COMMUNICATION ENGLISH
SH 601

Lecture : 3 Year : III
Tutorial : 1 Part : I
Practical : 2

Course Objective:

- To make the students capable of producing professional writings such as research articles, technical proposals, reports and project work.
- To familiarize the students with the native speakers' pronunciation with the use of audio-visual aids.

Unit I: Reading **(15 hours)**

1. **Intensive Reading** **[8 hours]**
   - 1.1. Comprehension
   - 1.2. Note-taking
   - 1.3. Summary writing
   - 1.4. Contextual questions based on facts and imagination
   - 1.5. Interpreting text
2. **Extensive Reading** **[5 hours]**
   - 2.1. Title/Topic Speculation
   - 2.2. Finding theme
   - 2.3. Sketching character
3. **Contextual Grammar** **[2 hours]**
   - 3.1. Sequence of tense
   - 3.2. Voice
   - 3.3. Subject-Verb agreement
   - 3.4. Conditional Sentences
   - 3.5. Preposition

Unit II: Writing **(30 hours)**

1. **Introduction to technical writing process** **[2 hours]**
   - 1.1. Composing and editing strategies
   - 1.2. MLA and APA comparison
2. **Writing notices with agenda and minutes** **[2 hours]**
   - 2.1. Introduction
   - 2.2. Purpose
   - 2.3. Process
3. **Writing Proposal** **[6 hours]**
   - 3.1. Introduction
   - 3.2. Parts of the proposal
     - 3.2.1. Title page
     - 3.2.2. Abstract/Summary
     - 3.2.3. Statement of Problem
     - 3.2.4. Rationale
     - 3.2.5. Objectives
     - 3.2.6. Procedure/Methodology
     - 3.2.7. Cost estimate or Budget
     - 3.2.8. Time management/Schedule
     - 3.2.9. Summary
     - 3.2.10. Conclusion
     - 3.2.11. Evaluation or follow-up
     - 3.2.12. Works cited
4. **Reports**
   - 4.1. Informal Reports **[6 hours]**
     - 4.1.1. Memo Report
       - 4.1.1.1. Introduction
       - 4.1.1.2. Parts
     - 4.1.2. Letter Report
       - 4.1.2.1. Introduction
       - 4.1.2.2. Parts
   - 4.2. Project/Field Report **[3 hours]**
     - 4.2.1. Introduction
     - 4.2.2. Parts
   - 4.3. Formal report **[9 hours]**
     - 4.3.1. Introduction
     - 4.3.2. Types of Formal Reports
       - 4.3.2.1. Progress Report
       - 4.3.2.2. Feasibility Report
       - 4.3.2.3. Empirical/ Research Report
       - 4.3.2.4. Technical Report
     - 4.3.3. Parts and Components of Formal Report
       - 4.3.3.1. Preliminary section
         - 4.3.3.1.1. Cover page
         - 4.3.3.1.2. Letter of transmittal/Preface
         - 4.3.3.1.3. Title page
         - 4.3.3.1.4. Acknowledgements
         - 4.3.3.1.5. Table of Contents
         - 4.3.3.1.6. List of figures and tables

4.3.3.1.7. Abstract/Executive summary
4.3.3.2. Main Section
4.3.3.2.1. Introduction
4.3.3.2.2. Discussion/Body
4.3.3.2.3. Summary/Conclusion
4.3.3.2.4. Recommendations
4.3.3.3. Documentation
4.3.3.3.1. Notes (Contextual/foot notes)
4.3.3.3.2. Bibliography
4.3.3.3.3. Appendix

5. Writing Research Articles [2 hours]

5.1. Introduction
5.2. Procedures

References

1. *Adhikari, Usha : Yadv, Rajkumar : Shrestha, Rup Narayan ; (2000)* Communicative Skills in english,Research Training Unit, IOE, Pulchowk Campus
2. Khanal, Ramnath, (2008) Need-based Language Teaching (Analysis in Relation to Teaching of English for Profession Oriented Learners) Kathmandu : D, Khanal.
3. Konar, Nira (2010), Communication Skills for Professional PHI Learning Private Limited, New Delhi.
4. Kumar, Ranjit (2006), Research Methodology, Pearson Education.
5. Laxminarayan, K.R (2001), English for Technical Communication. Chennai; Scitech publications (India) Pvt. Ltd.
6. Mishra, Sunita et. al. (2004), Communication Skills for Engineers, Pearson Education First Indian print.
7. Prasad, P. et. al (2007), The functional Aspects of Communication Skills S.K. Kataria & sons.
8. Rutherfoord, Andrea J. Ph.D (2001), Basic Communication Skills for Technology, Pearson Education Asia.
9. Rizvi, M. Ashraf (2008), Effective Technical Communication. Tata Mc Graw Hill.
10. Reinking A James et. al (1999), Strategies for Successful Writing: A rhetoric, research guide, reader and handbook, Prentice Hall Upper Saddle River, New Jersey.
11. Sharma R.C. et al. (2009), Business Correspondence and Report Writing: A Practical Approach to Business and Technical communication. Tata Mc Graw Hill.
12. Sharma, Sangeeta et. al (2010) Communication skills for Engineers and Scientists, PHI Learning Private Limited, New Delhi.
13. Taylor, Shirley et. al. (2009), Model Business letters, E-mails & other Business documents, Pearson Education.

Language lab		30 hours
Listening		12 hours
Activity I	General instruction on effective listening, factors influencing listening, and note-taking to ensure ttention. (Equipment Required: Laptop, multimedia, laser pointer, overhead projector, power point, DVD, video set, screen)	2 hours
Activity II :	Listening to recorded authentic instruction followed by exercises. (Equipment Required: Cassette player or laptop)	2 hours
Activity III	Listening to recorded authentic description followed by exercises. (Equipment Required: Cassette player or laptop)	4 hours
Activity IV	Listening to recorded authentic conversation followed by exercises (Equipment Required: Cassette player or laptop)	4 hours
Speaking		18 hours
Activity I	General instruction on effective speaking ensuring audience's attention, comprehension and efficient use of Audio-visual aids. (Equipment Required: Laptop, multimedia, laser pointer, DVD, video, overhead projector, power point, screen)	2 hours
Activity II	Making students express their individual views on the assigned topics (Equipment Required: Microphone, movie camera)	2 hours
Activity III	Getting students to participate in group discussion on the assigned topics	4 hours
Activity IV	Making students deliver talk either individually or in group on the assigned topics (Equipment Required: Overhead projector, microphone, power point, laser pointer multimedia, video camera, screen)	8 hours
Activity V	Getting students to present their brief oral reports individually on the topics of their choice. (Equipment Required: Overhead projector, microphone, power point, laser pointer multimedia, video camera, screen)	2 hours

