficient, correlation of Nusselt number, Prandtl and Reynold's number;

Empirical and practical relations for forced convection

**Unit 2:** Overall heat transfer coefficient, fouling factors, log mean temperature difference, heat exchange mechanism in various types of heat exchangers e.g. tubular, extended surface and plate heat exchangers, effectiveness/NTU relationships

**Unit 3:** Effect of heat, acid and short wave electromagnetic radiation on kinetics of enzyme inactivation; microbials destruction and nutrients loss in pasteurization, sterilization and UHT processing.

**Unit 4:** Mechanism of moisture removal in solid and liquid foods during drying; Spray, freeze, roller tray and through-flow drying operations.

**Unit 5:** Concept of water activity, concentration of liquid foods in batch and continuous type evaporators; Energy saving by use of multiple effect evaporators with mechanical and thermal vapour compression

**References**


1. Arora, S.C. and Domkundwar, S. (1994) A Course In Heat and Mass Transfer. Dhanpatrai and Sons, 4th Edition.
2. Chapmen, A. J. (1989) Heat Transfer, 4th Edition
3. Holman, J. P. (1992) Heat Transfer. McGraw Hill Publication
4. Toledo, R. T. (1980) Fundamental of Food Process Engineering. AVI publishing Co., West port.


| AE605 | Thermal Operation in Food Processing Lab | 0L:0T:2P | 1 Credits |
|---|---|---|---|

**Teaching Scheme** : Laboratory – 2 hours/week

**Course Outcomes:**

At the end of the course, the student will be able to:

- Understand the broad principles of thermal operations in food processing.
- Understand comparison study of drying and dehydration phenomena.
- Be able to apply various types of heat processing employed by the food industry

**Syllabus Contents:**

1. Canning of foods
2. Spray of liquid foods
3. Vacuum drying of food
4. Tray drying of foods
5. Freeze drying of foods
6. Z-factor analysis
7. Freezing/chilling of food materials
8. Thin layer drying characteristics of crops and other bio-materials

**References**


1. Brennam, J. G., Butters, J. R., Cowell, N. D and Lilly, A. E. I. (1990). Food Engineering Operations. Elsevier Science Pub. Co., Inc.
2. Henderson, S. and Perry, S. M. (1976) Agricultural Process Engineering. 5th ed. AVI Publishing Co. Inc.
3. McCabe, W.L., Smith, J. C. and Harriott, P. (1985). Unit operations of chemical Engineering. 4th Ed. McGraw -Hill Book Company, Inc.


| AE 602 | Machine Design and Drawing | 2L:0T:0P | 2 Credits |
|---|---|---|---|

**Teaching Scheme:** Lectures - 2 hours/week; Laboratory – 2 hours/week

**Objectives**

This course seeks to provide an introduction to the design of machine elements commonly encountered in mechanical engineering practice, through

- A strong background in mechanics of materials based failure criteria underpinning the safety-critical design of machine components
- An understanding of the origins, nature and applicability of empirical design principles, basedon safety considerations
- An overview of codes, standards and design guidelines for different elements
- An appreciation of parameter optimization and design iteration
- An appreciation of the relationships between component level design and overall machinesystem design and performance
- To provide an overview of how computers can be utilized in mechanical component design

**Syllabus Contents**

**Unit 1:** Design considerations - limits, fits and standardization, Review of failure theories for static and dynamic loading (including fatigue failure).
**Unit 2:** Design of shafts under static and fatigue loadings.
**Unit 3:** Analysis and design of sliding and rolling contact bearings.
**Unit 4:** Design of transmission elements: spur, helical, bevel and worm gears; belt and chaindrives.
**Unit 5:** Design of springs: helical compression, tension, torsional and leaf springs.
**Unit 6:** Design of joints: threaded fasteners, pre-loaded bolts and welded joints.
**Unit 7:** Analysis and applications of power screws and couplings.
**Unit 8:** Analysis of clutches and brakes.

| AE 606 | Machine Design and Drawing Lab | 0L:0T:2P | 1 Credit |
|---|---|---|---|

**Course Outcomes**

Upon completion of this course,

- Students will get an overview of the design methodologies employed for the design of various machine components.
- Students can use computer and CAD software for modeling mechanical components

**Syllabus Contents**

Engineering Graphics Software; -Spatial Transformations; Orthographic Projections; Model Viewing; Co-ordinate Systems; Multi-view Projection; Exploded Assembly; Model Viewing; Animation; Spatial Manipulation; Surface Modelling; Solid Modelling; Preparation of engineering drawings of machine / implement components.

**References**


1. Shigley, J.E. and Mischke, C.R., Mechanical Engineering Design, Fifth Edition, McGraw-HillInternational; 1989.
2. Deutschman, D., Michels, W.J. and Wilson, C.E., Machine Design Theory and Practice, Macmillan, 1992.
3. Juvinal, R.C., Fundamentals of Machine Component Design, John Wiley, 1994.
4. Spottes, M.F., Design of Machine elements, Prentice-Hall India, 1994.
5. R. L. Norton, Mechanical Design – An Integrated Approach, Prentice Hall, 1998.
6. Ibrahim Zeid, Mastering CAD CAM, Tata McGraw Hill Publishing Co. 2007.
7. C. McMohan and J. Browne, CAD/CAM Principles, II edition, Pearson Education, 1999.
8. W. M. Neumann and R.F. Sproul, Principles of Computer Gra[hics, McGraw Hill, 1989.
9. D. Hearn and M.P. Baker, Computer Graphics, Prentice Hall Inc., 1992.


| AE 603 | Soil & Water Conservation Engg. | 2L:0T:0P | 2 Credits |
|---|---|---|---|

**Teaching Scheme :** Lectures - 2 hours/week; Laboratory – 2 hours/week

**Course Outcomes**

Under the completion of the course, students will be able to

1. Understand the concept of soil, wind and water erosion and their conservation practices.
2. Recognize different types of erosion, rainfall and runoff.

3. Design and construction of soil and wind erosion control structures
4. Understand the concept of Universal Soil Loss Equation (USLE) with respect to soil loss
5. Recognize a land undergoing the process of desertification and how it can be controlled

**Syllabus**

**Unit 1: Soil Erosion Principle**

Effects of soil erosion, causes of soil erosion, types of erosion, factors affecting erosion, erosivity and erodibility, measurement of soil losses

**Unit 2: Conservation Measures for Agricultural Lands**

Biological and engineering measures, contour farming, strip cropping, contour bunds and graded bunds, conservation measures for hill slopes, design principles of bunds and terraces, vegetative and grassed waterways.

**Unit 3: Gully Erosion and its Control**

Process of gully development, classification of gullies, planning for gully control, methods of gully control, temporary and permanent structures for gully control

**Unit 4: Wind Erosion and its Control**

Factors influencing wind erosion, Mechanics of wind erosion, estimation soil losses by wind; wind erosion control, tillage practices, controlling soil factors

**Unit 5: Stream Bank Erosion Control**

Causes of stream bank erosion, methods of controlling stream bank erosion, direct protection works, diversion of runoff

**References**

1. Das, Ghanashyam. Hydrology and Soil Conservation Engineering, Prentice Hall of India, Pvt. Ltd, New Delhi
2. Michael, A. M. Irrigation Theory and Practice, Vikas Publication. New Delhi
3. James, L. G. Principles of Farm Irrigation System Design, John Wiley and Sons, USA
4. Walker, W.R. and Skogerboe, Q. V. Surface Irrigation: Theory and Practice, Prentice Hall Inc. New Jersey, USA

| AE 607 | Soil & Water Conservation Engg. Lab. | 0L:0T:2P | 1 Credit |
|---|---|---|---|

**Teaching Scheme :** Lectures - 2 hours/week; Laboratory – 2 hours/week

**Course Outcomes**

Under the completion of the course, students will be able to

1. Design and development of biological measures to control soil erosion
2. Design and construction of temporary and permanent soil and wind erosion control structures
3. Estimate of Soil Loss using different soil loss models for different topographical and hydrological conditions

