

# **COURSE STRUCTURE AND DETAILED SYLLABUS**

**(CBCS SYSTEM)**

**FOR**

**BACHELOR OF TECHNOLOGY**

**IN**

**AGRICULTURAL ENGINEERING**



**TRIGUNA SEN SCHOOL OF TECHNOLOGY**

**ASSAM UNIVERSITY, SILCHAR**



## Course Structure

### FISRT YEAR

#### FIRST SEMESTER

| <b>A. Theory</b>         |              |                                |                       |     |     |           |           |
|--------------------------|--------------|--------------------------------|-----------------------|-----|-----|-----------|-----------|
| Sl No.                   | Subject Code | Subjects                       | Contacts Periods/Week |     |     |           | Credits   |
|                          |              |                                | L                     | T   | P   | Total     |           |
| 1.                       | SOT101       | Engineering Mathematics        | 3                     | 1   | --- | 4         | 4         |
| 2.                       | SOT102       | Engineering Physics            | 3                     | 1   | --- | 4         | 4         |
| 3.                       | SOT103       | Economics & Human Development  | 2                     | 0   | --- | 2         | 2         |
| 4.                       | SOT104       | Environmental Science          | 2                     | 0   | --- | 2         | 2         |
| 5.                       | SOT105       | Communication Skill in English | 2                     | 0   | --- | 2         | 2         |
| 6.                       | SOT106       | Engineering Chemistry          | 3                     | 1   | --- | 4         | 4         |
| <b>Total Theory</b>      |              |                                |                       |     |     | <b>18</b> | <b>18</b> |
| <b>B. Practical</b>      |              |                                |                       |     |     |           |           |
| 1.                       | SOT107       | Engineering Physics            | ---                   | --- | 3   | 3         | 2         |
| 2.                       | SOT108       | Engineering Chemistry          | ---                   | --- | 3   | 3         | 2         |
| 3.                       | SOT109       | Engineering Drawing            | ---                   | --- | 3   | 3         | 2         |
| 4.                       | SOT110       | NCC/NSS                        | ---                   | --- | 2   | 2         | 1         |
| <b>Total Practical</b>   |              |                                |                       |     |     | <b>11</b> | <b>7</b>  |
| <b>Total of Semester</b> |              |                                |                       |     |     | <b>29</b> | <b>25</b> |



## SECOND SEMESTER

| <b>A. Theory</b>         |              |                                  |                       |     |     |           |           |
|--------------------------|--------------|----------------------------------|-----------------------|-----|-----|-----------|-----------|
| Sl No.                   | Subject Code | Subjects                         | Contacts Periods/Week |     |     |           | Credits   |
|                          |              |                                  | L                     | T   | P   | Total     |           |
| 1.                       | SOT 201      | Advanced Engineering Mathematics | 3                     | 1   | --- | 4         | 4         |
| 2.                       | SOT202       | Engineering Mechanics            | 3                     | 0   | --- | 3         | 3         |
| 3.                       | SOT203       | Computer Systems & Programming   | 3                     | 0   | --- | 3         | 3         |
| 4.                       | SOT204       | Electrical Technology            | 3                     | 1   | --- | 4         | 4         |
| 5.                       | SOT205       | Values and Ethics                | 2                     | 0   | --- | 2         | 2         |
| 6.                       | SOT206       | Basic Electronics                | 3                     | 0   | --- | 3         | 3         |
| <b>Total Theory</b>      |              |                                  |                       |     |     | <b>19</b> | <b>19</b> |
| <b>B. Practical</b>      |              |                                  |                       |     |     |           |           |
| 1.                       | SOT207       | Computer Systems & Programming   | ---                   | --- | 3   | 3         | 2         |
| 2.                       | SOT208       | Electrical and Electronics       | ---                   | --- | 3   | 3         | 2         |
| 3.                       | SOT209       | Workshop Technology              | ---                   | --- | 3   | 3         | 2         |
| <b>Total Practical</b>   |              |                                  |                       |     |     | <b>9</b>  | <b>6</b>  |
| <b>Total of Semester</b> |              |                                  |                       |     |     | <b>28</b> | <b>25</b> |



**SECOND YEAR**

**THIRD SEMESTER**

| <b>A. Theory</b>         |              |  |                       |     |     |           |           |
|--------------------------|--------------|--|-----------------------|-----|-----|-----------|-----------|
| Sl No.                   | Subject Code | Subjects                                   | Contacts Periods/Week |     |     |           | Credits   |
|                          |              |  | L                     | T   | P   | Total     |           |
| 1.                       | AE301        | Fluid Mechanics                            | 3                     | 0   | --- | 3         | 3         |
| 2.                       | AE302        | Operation Research & Industrial Management | 3                     | 0   | --- | 3         | 3         |
| 3.                       | AE303        | Strength of Material                       | 2                     | 1   | --- | 3         | 3         |
| 4.                       | AE304        | Thermodynamics and Heat Engines            | 2                     | 1   | --- | 3         | 3         |
| 5.                       | AE305        | Surveying and Leveling                     | 3                     | 0   | --- | 3         | 3         |
| 6.                       | AE306        | Crop Production Technology                 | 2                     | 0   | --- | 2         | 2         |
| <b>Total Theory</b>      |              |  |                       |     |     | <b>17</b> | <b>17</b> |
| <b>B. Practical</b>      |              |  |                       |     |     |           |           |
| 1.                       | AE307        | Fluid Mechanics                            | ---                   | --- | 3   | 3         | 2         |
| 2.                       | AE308        | Advanced Workshop Technology               | ---                   | --- | 3   | 3         | 2         |
| 3.                       | AE309        | Surveying and Leveling                     | ---                   | --- | 3   | 3         | 2         |
| 4.                       | AE310        | Crop Production Technology                 | ---                   | --- | 3   | 3         | 2         |
| <b>Total Practical</b>   |              |  |                       |     |     | <b>12</b> | <b>8</b>  |
| <b>Total of Semester</b> |              |  |                       |     |     | <b>29</b> | <b>25</b> |



### FOURTH SEMESTER

| <b>A. Theory</b>         |              |                                   |                       |     |     |           |           |
|--------------------------|--------------|-----------------------------------|-----------------------|-----|-----|-----------|-----------|
| Sl No.                   | Subject Code | Subjects                          | Contacts Periods/Week |     |     |           | Credits   |
|                          |              |                                   | L                     | T   | P   | Total     |           |
| 1.                       | AE401        | Soil Science                      | 2                     | 0   | --- | 2         | 2         |
| 2.                       | AE402        | Probability and Statistics        | 3                     | 1   | --- | 4         | 4         |
| 3.                       | AE403        | Kinetics and Dynamics of Machines | 2                     | 0   | --- | 2         | 2         |
| 4.                       | AE404        | Farm Power                        | 2                     | 1   | --- | 3         | 3         |
| 5.                       | AE405        | Watershed Hydrology               | 2                     | 1   | --- | 3         | 3         |
| 6.                       | AE406        | Post Harvest Operations           | 3                     | 0   | --- | 3         | 3         |
| <b>Total Theory</b>      |              |                                   |                       |     |     | <b>17</b> | <b>17</b> |
| <b>B. Practical</b>      |              |                                   |                       |     |     |           |           |
| 1.                       | AE407        | Soil Science                      | ---                   | --- | 3   | 3         | 2         |
| 2.                       | AE404        | Farm Power                        | ---                   | --- | 3   | 3         | 2         |
| 3.                       | AE409        | Watershed Hydrology               | ---                   | --- | 3   | 3         | 2         |
| 4.                       | AE410        | Post Harvest Operations           | ---                   | --- | 3   | 3         | 2         |
| <b>Total Practical</b>   |              |                                   |                       |     |     | <b>12</b> | <b>8</b>  |
| <b>Total of Semester</b> |              |                                   |                       |     |     | <b>29</b> | <b>25</b> |



**THIRD YEAR**

**FIFTH SEMESTER**

| <b>A. Theory</b>         |              |   |                       |     |     |           |           |
|--------------------------|--------------|---|-----------------------|-----|-----|-----------|-----------|
| Sl No.                   | Subject Code | Subjects                                | Contacts Periods/Week |     |     |           | Credits   |
|                          |              |   | L                     | T   | P   | Total     |           |
| 1.                       | AE501        | Instrumentation & Control               | 3                     | 0   | --- | 3         | 3         |
| 2.                       | AE502        | Machine Design                          | 3                     | 0   | --- | 3         | 3         |
| 3.                       | AE503        | Soil & Water Conservation Engg.         | 3                     | 0   | --- | 3         | 3         |
| 4.                       | AE504        | Food Chemistry and Microbiology         | 3                     | 0   | --- | 3         | 3         |
| 5.                       | AE505        | Mechanical Operation in Food Processing | 3                     | 0   | --- | 3         | 3         |
| <b>Total Theory</b>      |              |   |                       |     |     | <b>15</b> | <b>15</b> |
| <b>B. Practical</b>      |              |   |                       |     |     |           |           |
| 1.                       | AE506        | Summer Training – I                     | ---                   | --- | --- | ---       | 2         |
| 2.                       | AE507        | Machine Design and Drawing              | ---                   | --- | 3   | 3         | 2         |
| 3.                       | AE508        | Soil & Water Conservation Engineering   | ---                   | --- | 3   | 3         | 2         |
| 4.                       | AE509        | Food Chemistry & Microbiology           | ---                   | --- | 3   | 3         | 2         |
| 5.                       | AE510        | Mechanical Food Operations              | ---                   | --- | 3   | 3         | 2         |
| <b>Total Practical</b>   |              |   |                       |     |     | <b>12</b> | <b>10</b> |
| <b>Total of Semester</b> |              |   |                       |     |     | <b>27</b> | <b>25</b> |