Evaluation Scheme:

The questions will cover all the chapters of the syllabus. The evaluation scheme will be as indicated in the table below

Unit	Testing Items	Number of Questions	Marks Distribution*
I	Reading Passages	3	15
	Novel	1	5
	Novel	1	5
	Grammar	10 or 5	5
II	Composing & Editing strategies	1	5
	MLA and APA Comparison	1	4
	Writing Research Articles	1	10
	Writing notice, Agenda and minutes	1	5
	Writing Proposal	1	8
	I Writing Reports (Formal Report)	1	10
	II Writing short reports or Project Report	1	8
		Total	80

Language Lab

Title	Testing Items	Number of Questions	Marks Distribution*
Language Lab	Listening - Instruction - Description - Conversation	3	10
	Speaking - Expressing Individual views - Group/Round Table discussion - Talk delivery - Presenting brief oral report	3	15

- There may be minor Variation in marks distribution.

➢ The questions setting should be in the multiplication of either 8 or 10.

PROBABILITY AND STATISTICS
SH 602

Lecture : 3 Year : III
Tutorial : 1 Part : I
Practical : 0

Course Objective:
To provide the students with practical knowledge of the principles and concept of probability and statistics and their applications in engineering field.

1. Descriptive Statistics and Basic Probability **[6 hours]**
   1.1. Introductions in statistics and its importance in engineering
   1.2. Describing data with graphs (bar, pie, line diagram, box plot)
   1.3. Describing data with numerical measure (measuring center, measuring variability)
   1.4. Basic probability additive law, multiplic active law, Baye's theorem
2. Discrete Probability Distributions **[6 hours]**
   2.1. Binomial probability distributions
   2.2. Negative binomial distribution
   2.3. Poison distribution
   2.4. Hyper geometric distributions
3. Continuous Probability Distributions **[6 hours]**
   3.1. Continuous random variable and probability densities
   3.2. Normal distribution
   3.3. Gama distribution
   3.4. Chi-square distribution
4. Sampling Distribution **[5 hours]**
   4.1. Population and sample
   4.2. Central limit theorems
   4.3. Sampling distribution of sampling proportion
   4.4. Sampling distributing of sampling proportion
5. Correlation and regression **[6 hours]**
   5.1. Least square methods
   5.2. An analysis of variance of linear regression model
   5.3. Inferences concerning least square method
   5.4. Multiple correlation and regression
6. Inference concerning mean **[6 hours]**
   6.1. Point estimation and interval estimation
   6.2. Test of hypothesis
   6.3. Hypothesis test concerning one mean
   6.4. Hypothesis test concerning two mean
   6.5. One way ANOVA
7. Inference concerning proportion **[6 hours]**
   7.1. Estimation of proportions
   7.2. Hypotheses concerning one proportion
   7.3. Hypotheses concerning two proportions
   7.4. Chi-square test of independence
8. Application of computer on statistical data computing **[4 hours]**
   8.1. Application of computer in computing statistical problem e.g. scientific
   8.2. Calculator, EXCEL, SPSS, Matlab, etc.

References:

1. Richard A. Johnson, "Probability and statistics for engineers 7th edition, Miller and Freund's publication
2. Jay L devorce, probability and statistics for engineering and the sciences, brooks/ Cole publishing company, Monterey, California, 1982.
3. Richard. Levin, David s Rubin, statistics for management. Prentice hall publication
4. Mendenhall beaver, introduction probability and statistics 12th edition, Thomson brooks/Cole

Evaluation scheme:
The questions will cover the entire chapter of the syllabus. The evaluation scheme will be as indicated in the table below:

Chapter	Teaching hour	Marks distribution*
1	6	12
2	6	10
3	6	10
4	6	10
5	6	10
6	6	10
7	6	10
8	4	8
Total	**45**	**80**

* There may be mirror deviation in marks distribution.

- The questions setting should be in the multiplication of either 8 or 10.

HYDROLOGY AND AGRICULTURAL METEOROLOGY
AE 603

Lecture : 3 Year : III
Tutorial : 0 Part : I
Practical : 2

Course Objective:
The objective of this course is to give the students an understanding of the complex interactions between the waters of the land and atmosphere, the science of hydrology, and the role that hydrology plays in agricultural and urban system.

1. Introduction to Hydrology and Hydrologic Cycle [2 hours]
- 1.1. Hydrology as Science of Water
- 1.2. Scope and Application to Agricultural Engineering
- 1.3. Hydrolological Cycle and its Components
- 1.4. Hydro-meteorological Development in Nepal

2. Agricultural Meteorology [6 hours]
- 2.1. Definition and its importance in Agricultural Engineering
- 2.2. Use of meteorological information in agricultural planning and management
- 2.3. Agro-climatic factors affecting agriculture - radiation, temperature, vapor pressure and wing measuring instruments
- 2.4. Energy balance at the surface and at different crop canopies
- 2.5. Evaporation and evapotranspiration

3. Precipitation [6 hours]
- 3.1. Causes, Occurrence and Forms of Precipitation
- 3.2. Rainfall Measurement
- 3.3. Presentation of Rainfall Data
- 3.4. Test of Consistency of Rainfall Records
- 3.5. Network Design
- 3.6. Estimation of Missing Rainfall Data
- 3.7. Areal Averaging of Rainfall
- 3.8. Intensity-Duration – Frequency Analysis
- 3.9. Depth-Area-Duration Curve
- 3.10. Spatial and Temporal Variability of Rainfall in Nepal

4. Infiltration and Percolation [3 hours]
- 4.1. Mechanics of Infiltration and Percolation
- 4.2. Factors Affecting Infiltration and Percolation
- 4.3. Infiltration, Infiltration Capacity
- 4.4. Infiltration Indices
- 4.5. Measurement of Infiltration and Percolation Rates
- 4.6. Horton's Equation

5. Evaporation and evapotranspiration [5 hours]
- 5.1. Mechanics of Evaporation and Evapotranspiration
- 5.2. Potential and Actual Evapotranspiration
- 5.3. Factors Affecting Evaporation and Evapotranspiration
- 5.4. Estimation of Evaporation and Evapotranspiration by experimental field measurement and by climatic approach including Penman's Equation