**Syllabus Contents**

1. Design of contour bund and graded bund
2. Design of bench terraces
3. Design of grassed waterways
4. Design of temporary gully control structure
5. Design of drop spillway, chute spillway and drop inlet spillway
6. Design of farm pond and earthen embankment
7. Estimation of soil loss using different soil loss models
8. Design and development of wind erosion control structures

**References**

1. Das, Ghanashyam. Hydrology and Soil Conservation Engineering, Prentice Hall of India, Pvt. Ltd, New Delhi
2. Michael, A. M. Irrigation Theory and Practice, Vikas Publication. New Delhi

3. James, L. G. Principles of Farm Irrigation System Design, John Wiley and Sons, USA
4. Walker, W.R. and Skogerboe, Q. V. Surface Irrigation: Theory and Practice, Prentice Hall Inc. New Jersey, USA

| AE 604 | Irrigation & Drainage Engineering | 2L:0T:0P | 2 Credits |
|---|---|---|---|

**Teaching Scheme :** Lectures - 2 hours/week; Laboratory – 2 hours/week

**Course Outcomes**

- On the completion of the course students will be able to understand the concepts of irrigation and different hydraulic structures and their designs, different channels and other irrigation structures required for irrigation and drainage.
- It describes about merits and demerits of irrigation and drainage. What are the important points to be considered to select a suitable site for irrigation methods and drainage systems.
- It gives an idea about layout plan of different types of irrigation methods and drainage systems, Water supply system and types of irrigation and drainage systems, such as with treatment, without treatment, parallel and series system.
- This will introduce students to basic concepts of water, plants, their interactions, as well as irrigation and drainage systems design, planning and management.

**Syllabus Contents**

**Unit 1: Water Resource Utilization in India**

Sources of water, utilization in various sectors, irrigation potential and scope for further development and significant issues, Techniques of water distribution in the farm, Irrigation projects, Duty and Delta, factor affecting of duty, Quality of irrigation water, Water requirements to the crop.

**Unit 2: Irrigation Pump**

Indigenous water lifts, positive displacement pumps, centrifugal pumps, vertical turbine pumps, submersible pumps, propeller and mixed flow pumps, jet pumps, airlift pumps, Pump efficiency and economics of irrigation pumping plants, Net positive suction head, Pump characteristic curve.

**Unit 3: Soil-plant-water Relationships**

Water relation of soils, measurement of soil moisture, infiltration, water requirement of crops, consumptive use and evapotranspiration, Factor affecting consumptive use, Estimation of consumptive use, Irrigation efficiencies, irrigation scheduling, Optimum utilisation of irrigation water, Transpiration, Consumptive irrigation requirement, Net irrigation requirement, Soil-moisture-irrigation relationship,

**Unit 4: Measurement of Irrigation Water and its Application**

Methods of water measurement, weirs, gravity and non-gravity weir, parshall flumes, orifices and meter gates, methods of irrigation water application, water conveyance and control structures, Barrage, Layout of diversion head works and its components.

**Unit 5: Drainage of Agricultural Lands**

Drainage problems, causes and effect of water logging, prevention and control of drainage requirements of various crops, types of drainage systems, Land grading and land preparation for irrigation and drainage, design of irrigation channel, Tile drains , Layout of tile drains, Drainage coefficient, Leaching requirements of soil, Water logging control.

**References**

1. Michael, A. M. Irrigation Theory and Practice, Vikas Publication. New Delhi
2. Garg, S. K. Irrigation Engineering and Hydraulic Structures. Khanna Publisher.
3. Sharma, R.K., Text book of Irrigation Engineering and Hydraulic Structures, Oxford and IBK Publishing House, New Delhi.
4. Punmia, B.C., and B.B. Pande, “Irrigation and Water Power Engineering”, Laxmi Publication Pvt. Ltd., New Delhi.
5. James, L. G. Principles of Farm Irrigation System Design, John Wiley and Sons, USA

6. Walker, W.R. and Skogerboe, Q. V. Surface Irrigation: Theory and Practice, Prentice Hall Inc. New Jersey, USA

| AE 608 | Irrigation & Drainage Engineering Lab. | 0L:0T:2P | 1 Credit |
|---|---|---|---|

**Teaching Scheme :** Lectures - 2 hours/week; Laboratory – 2 hours/week

**Course Outcomes**

- Students will have practical knowledge about irrigation techniques and their designs. They will have the knowledge of drainage techniques and their field uses.
- At the end of the course the students will be able to understand how to determine soil moisture content, evapotranspiration i.e. crop water requirement in any locality for efficient irrigation, infiltration and hydraulic conductivity.

**Syllabus Contents**

1. Field and laboratory demonstration of hydro-met observatory, lysimeter, soil moisture measuring equipment, flow measurement devices.
2. Measurement of soil moisture by different soil moisture measuring instruments
3. Measurement of infiltration rate, computation of evaporation and transpiration
4. Measurement of advance and recession in border irrigation and estimation of irrigation efficiency
5. Determination of crop water requirement and irrigation scheduling
6. Measurement of uniformity coefficient of drip irrigation method
7. Measurement of uniformity coefficient of sprinkler irrigation method
8. Design of surface drainage systems and subsurface drainage systems
9. Determination of drainage coefficient
10. Land grading and land levelling methods

**References**

1. Michael, A. M. Irrigation Theory and Practice, Vikas Publication. New Delhi
2. Garg, S. K. Irrigation Engineering and Hydraulic Structures. Khanna Publisher.
3. Sharma, R.K., Text book of Irrigation Engineering and Hydraulic Structures, Oxford and IBK Publishing House, New Delhi.
4. Punmia, B.C., and B.B. Pande, “Irrigation and Water Power Engineering”, Laxmi Publication Pvt. Ltd., New Delhi.
5. James, L. G. Principles of Farm Irrigation System Design, John Wiley and Sons, USA
6. Walker, W.R. and Skogerboe, Q. V. Surface Irrigation: Theory and Practice, Prentice Hall Inc. New Jersey, USA

| AE 701 | Land and Water Resource Management | 3L:0T:0P | 3 Credits |
|---|---|---|---|

**Teaching Scheme :** Lectures - 3 hours/week

**Course Outcomes**

On completion of this course, the student shall learn:

- The different land suitability and capability classification of soil and its framework for evaluation.
- Assess the potential of groundwater and surface water resources including the different mathematical techniques about sustainable yields of the water resources.
- Design and construction of different type of wells.
- Assess the different salt related problems and methods to control them.

**Syllabus Contents**

**Unit 1: Land Resources for Agriculture**

Land classification, Land capability classification, United States department of agriculture system, land evaluation, the FAO framework for land evaluation

**Unit 2: Groundwater and Wells**

Subsurface distribution of water, geologic formation of groundwater supply, types of aquifers,

investigation of groundwater development, Hydraulics of wells

**Unit 3: Design and Construction of Wells**

Location of wells, drilling methods, construction of strainer type wells, cavity wells and open wells, development of tubewells, testing of tubewells

**Unit 4: Farm Ponds**

Types of ponds, design of farm ponds, site selection, capacity of the pond, design of embankment, seepage through embankments, spillway and outlet structures.