## SIXTH SEMESTER

| <b>A. Theory</b>         |              |  |                       |     |     |           |           |
|--------------------------|--------------|--|-----------------------|-----|-----|-----------|-----------|
| Sl No.                   | Subject Code | Subjects                                 | Contacts Periods/Week |     |     |           | Credits   |
|                          |              |  | L                     | T   | P   | Total     |           |
| 1.                       | AE601        | Thermal Operation in Food Processing     | 2                     | 1   | --- | 3         | 3         |
| 2.                       | AE602        | Farm Machinery                           | 2                     | 0   | --- | 2         | 2         |
| 3.                       | AE603        | Soil Mechanics                           | 2                     | 0   | --- | 2         | 2         |
| 4.                       | AE604        | Irrigation & Drainage Engineering        | 2                     | 1   | --- | 3         | 3         |
| 5.                       | AE605        | Elective – I                             | 2                     | 1   | --- | 3         | 3         |
| <b>Total Theory</b>      |              |  |                       |     |     | <b>13</b> | <b>13</b> |
| <b>B. Practical</b>      |              |  |                       |     |     |           |           |
| 1.                       | AE606        | Thermal Food Operations                  | ---                   | --- | 3   | 3         | 2         |
| 2.                       | AE607        | Farm Machinery Operation and Maintenance | ---                   | --- | 6   | 6         | 4         |
| 3.                       | AE608        | Soil Mechanics                           | ---                   | --- | 3   | 3         | 2         |
| 4.                       | AE609        | Irrigation & Drainage Engineering        | ---                   | --- | 3   | 3         | 2         |
| 5.                       | AE610        | Seminar & Technical Report Writing       | ---                   | --- | 3   | 3         | 2         |
| <b>Total Practical</b>   |              |  |                       |     |     | <b>18</b> | <b>12</b> |
| <b>Total of Semester</b> |              |  |                       |     |     | <b>31</b> | <b>25</b> |



**FOURTH YEAR**

**SEVENTH SEMESTER**

| <b>A. Theory</b>         |              |  |                       |     |     |           |           |
|--------------------------|--------------|--|-----------------------|-----|-----|-----------|-----------|
| Sl No.                   | Subject Code | Subjects                               | Contacts Periods/Week |     |     |           | Credits   |
|                          |              |  | L                     | T   | P   | Total     |           |
| 1.                       | AE701        | Refrigeration & Air Conditioning       | 2                     | 1   | --- | 3         | 3         |
| 2.                       | AE702        | Building Materials & Structural Design | 2                     | 0   | --- | 2         | 2         |
| 3.                       | AE703        | Tea Technology                         | 2                     | 0   | --- | 2         | 2         |
| 4.                       | AE704        | Renewable Energy Sources               | 2                     | 0   | --- | 2         | 2         |
| 5.                       | AE705        | Land and Water Resource Management     | 3                     | 0   | --- | 3         | 3         |
| 6.                       | AE706        | Elective – II                          | 2                     | 1   | --- | 3         | 3         |
| <b>Total Theory</b>      |              |  |                       |     |     | <b>15</b> | <b>15</b> |
| <b>B. Practical</b>      |              |  |                       |     |     |           |           |
| 1.                       | AE707        | Tea Technology                         | ---                   | --- | --- | 3         | 2         |
| 2.                       | AE708        | Project – I                            | ---                   | --- | 6   | 6         | 4         |
| 3.                       | AE709        | Summer Training – II                   | ---                   | --- | --- | ---       | 2         |
| 4.                       | AE710        | Renewable Energy Sources               | ---                   | --- | --- | 3         | 2         |
| <b>Total Practical</b>   |              |  |                       |     |     | <b>12</b> | <b>10</b> |
| <b>Total of Semester</b> |              |  |                       |     |     | <b>27</b> | <b>25</b> |





## EIGHTH SEMESTER

| <b>A. Theory</b>         |              |   |                       |     |     |           |           |
|--------------------------|--------------|---|-----------------------|-----|-----|-----------|-----------|
| Sl No.                   | Subject Code | Subjects                                    | Contacts Periods/Week |     |     |           | Credits   |
|                          |              |   | L                     | T   | P   | Total     |           |
| 1.                       | AE801        | Fruits and Vegetable Processing             | 2                     | 1   | --- | 3         | 3         |
| 2.                       | AE802        | Agricultural Business Management            | 3                     | 0   | --- | 3         | 3         |
| 3.                       | AE803        | Testing & Evaluation of Tractors & Machines | 2                     | 0   | --- | 2         | 2         |
| 4.                       | AE804        | Elective – III                              | 3                     | 0   | --- | 3         | 3         |
| <b>Total Theory</b>      |              |   |                       |     |     | <b>11</b> | <b>11</b> |
| <b>B. Practical</b>      |              |   |                       |     |     |           |           |
| 1.                       | AE805        | Project-II                                  | ---                   | --- | 9   | 9         | 9         |
| 2.                       | AE806        | Comprehensive Viva                          | ---                   | --- | --- | ---       | 3         |
| 3.                       | AE807        | Testing & Evaluation of Tractors & Machines | ---                   | --- | 3   | 3         | 2         |
| <b>Total Practical</b>   |              |   |                       |     |     | <b>12</b> | <b>14</b> |
| <b>Total of Semester</b> |              |   |                       |     |     | <b>23</b> | <b>25</b> |



### **LIST OF ELECTIVES**

Electives for B. Tech in Agricultural Engineering will be in three specializations i.e. Soil Water Conservation Engineering, Farm Machinery and Power, and Post Harvest Engineering. The electives may be changed depending on the areas/interests of the teachers present in the concerned semester.

#### **A. FARM MACHINERY AND POWER**

1. Farm Machinery Design
2. Farm Power and Machinery Management
3. Human Engineering and Safety
4. Mechanics of Tillage and Traction
5. Design of Tractors
6. Advanced Non-conventional Technology

#### **B. SOIL AND WATER CONSERVATION**

1. Remote Sensing and GIS Application
2. Micro Irrigation System Design
3. Watershed Planning and Management
4. Minor Irrigation and Command Area Development
5. Aquacultural Engineering
6. Design of Small Dams and Reservoirs

#### **C. POST HARVEST ENGINEERING**

1. Concentration and Drying
2. Design of Food Processing Plants
3. Project Management
4. Modeling of Food Processing Operations
5. Meat Processing
6. Milk and Milk Product Processing



**Summary of Contact Periods per Week and Credits**

| <b>Semester</b> | <b>Contact Periods/Week</b> | <b>Credits</b> |
|-----------------|-----------------------------|----------------|
| I               | 29                          | 25             |
| II              | 28                          | 25             |
| III             | 29                          | 25             |
| IV              | 29                          | 25             |
| V               | 27                          | 25             |
| VI              | 31                          | 25             |
| VII             | 27                          | 25             |
| VIII            | 23                          | 25             |
| <b>TOTAL</b>    | <b>223</b>                  | <b>200</b>     |



## DETAILED SYLLABUS

The detailed syllabus for the four year B. Tech in Agricultural Engineering course will comprised of papers involving theory, practical, trainings, viva and project work. The detailed syllabus for eight semesters is given below.

### First Semester

#### SOT101: Engineering Mathematics

##### **Unit 1: Vector**

Scalar triple product, vector triple product, Directional derivative, Gradient, divergence and curl of vector function and their properties, Green's theorem, Stocke's and divergence theorem (statement only with simple applications)

##### **Unit 2: Co-ordinate Geometry**

Transformation of axes: Translation, rotation, rotation followed by translation, pair of straight lines, Homogeneous and non-homogeneous form, angle between two straight lines. Systems of circles, orthogonal circles, radical axis, co-axial circles, limiting points, Parabola, ellipse and hyperbola and their properties, condition of tangency in each case, diameter, conjugate diameter and their related properties for central conics.

##### **Unit 3: Real Analysis**

Sequence, Limit of a sequence, Limit theorems, squeeze theorem, Monotone sequence, Monotone convergence theorem, cuchy convergence criterion, Infinite series, convergence of infinite series, comparison test, root test, Raabe's test, logarithmic test, uniform convergence, properties of uniform convergence, Fourier series

##### **Unit 4: Differential calculus**

Limits and continuity of a function, Boundedness of a function, Intermediate value theorem, Differentiability, Maxima and minima of a function, Rolles theorem and mean value theorem, increasing and decreasing functions, intermediate forms.

##### **Unit 5: Integral Calculus**

Improper integral of first and second kind, comparison test, Absolute convergence, application of definite integral: Area between two curves. Curve tracing, area between curves when their equations are given in polar co-ordinates, Double integrations

#### **Suggested readings**

1. Advanced Engineering Mathematics – E. Kreyszig (John Wiley & Sons)
2. Calculus and Analytical Geometry – Thomas and Finney (Narosa)
3. Higher Engineering Mathematics – B. S. Grewal



## **SOT102: Engineering Physics**

### **Unit 1: Classical Physics**

**Properties of areas:** Moments of inertia and product of inertia of areas, polar moment of inertia, principal axes and principal moments of inertia.

**Concept of stress and strain:** Normal stress, shear stress, state of stress at a point, ultimate strength, allowable stress, factor of safety; normal strain, shear strain, Hooke's law, Poisson's ratio, generalized Hooke's law; analysis of axially loaded members

**Surface tension:** Angle of contact, excess of pressure inside a spherical surface, capillary rise, determination of surface tension by Jaegers' method

### **Unit 2: Optics**

**Optics :** interference, thinfilms – testing of the optical planeness of surface, Young's double slit experiment – coherent sources – lasers, intensity in Young's experiment, interference in thin films, Newton's ring and Michelson interferometer.

**Diffraction:** Fraunhofer – diffraction at single slit, diffraction at a circular aperture, diffraction at double slit, diffraction gratings, resolving and dispersive power of a grating.

**Polarisation :** production and detection of circularly and elliptically polarized light, Quarter and half wave plates, optical activity, specific rotation, Lorentz half shade polarimeter, Determination of specific rotation and strength of sugar solution.

### **Unit 3: Heat and Thermodynamics**

Second law of thermodynamics, entropy, relation between entropy and probability, thermodynamic relations and their applications, Maxwell's law of distribution of velocity and its experimental verification, most probable velocity, root mean square velocity, average velocity and their relations. Basic features of black body radiation spectrum, Wien's displacement law, Rayleigh-Jean's law, ultraviolet catastrophe, Planck's law

### **Unit 4: Solid State Physics**

**Crystal structure:** Seven systems of crystals, Bravais space, lattice, crystal structure (bcc, fcc and sc) lattice dimensions, lattice planes, and miller indices and their significance, X-rays-absorption of X-rays diffraction, Bragg's law. Bragg's X-ray spectrometer

### **Unit 5: Modern Physics**

**Lasers:** Coherence – temporal and spatial, Einstein's spontaneous and stimulated emission, population inversion, laser gain (pumping), spectral narrowing in lasers coherence length, different types of laser source and their applications.