6. Runoff and Stream Flow [5 hours]
- 6.1. Definition and Components of Runoff
- 6.2. Factors Affecting Runoff
- 6.3. Estimation of Runoff
- 6.4. Rainfall- Runoff Relationship
- 6.5. Stream Gauging: types and site selection
- 6.6. Rating Curves
- 6.7. Stream Flow Measurement using direct and indirect methods
- 6.8. Use and Calibration of Current Meter

7. Hydrograph Analysis [7 hours]
- 7.1. Hydrograph: concept and components
- 7.2. Development and use of stream flow hydrograph
- 7.3. Unit hydrograph: assumptions, limitation and uses
- 7.4. Derivation of unit hydrograph
- 7.5. Derivation of runoff hydrograph using effective rainfall hyetograph
- 7.6. Synthetic unit hydrograph, instantaneous unit hydrograph and dimensionless unit hydrograph

8. Statistics and Probabilities in Hydrology [6 hours]
- 8.1. Frequency and Probability Concepts-plotting position formulae
- 8.2. Frequency Analysis and Recurrence Interval
- 8.3. Frequency Distribution Functions and their Application: normal, log-normal, gumbel distribution, log Pearson type-III
- 8.4. Selection of Distribution Type
- 8.5. Confidence Limits

8.6. Risk, Reliability and Safety Factor

9. Hydrology of Floods [5 hours]]

9.1. Definition, causes and effects of floods
9.2. Estimation of floods peaks for gauged and ungauged catchments
9.3. Flood prediction and design floods
9.4. Flood routing, hydrologic routing
9.5. Flood control measures

Practical:

S.N.	Practical	Periods
1	Areal Averaging of Rainfall by Different Methods	2
2	Problems Related to Estimation of Missing Precipitation Data	2
3	Problems Related to Mass Curve Analysis	2
4	Problems Related to Intensity-Duration Analysis and Preparation of Intensity-Duration Curves	2
5	Problems related to DAD curves	2
6	Frequency Analysis of Rainfall and Determination of Return Period	3
7	Measurement of Infiltration and Percolation Rates by Double Ring infiltrometer and Determination of Infiltration Indices	2
8	Estimation of Runoff Using Empirical Methods	3
9	Estimation of runoff using empirical methods	2
10	Hydrograph Analysis and Derivation of Unit Hydrograph	3
11	Use of Current Meter for the Determination of Flow Velocity	2
12	Stream Flow Measurement by Float Method	2
	Total	27

One day visit to nearby weather station and report writing

References:

1. Hydrology for Engineers by R. K. Linsley, M. A. Kohler and J. L. H. pulhus. McGraw Hill International Book Company.
2. Applied Hydrology by V. T. Chow, D. R. Midment and L.W. Mays. McGraw-Hill International Edition.
3. Engineering Hydrology by K. Subramanya. Tata McGraw-Hill Publishing Company Ltd., New Delhi.
4. Engineering Hydrology by R. S. Varshney. Nem Chand & Bros. Roorkee.
5. Practical Agricultural Engineering (Vol. I & II) by R. K. Ghosh and S. Swain. Naya Prakashan, Calcutta.

Evaluation Scheme:

The questions will cover the entire chapter of the syllabus. The evaluation scheme will be as indicated in the table below:

Chapter	Period	Marks Distribution*
1	2	05
2	6	10
3	6	10
4	3	05
5	5	10
6	5	10
7	7	12
8	6	10
9	5	08
Total	45	80

*There may be minor variation in marks distribution.

- The questions setting should be in the multiplication of either 8 or 10.

TRACTOR SYSTEMS AND CONTROL
AE 601

Lecture : 3 Year : III
Tutorial : 1 Part : I
Practical : 2

Course Objective:

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

- Understand tractor developing patterns and principles.
- Apply appropriate engineering principles, concepts, theories, definitions, laws, models and patterns to understand and present tractor control systems in a clear and logical form.
- Apply knowledge and understanding of power transmission and control in familiar and unfamiliar situations of tractor application.
- Analyze the result of experiments accurately and clearly, draw conclusion and make generalization from experiment, and
- Appreciate the scientific, social, economic, environmental and technological contributions and applications of tractor.

1. Tractor as Source of Mechanical Farm Power [3 hours]
- 1.1. History of Development of Tractors
- 1.2. Classification of Tractors
- 1.3. Essential Features of Farm Tractors
- 1.4. Ranges and Availability in the Country
- 1.5. Tractor Selection Criteria

2. Systems and Controls in Farm Tractors

2.1 Types of Power Transmission [3 hours]
- 2.1.1 Two and Four Wheeled Drive
- 2.1.2 Hydrostatic and Hydrodynamic Drives
- 2.2.3 Design Principles for Power Transmission

2.2 Clutch System [2 hours]
- 2.2.1 Purpose and Types
- 2.2.2 Principle of operation
- 2.2.3 Functional Requirements
- 2.2.4 Design Parameters and Procedure

2.3 Gear Box [3 hours]
- 2.3.1 Purpose and Types
- 2.3.2 Principle of Operation
- 2.3.3 Functional Requirements
- 2.3.4 Design Parameters and Procedure

2.4 Differential and Final Drive [2 hours]
- 2.4.1 Purpose and Types
- 2.4.2 Principle of Operation
- 2.4.3 Functional Requirements
- 2.4.4 Design Parameters and Procedure

2.5 Steering System [2 hours]
- 2.5.1 Purpose and Types
- 2.5.2 Principle of Operation
- 2.5.3 Components Involved in Mechanical Steering
- 2.5.4 Functional Requirements
- 2.5.5 Adjustments: Camber, Caster, Toe-in, Toe-out, Kingpin Inclination, Tie-Rod Locking
- 2.5.6 Design Parameters and Procedure in Reference to Mechanical Steering

2.6 Brake System [2 hours]
- 2.6.1 Purpose and Types
- 2.6.2 Principle of Operation
- 2.6.3 Functional Requirements
- 2.6.4 Design Parameters and Procedures

2.7 Hydraulic System [3 hours]
- 2.7.1 Purpose and Types
- 2.7.2 Hydraulic Circuit Symbols
- 2.7.3 Principle of Operation
- 2.7.4 Functional Requirements
- 2.7.5 Design Parameters and Procedures (Pump, Motor and Cylinder)
- 2.7.6 Automatic Position and Draft Controls

2.8 Auxiliary Power Transmission and Power Outlets [2 hours]
- 2.8.1 P.T.O. System
- 2.8.2 Belt, Pulley and Drawbar - functional requirements and design parameters
- 2.8.3 Special Power Drives for Front and Side Mounted Implements

3. Traction and Traction Theory [4 hours]
- 3.1 Mechanics of a Rigid Wheel (Traction and Towed)
- 3.2 Construction of Tractor Tyre
- 3.3 Inflation Pressure
- 3.4 Theoretical Soil Thrust on Traction Device