**Unit 5: Salt Problems in Soil and Water**

Salt affected soils, classification of salt affected soils, quality of irrigation waters, salt balance in irrigated lands, reclamation of salt affected soils

**References**

1. Suresh, R. Soil and Water Conservation Engineering. Standard Publishers, and Distributors, New Delhi
2. G. O. Schwab, D. D. Fangeir, W. T. Edminister and R.K. Frevert. Soil and Water Conservation Engineering, John Wiley and Sons.
3. V.V.N. Murty. Land and Water Management Engineering. Kalyani Publisher, Ludhiana, India
4. V.V.N. Murty and D. K. Takeuchi, Land and Water Development for Agriculture in AssiaPacific Region. Oxford and IBH Publishing Co. New Delhi.

| AE702 | Fruits and Vegetable Processing | 3L:0T:0P | 3 Credits |
|---|---|---|---|

**Teaching Scheme :** Lectures - 3 hours/week

**Course Outcomes:**

- To reduce wastage and losses: Fruit and vegetable industry is the backbone of horticulture industry as it takes care of all possible waste that occurs in spite of improvement in the distribution and marketing of fresh produce
- To generate employment: Processing of fruits and vegetables being a labour intensive helps to generate both direct and indirect employment for the masses.
- To add variety to the diet: Value addition/processing make the food more attractive and palatable.
- To ensure nutritional security

**Syllabus Contents:**

**Unit 1:** Unit operations in primary and secondary processing; processing technologies, equipment and systems such as cleaning, grading, pretreatment

**Unit 2:** Principles and techniques in preservation of foods and vegetables-cold storage, freezing, addition of chemicals, dehydration and canning, packaging. Manufacturing methods of major horticultural and plantation crop products-juices, pickles, jams, jellies, marmalades, tea, coffeeprocessing

**Unit 3:** Quality; packaging of processed products; utilization and management of byproducts; storage of milled products; BIS standards for various processed products; layout and design of processing systems

**Unit 4:** Seed processing with reference to drying, cleaning, processing and treatment of seed packaging, post harvest control of insect, pest and fungi in storage

**Unit 5:** Packaging, seed testing, seed germination and vigour, maintenance and distribution of breeders seed

**References**

1. J. J. Asiedu. Processing tropical crops. ELBS Macmillan.
2. A. Chakraverty. Post Harvest Technology of cereals, Pulses and oilseeds. 3rd Oxford IBH Publishing Co. Pvt. Ltd.
3. D.A. Dendy and B.J. Dobraszczyk. Cereals and Cereal products: Chemistry and Technology. Aspen publishers, Maryland
4. B. Godon and C. Williams. Primary cereal processing: A comprehensive source book
5. B.R. Greg, A.G. Law, S.S. Virdi and J.S. Balis, Seed Processing. Avion Printers, ND.

**PROFESSIONAL ELECTIVE COURSES**

| AE A01 | Environmental Engineering Fundamentals | 3L:0T:0P | 3 Credits |
|---|---|---|---|

**Teaching Scheme :** Lectures - 3 hours/week

**Course Outcomes**

After completing the course, students should be able to:

Define and describe the role of Environmental Engineers in identifying and solving problems related to the human interaction with the environment (including regulations development).

- Assess the impact of human activity on the environment
- Illustrate the impact of engineered systems on the environment and apply current engineering technologies to protect the environment (water, air and soil).
- Design processes and operations aimed to decrease the effects of pollution in air, water and land systems.

**Syllabus Contents**

**Unit 1:** Introduction to environmental engineering, Domains of environmental engineering, History of environmental engineering, Environmental issues of emerging concern, laws and regulations, Environmental engineering management, Development of environmental regulations, environmental legislation in India, environmental ethics.

**Unit 2:** Ecology and the environment, Ecosystems, Nutrient cycles, Biodiversity, Ecology and the environment, Limnology, Water budget, Population growth.

**Unit 3:** Overview of chemistry, Mass relationships, Units of measurement, Equilibrium, Acid-base reactions, Solubility reactions, Redox reactions, Chemical reaction rates; Mass balance.

**Unit 4:** Overview of microbiology, Microbes in the environment, Microbes in engineering systems, Microbial energetic, Microbial growth kinetics, Microbial genetics; Microbial diseases.

**Unit 5:** Environmental quality, Water pollution (Organic pollutants, Inorganic pollutants, Physical pollutants), Water pollution (Oxygen sag curve), Air pollution (Greenhouse gases; Hazardous gases), Pollution control (Wastewater treatment), Pollution control (Water treatment; Desalination & Membranes; Land-based treatment)

**References**


**1.** Davis M.L., Cornwell D.A., "Introduction to Environmental Engineering", Tata McGraw Hill Education (P) Ltd., New Delhi

**2.** De A.K., "Environmental Chemistry ", New Age International (P) Ltd., New Delhi.

**3.** Khopkar S.M., "Environmental Pollution Analysis", New Age International (P) Ltd., New Delhi.

**4.** Cunningham W.P., Cunningham M.A., "Principles of Environmental Science", Tata McGraw Hill

**5.** Krishnamoorthy B., "Environmental Management, Text Book and Cases", PHI Learning (P) Ltd.

**6.** Chandrappa R., Das D.B., "Solid Waste Management: Principals and Practice"

**7.** Pelczar, M., J.Chan E.C.S. and Krieg, N. R. Microbiology, Tata McGraw Hill, New Delhi.

**8.** Droste R.L., "Theory and Practice of Water and Wastewater Treatment", Wiley India (P) Ltd.

**9.** Dara S.S., "A Textbook of Environmental Chemistry and Pollution Control", S. Chand and Company Ltd., New Delhi.


| AE A02 | Watershed Planning and Management | 3L:0T:0P | 3 Credits |
|---|---|---|---|

**Teaching Scheme :** Lectures - 3 hours/week

**Course Outcomes**

**Under the completion of the course, students will be able to**

- Understand the concept of watershed, delineation, and importance of watershed management
- Assess the impact of land use changes on various hydrological cycle parameters and soil

erosion and choosing suitable soil and water conservation techniques to control it.

- Have capacity building to undertake research work or professional assignment in the sub-fields of watershed management, which plays a key role in sustainable development.
- Understand different watershed behavior
- Interpret runoff data and quantify erosion by using various modelling methods

**Syllabus Contents**

**Unit I**

Watershed concept and characteristics, their role in watershed management. Watershed management: definition and concept, principle and components, objectives. Watershed management programs. Watershed delineation, demarcation, and analysis.

**Unit II**

Soil and water conservation measures for arable lands and non-arable lands. Arable lands - agriculture and horticulture, Non-arable lands - forestry, fishery and animal husbandry. Effect of cropping systems, land management and cultural practices on watershed hydrology.

**Unit- III**

Management measures - rainwater conservation technologies - in-situ and ex-situ storage, water harvesting and recycling. Dry farming techniques - inter-terrace and inter-bund land management. Indigenous soil water conservation measures.

**Unit-IV**

Hydrologic data for watershed planning, Water budgeting in a watershed. Hydrologic and sediment monitoring of watershed and Reservoir sedimentation.

**Unit-V**

Benefit cost ratio of watershed development projects and Watershed management work plan, Watershed programme - execution, follow-up practices, maintenance, monitoring and evaluation. Participatory watershed management - role of watershed associations, user groups and self-help groups.

**References**

1. Soil Conservation and Land Management. S. K. Datta, International Book Distributors, Dehradun, 1985

2. Soil and Water Conservation Engg. R. Suresh, Standard Publishers Distributors, Delhi-6, Reprint Edition 2006

3. Watershed Planning and Management. Rajvir Singh. Yash Publishing House, Bikaner. 2000

4. Field Manual on Watershed Management. 2013. B. Venkateswarlu, Mohammed Osman, M.V. Padmanabhan, K. Kareemulla, P.K. Mishra, G.R. Korwar& K.V. Rao, CRIDA, Hyderabad

7. Watershed Management. V.V. DhruvaNarayana G. Sastry& U.S. Patnaik. ICAR, New Delhi, 1997

8. Watershed Management: Guidelines for Indian Conditions. Tideman, E.M., Omega Scientific Publishers, New Delhi. 1996

| EA03 | Environmental Microbiological Principles | 3L:0T:0P | 3 Credits |
|---|---|---|---|

**Teaching Scheme :** Lectures - 3 hours/week

**Course Outcomes:**

Understanding the relationship between natural ecosystem, waste management and engineering systems, Waste treatment plants, Environmental importance of microorganisms, Advantages and Challenges of microbial population

**Syllabus Contents**

**Unit 1:** Introduction, Overview of microbiology, Microbiology in environmental engineering, Microbial cell structure and function, Macromolecules, prokaryotic cell structure / function, Bacterial classification and taxonomy, Phenotypic classicisation, Genotypic classification, Microbial metabolism.