**Quantum theory:** Wave particle, duality and uncertainty principle, Schrodinger equation and its application to particle in box and harmonic oscillator.

### **Suggested readings**

1. Elements of properties of matter – D.S.Mathur (S.Chand & Co.)
2. Fundamentals of Optics – Jenkins and White (McGraw Hill)
3. Lasers and Non-linear Optics – B. B. Land (Wiley Eastern Ltd)
4. Introduction to Solid State Physics – Charles Kittel (John Wiley & Sons)



### **SOT103: Economics and Human Development**

#### ***Unit 1: Introduction to Economics***

What is Economics, Relationship of Economics and Engineering, Concept of Demand and Demand Function, Supply and Supply Function, Utility and Utility Function

#### ***Unit 2: Theory of Cost and Production***

Concepts and types of Costs, Derivation of Cost Function and Profit Maximization, Short-run and Long-run behaviour of Production, Analysis and Properties of ISO quant, Meaning and Types of Production Function.

#### ***Unit 3: Price output determination under different market structure***

Perfect competition, Monopoly, Monopolistic competition and oligopoly

#### ***Unit 4: Theory of Distribution***

Derived demand, Factor price determination: wage, rent, capital, service, profit

#### ***Unit 5: Human Development and Economic Development***

Meaning, difference between Human Development (HD) and Human Resource Development (HRD), Human Development Index (HDI) and its measurement, Human Development and sustainable Growth, Human Development and Governance, Millennium Development Goals

#### **Suggested readings**

1. Modern Micro-economics – A. Koutsoyianis (McMillan)
2. Microeconomic Theory: A Mathematical Approach – Henderson and Qnout (McGraw Hill)
3. Microeconomic Analysis – R. P. Barthwal (Willey Eastern)
4. Reflections on Human Development – Hahub ul Haq (Oxford University Press)
5. Social Capital – J. Field (Routledge)

### **SOT104: Environmental Science**

As prescribed in the Assam University undergraduate courses in PG departments

#### **Suggested readings**

1. G. M. Masters. Introduction to Environmental Engineering and Science. Prentice Hall.
2. B. J. Nebel. Environmental Science. Prentice Hall.
3. E. P. Odum. Ecology: The link between the Natural & Social Sciences. IBH Publishing Co.

### **SOT105: Communication Skills in English**

#### ***Unit 1: Phonetics and Phonology of English***

How speech organs work in English, Vowel sounds in the English language, Consonant sounds in the English language, Sound sequence: Diphthongs and Consonant clusters, Word accent in English, Stress and intonation in English, Accent and rhythm in connected speech



**Unit 2: The basic grammatical structure of English**

Word order, Sentence types, Tense, Transformation of Sentences, Voice, Usage

**Unit 3: Technical Communication**

Process of Communication; Process of letter writing; Resume, Social correspondence, Types of Reports, Structure of formal reports, Elements of Style, Use of illustrations, Making presentations

**Unit 4 and 5: Group discussion**

**Suggested readings**

1. W. W. S. Bhaskar and N. S. Prabhu. English through Reading. Vol 1 and 2. Macmillan.
2. Eunice D'Souza and G Sahani. Communication Skills in English. Noble Publishing House.
3. R. C. Sharma and K. Mohan. Business Correspondence and Report Writing. McGraw Hill.
4. John Fiske. Introduction to Communication Studies. Rotledge.
5. L. Gartside. Model Business Letters.

**SOT106: Engineering Chemistry**

**Unit 1:** Thermodynamics of Chemical Processes: Concept of entropy, Chemical potential, Equilibrium conditions for closed systems, Phase and reaction equilibria, Maxwell relations, Real gas and real solution. Electrochemical cells and EMF, Applications of EMF measurements:

**Unit 2:** Thermodynamic data, activity coefficients, solubility product and pH, corrosion. Kinetics of Chemical Reactions: Reversible, consecutive and parallel reactions, Steady state approximation, Chain reactions, Photochemical kinetics.

**Unit 3:** Bonding Models in Inorganic Chemistry: Molecular orbital theory, Valence-bond theory, Crystal field theory. Coordination Chemistry: Coordination numbers, Chelate effect, Coordination complexes and application, Bio-inorganic chemistry: Metal ions in Biological systems, environmental aspects of Metals, NO<sub>x</sub>, CO, CO<sub>2</sub>.

**Unit 4:** Fundamentals of Microwave, IR and UV-VIS Spectroscopy: Basic concepts of spectroscopy, Selection rule, Determination of molecular structure.

**Unit 5:** Organic Reaction Mechanism: Mechanisms of selected organic, bio-organic, polymerization and catalytic reactions. Stereochemistry of Carbon Compounds: Selected Organic Compounds: Natural products and Biomolecules (Amino acids/nucleic acids/proteins).

**Suggested readings**

1. J. D. Lee. Inorganic Chemistry
2. Lewis. Physical Chemistry.
3. I. L. Finar. Organic Chemistry (Vol. 1 & 2).
4. B. K. Sharma. Engineering Chemistry. Krishna Prakashan Media
5. E. E. Conn and P. K. Stumpf. Outlines of Biochemistry. Wiley Eastern.
6. C. N. R. Rao and U. C. Agrawal. Experiments in General Chemistry. East-West Press.



### **SOT109: Engineering Drawing**

1. Introduction to IS code of drawing
2. Conics and Engineering Curves – ellipse, parabola, hyperbola, cycloid, trochoid, involute
3. Projection of lines – traces, true length
4. Projection of planes and solids; solid objects – cube, prism, pyramid, cylinder, cone and sphere
5. Projection on Auxiliary planes
6. Isometric projection, isometric scale
7. Section of solids – true shape of section

### **Suggested readings**

1. N. D. Bhatt. Elementary Engineering Drawing. Charotar Publishing House.
2. K. L. Narayana and P. Kannaiha. Engineering Graphics. Tata McGraw Hill.

### **Second Semester**

### **SOT201: Advanced Engineering Mathematics**

#### ***Unit 1: Ordinary Differential Equations***

Numerical solution of first order ordinary differential equation with initial condition by Picard's, Euler's & Taylor series method; Runge Kutta Method, Predictor-Corrector methods (Milne & Adams-Bashforth). Boundary value problem linear, non-linear, shooting and finite difference method

#### ***Unit 2: Partial Differential Equations***

Introduction to p.d.e.s, Linear and quasi-linear equations of first order; Classification of integrals, Lagrange's Method of solution and its geometrical interpretation, Compatibility condition, Charpits method, Special types of first order equations. Second order p.d.e. with constant and variable coefficients; classification and reduction of second order equation to normal form. Cauchy's Problem, Neumann problem and Dirichlet problems

#### ***Unit 3: Laplace Transformations***

Standard unit step functions, periodic functions-convolution theorem application to ordinary differential equation with constant coefficient. Fourier series solution of wave equation, Separation of variables method to solve heat equation, Laplace equation, Diffusion equation; Integral transform method to solve 2nd order p.d.e

#### ***Unit 4: Complex Variables***

Analytical functions, Cauchy Riemann equations, mapping complex integration Cauchy fundamental theorem residues, residue theorem, Cauchy Lemma and Jorens-lemma, contour integration.

#### ***Unit 5: Numerical Analysis***

Error in numerical methods, round-off error, truncation error (definition only), interpolation, Lagrange interpolation formula, Newton Divided difference, Newton forward and backward interpolation formula, Numerical solution to non-linear equations, Bisection method, Newton-Raphson method, Fixed point iteration method, Numerical differentiation, Numerical Integration, rectangle rule, Mid





point rule, trapezoidal rule, Simpson's rule, Simpson's 3/8<sup>th</sup> rule.

### **Suggested readings**

1. E. Kreyszig. Advanced Engineering Mathematics. Wiley Eastern.
2. Boyce and R. C. DiPrima. Elementary differential equations and Boundary Value Problems. Wiley.
3. Thomas and Finney. Calculus and Analytical Geometry Narosa
4. B. S. Grewal. Higher Engineering Mathematics

### **SOT202: Engineering Mechanics**

#### **Unit 1: Force systems**

Moment of a force about a point and about an axis; couple moment; reduction of a force system to a force and a couple

**Equilibrium:** Free body diagram; equations of equilibrium; problems in two and three dimensions; plane frames and trusses

#### **Unit 2: Friction**

Laws of Coulomb friction, problems involving large and small contact surfaces; square threaded screws; belt friction; rolling resistance

**Kinematics and Kinetics of particles:** Particle dynamics in rectangular coordinates cylindrical coordinates and in terms of path variables; central force motion.

**Properties of areas:** Moments of inertia and product of inertia of areas, polar moment of inertia, principal axes and principal moments of inertia.

#### **Unit 3: Concept of stress and strain**

Normal stress, shear stress, state of stress at a point, ultimate strength, allowable stress, factor of safety; normal strain, shear strain, Hooke's law, Poisson's ratio, generalized Hooke's law; analysis of axially loaded members.

**Torsion:** Torsion of cylindrical bars, torsional stress, modulus of rigidity and deformation.

#### **Unit 4: Flexural loading**

Shear and moment in beams; load, shear and moment relationship; shear and moment diagrams; flexure formula; shear stress in beams; differential equation of the elastic curve, deflection of beams.

**Transformation of stress and strain:** Transformation of stress and strain, principal stresses, principal strains, Mohr's circle for stress and strain.

#### **Unit 5: Combined loading**

Axial and torsional; axial and bending; axial, torsional and bending

**Column:** Buckling of slender columns, Euler buckling load for different end conditions.

### **Suggested readings**

1. J. L. Meriam and L. G. Craigie. Engineering Mechanics (Vol. 1 and 2) John Willey.
2. F. P. Beer and R. Johnston. Vector Mechanics for Engineers: Statics and Dynamics McGraw Hill



3. I. H. Shames. Engineering Mechanics. Prentice Hall.
4. Timoshenko and D. H. Young. Engineering Mechanics. McGraw Hill.