3.5 Rolling Resistance and Travel Reduction
3.6 Coefficient of Traction and Tractive Efficiency
3.7 Tractive Effort, Rim Pull, Drawbar Pull
3.8 Traction Parameters and Design of Traction Device
3.9 Traction Aids and Wheel Ballasting - types and selection criteria
3.10 Soil Compaction in Tillage and Traction

4. Mechanics of Tractor Chassis [4 hours]
4.1 Static and Dynamic Forces Acting on Tractor Chassis
4.2 Location of Center of Gravity and Moment of Inertia
4.3 Static Equilibrium Analysis
4.5 Analysis for Maximum Achievable Drawbar Pull
4.6 Longitudinal Stability and Stability at Turns

5. Tractor Hitching [3 hours]
5.1 Terminology Used in Tractor Hitching
5.2 Types: Single Axis Hitching, Two-Axes Hitching, Automatic Hitching
5.3 Weight Transfer and Stability
5.4 Break-away Principle and Other Safety Devices

6. Power Tiller [4 hours]
6.1 Purpose and Types
6.2 Range and Availability
6.3 Control Systems of Power Tillers

7. Ergonomic Principles in Tractor Design [3 hours]
7.1 Human Factors in Tractor Design
7.2 Human Tolerance to Temperature, Noise and Vibration
7.3 Design of Operators' Seat, Controls and Control Panel

8. Tractor Testing [3 hours]
8.1 Introduction and Purpose
8.2 Tractor Test Codes
8.4 Engine and Drawbar Performance at Full and Part Load
8.5 Performance Data of Major Makes and Models of Tractors Used in Nepal

9. Economics of Tractor Use [2 hours]

Practical
1. Dissembling and Assembling of Clutch System, Components Involved and Maintenance Operation (One practical)
2. Dissembling and Assembling of Gear Box, Components Involved and Maintenance Operation (One practical)
3. Dissembling and Assembling of Differential and Final Drive, Components Involved and Maintenance Operation (Two practical)
4. Dissembling and Assembling of Steering System, Components Involved and Adjustments of Camber, Caster, Toe-in and Toe-out (Two practical)
5. Dissembling and Assembling of Brake System, Components Involved and Maintenance Operation (One practical)
6. Dissembling and Assembling of Hydraulic System, Components Involved and Maintenance Operation (One practical)
7. Study on Wheel Parameters and Ballasting in Farm Tractors (One practical)
8. Hitching of Mounted, Semi-Mounted and Trailed Type Farm Implements and Stability Analysis (Two practical)
9. Study on Control Systems of Power Tillers (One practical)

Tutorials
Tutorial classes shall be devoted to design problem solving on:
a) Gear Box
b) Differential and Final Drive
c) Steering System
d) Brake System
e) Hydraulic System
f) Hitch System

References:

1. Tractors and their Power Units by J. B. Liljedahl, W. M. Carleton, P. K. Turnquist and D. W. Smith. John Wiley & Sons, New York
2. Goering, Carroll E. and Alan C. Hansen. 2004. Engine and Tractor Power, 4th edition, ASABE, St. Joseph, Michigan, USA.
3. Test Codes of Bureau of Indian Standards, New Delhi for Agricultural Implements, I.C. Engines and Tractors.
4. Soil Dynamics in Tillage and traction (US Hand Book) by Gill and Vandenberg.
5. Power Hydraulics by Michael J. Pinches and John G. Ashby. Prentice Hall International (U. K.) Ltd.
6. Tractors and Crawlers by Irving Frazee and V.E. Philip.
7. Design of Automotive Engines by Kolchin and Demidov.

Evaluation Scheme

The questions will cover all the chapters in the syllabus. The evaluation for the final theory examination is indicated as follows:

Chapter	Hours	Marks Distribution*
1	3	10
2.1	3	
2.2	2	10
2.3	3	
2.4	2	10
2.5	2	
2.6	2	
2.7	3	10
2.8	2	
3	4	20
4	4	
5	3	
6	4	10
7	3	
8	3	10
9	2	
Total	**45 Hours**	**80**

* There may be minor deviation in marks distribution.

- The questions setting should be in the multiplication of either 8 or 10.

ENGINEERING PROPERTIES OF BIO-MATERIALS
AE 602

Lectures : 2 Year : III
Tutorials : 0 Part : I
Practical : 2

Course objective:

- To acquaint and equip the students with different techniques of measurement of engineering properties and their importance in the design of processing and material handling equipments.
- To acquaint and equip the students with the latest standards to maintain food quality as well as to study Hazard Analysis Critical Control Point (HACCP) protocol.

1. **Importance of Engineering Properties of Bio-materials [2 Hours]**
   1.1. Physical Properties, Mechanical Properties, Optical Properties
   1.2. Use of Engineering Properties in Processing Equipment Design

2. **Geometrical Properties [4 Hours]**
   2.1. Shape, Size, Volume, Sphericity, Roundness
   2.2. Importance and Measurement of Geometrical Properties
   2.3. Characterization of Shape and Size of Irregular Shaped Materials

3. **Gravimetric Properties [3 Hours]**
   3.1. Bulk Density, True density, Specific Gravity, Porosity
   3.2. Importance and Measurement of Gravimetric Properties

4. **Optical Properties [2 Hours]**
   4.1. Colour, Gloss, Hue
   4.2. Importance of Optical Properties and their Measurement

5. **Electrical Properties [3 Hours]**
   5.1. Dielectric Constant, Dielectric Loss Tangent, Electrical Conductivity
   5.2. Importance of Electrical Properties and their Measurement

6. **Thermal Properties [3 Hours]**
   6.1. Thermal Conductivity, Thermal Diffusivity
   6.2. Specific Heat, Heat of Respiration
   6.3. Importance of Thermal Properties and their Measurement

7. **Aerodynamic Properties [3 Hours]**
   7.1. Aerodynamic behaviour of Grains and their byproducts
   7.2. Terminal Velocity, Drag Coefficient
   7.3. Importance of Aerodynamic Properties and their Measurement

8. **Rheological Properties [5 Hours]**
   8.1. Properties of Solid and Liquid Foods
   8.2. Properties of Granular and Powder Foods
   8.3. Properties of Suspension and Concentrated Products
   8.4. Properties of Visco-elastic Materials
   8.5. Stress-Strain Behaviour
   8.6. Flow Behaviour of Food Materials
   8.7. Angle of Ripose
   8.8. Coefficient of Internal and External Friction
   8.9. Pressure Distribution in Granular Materials