**Unit 2:** Cell composition, Metabolism I, Metabolism II, Introduction Lab Experiment 1, Microbial Growth and Control Cell growth measurement / Environmental factors, Introduction lab Experiment 2.
**Unit 3:** Eukaryotes / Viruses, Diversity of Eukaryotic microorganisms, Virology, Aero-microbiology, Introduction Lab experiment 3, Molecular Microbiology , Central dogma of biology (DNA/RNA/protein), Microbial genomics, Metabolic diversity of microorganisms, Metabolic diversity
**Unit 4:** Stoichiometry and bacterial energetic, (Carbon and Nitrogen), Functional diversity of Microorganism, The Carbon cycles, The Nitrogen / sulphur cycles, Other nutrient cycles, Applied Microbiology in Natural Environments, The microbial environment (bio film), Aquatic environment.
**Unit 5:** Applied Microbiology in Built environments, Terrestrial environments / Bioremediation, Wastewater and drinking water treatment, Fecal indicator bacteria and public health

**References**
1. Sawyer C.N., McCarty P.L. and Parkin G.F., "Chemistry for Environmental Engineering and Science", Tata McGraw Hill Publishing Company Ltd., New Delhi
2. Pani B., "Textbook of Environmental Chemistry", I.K. International Publishing House (P) Ltd., New Delhi
3. Nathanson J.A., "Basic Environmental Technology, Water Supply, Waste Management and Pollution Control", PHI (P) Ltd., New Delhi
4. Krishnamoorthy B., "Environmental Management, Text Book and Cases", PHI Learning (P) Ltd.

| AEB01 | Food Chemistry and Microbiology | 3L:0T:0P | 3 Credits |
|---|---|---|---|

**Teaching Scheme :** Lectures - 3 hours/week

**Course Outcomes:**
- To understand the chemistry of foods - composition of food, role of each component and their interaction.
- To understand the functional aspects of food components and to study their role in food processing.
- To know the important genera of microorganisms associated with food and their characteristics.
- To understand the role of microbes in fermentation, spoilage and food borne diseases.

**Syllabus Contents:**
**Unit 1:** Introduction to Food Chemistry: Definition, Composition of food; Water: Definition of water in food • Structure of water and ice 33 • Types of water • Sorption phenomenon • Water activity and packaging • Water activity and shelf-life.
**Unit 2:** Lipids: Classification of lipids • Physical and chemical properties of lipids. Protein classification and structure • Nature of food proteins (plant and animal proteins) • Properties of proteins (electrophoresis, sedimentation, amphoterism and • denaturation,)
**Unit 3:** Carbohydrates: Classification (mono, oligo and poly saccharides) • Structure of important polysaccharides (starch, glycogen, cellulose, pectin, • hemicellulose, gums) Vitamins: Structure ,Importance and Stability • Water soluble vitamins • Fat soluble vitamins
**Unit 4:** Introduction to Food Microbiology: History and Development of Food Microbiology • Definition and Scope of food microbiology • Microbial Growth in Food: Bacterial growth curve and microbial growth in food • Factors affecting the growth of micro organisms in food; Microbial Food Spoilage: Sources of Microorganisms in foods • Some important food spoilage microorganisms •
**Unit 5:** Food Fermentations: definition and types • Microorganisms used in food fermentations • Dairy Fermentations-starter cultures and their types, Foodborne Diseases; Types and Common

and Recent Examples.

**References**


**1.** Frazier William C and Westhoff, Dennis C. Food Microbiology, TMH, New Delhi, 2004
**2.** Jay, James M. Modern Food Microbiology, CBS Publication, New Delhi, 2000
**3.** Fennema, Owen R, Food Chemistry, 3rd Ed., Marcell Dekker, New York, 1996
**4.** Whitehurst and Law, Enzymes in Food Technology, CRC Press, Canada, 2002


| AE B02 | Refrigeration and Air Conditioning | 3L:0T:0P | 3 Credits |
|---|---|---|---|

**Teaching Scheme:** Lectures - 3 hours/week

**Objectives**

- To familiarize with the terminology associated with refrigeration systems and air conditioning
- To understand basic refrigeration processes
- To understand the basics of psychrometry and practice of applied psychrometrics
- To acquire the skills required to model, analyse and design different refrigeration as well as air conditioning processes and components

**Syllabus Contents**

**Unit-1:** Classification of refrigeration systems; Ozone depletion and global warming issues
**Unit-2:** Advanced vapour compression cycles, Refrigerants and their mixtures: properties and characteristics.
**Unit-3:** System components: Compressors, Condensers, Expansion devices and Evaporators-Performance matching of components of refrigeration systems
**Unit-4:** Advanced sorption refrigeration systems and their components.
**Unit-5:** Review of Psychrometry and Air-conditioning processes-Comfort air conditioning and Cooling load calculations
**Unit-6:** Applications of AC systems - Concept of enthalpy potential - Air washers, Cooling towers, Evaporative condensers, Cooling and dehumidifying coils.

**Course Outcomes**

A student who has done the course will have a good understanding of the working principles ofrefrigeration and air-conditioning systems

**References**


1. Gosney, W.B, Principles of Refrigeration, Cambridge University Press, 1982.
2. Stoecker, W.F. and Jones, J.W., Refrigeration and Air conditioning, Tata McGraw Hill, 1986.
3. Arora, C.P., Refrigeration and Air conditioning, Tata McGraw Hill, 2nd Edition, 2000.
4. Kuehn, T.H., Ramsey, J.W. and Threlkeld, J.L., Thermal Environmental Engineering, 3rd Edition, Prentice Hall, 1998.


| AE B03 | Tea Technology | 3L:0T:0P | 3 Credits |
|---|---|---|---|

**Teaching Scheme :** Lectures - 3 hours/week

**Course Outcomes**

- At the end of this course students will demonstrate the ability to understand the basic criteria to select the land for tea plantation.
- Understand and be able to apply the concept of irrigation and drainage, types of irrigation methods used for tea estates.
- Understand variety and type of tea and their manufacturing process.
- The students will be able to evaluate the performance of various tea processing unit operations

**Syllabus Contents**

**Unit 1: Land Preparation and Transplantation**

Field selection, Physical land preparation, Type of soil and climatic conditions suitable for growing tea, Soil testing and analysis, Methods of transplanting, Practice for planting, Methods of propagation, Nutrient management in tea plantation, Methods of fertilization and micro nutrients application, Shade and shade trees.

**Unit 2: Irrigation systems for tea plantation**

The interaction effects of soil type, level of the land and water availability on the plant growth and its yield, Timing and methods of determination of irrigation requirements, Design and maintenance, Irrigation practices in young tea, Selection of appropriate Drainage system and design.

**Unit 3: Tea Processing**

Types and grades of tea, Flavor profile of tea, Suitable environment for manufacturing, Methods and equipment for production, plucking, types of plucking, plucking table, pruning, types of pruning, Types of tea processing, Unit operations for tea processing, CTC and Orthodox tea processing.

**Unit 4: Human Resource Management**

Principle of management, Employment issues, Selecting and Hiring processes, Orientation and training programme, Employee Separation and the impact of downsizing and outsourcing, Maslow's hierarchy of needs theory, Goal setting theory, Labour-Management relations.

**Unit 5: Waste utilization and management**

Introduction, Causes and effects of tea waste, Factory tea waste, Decaffeinated tea waste, Method of tea waste disposal and management, Rules and regulation for sale of tea waste.