### **SOT203: Computer Systems and Programming**

#### **Unit 1: Introduction to Computer**

Overview of Computer organization and historical perspective of computer applications in various fields of science and management. Concepts of the finite storage, bits, bytes, kilo, mega and gigabytes  
**Data representation:** Number systems, character representation codes, Binary, hex, octal codes and their inter conversions. Binary arithmetic, Floating-point arithmetic, signed and unsigned numbers.

#### **Unit 2: Introduction to Programming**

Concept of algorithms, Flow Charts, Data Flow diagrams etc., Introduction to the Editing tools  
**Programming using C:** Concept of variables, program statements and function calls from the library, data types, int, char, float etc., declarations and expressions, arithmetic operation, relational and logical operations, C assignment statements, extension of assignment of the operations. C primitive input output functions, C Statements.

#### **Unit 3: Control Statements**

Branching: conditional execution using if, else. switch and break statements may be mentioned.  
**Looping:** Concept of loops, example of loops in C using for, while and do-while, continue may be mentioned. One dimensional arrays and example of iterative programs using arrays, 2-d arrays Use in matrix computations

#### **Unit 4: Functions**

Concept of Sub-programming, functions Example of functions. Argument passing, Recursion  
**Pointers:** Pointers, relationship between arrays and pointers, Argument passing using pointers, Array of pointers, passing arrays as arguments.

#### **Unit 5: Structures and Unions**

Defining C structures, passing strings as arguments Programming examples, Unions  
**Data Files:** Concept of files, file operations – opening, closing, reading, writing and processing, Binary files

#### **Suggested readings**

1. Rajaraman. Fundamentals of Computers. Prentice Hall of India, 3rd Edition.
2. B. S. Gottfried. Programming with C. McGraw Hill
3. Venugopal & Prasad. Mastering C. McGraw Hill
4. Raja Raman. Computer Programming in C. Prentice Hall of India.

### **SOT204: Electrical Technology**

#### **Unit 1: Introduction**

Sources of energy; General structure of electrical power systems, Power transmission and distribution via overhead lines and underground cables, Steam, Hydel, Gas and Nuclear power generation



**Unit 2: DC Networks**

Kirchoff's laws, node voltage and mesh current methods, Delta-star and star-delta conversion, Superposition principle, Thevenin's and Norton's theorems

**Unit 3 and 4: Single phase AC Circuits**

Single phase EMF generation, average and effective values of sinusoids, solution of R,L,C series circuits. The j operator, complex representation of impedances, phasor diagram, power factor, power in complex notation, solution of parallel and series – parallel circuits.

**Unit 5: Electrical Measuring Instruments**

DC PMMC instruments, shunt and multipliers, multimeters, Moving iron ammeters and voltmeters, dynamometer, wattmeter, AC watt-hour meter, extension of instrument ranges

**SOT205: Values and Ethics**

**Unit 1: Effects of Technological Growth**

Science, Technology and Engineering as Knowledge and as Social and Professional Activities, Rapid Technological growth and depletion of resources. Reports of the Club of Rome, Limits of growth; sustainable development Energy Crisis; Renewable Energy Resources, Environmental degradation and pollution, Eco-friendly Technologies, Environmental Regulations

**Unit 2: Environmental Ethics**

Appropriate Technology Movement of Schumacher: later developments Technology and developing nations. Problems of Technology transfer. Technology assessment, impact analysis, Human Operator in Engineering projects and industries, Problems of man machine interaction, Impact of assembly line and automation, Human centred Technology

**Unit 3: Ethics of Profession**

Engineering profession: Ethical issues in engineering practice. Conflicts between business, demands and professional ideals, Social and ethical Responsibilities of Technologists, Codes of professional ethics. Whistle blowing and beyond. Case studies

**Unit 4: Profession and Human Values**

Value Crisis in contemporary society, Nature of values; Value Spectrum of a 'good' life, Psychological values: Integrated personality; mental health.

**Unit 5: Societal values**

The modern search for a 'good' society, justice, democracy, secularism, rule of law; values in Indian Constitution, Aesthetic values; Perception and enjoyment of beauty, simplicity, clarity.

**Moral and ethical values:** Nature of moral judgments; canons of ethics; Ethics of virtue; ethics of duty; ethics of responsibility.

**Suggested readings**

1. Dr. Subir Chowdhury. Blending the best of the East & West. EXCEL
2. Ghosh. Ethics & Mgmt. & Indian Ethos. VIKAS.



3. Pherwani. Business Ethics. EPH

### **SOT206: Basic Electronics**

#### **Unit 1: Semiconductors Diodes and Rectifiers**

Introduction, general characteristics, energy levels, extrinsic materials n & p type, ideal diode, basic construction and characteristics, DC & AC resistance, equivalent circuits, drift & diffusion currents, transition & diffusion capacitance, reverse recovery times, temperature effects, diode specifications, different types of diodes (zener, varactor, schottky, power tunnel, photodiode & LED), Half wave & full wave rectifiers

#### **Unit 2: Bipolar junction transistor**

Introduction, Transistor, Construction, transistor operations, BJT characteristics, load line, operation point, leakage currents, saturation and cut off mode of operations Eber-mall's model

**Bias stabilization:** Need for stabilization, fixed Bias, emitter bias, self bias, bias stability with respect of variations in  $I_{co}$ ,  $V_{be}$  &  $\beta$ , stabilization factors, thermal stability.

#### **Unit 3: Small Signal Amplifiers**

CB, CE, CC configurations, hybrid model for transistor at low frequencies, RC coupled amplifiers.

**Field Effect Transistors:** Classification & characteristics, operating point, biasing, enhancement & depletion type MOSFETS.

#### **Unit 4: Operational Amplifier**

Ideal OPAMP, OPAMP stages, OPAMP Parameters, equivalent circuit, Ideal voltage transfer curve, open loop OPAMP configuration, closed loop OPAMP configuration,

#### **Unit 5: OPAMP applications**

Comparator, current sources, rectifiers, first and second order filters, summer, integrator, differentiators, Clipper, clamper, waveform generators, instrumentation amplifier, log, antilog amplifier.

#### **Suggested readings**

1. J. Millman and Halkias. Electronic devices and circuits TMH.
2. Salivahanan, Suresh Kumar, Vallavaraj. Electronic devices and circuits TMH.
3. J. Millman and Halkias, Integrated Electronics, Analog & Digital Circuits & Systems, TMH.

### **SOT207: Computer Systems and Programming Lab**

#### **Suggested readings**

1. Rajaraman. Fundamentals of Computers. Prentice Hall of India, 3rd Edition.
2. B. S. Gottfried. Programming with C. McGraw Hill
3. Venugopal & Prasad. Mastering C. McGraw Hill
4. Yashwant Kanetkar. Let us C. BPB Publications,
5. Alexis Leon & Mathews Leon. Fundamentals of Computer Science & Communication Engineering, Leon Techworld.



6. Raja Raman. Computer Programming in C. Prentice Hall of India.

### **SOT 208: Electrical & Electronics Lab**

1. Verification of Kirchhoff's laws.
2. Verification of circuit theorems – Thevenin's and superposition theorems (with DC sources only).
3. Measurement of current, voltage, frequency and power.
4. Electromagnetic relays and solenoids.
5. To measure the armature and field resistance of a DC machine.
6. To calibrate a test (moving iron) ammeter and a (dynamometer) Wattmeter with respect to standard (DC PMMC) ammeter and voltmeters.
7. Calibration of energy meter with wattmeter.
8. Measurement of current, voltage and power in R-L-C series circuit excited by single phase) AC supply.
9. Open circuit and short circuit tests on a single-phase transformer.
10. Efficiency of transformer

### **Suggested readings**

1. B. L. Thareja. Electrical Technology (Vol. 1 & 2)
2. H. Cotton. Advanced Electrical Technology. Issac Pitman
3. Edward Huges. Electrical Technology. English Language Book Society
4. Smith S. Parker. Problems in Electrical Engineering. Asia Publication

### **SOT209: Workshop Technology**

#### **Unit 1: Wood and Wood Working (Carpentry)**

Classification and conservation of wood, common varieties of Indian timber, defects in timber, carpentry tools, auxiliary materials used in carpentry.

#### **Unit 2: Bench Work and Fitting**

Operations commonly used in bench and fitting work, description and use of vices, hammers, chisels, files, scraper, hacksaw, punches, measuring & marking tools, reamers, punches, gauges.

#### **Unit 3: Manufacturing Processes**

Classification of manufacturing processes, manufacturing and basic definitions, industrial safety, ferrous and non-ferrous metals, steels and alloy steels, heat treatment of metals and alloys

#### **Unit 4: Smithing and Forging**

Introduction, forging materials, heating devices, hand tools & appliance, smith forging operations

#### **Unit 5: Welding and Related Processes**

Introduction, weldability, types of welding, metallurgy of weld, gas welding, arc welding, resistance welding, solid state welding, soldering, brazing, welded joints and edge preparation, safety in welding.



**Workshop Practices:**

1. Sawing and simple joints, planning
2. Chipping marking and filing
3. Forging operation
4. Welding joint preparation
5. Metal arc welding and gas welding practice

**Suggested readings**

1. S.K. Choudhury, A.K. Choudhury and N. Roy. Elements of Workshop Technology, Vol: I-II, Manufacturing Processes, Media Promoters & Publishers Pvt. Ltd.,
2. W. A. J. Chapman and E. Arnold. Vol 1 and 2. Viva Low Priced Edition.
3. B. S. Raghuvanshi. Workshop Technology. Dhanpat Rai and Sons.

**Third Semester**

**AE301: Fluid Mechanics**

**Unit 1: *Definition and properties of fluids***

Units of measurements; fluid statics, pressure at a point and its measurement; fluids static force on submerged surfaces, buoyancy, condition of floatation and stability of submerged and floating bodies.

**Unit 2: *Kinematics of fluids***

Lagrangian and Eulerian description of fluid motion, stream lines, path lines, streak lines, types of fluid flow: translation, rotation, circulation and vorticity stream function, velocity potential and flow net; discharge: system, control volume and cross section; stress-strain rate relationship, linear and angular momentum theorems and applications; some exact solutions of Navier-Stokes equations.