9. **Quality control [5 Hours]**
   9.1. Concept, objectives and need of quality
   9.2. Quality control, methods of quality control
   9.3. Sampling: purpose, sampling techniques
   9.4. Sensory & statistical quality control
   9.5. TQM and TQC
   9.6. Food grades and standards BIS, AGMARK, PFA, FPO, CAC
   9.7. (Codex Alimantarious Commission)
   9.8. Sanitation in food industry, GMP, HACCP and ISO 9000 Series

Practical

S. N.	Name of the experiment	Hours
1	Determination of shape and size of Grains, fruits and vegetables	2
2	Determination of Particle density/True density, Bulk Density porosity and Specific Gravity of Food Grains	2
3	Determination of Angle of Ripose and Coefficient of Internal and External Friction for Food Grains	2
4	To study the separation behaviour of a grain sample in a vertical wind tunnel (Aspirator column)	2
5	Determination of Stress-Strain Behaviour of Different Food Grains	2
6	Determination of Thermal Conductivity of Different Food Grains	2
7	Determination of Thermal Diffusivity of Different Food Grains	2
8	Determination of Specific Heat of Food Grains	2
9	Determination of Electrical Conductivity of Liquid Food Materials	2

10	Detection of adulteration in food products viz. milk, ghee, honey etc.	2
	Total	20

Reference:

1. Mohesenin N.N. 1980. *Physical Properties of Plant and Animal Materials*. Gordon & Breach Science Publ.
2. Mohesenin NN. 1980. *Thermal Properties of Foods and Agricultural Materials*. Gordon & Breach Science Publ.
3. Peleg M & Bagelay EB. 1983. *Physical Properties of Foods*. AVI Publ. Co.
4. Rao M.A. & Rizvi S.S.H. (Eds.). 1986. *Engineering Properties of Foods*. Marcel Dekker.
5. Singhal OP & Samuel DVK. 2003. *Engineering Properties of Biological Materials*. Saroj Prakasan.
6. Hallstrom B, Meffert HF, Th Spesis WEL & Vos G. 1983. *Physical Properties of Food*. Elsevier.
7. Ronal Jowitt, Felix Escher, Bengt Hallsrram, Hans F, Th. Meffert, Walter EC Spices & Gilbert Vox. 1983. *Physical Properties of Foods*. Applied Science Publ.

Evaluation Scheme

The questions will cover all the chapters of the syllabus. The evaluation scheme will be as indicated in the table below

Chapter	**Hours**	**Marks Distribution***
1	2	8
2	4	
3	3	8
4	2	
5	3	4
6	3	4
7	3	4
8	5	12
9	5	
Total	**30**	**40**

*There may be minor variation in marks distribution

- The questions setting should be in the multiplication of either 8 or 10.

Theory and Design of Machine Elements
ME 603

Lecturer : 3 Year : III
Tutorial : 1 Part : I
Practical : 2

Course Objective:
After completion of this course, the students will be able to:

- Select proper mechanisms and analyze it for agricultural machines.
- Carry out simple design or modify the existing design for product development or repair and maintenance work.
- Know how the failure can take place on components of agricultural machines.
- Select the most appropriate machine elements by catalogue/data book references.

1. Mechanism [4 hours]
- 1.1 Introduction of mechanism
- 1.2 Mechanism configuration, Link, pair and chain
- 1.3 Degree of freedom of mechanism
- 1.4 Inversion of mechanism – single slider crank mechanism

2. Kinematic Analysis of Mechanism [8 hours]
- 2.1 General plane motion representation
- 2.2 Relative motion velocity analysis – Velocity polygons
- 2.3 Velocity of any point on the link or outside the link [offset point]
- 2.4 Velocity and angular velocity of different links
- 2.5 Velocity and angular velocity diagrams of quadratic cycle chain and slider crank mechanism
- 2.6 Velocity of rubbing at pin joints
- 2.7 Instantaneous centers of velocity and Kennedy's theorem
- 2.8 Instantaneous center method to find out velocity of any link on quadratic cycle chain
- 2.9 Acceleration diagrams of quadratic cycle chain and slider crank mechanism
- 2.10 Centripetal, tangential and coriolis components of acceleration of a link

3. Fundamentals of Machine Design [6 hours]
- 3.1 Introduction to engineering design and design process
- 3.2 Material properties and selection of material in m\ c design
- 3.3 Theories of failures
- 3.4 Endurance limit of materials
- 3.5 Factors affecting fatigue strength
- 3.6 Stress concentration effects
- 3.7 Fatigue failure curves
- 3.8 Factors of safety and basis for safety factor
- 3.9 Use of data hand book for safety factor, design codes [ISI and ISO codes]

4. Shaft, Axle, Keys and Shaft Couplings [5 hours]
- 4.1 Functions application, type and material
- 4.2 combined bending and torsion effects
- 4.3 Power and torque considerations
- 4.4 Fatigue strength stress concentration and keyways effect
- 4.5 Critical speed of shaft
- 4.6 Design of keys
- 4.7 Design of couplings

5. Journal Bearing [6 hours]
- 5.1 Types, application and material
- 5.2 Journal bearing terminology
- 5.3 Hydrodynamic theory of lubrication of rotating journal
- 5.4 Viscosity, petroff's law, bearing characteristic numbers
- 5.5 Operating pressure load and heat balance of bearing
- 5.6 Design procedure

6. Ball and Roller Bearing [5 hours]
- 6.1 Construction and types of ball bearing
- 6.2 Design for variable loads and axial load
- 6.3 Operating capacity of rolling element bearing
- 6.4 Bearing load, life and reliability relationship
- 6.5 Selection of bearings, lubrication, mounting and enclosure

7. Gears [6 hours]
- 7.1 Classification of gears and gear terminology
- 7.2 Gear tooth profiles – Cycloidal and Involute
- 7.3 Angle of obliquity
- 7.4 Causes of gear tooth failure
- 7.5 Design of spur gear considering static, dynamic and wear tooth load
- 7.6 Helical, Bevel and Worm gear characteristic requirements for design

8. Clutch and Brake [5 hours]
- 8.1 Purpose, Type, Working principle and application of clutch

8.2 Design steps for friction clutch – Multidisc and cone clutch
8.3 Design basis of uniform wear and uniform pressure assumption
8.4 Purpose, Type, Working principle and application of brake
8.5 Design procedure for block brake
8.6 Friction material and heat dissipation
8.7 Operation system and control system

Practical:

1. **Pro-active learning approach:** Each student will carry out a research project. S/he should write 4-8 pages summary on her/his topic and deliver it taking 10-15 minute time. The sample topic may be one of the following:
   a) Design for manufacturing
   b) Material selection for gear
   c) Design for assembly
   d) Optimal design
   e) Value engineering
   f) Patenting
   g) Bench marking
2. **Undertaking Design project:** One team of the student will be 2 to 3 in number and it will complete a design project of a product on:
   a) A gravel conveyor
   b) A garage door opener
   c) A lifting device
   d) A maze planter
   e) A sprinkler
   f) A mechanical jack to lift and lower the load
3. **Live field project:** Mechanical design related industrial problems as an assignment.