**References**

1. Collin. Tea Production and Processing. J.W. Publication
2. Baruah. The tea industry in Assam. Eastern Publication

| AEB04 | Dairy Food Technology | 3L:0T:0P | 3 Credits |
|---|---|---|---|

**Teaching Scheme :** Lectures - 3 hours/week

**Course Outcomes:**

Design and planning for a dairy industry, Properties of Milk, Spoilage factors, Processing and preservation techniques, Emerging methods in dairy processing, Microbial analysis and control.

**Syllabus Contents:**

**Unit 1:** Milk and its properties, Detailed Composition, General characteristics (color, taste, chemical properties, physical properties), Constituents of milk (Major and minor)

**Unit 2:** Engineering Properties of milk, Viscosity, Density, Boiling and freezing point, Refractive index, Acidity and pH, Thermal properties, Equations for thermal properties (Specific heat, latent heat and thermal conductivity), Industrial applications and related problems

**Unit 3:** Dairy Products and Processes, Detailed processes for producing Cheese, Butter, Yoghurt and Dried Milk Powder, Different Unit operations in Dairy Processing – material handling, storage, homogenization, centrifugation, drying, fermentation and packaging

**Unit 4:** Food Deterioration – defining terms and factors, Factors- physical, chemical and biological, Controlling deterioration by thermal treatment, Pasteurization – purpose and outcome, Methods of Pasteurization: Batch, Continuous, Uperization, Vacreation, time – temperature relationship.

**Unit 5:** Sterilization – purpose and outcome, Methods of sterilization – Batch, Continuous, In-bottle sterilization, Ultra high temperature (UHT), Double stage, Microbial Death kinetics, F-value, D-value, Z-value, Q10 value, sterilization time, pasteurization time.

**References**

1. De Sukumar., Outlines of Dairy Technology, Oxford University Press, 2007

2. De S, Outlines of Dairy Technology, Oxford Publishers, 1980
3. Ramaswamy H and Marcott M,Food Processing Principles and Applications CRC Press, 2006
4. Coles R, McDowell D and Kirwan MJ, Food Packaging Technology, CRC Press, 2003

| AE C01 | Testing & Evaluation of Tractors & Machines | 3L:0T:0P | 3 Credits |
|---|---|---|---|

**Teaching Scheme:** Lectures - 3 hours/week

**Course Outcomes**

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

- Acquire the skills for testing tractor, farm implements and machinery, power tiller etc.
- Carry out the performance evaluation of farm implements and machinery.
- Understand the technical specification of engines, tractors and farm machinery.

**Syllabus Contents**

**Unit 1:** Test code, performance index, selection of machines, testand soil conditions, measurement of power, preparation of data sheet and analysis, Instrumentation for testing and data acquisition.

**Unit 2:** Ergonomic appraisal of agricultural equipment, Ergonomic assessments, animal and machine performance, Human characteristics, energy demands, environmental factors, safety and comfort.

**Unit 3:** Test procedures for agricultural hand tools and animal drawn agricultural equipment and implements. Procedure for evaluation of implements for primary tillage, secondary tillage, hand hoes

**Unit 4:** Procedure for evaluation of seeders, seed drills and planters, transplanters, fertiliser distributors. Procedure for evaluation of knapsack sprayer, field sprayer and dusters,

**Unit 5:** Testing procedures for power tiller drawn/self-propelled agricultural equipment/ implements, reapers, binders, grain threshers and combine harvesters, maize shellers, decorticators, winnowers.

**Unit 6:** Testing of farm tractor and power tiller – Tractor test codes: BIS: ISO: ASABE, OECD and SAE

**References**

1. Smith, D.W., Sims, B.G. and O'Neill, D.H. 1994. Testing and Evaluation of Agricultural Machinery and Equipment: Principles and Practices. FAO, Rome.
2. Goering, C.E. and Hansen, A.C. 2013.Engine and Tractor Power. ASABE, USA.
3. Singh, T.P. 2017. Farm Machinery. PHI Learning Pvt. Ltd., Delhi.
4. Singh, S. 2007. Farm Machinery Principles and Applications. ICAR, New Delhi.

| AE C02 | Advanced Farm Power | 3L:0T:0P | 3 Credits |
|---|---|---|---|

**Teaching Scheme :** Lectures - 3 hours/week

**Course Outcomes**

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

- Understand the recent trends and developments in tractor design
- Acquire the knowledge of application of hydraulic system and mechanics in lifting of loads and pulling the implement by the tractor under actual field conditions.
- Carry out the design of hydraulic circuit for various applications and know the importance of ergonomics in the design of tractor.

**Syllabus Contents**

**Unit 1**: Hydraulic system circuits, design and selection of hydraulic system components, automatic draft and position control system. Hydrostatic transmission, Power steering

**Unit 2**: Tractor chassis mechanics, hitching systems, 3-point hitch linkage design, hydraulic control of tractors, Determination of CG and moment of inertia, Dynamic stability and tractive

ability of tractor, Tire selection.

**Unit 3**: Recent trends in tractor design, emissions and control of pollutants, Design of mechanical steering and brake system of tractor, hydraulic brake system, Steering geometry and stability during turning

**Unit 4**: Introduction of traction devices, tyres-types, function and size, their selection; mechanics of traction devices. Deflection between traction devices and soil, slippage and sinkage of wheels, evaluation and prediction of traction performance, design of traction and transport devices.

**Unit 5**: Ergonomics in tractor system design, noise and vibration effects, Design of operators'seat and suspension, work-place area and controls.

**References**

1. Liljedahl, J.B., Turnquist, P.K., Smith, D.W. and Hoki, M. 1999. Tractors and their PowerUnits. Wiley, New York.
2. Mathur, M.L. and Sharma, R.P. 1994. Internal Combustion Engines. DhanpatRai and Sons,New Delhi.
3. Goering, C.E. and Hansen, A.C. 2013. Engine and Tractor Power. ASABE, USA.
4. Lal, R. and Datta, A.C. 1979. Agricultural Engineering (through worked examples). SarojParkashan, Karta.
5. Upadhyaya, S.K. 2013. Advances in Soil Dynamics. ASABE, St. Joseph, USA.

| AE C03 | Instrumentation and Control | 3L:0T:0P | 3 Credits |
|---|---|---|---|

**Teaching Scheme:** Lectures - 3 hours/week

**Objectives**

- To provide a basic knowledge about measurement systems and their components
- To learn about various sensors used for measurement of mechanical quantities
- To learn about system stability and control.
- To integrate the measurement systems with the process for process monitoring and control

**Course Outcomes**

Upon completion of this course, the students will be able to understand the measurement ofvarious quantities using instruments, their accuracy & range, and the techniques for controlling devices automatically.

**Syllabus Contents**

**Unit-1:** Measurement systems and performance – accuracy, range, resolution, error sources; Introduction to functional elements of instruments. Active and passive transducers, Analog and digital modes. Static and dynamic characteristics of instruments.

**Unit-2:** Strain and stress, strain relationship, strain gauges. Mechanical, optical, electrical acoustical and pneumatic etc. and their use. Various methods of determining strain/stress experimentally. Strain gauges: types and their application in two and three dimensional force measurement.

**Unit-3:** Instrumentation system elements – sensors for common engineering measurements; Measuring devices for displacement (linear and rotational), velocity, force, torque and shaft power. Devices for measurement of temperature, relative humidity, pressure, flow, sound and vibration. Measuring instruments for calorific value of solid, liquid and gaseous fuels.

**Unit-4:** Signal processing and conditioning; correction elements- actuators: pneumatic, hydraulic, electric; Recording devices and their types. Data acquisition system, micro computers, data storage and their application.

**Unit-5:** Control systems – basic elements, open/closed loop, design of block diagram; control method – P, PI, PID, when to choose what, tuning of controllers. System models, transfer function and system response, frequency response; Nyquist diagrams and their use.