**Unit 3: *Dynamics of fluid***

Equations of motion, Euler's equation of motion, Bernoulli's equation from Euler's of motion, Practical examples of Bernoulli's equation, the momentum equation, the moment of momentum Transport theorem, conservation laws, equation of continuity, Euler's equation of motion, Bernoulli's equation, viscous flow.

**Unit 4: *Flow through pipes***

Loss of energy in pipes, head loss due to friction, minor energy (head) loss, hydraulic gradient and total energy line, flow through siphon, flow through pipes in series, equivalent pipe, flow through parallel pipes, flow through branched pipes, power transmission through pipes, water hammer.

**Unit 5: *Dimensional and model analysis***

Secondary or derived quantities, dimensional homogeneity, methods of dimensional analysis: Raleigh's method and Buckingham's  $\pi$  theorem, model analysis, Similitude: types of similarities, types of forces acting in moving fluid, dimensionless numbers, model laws or similarity laws.

**Suggested readings**

1. E. H. Lewitt. Hydraulics and Fluid mechanics. Issac Pitman and Sons, London



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2. Jagdish Lal. Hydraulics and Fluid Mechanics. Metropolitan Book Co.
  3. S. C. Rangwala. Fluid Mechanics. Charotar Publishing House.
  4. R. K. Bansal. A text book of Fluid Mechanics & Hydraulic machines. Laxmi Publ
  5. R. S. Khurmi. A text Book of Fluid Mechanics. S. Chand and Co.

### **AE302: Operational Research and Industrial Management**

**Unit 1:** System concepts, system approach to Agricultural Engineering, Linear programming problems, Mathematical formulation, Graphical solution, Simplex method; Degeneracy and Duality in linear programming;

**Unit 2:** Transportation problems, Assignment problems, Decision analysis

**Unit 3:** Waiting line problems, Project Management by PERT/CPM, Inventory control.

**Unit 4:** Mathematical models of physical systems, Modeling of systems and operations

**Unit 5:** Response of systems, Computer Simulation as a tool in analysis

#### **Suggested readings**

1. G. Gillet. Introduction to Operations Research. Tata McGraw Hill.
2. W. J. Grawham and T. L. Vincent. Modern Control Systems Analysis and Design. John Wiley and Sons.
3. Ravindran. Operation Research and Management.
4. Taha. Operations Research: An Introduction.

### **AE303: Strength of Material**

**Unit 1:** Elasticity-stress and strain-elastic limit – Hooke’s law : Young’s modulus-stress in bar due to its own weight, varying section and uniformly tapering circular bars-primary and secondary strain-bulk and shear modulus and their relationship-volumetric strain in a body.

**Unit 2:** Principle stresses and strains, Mohr’s circle. Temperature stresses, Resilience. Shear force and bending moment diagram for simply supported beams and over hanging beams-centroid of different cross sectional laminar, moment of inertia, parallel axis theorem and perpendicular axis theorem, moment of inertia of different cross sectional laminae.

**Unit 3:** Bending stress in beams, derivation of bending equation, shearing stresses in beams, derivation of shearing stresses equation, deflection-derivation of double order differential equation-Macaulay’s method.

**Unit 4:** Stresses in thin cylinder and spherical shells, derivation of equations for circumferential and longitudinal stresses in shells and their applications, bombined bending and direct thrust, middle third rule, columns and struts, assumptions made in Euler’s theory, derivation of buckling load equation for



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both the ends hinged, one end fixed and the other end free, empirical formulae for columns derivation of torsional equation.

**Unit 5:** Design of helical and laminated spring analysis of different types of propped beam subjected to different types of loads, fixed beam. Mohr's theorem-derivation of equation, determination of fixed end, moments for fixed beam subjected to concentrated and distributed loads.

**Suggested readings**

1. S.B. Junnarkar and S.J. Shah. Mechanics of Structures, Vol. 1. Charotar Publishing House.
2. O.P. Jain and B.K. Jain. Theory and Analysis of Structures. Nemchand and Brothers, Roorkee.
3. S.P. Timoshenko and D. H. Young. Strength of Materials. Van Nostrand and Co.
4. E.P. Popov. Mechanics of Materials. McGraw Hill
5. S. Singh. Strength of Materials. Vikas Publishing House

**AE304: Thermodynamics and Heat Engines**

**Unit 1: System and Concepts of Energy**

Thermodynamic system and control volume, Thermodynamic properties, processor and cycles. Homogenous and Heterogeneous systems, Thermodynamic equilibrium, work done by a system. Energy as a property of the system, different forms of stored energy, Energy of an isolated system, Mass balance and energy balance in a simple steady flow process, Energy equation. Available energy, work transfer, heat transfer, different types of work

**Unit 2: Temperature & Heat**

Zeroth law of thermodynamics, measurement of temperature, comparison of thermometers, Thermocouple, Heat transfer as a path function, specific heat & latent heat, Specific heat of constant volume, Enthalpy, specific heat at constant pressure

**Unit 3: First Law of thermodynamics and pure substance and properties**

Closed system for undergoing a change of state and cycle, Kinetic Energy, internal energy, Polytropic processes and related numericals, control volume, Steady flow process, variable flow processes, Examples of a variable flow process. P-V diagram for pure substances, p.t. diagram for pure crude-substances, p.v.t. surface, T S diagram for a pure substance, molliar diagram for a pure substance, Quantity of dryness fraction, Thermodynamic properties of steam, steam tables and charts, measurement of steam quality.

**Unit 4: Second law of thermodynamics**

Difference between heat and work, cyclic heat engine, heat reservoirs, statements of Kelvin plank's, Clausius statement, refrigeration and heat pump, Carnot theorem and Carnot cycle, irreversible heat engine, Reversibility& irreversibility of process and numerical examples.

**Unit 5: Boiler and IC Engines**

Mountings and accessories, boiler efficiency Steam engines Rabine cycle Indicator diagrams, Steam turbines, first law applied to flow process. Air standard cycles, Ottocycle, Diesel cycle, Joule cycle, Air standard cycle for jet propulsion, Reversed Heat engine cycle





### **Suggested readings**

1. N. C. Pandya, C. S. Shah and S. S. Khandare. Heat Engines. (Vol. 1 and 2). Charotar Publishing House
2. D. B. Spalding and E. H. Cole. Engineering Thermodynamics
3. G. A. Hawkins. Engineering Thermodynamics. John Wiley and Sons.
4. P. K. Nag. Engineering Thermodynamics. McGraw Hill.
5. G. J. Van Wylen and R. E. Sonntag. Fundamentals of classical Thermodynamics. John Willey and Sons
6. M. L. Mathur and P. Sharma. I. C. Engines. Dhanpat Rai and Sons
7. W. Paul, Gill James, H. Smith and J. Z. Eugene. Fundamentals of I. C. Engines. Oxford and IBH Publishing Co.

### **AE305: Surveying and Levelling**

#### **Unit 1 and 2: Surveying**

Definition, principles and basic concepts of surveying, classification, basic measurements, units of measurements, plans and maps, types of scales. 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.

### **Suggested readings**

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.

### **AE306: Crop Production Technology**



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**Unit 1: Introduction**

Definition and scope of agronomy; classification of crop; effect of different weather parameters on crop growth and development

**Unit 2: Utilities for crop production**

Principles of tillage; tillage and its characteristics; tillage implements; soil-water-plant relationship, water requirement of crops and irrigation scheduling

**Unit 3: Crop Improvement Techniques**

Fertilization and plant protection; concept of dry farming; rain water harvesting and in-situ moisture conservation

**Unit 4: Crop Production**

Classification of crops; cropping system for major agro-ecological regions; organic farming and sustainable agriculture; modern techniques of raising field crops, horticultural crops, medicinal and aromatic plants, seeding, fertilizer and water management, plant protection measures; crop growth assessment; dry farming practices

**Unit 5: Harvest and Post Harvest**

Post harvest operation of crops and quality assessment

**Suggested readings**

1. Hall, C. W. Handling and storage of food grains in tropical and subtropical areas. FAO Pub. Oxford and IBH Publication Co. Pvt. Ltd., New Delhi
2. Henderson, S. and Perry, S. M. Agricultural Process Engineering. 5th Edition AVI Publishing Co. Inc..
3. Pantastico, E. C. B. Post harvest physiology, handling and utilization of tropical and subtropical fruits and vegetables. AVI Publication Co.
4. Shewfelt, R.L. and Prussi., S.E. Post harvest handling- A systems approach. Academic Press, Inc.
5. Chidda Singh. Modern Techniques of raising of Field Crops. Oxford and IBH Publishing house.

**AE307: Fluid Mechanics Lab**

1. Study of product measuring devices.
2. Determination of metacentric height of floating vessels.
3. Verification of Bernoulli's theorem.
4. Demonstration of laminar and turbulent flows.
5. Determination of head loss through pipes and pipe fittings.
6. Determination of coefficient of discharge for a venturimeter.
7. Determination of orifice meter coefficient.
8. Calibration of a notch.
9. Experiments using water table to demonstrate various flow phenomena.
10. Measurement of viscosity and surface tension of liquids.



### **Suggested readings**

1. E. H. Lewitt. Hydraulics and Fluid mechanics. Issac Pitman and Sons, London
2. Jagdish Lal. Hydraulics and Fluid Mechanics. Metropolitan Book Co.
3. S. C. Rangwala. Fluid Mechanics. Charotar Publishing House.
4. R. K. Bansal. A text book of Fluid Mechanics & Hydraulic machines. Laxmi Publ
  
5. R. S. Khurmi. A text Book of Fluid Mechanics. S. Chand and Co.

### **AE308: Advanced Workshop Technology**

#### **Unit 1: The Lathe**

Introduction, Function of lathe, Types of lathe, the size of a lathe, descriptions and functions of lathe parts, lathe operations, lathe accessories and attachments.

#### **Unit 2: Drilling and Boring Machines**

Introduction, types of drilling and boring machine, work holding devices, tool holding devices, drilling and boring machine operations, drilling and boring machine tools.

#### **Unit 3: Grinding and Milling Machines**

Introduction, types of grinding and milling machine, work holding devices, tool holding devices, grinding and milling machine operations, grinding and milling machine tools.