Tutorial:

1. Problem solving on related topics.
2. Old questions of TU examination will be the base for tutorial classes.
3. Number of numerical examples in each chapter should be solved in the classes according to the weight-age given for TU final examination.
4. Preference is to be given for applied type of questions that includes synthesis and analysis of real problem of machine design.

Evaluation Scheme:

The questions will cover all the chapters of the syllabus. The evaluation scheme will be as indicated in the table below

Chapter	Hours	Mark Distribution*
1	4	8
2	8	12
3	6	12
4	5	8
5	6	12
6	5	8
7	6	12
8	5	8
Total	45	80

*There may be minor variation in marks distribution.

References:

1. Theory of Machine and Mechanisms by J. E. Shigley and J. J. Uicker, Jr. McGraw Hill Publication, 1980.
2. Mechanisms and Dynamics of Machinery, Fourth Edition by H. H. Mabie and C. F. Reinholtz, Wiley Publication.

SOIL MECHANICS AND FOUNDATION ENGINEERING
CE 608

Lecture : 3 Year : III
Tutorial : 1 Part : I
Practical : 2

Course Objective:
After completion of this course, the students will be familiar about the fundamental properties, behaviour of soil under different load condition and environment around and nature of soil.

1. Introduction (2 hours)
- 1.1. Definition of soil and Rock
- 1.2. Importance of Soil Mechanics and soil Problems
- 1.3. Historical Development
- 1.4. Soil formation and Soil types

2. Physical and Index Properties of Soils (6 hours)
- 2.1. Phase Diagrams
- 2.2. Basic Definition of Phase relationship
- 2.3. volume weight relationships
- 2.4. Water Content Determination
- 2.5. Insitu Unit Weight Determination
- 2.6. Index Properties of Soil
- 2.7. soil Grained and Soil Aggregate Properties of Soil
- 2.8. Sieve Analysis and Sedimentation analysis
- 2.9. Relative Density and Atterberg's Limits

3. Soil Classification and Identification (3 hours)
- 3.1. Field identification of Fine and Coarse Grained Soil
- 3.2. Soil Classification as per
  - 3.2.1. Unified Soil Classification
  - 3.2.2. IS Classification
  - 3.2.3. MIT, US Bureau and International classification System
  - 3.2.4. Textural Classification System

4. Soil-Water Integration (4 hours)
- 4.1. Type of Soil Water
- 4.2. Flow of Water Through Soil Mass-Darcy's Law
- 4.3. Permeability of Soils
- 4.4. Permeability of Stratified Soil Deposits
- 4.5. Determination of Coefficient of Permeability of soil by Laboratory and Field Methods

5. Soil Compaction (3 hours)
- 5.1. Definition of Compaction
- 5.2. Factors Affecting compaction
- 5.3. Engineering Significance of Compaction
- 5.4. Moisture-Density Relationship and Degree of Compaction
- 5.5. Zero air Soil Line
- 5.6. Laboratory test
- 5.7. Field Compaction and Compaction Control

6. Principle of Effective Stress (5 hours)
- 6.1. Stress in subsoil
- 6.2. Effective Stress Principle / Physical meaning of Effective Stress
- 6.3. Computation of Effective Stress for the Static and Flow conditions
- 6.4. Capillarity in soils
- 6.5. Quick sand Condition and Remedial Measures
- 6.6. Seepage Pressure
- 6.7. Flow Nets and their application

7. Shear Strength of Soils (5 hours)
- 7.1. Concept of Shear Strength
- 7.2. Principle Planes and Principle Stresses
- 7.3. Mohr's Stress circle and Failure Envelope
- 7.4. Mohr-Coulomb theory of Shear Strength
- 7.5. Relation Between Principle Stresses at Failure
- 7.6. Critical Void ratio
- 7.7. Types of Shear Tests
- 7.8. Measurement of Shear Strength in Laboratory

8. Consolidation and Settlement (4 hours)
- 8.1. Difference between compaction and Consolidation
- 8.2. Type of Earth Pressure
- 8.3. Effect of Wall Movement on Earth Pressure
- 8.4. Tarzaghi's Piston Spring Analogy for Primary Consolidation
- 8.5. Consolidation Tests
- 8.6. Pressures-Void Relationship
- 8.7. Settlement Calculation

9. Earth Pressure (5 hours)
- 9.1. Introduction to Earth Pressure
- 9.2. Types of Earth Pressure

9.3. Effect of Wall Movement on Earth Pressure
9.4. Rankine's Earth Pressure Theory
9.5. Computation of Active and Passive Earth Pressure on Backfill by Rankine's Theory
9.6. Coulomb's Earth Pressure Theory
9.7. Stability Analysis on Earth Retaining Structures

10. Foundation (3 hours)

10.1. Definition and Types of Foundation
10.2. Types of Shallow and Deep Foundation
10.3. Functions of Foundation
10.4. Location and Depth of Foundation
10.5. Factors Affecting Types of foundation
10.6. Concept of Spread and Mat Foundation
10.7. Site Investigation for Foundation

11. Bearing Capacity and Settlement of Shallow Foundations (5 hours)

11.1. Basic Definition
11.2. Factors Affecting Bearing Capacity
11.3. Types of Shear Failures
11.4. Tarzaghi's General Bearing Capacity Theory
11.5. Ultimate Bearing Capacity in Cohesive and Cohesion less Soils
11.6. Foundation settlement
11.7. Insitu Test of Bearing Capacity

Tutorials

1. Numerical Problems on three phase diagrams of soils.
2. Numerical Problems on soil water and permeability of soils.
3. Numerical Problems on soil compaction
4. Numerical Problems on effective stress
5. Numerical Problems on shear strength of soils
6. Numerical Problems on Press void relationship and settlement due to primary consolidation of soils
7. Numerical Problems on earth pressure and stability analysis of retaining structure
8. Numerical problems on bearing capacity of soils.