**References**

1. Instrumentation and control systems by W. Bolton, 2nd edition, Newnes, 2008

2. Thomas G. Beckwith, Roy D. Marangoni, John H. LienhardV , Mechanical Measurements(6th Edition) 6th Edition, Pearson Education India, 2007
3. Gregory K. McMillan, Process/Industrial Instruments and Controls Handbook, 5th Edition,
McGraw-Hill: New York, 1999.

| AE C04 | Earth Moving Machinery | 3L:0T:0P | 3 Credits |
|---|---|---|---|

**Teaching Scheme:** Lectures - 3 hours/week

**Course Outcomes**

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

- Select the appropriate machinery for various earth moving operations.
- Apply the skills of hydraulic and mechanics to understand the working of various earth moving machines.
- Evaluate the performance of earth moving machinery.

**Syllabus Contents**

**Unit 1**: Types of earth moving machinery, Crawler tractor: Differential, brake, clutch, suspension, track assembly.

**Unit 2**: Study of bulldozer, grubber, ditcher, excavator, and their applications in agricultural operations.

**Unit 3**: Machinery for grading, terracing, gully control, land levelling, ditch making etc. Principles of operation of shovels, excavators.

**Unit 4**: Application of hydraulic system in earth moving machinery. Repair and maintenance ofhydraulic system, Trouble shooting, repair and maintenance of earth moving machinery.

**Unit 5**: Production in Earth moving machinery, cost of operation, and management of earth moving machines.

**References**

1. De, Amitosh. 2015. Latest Development of Heavy Earth Moving Machinery. Galgotia Publications Pvt. Ltd., New Delhi.
2. Herbert L. Nichols, Jr. 2005. Moving the Earth: The Workbook of Excavation, 5th Edition.McGraw-Hill, New York.
3. Borshchow, T., Mansurou, R. and Sergeev, V. 1988. Land Reclamation Machinery, MIR Publication, Moscow.
4. Alekseeva, T.V. 1985. Machines for Earthmoving Work: Theory and Calculations. AmerindPublishing Co., New York.

| AE C05 | Ergonomics and Safety | 3L:-0T:0P | 3 Credits |
|---|---|---|---|

**Teaching Scheme:** Lectures – 3 hours/week; Tutorial – 1 hour/week

**Course Outcomes**

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

- Apply the data of anthropometry and strength parameter for the design of farm machinery.
- Evaluate the farm machines from ergonomic considerations.

**Syllabus Contents**

**Unit-1:** Concept and design criteria for optimum mutual adjustment of man and his work: Importance of ergonomics and its application in agriculture, liberation and transfer of energy in human body, concept of indirect calorimeter, work physiology in various agricultural tasks.

**Unit-2:** Physiological stress indices and their methods of measurement: Mechanical efficiency of work, fatigue and shift work.

**Unit-3:** Anthropometry and Biomechanics: Anthropometric data and measurement techniques, joint movement and method of measurement, analysis and application of anthropometric data, measurement of physical and mental capacities.

**Unit-4:** Human limitations in relation to stresses and demands of working environments.

Mechanical environment; noise and vibration and their physiological effects, thermal environment; heat stress, thermal comfort, effect on performance and behavior, field of vision, color discrimination, general guidelines for designing visual display, safety standards at work place during various farm operations and natural hazards on the farm. Farm safety legislation.

**Unit-5:** Man-machine system concept. Human factors in adjustment of man and his work. Design aspects of foot and hand controls on tractors and farm equipment. Design of operator's seat for tractors and agricultural equipment.

**References**


1. Bridger RS. 1995. Introduction to Ergonomics. McGraw Hill.
2. Charles D Reese. 2001. Accident / Incident Prevention Techniques. Taylor & Francis.
3. GavrielSalvendy. 1997. Hand Book of Human Factors and Ergonomics. John Wiley & Sons.
4. Kromer KHE. 2001. Ergonomics. Prentice Hall.
5. Mathews J & Knight AA. 1971. Ergonomics in Agricultural Design. National Institute ofAgric. Engineering, Wrest Park Silsoe, Bedford.
6. Sanders, M.S and McCormick, E.J. 1978. Human Factors in Engineering and Design. McGraw Hill Inc., Singapore
7. William D McArdle. 1991. Exercise Physiology. 1991. Lea &Febiger. Zander J.1972. Principles of Ergonomics. Elsevier.
8. Zander J. 1972. Ergonomics in Machine Design. Elsevier.
9. Grandjean, E. 1988. Fitting the Task to the Man. Taylor and Francis, London
10. Griffin, M. J., 1996. Hand Book of Human Vibration, Academic Press, London


| AE C06 | Hydraulic Drives and Controls | 3L:0T:0P | 3 Credits |
|---|---|---|---|

**Teaching Scheme:** Lectures - 3 hours/week

**Course Outcomes**

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

- Develop hydraulic circuit for particular applications
- Select the appropriate components for the development of hydraulic system
- Acquire the knowledge of working of hydraulic system of tractor and other farm machinery.

**Syllabus Contents**

**Unit 1** :Hydraulic Basics: Pascal's Law, Flow, Energy, Work, and Power. Hydraulic Systems, Color Coding, Reservoirs, Strainers and Filters, Filtering Material and Elements. Accumulators, Pressure Gauges and Volume Meters, Hydraulic Circuit, Fittings and Connectors.

**Unit 2** :Pumps, Pump Classifications, Performance, Displacement, Designs, Gear Pumps, Vane Pumps, Piston Pumps, Pump Operation. Hydraulic Actuators, Cylinders, Construction and Applications, Maintenance, Hydraulic Motors.

**Unit 3** :Valves, Pressure-Control Valves, Directional- Control Valves, Flow-Control Valves, Valve. Installation, Valve Failures and Remedies, Valve Assembly, Troubleshooting Valves.

**Unit 4** :Hydraulic Circuit Diagrams and Troubleshooting, United States of American Standards Institute USASI Graphical Symbols. Tractor hydraulics, nudging system, ADDC.

**Unit 5** :Pneumatics: Air services, logic units, Fail safe and safety systems Robotics: Use of Hydraulics and Pneumatics drives in agricultural systems, PLCs (Programmable Logic Controls).

**References**


1. Rabie, M.G. 2009. Fluid Power Engineering, McGraw Hill, New Delhi
2. Jagadeesha, T. and Gowda, T. 2009. Fluid Power: Generation, Transmission and Control, Wiley India Limited, New Delhi
3. Goering, C.E. and Hansen, A.C. 2013. Engine and Tractor Power. ASABE, USA.
4. Esposito, A. 2009. Fluid Power with Applications, 7th Edition, Pearson Education, New York.
5. Sullivan, J. 1997. Fluid Power: Theory and Applications, 4th Edition, Pearson Education, NewYork.

| AE D01 | Aquacultural Engineering | 3L:0T:0P | 3 Credits |
|---|---|---|---|

**Teaching Scheme :** Lectures - 3 hours/week

**Course Outcomes**

On the completion of the course students will be able to understand: hydrological information for design and operation of aquaculture systems; criteria for selection of site for fish farms; survey and select site for fish ponds; types of fish farms and their characteristics; different designs for fish farms and facilities; construction procedures for fish farms; different maintenance methods for Fish farms; different types of water pumps, aerators and filters; functions of water pumps, aerators and filters.

**Syllabus Contents**

**Unit 1- Open Channel Hydraulics**

Open channel flow, pipe flow, type of open channel flows, open channel and their properties, velocity distribution in open channels, local phenomenon in open channel flow, Critical flow, Continuity, Manning's Equation, Flow Measurement Flumes and Weirs, In-Situ Instrumentation Pipe flow: Minor and Major Losses, Design Considerations,

**Unit 2 – Water Quality Management Practices**

Chemical equilibrium, important water quality parameter; pH, carbon dioxide, nitrogenous compounds, nitrogen cycle, phosphorous cycle, BOD, COD, DO, C:N ratio, fertilization and liming of pond. Tanks and Piping, Pumps and Motors, Filters and Filtration, Physical (Screen/Overflow/Sand or Rock), Biological (e.g. Filter beds, RBC's, PAS applications, etc.)