#### **Unit 4: Transmission of Motion and Power**

Introduction, methods of drive, power of transmission elements, shafting, coupling for shafting, bearing for shafting, belt drive, belting, pulleys, rope drive, chain drive, clutches, gear drive, rack and pinion, power transmitted by gearing, hydraulic system., gear cutting.

#### **Unit 5: Surface Finishing Processes**

Introduction, lapping, honing, super finishing, polishing, buffing, power brushing, tumbling, galvanizing, plumbing, specification of pipes, pipefitting and joints, taps and valves, plumber's tools, threaded fasteners, screw threads and their use.

### **Workshop practices**

1. Exercises based on drilling, fitting and tapping operation
2. Exercise based on different types of joints in carpentry
3. Exercise based as taper turning, threading and milling
4. Revetting operation for lap joints
5. Knurling, centering, drilling and threading

### **Suggested readings**

1. S. K. Choudhury, A. K. Choudhury and N. Roy. Elements of Workshop Technology, Vol. I & II, Manufacturing Processes, Media Promoters and Publishers Pvt. Ltd., Mumbai.
2. W. A. J. Chapman and E. Arnold. Vol 1 and 2. Viva Low Priced Edition.
3. M. L. Begeman and B. H. Amstead. Manufacturing Process. John Wiley.
4. B. S. Raghuvanshi. Workshop Technology. Dhanpat Rai and Sons.



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5. S. Crawford. Basic Engineering Processes. Hodder and Stoughton.

**AE309: Surveying and Levelling Lab**

1. Handling of chain and chain accessories, offsetting, acquaintance with field book
2. Ranging out survey line and plotting chain survey
3. Triangulation by chain and offsetting for details for preparation of map of a small area.
4. Plotting of field book, reading for preparation of map – acquaintance with symbols of different objects used in maps and scale of map.
5. Setting up of prismatic compass and measurement of angles.
6. Traversing of a small area with chains and prismatic compass and offsetting for details
7. Plotting of the map with chain and prismatic survey
8. Setting of a 20" accuracy transit theodolite and measurement of horizontal and vertical angles.
9. Setting up of plane table and offsetting by inter-section method.
10. Plane table traversing.
11. Setting up of dumpy levels and exercise in fly levelling and reciprocal levelling.

**Suggested readings**

1. R. E. Davis. Elementary Plane Surveying. McGraw Hill
2. A. L. Higgins. Elementary Surveying. McGraw Hill.
3. T. P. Kanetkar and S. V. Kulkarni. Surveying and Levelling. (Part I and II). Griha Prakashan.

**AE310: Crop Production Technology Lab**

1. Identification of common crop and plants and seed.
2. Identification of crops and their varieties, seeds and weeds
3. Fertilizer application methods
4. Different weed control methods
5. Different seedbed preparation methods
6. Different methods of sowing and transplanting
7. Judging maturity time for harvesting of crop
8. Acquaintance with different methods of harvesting
9. Preparation of charts showing major agro-climatic zones and rainfall pattern

**Suggested readings**

1. Hall, C. W. Handling and storage of food grains in tropical and subtropical areas. FAO Pub. Oxford and IBH Publication Co. Pvt. Ltd., New Delhi
2. Henderson, S. & Perry, S.M. Agricultural Process Engineering. AVI Publishing Co. Inc..
3. Pantastico, E. C. B. Post harvest physiology, handling and utilization of tropical and subtropical fruits and vegetables. AVI Publication Co.
4. Shewfelt, R.L. and Prussi., S.E. Post harvest handling- A systems approach. Academic Press, Inc.
5. Chidda Singh. Modern Techniques of raising of Field Crops. Oxford and IBH Publishing house.

**Fourth Semester**



## **AE401: Soil Science**

### **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**

Concept of individual soils, soil taxonomy, soil orders, entisols, inceptisols, andisols, gelisols, histosols, vertisols, mollisols, oxisols. Lower level categories in soil taxonomy

### **Unit 3: Soil Architecture and Physical Properties**

Soil colour, soil texture, structure, densities, pore spaces of mineral soils, soil properties relevant to engineering uses

### **Unit 4: Soil Aeration and Temperature**

The nature of soil aeration, soil aeration in the field, oxidation-reduction potential, factors affecting soil aeration, wetlands and their poorly aerated soils, processes affected by soil temperature, thermal properties of soils, soil temperature control.

### **Unit 5: 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.

### **Suggested Readings**

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. B. P. Ghildyal and R. P. Tripathi. Soil Physics. Wiley Eastern.
4. H. D. Foth. Fundamental of Soil Science. Wiley Eastern.
5. H. L. S. Tandon. Methods of Analysis of Soils, Plants, Water and Fertilisers.

## **AE402: Probability and Statistics**

### **Unit 1: Fundamentals**

Statistics population parameter, arithmetic, weighted geometric and harmonic means, mode and median for ungrouped and grouped data. Frequency distribution, standard deviation, means deviation and coefficient of variation. Simple and multiple correlation coefficient, frequency polygon histograms and bar charts

### **Unit 2: Curve Fitting**



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Fitting equation to data, normal equation, regression coefficients, curvilinear regressions, test of significant, t test, f test and chi square test. Normal Poisson and binomial distribution, Confidence levels

**Unit 3: Probability**

Sample space and events, probability defined on events, conditional probability, independent events, Bayes' formula, Bernoulli, Binomial, geometric and Poisson distributions, Uniform, Exponential, Gamma: K-erlang Normal and Weibull distributions, Expectation and Variance joint distributions

**Unit 4:** Moment generating functions, Probability generating function, Stochastic processes, Markov chain, Poisson process. Birth death processes, queuing models, reliability theory and structure functions. Reliability at systems of independent components, system life as a function of component lives.

**Unit 5:** Statistical estimation; maximum likelihood estimators, minimum variance on biased estimators Bayes' estimators, estimation of the rate or Poisson processes, estimating the transition probabilities of Markov chain.

**AE403: Kinematics and Dynamics of Machines**

**Unit 1:** Definition of mechanisms, kinematic link, Grubler's criterion and motion conversion, inversions of quadric cycle chain, slider crank chain and double slider crank chain.

**Unit 2:** Analysis of displacement, velocity and acceleration; method of instantaneous center, method of relative velocity and relative acceleration

**Unit 3:** Coriolis component, graphical method of analysis, geometrical methods; analysis of four-bar chains

**Unit 4:** Partial balancing of inertia forces of piston, balancing of single cylinder engines and multi cylinder engines, equivalent mass of connecting rod. Balancing of rotating machinery, torque diagram and design of flywheel

**Unit 5:** Gears and gear trains, cams, cams with knife-edge follower, roller follower and flat faced follower; governors, brakes, dynamometers, clutches, journal bearing roller bearing

**Suggested readings**

1. D. H. Myszka. Machines and Mechanisms: Applied Kinematic Analysis. Prentice Hall
2. Amithabh Ghosh and A. K. Mallick. Theory of Mechanism and Machines Affiliated East West Press
3. W. G. Green. Theory of Machines. Blackie and Sons.
4. J. E. Shigley. Kinematics Analysis of Mechanisms
5. Thomas Bevan. Theory of Machines. CVS Publishers
6. R. S. Hartenberg and J. Denavit. Kinematic Synthesis of Linkages. McGraw Hill

**AE404: Farm Power**



**Unit 1:** Power availability on the farms from animate and inanimate sources of energy, their capacities and efficiencies

**Unit 2:** Tractor engine components and their construction

**Unit 3:** Operating principles and function of engine systems, valve and valve mechanism. Fuel and air supply, cooling lubrication, ignition, starting and electrical systems

**Unit 4:** Engine governing, transmission systems of wheel and track type tractors, clutch and brake, gear box, differential, PTO, belt pulley and draw bars and final drive mechanisms

**Unit 5:** Power tillers and small engines for farm operations, performance and cost analysis of farm tractors and power tillers. Human factors in the design of tractor seat and different controls

#### **Suggested readings**

1. A. M. Michael and T. P. Ojha. Principles of Agricultural Engineering. Vol. 1
2. C. P. Nakra. Farm Machines and Equipments
3. E. J. Johnson and A. H. Hollenberg. Servicing and Maintenance of Farm Tractors.

#### **AE405: Watershed Hydrology**

**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

#### **Suggested readings**

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

#### **AE406: Post Harvest Operations**



**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 demidification 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

### **Suggested readings**

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.

### **AE407: Soil Science Lab**

1. Demonstration of bulk density, particle density and porosity of soil.
2. Demonstration of textural class of soil by field method.
3. Determination of water holding capacity of soil.
4. Identification of rocks.
5. Determination pH of soil.

### **Suggested Readings**

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. B. P. Ghildyal and R. P. Tripathi. Soil Physics. Wiley Eastern.
4. H. D. Foth. Fundamental of Soil Science. Wiley Eastern.





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5. H. L. S. Tandon. Methods of Analysis of Soils, Plants, Water and Fertilisers.

**AE408: Farm Power Lab**

1. Study of constructional details and working principle of engine parts.
2. Evaluation of tractor fuel supply system.
3. Evaluation of tractor cooling and lubrication system.
4. Evaluation of tractor electrical systems.
5. Design and demonstration of tractor clutches and brakes
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6. Study and design of tractor power transmission systems.
7. Study and evaluation of tractor ground drive components.
8. Study of mechanical and hydrostatic steering system of tractors.
9. Laboratory testing of an industrial engine.
10. PTO power testing of an agricultural tractor.
11. Evaluation of tractor noise and vibration.
12. Field evaluation of a tractor operator's activities.

**Suggested readings**

1. A. M. Michael and T. P. Ojha. Principles of Agricultural Engineering. Vol 1
2. C. P. Nakra. Farm Machines and Equipments
3. Mosses and Frost. Farm Power.
4. E. J. Johnson and A. H. Hollenberg. Servicing and Maintenance of Farm Tractors.
5. Hunt. Farm Power and Machinery Management

**AE409: Watershed Hydrology Lab**

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.

**Suggested readings**

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
6. K. Subramanya. Engineering Hydrology. McGraw Hill

**AE410: Post Harvest Operations Lab**

1. Measurement of physical properties of food grains
2. Particle size analysis and energy requirement in comminution



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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

### **Suggested readings**

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.

### **Fifth Semester**

#### **AE501: Instrumentation and Control**

##### **Unit 1: Introduction**

Review of Laplace Transforms; Zero, first and second order responses of instruments, motion and Displacement Measurement: Strain gages, differential transformers, piezoelectric transducers, nozzle flappers.

##### **Unit 2: Pressure Measurement**

Manometer dynamics, Bourdon tubes, pressure transducers, force balance transducers, McLeod gage, Knudsen gage, thermal conductivity gage, Pirani gage, ionization gage

##### **Unit 3: Force and Torque Measurement**

Drawbar dynamometers, octagonal ring transducers, torque transducers, Pitot static tube, hot wire anemometer, orifice meter, rotameter, turbine flowmeter

##### **Unit 4: Temperature Measurement**

Bimetallic thermometers, pressure thermometers, thermocouples, thermopiles, resistance thermometers, thermistors, radiation thermometers, Humidity Measurement; Concept of Biosensors

##### **Unit 5: Control Theories**



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Proportional, integral and derivative controls, transfer functions, feedback control, transient response, stability criterion, Routh test, root loci, frequency response, Bode plots, controller tuning; Application in Food Industry, Sampling and Z transforms, sampled data control; Microprocessor based Systems.

### **Suggested readings**

1. D. O. Doebelin. Measurement Systems: application and Design. McGraw Hill.
2. D. M. Considine. Process/Industrial instruments and Control Handbook. McGraw Hill
3. X. Ogate. Modern control Engineering. Prentice Hall
4. D. Patranabis. Principles of industrial Instrumentation. Tata McGraw Hill

### **AE502: Machine Design**

**Unit 1:** Materials of construction and their properties. Manufacturing consideration in machine design

**Unit 2:** Stresses in elementary machine parts, metal fits and tolerances, design of machine members subjected to variable loads, machine vibrations

**Unit 3:** Design of joints, critical speeds of shafts, power transmission shafting, coupling design, keys, pins and splines, power screw and threaded fasteners,

**Unit 4:** Bolt loading, clutches and brake designs, springs, different types of gears, roller bearings,

**Unit 5:** Chain and belt drives, pulleys and flywheels.

### **Suggested readings**

1. N. C. Pandya and C. S. Shah. Machine Design. Charotar Publishing House.
2. N. D. Bhatt and V. M. Panchal. Geometrical and Machine Drawing. Charotar Publishing House.
3. P. C. Sharma and D. K. Agarwal. Machine Design.
4. R. S. Khurmi and J. K. Gupta. Theory of Machines. Burasia Publishing House.
5. M. F. Spotts. Design of Machine Elements. Prentice Hall.
6. A. S. Hall, A. Holowenko and H. G. Laughlin. Theory and Problems of Machine Design. McGraw Hill

### **AE503: Soil and Water Conservation Engineering**

#### **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.



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**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

**Suggested readings**

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

**AE504: Food Chemistry and Microbiology**

**Unit 1:** Food quality characteristics; chemical composition and physical structure of food; chemical and nutritive value of common foods

**Unit 2 and 3:** Structure, properties and metabolic functions of food constituents viz., water, protein, fats, carbohydrates, enzymes, vitamins, minerals; pigments, colour and flavouring substances

**Unit 4 and 5:** Microbial grouping and identification; morphology and characteristics of bacteria, yeasts and molds; factors affecting microbial growth and decay; microbial growth and death kinetics; food poisoning, intoxicating and infective organism; microbial spoilage of foods.

**Suggested readings**

1. O. R. Fennema. Food Chemistry. Marcel Dekker Publications, New York
2. Frazier, Food Microbiology, CBS publishers (Indian print).

**AE505: Mechanical Operation in Food Processing**

**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

### **Suggested readings**

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.

### **AE507: Machine Design and Drawing**

**Unit 1:** Introduction to computer-aided design. Geometric modelling and interactive graphics, computer-aided analysis and synthesis of common mechanical components, Application of numerical methods and optimal techniques to machine design problems, Computer-aided selection of standard mechanical components, Introduction to FEM

**Unit 2:** Preparation of engineering drawings of machine/implement components, design of plough share/furrow openers/plough discs, and other components of farm machinery, preparation of bill of materials and costing.

**Unit 3:** Forms of screw threads: BSW-square-metric, representations of threads, bolts, headed counter sunk-stud, screws and set screws, nuts-hexagonal-square, keys-type, taper, sunk taper, hollow saddle, flat saddle, round-gib head feather and woodruff keys, spline shaft.

**Unit 4:** Bearings: types, journal, solid, bushed and plummer block, pulley assembly drawings of tailstock, plummer block and simple agril implements.

**Unit 4:** Rivets and joints

### **Suggested readings**

1. N. C. Pandya and C. S. Shah. Machine Design. Charotar Publishing House.
2. N. D. Bhatt and V. M. Panchal. Geometrical and Machine Drawing. Charotar Publishing House.
3. P. C. Sharma and D. K. Agarwal. Machine Design.



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4. R. S. Khurmi and J. K. Gupta. Theory of Machines. Burasia Publishing House.
  5. M. F. Spotts. Design of Machine Elements. Prentice Hall.
  6. A. S. Hall, A. Holowenko and H. G. Laughlin. Theory and Problems of Machine Design. McGraw Hill

**AE508: Soil and Water Conservation Engg. Lab**

1. Design of contour bund and graded bund
2. Design of bench terraces and grassed waterway
3. Design of temporary gully control structure
4. Design of drop spillway, chute spillway and drop inlet spillway
5. Design of farm pond and earthen embankment

**Suggested readings**

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

**AE509: Food Chemistry and Microbiology Lab**

1. Quantitative analysis of food for proximate composition
2. Determination of acidity and pH of food sample
3. Determination of total and reducing sugar
4. Estimation of mineral content in food sample (Ca, P)
5. Microscopic observation of bacteria, yeasts and moulds
6. Staining of micro-organisms
7. Quantitative estimation of bacteria, yeasts and moulds
8. Isolation and identification of micro organism

**Suggested readings**

1. S. Ranganna. Handbook of Analysis and Quality Control for Fruit and Vegetable Products. McGraw Hill.

**AE510: Mechanical Operation in Food Processing lab**

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. Mixing of solids
7. Viscosity measurement of liquid foods
8. Measurement of flow properties of powders
9. Estimation and measurement of flow rate



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## **Sixth Semester**

### **AE601: Thermal Operation in Food Processing**

**Unit 1:** Fourier's law, heat conduction through composite walls, optimum thickness of insulation, general equation under unsteady state, 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; microbial 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

#### **Suggested readings**

1. Arora, S.C. and Domkundwar, S. (1994) A Course In Heat and Mass Transfer. Dhanpatrai and Sons, 4th Edition.
2. Chapman, 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.

### **AE602: Farm Machinery**

#### **Unit 1 and 2: Farm machines**

Machines and tools for crop production and processing, Machines for tillage, sowing, fertilizer application, inter-culture, plant protection, harvesting and threshing.

#### **Unit 3: Equipment design**

Principles of operation and design of simple farm equipments and tools

#### **Unit 4: Farm operations**

Hitching of implements, Field efficiency, Performance testing, Cost of use of machines



### **Unit 5: New techniques**

Application of computer vision and GIS in farm equipments

#### **Suggested readings**

1. Bainer Roy, R. A. Kepner and E. L. Berger. Principles of Farm Machinery. John Wiley and Sons.
2. H. P. Smith and Pearson. Farm Machinery and Equipment. McGraw Hill.
3. Richey. Hand Book of Agricultural Engineering.

### **AE603: Soil Mechanics**

#### **Unit 1: *Elementary Properties***

Introduction, preliminary definitions and relationship, determination of index properties, classification of soil, soil structure and clay mineralogy

#### **Unit 2: *Soil Hydraulics***

Soil water, permeability, seepage analysis, soil hydraulics, seepage below hydraulic structures

#### **Unit 3: *Elasticity Applied to Soil***

Elements of elasticity, stress distribution

#### **Unit 4: *Compressibility***

Compression and compressibility, one and three dimensional consolidation, compaction

#### **Unit 5: *Strength and Stability***

Shear strength, Mohr's circle of stresses, active and passive earth pressures, retaining walls, stability analysis of earthen slopes, bearing capacity of soils, foundations.

#### **Suggested readings**

1. B. C. Punmia., Soil Mechanics and Foundations, Laxmi Publication Pvt. Ltd., New Delhi
2. S. G. Bowell. Soil Mechanics. Wiley Eastern.
3. Gopalrajan and A. S. R. Rao. Basic and Applied Soil Mechanics.

### **AE604: Irrigation and Drainage Engineering**

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

Sources of water, utilization in various sectors, irrigation potential and scope for further development and significant issues

#### **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, Efficiency and economics of Irrigation pumping plants.





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

Water relation of soils, measurement of soil moisture, infiltration, water requirement of crops, consumptive use and evapotranspiration

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

Methods of water measurement, weirs, parshall flumes, orifices and metergates, methods of irrigation water application, water conveyance and control structures, irrigation efficiencies, irrigation scheduling

**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.

**Suggested Readings**

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

**AE605: Elective –I**

**AE606: Thermal Food Operations Lab**

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

**Suggested readings**

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.

**AE607: Farm Machinery, and Operation and Maintenance**

1. Performance of primary tillage implements.
2. Performance of offset disc harrow.
3. Field evaluation of wetland tillage machinery.
4. Field-testing of tractor-mounted rotavator.



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5. Performance evaluation of seed metering mechanisms.
  6. Calibration and field-testing of seed cum fertilizer drill.
  7. Field-testing of rice transplanter.
  8. Field-testing of mechanical weeder.
  9. Performance of hydraulic spray nozzles.
  10. Performance of air carrier sprayers.
  11. Optimal throughput capacity of threshers.
  12. Wear testing of a tillage tool

### **Operation and Maintenance of Tractors and Engines**

1. Field operation and adjustment of ploughs
2. Field operation and adjustment of harrows.
3. Field operation and adjustment of cultivators
4. Field operation of sowing and planting equipments and their adjustments.
5. Field operation of plant protection equipment.
6. Field operation of mowers and reapers.
7. Field operation of threshers and their performance evaluation.
8. Opening and reassembling of disc harrows, determination and adjustment of tilt and disc angles.
9. Hitching of agricultural implements and trailers.