**Unit 3 – Planning and Design of Aquaculture Project**

Selection of suitable site for aquacultural project, topography, type of soil and its quality, water supply, drainage, environmental considerations, process of farm design, computations for water requirement, seepage and evaporation, types of ponds and their designs, dykes, pump fed farm, tide fed farm, Flow-Through or Fixed Systems, Production Ponds, Polyculture with aquatic plants (e.g. Crawfish/Rice), Cages Recreational Ponds

**Unit 4 – Design of Aquaculture Facilities**

Aerator, need of aeration, types of aerators: Diffuser aerator, Propeller-aspirator pump aerator, paddle wheel aerator and cascade aerator, design of surface water aeration system, recirculating aquaculture systems, component of recirculating aquaculture system, advantages and disadvantages of recirculating aquaculture system,

**Unit 5- Hatchery**

Type of hatchery, component of hatchery, design and construction of carp hatchery, design of commercial freshwater prawn hatchery, Natural seed resources, site selection and collection methods, Health management in hatcheries.

**References**

1. Chow, Ven TE, Open Channel Hydraulics, McGraw-Hill International BOOK Company.
2. Lawson, Thomas B., Fundamental of Aquacultural Engineering, Springer
3. Boyad, C.E. and Tuker C.S. Pond Aquaculture Water Quality Management, Springer.
4. Timmons. B. Michal, Recirculating Aquacultural System. Ithaca Publishing Company.

| AE E01 | Agricultural Business Management | 3L:0T:0P | 3 Credits |
|---|---|---|---|

**Teaching Scheme:** Lectures - 3 hours/week

**Course Outcomes**

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

- Acquire the knowledge of labour, marketing and financial management
- Develop the interest in running a small agri-business enterprise.
- Understand various agricultural extension activities and programmes

**Syllabus Contents**

**Unit 1:** ***Introduction:*** Basics of agri-business management, planning, organising, controlling and

leading, Forecasting for agri-business, location and layout of facilities, work force management, Quality management and maintenance, financial analysis of agri-business, process strategy, inventory management, Knowledge management, organisational behaviour, human resource management

**Unit 2:** ***Marketing****:* Core concepts: needs & Maslow's hierarchy of needs, wants, demands, products, utility, value, satisfaction, exchange, transactions, relationships, markets; management: production concept, product concept, selling concept, marketing concept; planning and process: SBU identification, SWOT analysis, marketing mix, resource allocation; industrial markets; segmentation variables in consumer and industrial markets; state of branding in agro and food sectors; pricing strategies and programs; product life cycle.

**Unit 3:** ***Finance****:* Elements of engineering economics; balance sheet & loss and profit accounts; agricultural finance, institutional and non-institutional credits; principles of farm finance – need for specialised agencies for agricultural credit, risk involved in finance, recovery of loans, supervision, linking credit with marketing management of agricultural credit

**Unit 4:** ***Agrarian Economics:*** Quantitative techniques for agri-business, rural credit, agri-finance, micro-finance, WTO, cost and financial analysis, agri-insurance, custom hiring and agro-service centres, cooperative and contact farming, agricultural policy, business statistics, farm business organisations, labour management, business policy analysis – concepts and methods, leadership, motivation.

**Unit 5:** ***Agril Extension:*** Definitions, philosophy and scope of agricultural extension, basic principles and their applications to agricultural engineering, Role and quality of extension workers, Various extension agencies, their functions and mode of working with reference to agricultural engineering, Extension programme planning and its importance, extension need for farm implements and machinery, soil and water engineering, farm structures and post harvest technology. Transfer of technology, training and visit system, monitoring of extension activities and feed back.

**References**

1. Wills, W.J. 1979. An introduction to agri-business management, 2nd Edition. Vero Media Inc.
2. Megginson, L.C., Byrd, M.J. and Meginson, W.L. 2012. Small business management: AnEntrepreneur's Guidebook, 7rg Edition. McGraw Hill Education, New York.
3. Truet, L.J. and Truett, D.B. Managerial Economics, 8th Edition. John Willey and Sons.

| AE E02 | Building Materials & Structural Design | 3L:0T:0P | 3 Credits |
|---|---|---|---|

**Teaching Scheme :** Lectures - 3 hours/week

**Course Outcomes**

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

- Select the appropriate building materials for various applications
- Design the beam, columns, roof etc. for various strictures.
- Design the farm house, cattle shed and various storage structures for the farm.

**Syllabus Contents**

**Unit 1:** Properties and classification of conventional building materials, like bricks, lime, cement, sand, coarse aggregates, timber, asbestos, glass etc. Classification of seasoning and preservation of timbers.

**Unit 2:** Use of materials like plywood, asbestos, plastic and PVC, glass, aluminium etc. in buildings and sheds. Use of flyash and flyash products in construction and waterproofing materials for concrete. Constructional elements such as brick work, stone work, mortar, concrete, plastering, painting, ceiling, roofing etc.

**Unit 3:** Concept of determinate and indeterminate structures, moments of inertia of sections, bending moment and shear force diagrams and design of steel and concrete beams.

**Unit 4:** Design of steel and R.C.C. columns and column footings. Design of roof slabs, roof trusses. Partitions and bracings for sheds, concept of ferro-cement structures like grain containers

used in agricultural work.

**Unit 5:** Structural details of underground and overhead liquid containers, silos, cold storage structures and open web structures. Design of farm house, cattle shed, farm fence etc.

**References**

1. Michael, A.M. and Ojha, T.P. 2005. Principles of Agricultural Engineering, Vol. I. Jain Brothers, New Delhi
2. Pandey, P.H. 2014. Principles and Practices of Agricultural Structures and Environmental Control. Kalyani Publishers, New Delhi
3. Lindley, J.A. 1997. Agricultural Buildings & Structures. ASABE, USA.
4. Merritt, F.S. and Ricketts, J.T. 2001. Building Design and Construction Handbook, 6th Edition. McGraw Hill, New York.

| AE E03 | Statistical Methods in Agriculture | 2L:1T:0P | 3 Credits |
|---|---|---|---|

**Teaching Scheme:** Lectures – 2 hours/week; Tutorial – 1 hour/week

**Course Outcomes**

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

- Apply probability and probability distributions to various applications.
- Test the hypothesis for conducting experiments.
- Analyze the variances in the experiment and study the effect of variables on the outcome ofthe experiment.

**Syllabus Contents**

**Unit-1:** Probability and probability distributions.

**Unit-2:** Principle of least squares. Linear and non-linear regression. Multiple regression. Correlation analysis. Selection of variables. Validation of models. Sampling techniques. Determination of sample size. Sampling distribution of mean and proportion.

**Unit-3:** Hypothesis testing. Concept of p-value. Student's t-test. Chi- square test and large sample tests. Confidence intervals.

**Unit-4:** ANOVA and testing of hypothesis in regression analysis. Analysis of variance for one way and two way classification (with equal cell frequency).

**Unit-5:** Transformation of data. Advantages and disadvantages of non- parametric statistical tests. Scales of measurements. Sign test. Median test. Run-test. Wilcoxon-Mann- Whitney test. Chi-square test for two independent samples. Kruskal-Walli's one way and Friedman's two way ANOVA by ranks. Kendall's Coefficient of concordance.

**Tutorial:** Fitting of distributions. Sample and sampling distributions. Correlation analysis. Regression analysis (exponential, power function, quadratic, multi-variate, selection of variables, validation of models, ANOVA and testing of hypothesis). Tests of significance (Z-test, t-test, Ftest and Chi-square test). Analysis of variance. Non-parametric tests.