### **Suggested readings**

1. A.M. Michael and T.P. Ojha. Principles of Agricultural Engineering. Vol 1. Jain Brothers.
2. J. Sahay. Elements of Agricultural Engineering.
3. Bainer Roy, R. A. Kepner and E. L. Berger. Principles of Farm Machinery. John Wiley and Sons.
4. H. P. Smith and Pearson. Farm Machinery and Equipment. McGraw Hill.
5. Richey. Hand Book of Agricultural Engineering.

### **AE608: Soil Mechanics Lab**

1. Determination of particle and bulk density of soil.
2. Mechanical analysis of soil by sieving.
3. Hydrometer analysis for grain size distribution.
4. Determination of hydraulic conductivity by constant and variable head permeameter
5. Settlement analysis of soils

### **Suggested readings**

1. B. C. Punmia., Soil Mechanics and Foundations, Laxmi Publication Pvt. Ltd., New Delhi
2. S. G. Bowell. Soil Mechanics. Wiley Eastern.
3. Gopalrajan and A. S. R. Rao. Basic and Applied Soil Mechanics.

### **AE609: Irrigation and Drainage Engineering Lab**

1. Field and laboratory demonstration of hydro-met observatory, lysimeter, soil moisture measuring equipment, flow measurement devices
2. Determination of crop water requirement and irrigation scheduling



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3. Performance evaluation of irrigation systems
  4. Design of drainage system
  5. Land grading and land leveling

### **Suggested Readings**

1. Michael, A. M. Irrigation Theory and Practice, Vikas Publication. New Delhi
2. James, L. G. Principles of Farm Irrigation System Design, John Wiley and Sons, New York,
3. Walker, W.R. and Skogerboe, Q. V. Surface Irrigation: Theory and Practice, Prentice Hall Inc. New Jersey

### **AE610: Seminar and Technical Report Writing**

#### **Seventh Semester**

### **AE701: Refrigeration and Air Conditioning**

#### **Unit 1: Psychrometry**

Principles, Psychrometry process; comfort chart and effective temperature and respiration heat.

#### **Unit 2: Refrigeration**

Principles, properties of refrigerant, refrigeration effect; thermodynamic cycle: Carnot cycle, Bell coleman cycle- vapor compression cycle; temperature-entropy diagram; pressure-enthalpy charts; compressor; expansion valves; evaporators and condensers.

#### **Unit 3: Vapour compression refrigeration**

Effect of dry compression; wet compression- under cooling- superheating-actual vapour compression; cycle- vapour absorption cycle

#### **Unit 4: Refrigeration system**

Centrifugal and steam jet refrigeration systems; thermoelectric refrigeration systems; vortex tube and other refrigeration systems; ultra low temperature refrigeration; absorption system of refrigeration.

#### **Unit 5: Air conditioning**

Types and functions of air conditioning; physiological principles in air-conditioning; humidification and dehumidification- room dehumidifiers; calculation of cooling and heating loads; air distribution and duct design methods; fundamentals of design of complete air conditioning systems.

### **Suggested readings**

1. S.C. Arora and S. Domkundwar. A Course In Heat and Mass Transfer. Dhanpat Rai and Sons, 4th Edition.
2. R. J. Dossat. Principles of refrigeration. Wiley Eastern.
3. W. F. Stoecker. Refrigeration and Air Conditioning. McGraw Hill.
4. Manohar Prasad. Refrigeration and Air Conditioning. Wiley Eastern.
5. C. P. Arora. Refrigeration and Air Conditioning. McGraw Hill

### **AE702: Building Materials and Structural Design**



**Unit 1 and 2:** Properties and classification of conventional building materials like bricks, lime , cement , sand, coarse aggregates etc. classification of seasoning and preservation of timbers, use of materials like plywood, asbestos, plastic and PVC, glass, aluminum etc. in buildings and sheds. Use of fly-ash and fly-ash products in construction waterproofing materials

**Unit 3 and 4:** Concept of derminate and indeterminate structures, moment of inertia of sections, bending moment and shear force diagram and design of steel and concrete bins, design of steel and R.C.C, columns and column footings; design of different kinds of bins and column, single and double

reinforced beams, T-beams, shear distribution in R.C section, design of column footings, design of roof slab, trashes, design of storage structure, dairy barn, poultry houses , concept of ferro-cement structures, structural details of underground & overhead liquid containers , silos & cold storage structure & open web structure

**Unit 5:** Concept of detailed and obstruct estimates, estimation procedure for welding, sheds and roads

### **Suggested readings**

1. Michael, A. M., and Ojha, T. P. Principles of Agricultural Engineering. Vol. II. Jain Brothers, New Delhi, India.
2. B. N. Dutta. Estimating & Costing in Civil Engineering: Theory & Practice. S. Dutta & Co.
3. L. W. Neubaur and H. B. Walker. Farm Buildings Design. Prentice Hall.

### **AE703: Tea Technology**

**Unit: 1** Soil Preparation for tea plantation

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

**Unit: 3** Tea Processing

**Unit: 4** Human resource management

**Unit: 5** Waste utilization and management

### **Suggested reading**

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

### **AE704: Renewable Energy Sources**

**Unit 1: Solar Energy**

Solar system, Design of solar energy operated systems for application in agriculture, Photovoltaic devices.

**Unit 2: Wind Energy**



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Horizontal and vertical axis wind rotors, Wind regime analysis, Design and evaluation of wind mills  
Power torque characteristics, design and performance of rotors, wind mill structure design

**Unit 3: Energy from Plants**

Microbiological conversion of plant materials to fuels, Bio diesel

**Unit 4: Wastes for fuel and energy**

Biochemistry of anaerobic fermentation, Recycling of agricultural waste, Design of biogas systems for heating, Briquetting – concept, advantage, technology, lighting and running IC engines

**Unit 5: Cost Economics**

Economics of use of various alternative sources of energy in agriculture

**Suggested readings**

1. Culp, A. W. principles of energy conversions. McGraw Hill
2. H.P. Garg and J. Prakash. Solar energy – Fundamentals & applications. Tata McGraw Hill.

**AE705: Land and Water Resources Development**

**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

**Suggested readings**

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



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4. V.V.N. Murty and D. K. Takeuchi, Land and Water Development for Agriculture in Assia-Pacific Region. Oxford and IBH Publishing Co. New Delhi.

**AE706: Elective – II**

**AE707: Tea Technology Lab**

1. Identification and characteristics of farm for tea cultivation
2. Selection of farm equipments and machineries for tea cultivations
3. Study of irrigation systems for tea
4. Tea flocking
  
5. Processing equipments for tea leaves
6. Study of tea processing
7. Quality evaluation and value addition of tea
8. Energy audit in tea garden

**AE708: Project – I**

**AE709: Summer Training – II**

**AE710: Renewable Energy Sources Lab**

1. Study and performance evaluation of solar cells
2. Study and performance evaluation of wind mills
3. Preparation of biomass sample
4. Determination of calorific value of different bio-fuels
5. Estimation of ash content of biomass
6. Estimation of moisture content of biomass
7. Estimation of fixed carbon and volatile matter content of biomass
8. Study on bio-diesel preparation
9. Study of different biogas plants
10. Demonstration of solar heaters and solar cookers
11. Study of gasifiers

**Suggested readings**

1. Culp, A. W. principles of energy conversions. McGraw Hill
2. H.P. Garg & J. Prakash. Solar energy – Fundamentals & applications. Tata McGraw Hill.

**Eighth Semester**

**AE801: Fruit and Vegetable Processing**

**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



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horticultural and plantation crop products-juices, pickles, jams, jellies, marmalades, tea, coffee-processing

**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

### **Suggested readings**

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. Viridi and J.S. Balis, Seed Processing. Avion Printers, ND.

### **AE802: Agricultural Business Management**

**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 contract farming, agricultural policy, business statistics, farm business



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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

### **Suggested Readings**

1. Walter J. Wills. An introduction to agri-business management
2. Megginson, L. C., Byrd. M. J. and Meginson, W. L. Small business management: An Entrepreneur's guidebook, McGraw Hill.
3. Truet, L. J. and Truett, D. B. Managerial Economics, John Willey and Sons.

### **AE803: Testing and Evaluation of Tractors and Machineries**

**Unit 1:** Test code, performance index, selection of machines, testing conditions, preparation of data sheet and analysis

**Unit 2:** Testing procedures for agricultural hand tools and animal drawn agricultural equipments implements

**Unit 3:** Testing procedures for power tiller drawn/self propelled agricultural equipments/ implements, reapers and transplanters

**Unit 4:** Testing procedures for tractor drawn/power operated agricultural equipments/ implements i.e. mb plough, disc plough, cultivator

**Unit 5:** Testing procedures for manually and power threshers, decorticators, shellers, winnowers,

### **Suggested readings**

1. B. Roy, R. A. Kepner and E. L. Berger. Principle of Farm Machinery. John Wiley & Sons.
2. H. P. Smith and Pearson. Farm Machinery and Equipment. McGraw Hill
3. C. P. Makra. Farm Machines and Equipment.
4. Radhey Lal and A. C. Dutta. Agricultural Engineering through Solved Examples.

### **AE804: Elective – III**

### **AE805: Project – II**

### **AE806: Comprehensive Viva**





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**AE807: Testing and Evaluation of Tractors and Machineries**

1. Testing and evaluation of manual weeder
2. Testing and evaluation of MB plough
3. Testing and evaluation of disc plough
4. Testing and evaluation of disc harrow
5. Testing and evaluation of cultivator
6. Testing and evaluation of manual transplanter
7. Testing and evaluation of manual and power thresher
8. Testing and evaluation of reaper
9. Testing and evaluation of decorticator

**Suggested readings**

1. B. Roy, R. A. Kepner & E. L. Berger. Principle of Farm Machinery. John Wiley & Sons.
2. H. P. Smith and Pearson. Farm Machinery and Equipment. McGraw Hill
3. Richey. Handbook of Agricultural Engineering.
4. C. P. Nakra. Farm Machines and Equipment.
5. Radhey Lal and A. C. Dutta. Agricultural Engineering through Solved Examples.