**References**

1. K.P. Dhamu and K. Ramamoorthy. 2007. Statistical Methods, Agrobios (India), Jodhpur.
2. Holman JP 1996. Experimental Methods for Engineers. McGraw Hill.
3. RudraPratap. 2003. Getting Started with MATLAB. A Quick Introduction for Scientistsand Engineers. Oxford Univ. Press.
4. Santhosh Gupta. 1979. Research Methodology and Statistical Techniques. Khanna Publ.
5. Stephen J Chapman. 2003. MATLAB Programming for Engineers. Eastern Press.
6. Steven C Chapra& Raymond P Canale. 2000. Numerical Methods for Engineers withProgramming and Software Applications. Tata McGraw.
7. William J Palm. 2001. Introduction to Matlab 6 for Engineers. McGraw Hill

## PROJECT WORK, SEMINAR AND INTERNSHIP IN INDUSTRY OR ELSEWHERE [PROJ]

| | | |
|---|---|---|
| **AE 510** | **Summer Industry Internship - I** | **2 Credits** |
| **AE 703** | **Summer Industry Internship - II** | **2 Credits** |

Minimum of 4 weeks in an Industry / Training Institute in the area of Agricultural Engineering. The summer internship should give exposure to the practical aspects of the discipline. In addition, the student may also work on a specified task or project which may be assigned to him/her. The outcome of the internship should be presented in the form of a report.

| | | | |
|---|---|---|---|
| **AE 704** | **Project- I** | **0L:0T:10P** | **5 Credits** |
| **AE 801** | **Project- II** | **0L:0T:12P** | **6 Credits** |

This course is aimed to provide more weightage for project work. The project work could be done in the form of a summer project in the industry or even a minor practical project in the college. Participation in any technical event / competition to fabricate and demonstrate an innovative machine or product could be encouraged under this course. It is intended to start the project work early in the seventh semester and carry out both design and fabrication of a mechanical device whose working can be demonstrated. The design is expected to be completedin the seventh semester and the fabrication and demonstration will be carried out in the eighth semester.

## MANDATORY COURSES (ENVIRONMENTAL SCIENCES, INDUCTION PROGRAM, INDIAN CONSTITUTION, ESSENCE OF INDIAN KNOWLEDGE TRADITION) [MC]

| | | | |
|---|---|---|---|
| **MC 1** | **Environmental Sciences** | | **0 Credits** |

We as human being are not an entity separate from the environment around us rather we are a constituent seamlessly integrated and co-exist with the environment around us. We are not an entity so separate from the environment that we can think of mastering and controlling it ratherwe must understand that each and every action of ours reflects on the environment and vice versa. Ancient wisdom drawn from Vedas about environment and its sustenance reflects these ethos. There is a direct application of this wisdom even in modern times. Idea of an activity based course on environment protection is to sensitize the students on the above issues through following two type of activities.

**(a) Awareness Activities:**

(i) Small group meetings about water management, promotion of recycle use, generation of lesswaste, avoiding electricity waste
(ii) Slogan making event
(iii) Poster making event
(iv) Cycle rally
(v) Lectures from experts

**(b) Actual Activities:**

(i) Plantation
(ii) Gifting a tree to see its full growth
(iii) Cleanliness drive
(iv) Drive for segregation of waste
(v) To live some big environmentalist for a week or so to understand his work
(vi) To work in kitchen garden for mess
(vii) To know about the different varieties of plants
(viii) Shutting down the fans and ACs of the campus for an hour or so

| MC 2 | Constitution of India / Essence of Indian Knowledge Tradition | 0L:0T:0P | 0 Credits |
|---|---|---|---|

The Constitution of India is the supreme law of India. Parliament of India can not make any law which violates the Fundamental Rights enumerated under the Part III of the Constitution. The Parliament of India has been empowered to amend the Constitution under Article 368, however, it cannot use this power to change the "basic structure" of the constitution, which has been ruled and explained by the Supreme Court of India in its historical judgments. The Constitution of India reflects the idea of "Constitutionalism" – a modern and progressive concept historically developed by the thinkers of "liberalism" – an ideology which has been recognized as one of the most popular political ideology and result of historical struggles against arbitrary use of sovereign power by state. The historic revolutions in France, England, America and particularly European Renaissance and Reformation movement have resulted into progressive legal reforms in the form of "constitutionalism" in many countries. The Constitution of India was made by borrowing models and principles from many countries including United Kingdom and America.

The Constitution of India is not only a legal document but it also reflects social, political and economic perspectives of the Indian Society. It reflects India's legacy of "diversity". It has been said that Indian constitution reflects ideals of its freedom movement, however, few critics have argued that it does not truly incorporate our own ancient legal heritage and cultural values. No law can be "static" and therefore the Constitution of India has also been amended more than one hundred times. These amendments reflect political, social and economic developments since the year 1950. The Indian judiciary and particularly the Supreme Court of India has played an historic role as the guardian of people. It has been protecting not only basic ideals of the Constitution but also strengthened the same through progressive interpretations of the text of the Constitution. The judicial activism of the Supreme Court of India and its historic contributions has been recognized throughout the world and it gradually made it "as one of the strongest courtin the world".

**Outcome:** Ability to understand, connect up and explain basics of Indian traditional knowledge in modern scientific perspective.

**Course content**

1. Meaning of the constitution law and constitutionalism
2. Historical perspective of the Constitution of India
3. Salient features and characteristics of the Constitution of India
4. Scheme of the fundamental rights
5. The scheme of the Fundamental Duties and its legal status
6. The Directive Principles of State Policy – Its importance and implementation
7. Federal structure and distribution of legislative and financial powers between the Union andthe States
8. Parliamentary Form of Government in India – The constitution powers and status of thePresident of India
9. Amendment of the Constitutional Powers and Procedure
10. The historical perspectives of the constitutional amendments in India
11. Emergency Provisions : National Emergency, President Rule, Financial Emergency
12. Local Self Government – Constitutional Scheme in India
13. Scheme of the Fundamental Right to Equality
14. Scheme of the Fundamental Right to certain Freedom under Article 19
15. Scope of the Right to Life and Personal Liberty under Article 21.

**Essence of Indian Knowledge Tradition Part-I**

**Course objective**

The course aims at imparting basic principles of thought process, reasoning and inferencing.

Sustainability is at the core of Indian Traditional knowledge Systems connecting society and nature. Holistic life style of yogic science and wisdom capsules in Sanskrit literature are also important in modern society with rapid technological advancements and societal disruptions. Part-I focuses on introduction to Indian Knowledge Systems, Indian perspective of modern scientific world-view, and basic principles of Yoga and holistic health care system.

**Course Contents**

Basic structure of Indian Knowledge System: अष्टादशविद्या -४वेद,४उपवेद (आयुर्वेद, धनुर्वेद, गन्धर्ववेद, स्थापत्य आदि) ६वेदांग (शिक्षा, कल्प, निरुक्त, व्याकरण, ज्योतिष, छंद) ४ उपाङ्ग (धर्मशास्त्र, मीमांसा, पुराण, तर्कशास्त्र)

Modern Science and Indian Knowledge SystemYoga and Holistic Health care Case studies

**References**


1. V. Sivaramakrishnan (Ed.), *Cultural Heritage of India-course material*, Bharatiya Vidya Bhavan, Mumbai. 5th Edition, 2014
2. Swami Jitatmanand, *Modern Physics and Vedant*, Bharatiya Vidya Bhavan
3. Swami Jitatmanand, *Holistic Science and Vedant*, Bharatiya Vidya Bhavan
4. Fritzof Capra, *Tao of Physics*
5. Fritzof Capra, *The Wave of life*
6. VN Jha (Eng. Trans.), *Tarkasangraha of Annam Bhatta*, International Chinmay Foundation,Velliarnad, Arnakulam
7. *Yoga Sutra of Patanjali*, Ramakrishna Mission, Kolkata
8. GN Jha (Eng. Trans.), Ed. RN Jha, *Yoga-darshanam with VyasaBhashya*,Vidyanidhi Prakashan, Delhi 2016
9. RN Jha, *Science of Consciousness Psychotherapyand Yoga Practices*, Vidyanidhi Prakashan,Delhi 2016
10. B Sharma (English translation), *Shodashang Hridayan*


**Pedagogy:** Problem based learning, group discussions, collaborative mini projects.