Laboratories:

1. Determination of Water Content by oven drying method
2. Determination of Water Content by pycnometer method
3. Determination of specific gravity by pycnometer method
4. Determination of field density by core cutter methods
5. Determination of field density by sand replacement methods
6. Sieve analysis of coarse grained Soil
7. Hydrometer analysis of fine grained soil
8. Determination of liquid limit and plastic limit of fine grained soil
9. Determination of coefficient of permeability by constant head and variable head permeameter test method
10. Proctor compaction test of soil
11. Unconfined compression test of soil
12. Direct shear test of soil

References:

1. Basic and Applied Soil Mechanics by Gopal Rajan; New Age International (P) Limited
2. Soil Mechanics and Foundation Engineering by b.C. Punmia. Laxmi Publications Pvt. Ltd.
3. A Textbook of soil Mechanics and Foundation Engineering by V.N.S Murthy. UBS Publishers and Distributors.
4. Soil Mechanics and Foundation 'Engineering by K.R. Arora. Standard Book House, New Delhi.

Evaluation Scheme:

The questions will cover all the chapters of the syllabus. The evaluation scheme will be as indicated in the table below

Chapter	Hours	Mark Distribution*
1	2	16
2	6	
3	3	16
4	4	
5	3	
6	5	8
7	5	8
8	4	8
9	5	8
10	3	16
11	5	
Total	**45**	**80**

* There could be a minor deviation in the marks distribution

➢ The questions setting should be in the multiplication of either 8 or 10.

SURVEY CAMP

CE 609

Lecture: 0
Tutorial: 0

Year : III
Part : I

Practical: 10 days

Course Objective:

The survey camp is scheduled after the completion of second year second part theory exam. It has following objective for 10 days incentive field work:

(a) To provide the students real field based exposure to learn and apply different surveying methods in:
   (i) Mapping detailed land features
   (ii) Mapping and describing topographical variations
   (iii) Planning irrigation, drainage, land farming, soil conservation and watershed management works
(b) To accomplish a project based surveying task focusing on:
   (i) Detailed survey of irrigation command area
   (ii) Detailed survey of main canal alignment and headwork
   (iii) L–section and cross section of Rural Roads
   (iv) Soil conservation and farm leveling works e.g.-gully control, stream bank control, terracing, bunding, check dams.

Requirements:

Students in each camp group should not be more than 4 (four). For conducting camp as far as possible modern surveying equipments such as Total Station, EDM, Digital level etc are to be used.

Implementation of the Survey Camp:

Field work will be conducted in between second and third year; and its evaluation will be submitted on third year part A based on third year part A based on field/project work produced by the students & viva-voce conducted at the end of the field work.

Survey Camp shall be implemented jointly by Department of Civil and Agricultural Engineering. The camp site should be objective oriented so that students could gain ample opportunity to learn, consolidate and update their practical and theoretical knowledge in Agricultural Engineering field.

Evaluation scheme:

50 marks–Internal Assignment i.e. field work and viva-voce, and 50 marks, from field report and viva voce.

POST HARVEST ENGINEERING
AE 653

Lectures : 3 Year : III
Tutorials : 0 Part : II
Practical : 2

Course Objective:

- To acquaint and equip the students with different unit operations of food process industries.
- To acquaint and equip the students with the post harvest technology of cereals, pulses and oilseeds with special emphasis on their equipments.

1. **Food Processing:** [**6 Hours]**
   - 1.1. Scope and importance of food processing
   - 1.2. Principles and methods of food processing
   - 1.3. Processing of farm crops: Cereals, pulses, oil seeds etc.
   - 1.4. Fruits and vegetables and their products for food and feed
   - 1.5. Processing of animal products

2. Size Reduction: [5 Hours]
   - 2.1. Principle of size reduction,
   - 2.2. Grain shape
   - 2.3. Size reduction machines:
   - 2.4. crushers, grinders, cutting machines, etc.
   - 2.5. Milling: modern rice milling; huller, Sheller, polisher
   - 2.6. Flour milling: steam conditioning
   - 2.7. Operation, efficiency and power requirement
   - 2.8. Rittinger's, Kick's and Bond's equation,

3. Mixing: [5 Hours]
   - 3.1. Theory of mixing (solid and liquid)
   - 3.2. Types of mixtures for dry and paste materials,
   - 3.3. Rate of mixing and power requirement,
   - 3.4. Mixing indices, its importance and applications

4. Separation: [5 Hours]
   - 4.1. Theory of separation
   - 4.2. Mechanical, Electrostatic and Pneumatic separation
   - 4.3. Types of separators
   - 4.4. Sieve analysis: Actual and Ideal screens
   - 4.5. Capacity and effectiveness of screens
   - 4.6. Fineness modulus

5. Filtration: [4 Hours]
   - 5.1. Theory of filtration
   - 5.2. Types of filters (batch and continuous)
   - 5.3. Constant pressure and constant rate filtration
   - 5.4. Rate of filtration
   - 5.5. Pressure drop during filtration.

6. Material Handling: [8 Hours]
   - 6.1. Scope & importance of material handling devices
   - 6.2. Different types of material handling systems;
   - 6.3. Belt, Chain and Screw conveyor
   - 6.4. Bucket elevator, trajectory of particles
   - 6.5. Pneumatic conveying mechanism
   - 6.6. Design considerations of various material handling devices,
   - 6.7. Capacity and power requirement.

7. Moisture Content: [4 Hours]
   - 7.1. Importance and applications moisture in processing
   - 7.2. Types of moisture in food
   - 7.3. Methods for determination
   - 7.4. Importance and applications of EMC
   - 7.5. Methods of its determination
   - 7.6. EMC curve and EMC model, water activity

8. Drying & Storage: [8 Hours]
   - 8.1. Theory of drying
   - 8.2. Mechanism of thin layer drying
   - 8.3. Critical moisture contents, falling rate and constant rate periods
   - 8.4. Deep bed drying and their analysis
   - 8.5. Shred's and Hukill's curve, Drying models
   - 8.6. Methods of drying grain drying,
   - 8.7. Types of dryers, Performance and energy utilization pattern
   - 8.8. Types and causes of spoilage in storage
   - 8.9. Control of temperature and Rh inside storage
   - 8.10. Modified and Controlled atmospheric storage and control of its environment,
   - 8.11. Moisture and temperature changes in stored grains;

8.12. Grain storage structures: Bukhari, Morai, Kothar, silo, bins, warehouses etc.

8.13. Economic, aspects of storage

Practical:

S N	Name of the experiment	Hours
1	Preparation of flow and layout charts of a food processing plant	2
2	Determination of fineness modulus and uniformity index	2
3	Performance evaluation of hammer mill	3
4	Performance evaluation of attrition mill	3
5	Study of cleaning equipments	2
6	Separation behaviour in pneumatic separation	2
7	Mixing index and study of mixers	2
8	Study of conveying equipments	2
9	Performance evaluation of bucket elevator	3
10	Drying characteristic and determination of drying constant	3
11	Determination of EMC and ERH	2
	Total	26

Reference:

1. Sahay KM & Singh KK. 1994. *Unit Operation of Agricultural Processing*. Vikas Publ. House.
2. Brennan JG, Butters JR, Cowell ND & Lilly AEI. 1990. *Food Engineering Operations*. Elsevier.
3. Earle R.L. 1985. *Unit Operations in Food Processing*. Pergamon Press.
4. Fellows P. 1988. *Food Processing Technology: Principle and Practice*. VCH Publ.
5. McCabe WL & Smith JC. 1999. *Unit Operations of Chemical Engineering*. McGraw Hill.
6. Geankoplis J Christie. 1999. *Transport Process and Unit Operations*. Allyn & Bacon.

Evaluation Scheme

The questions will cover all the chapters of the syllabus. The evaluation scheme will be as indicated in the table below

Chapter	Hours	Marks Distribution*
1	6	16
2	5	
3	5	8
4	5	8
5	4	8
6	8	16
7	4	8
8	8	16
Total	**45**	**80**

*There may be minor variation in marks distribution.

- The questions setting should be in the multiplication of either 8 or 10.

FARM STRUCTURES AND BUILDING TECHNOLOGY
AE 654

Lectures : 3 Year : III
Tutorial : 2 Part : II
Practical : 2

Course Objective:
After completion of this course the students will be able to:
1. Understand the functional requirement and planning of farmstead
2. Carryout design and modification of existing design of cattle housing and agricultural structures

Part – A BUILDING TECHNOLOGY

1. Foundation: [2 hours]
   - 1.1. Function and types of foundation
   - 1.2. Components of foundation
   - 1.3. Simple spread footing foundations
   - 1.4. Common problem with foundations
2. Brick and stone masonry: [4 hours]
   - 2.1. Brick masonry
     - 2.1.1. Brick laying and bonding
     - 2.1.2. Causes of failure of bonding
     - 2.1.3. Damp proofing
     - 2.1.4. Reinforced brick work
     - 2.1.5. Thickness of wall
     - 2.1.6. Load bearing and non load bearing wall
     - 2.1.7. Maintenance of Brick masonry
   - 2.2. Stone masonry
     - 2.2.1. Types of stone masonry – Rubble and Ashler
     - 2.2.2. General principles of stone masonry
     - 2.2.3. Dry stone masonry
     - 2.2.4. Maintenance of stone masonry
   - 2.3. Hollow block masonry
     - 2.3.1. Laying of hollow concrete blocks
     - 2.3.2. General structural considerations
   - 2.4. Partition and cavity wall
     - 2.4.1. Partition wall
     - 2.4.2. Cavity wall
3. Damp prevention [2 hours]
   - 3.1. Source and effect of dampness
   - 3.2. Prevention of dampness
   - 3.3. Water proofing mixtures
   - 3.4. Water proof surface treatment
4. Lintel and Arches [2 hours]
   - 4.1. Types of Lintels and their use
   - 4.2. Types of Arches
   - 4.3. Centering of arches
5. Floors [2 hours]
   - 5.1. Types of floors
   - 5.2. General principles for the selection of floors and flooring materials
6. Roofs and roof coverings [2 hours]
   - 6.1. Classification of roofs- Flat and Pitched
   - 6.2. Types of pitched roofs
   - 6.3. Methods of securing pitched roofs against uplift
   - 6.4. Constructional details of flat and pitched roofs
   - 6.5. Roof coverings- Thatch, Tiles, slates, CGI and AC sheets
   - 6.6. Selection of roof covering
7. Staircases [2 hours]
   - 7.1. Elements of staircase
   - 7.2. Types of stair
   - 7.3. Relation between rise and tread of stair
   - 7.4. Simple design of stair
8. Doors and windows [2 hours]
   - 8.1. Location, size and materials of Doors and Windows
   - 8.2. Door parts – Frame, shutter and their detail
   - 8.3. Fittings of door and windows
   - 8.4. Ventilators – types and detail
9. Plastering and Pointing [2 hours]
   - 9.1. Materials for plastering
   - 9.2. Design consideration for Plastering
   - 9.3. Defects in Plastering
   - 9.4. External finishes
   - 9.5. Pointing – Types and use
10. Painting, Distempering and Whitewashing [2 hours]

10.1. Types of paints
10.2. Process of painting on – Wood work, Iron work, Plastered surface and Masonry
10.3. Surface
10.4. Distempering
10.5. White washing and colour washing

11. Thermal Insulation [2 hours]
11.1. Heat transference
11.2. Types of insulating materials and their applications
11.3. Thermal Insulation of roofs, walls and floors
11.4. Thermal treatment in tropical and subtropical regions

12. Ventilation [2 hours]
12.1. Types of ventilations – Natural and Mechanical ventilation
12.2. Requirements of a good ventilation system in Residential and Farm buildings

13. Lighting [2 hours]
13.1. Requirements of lighting in Residential and Farm buildings
13.2. Natural and Artificial lighting
13.3. Requirements of electricity

Part: B FARM STRUCTURES

1. Selection and planning of structures [2 hours]
1.1. Types of farmstead
1.2. Planning principle and layout of farmstead

2. Dairy cattle housing [2 hours]
2.1. Functional requirement and sizing
2.2. Location and orientations
2.3. Types of dairy cattle housing and their relative merits and demerits
2.4. Structural details
2.5. Functional and structural requirement of milking parlor

3. Poultry housing [2 hours]
3.1. Functional requirement and sizing
3.2. Location and orientations
3.3. Types of poultry housing and their relative merits and demerits
3.4. Structural details
3.5. Structure for poultry feeding and watering

4. Swine housing [2 hours]
4.1. Functional requirement and sizing
4.2. Location and orientations
4.3. Types of swine housing
4.4. Structural details

5. Goat and Sheep housing [2 hours]
5.1. Functional requirement and sizing
5.2. Location and orientations
5.3. Types of Goat and Sheep housing
5.4. Structural details

6. Fish ponds [2 hours]
6.1. Functional requirements
6.2. Constructions and maintenance of Fish ponds

7. Feed and Forage structures [2 hours]
7.1. Bag and bulk storage structures
7.2. Silo
7.3. Sizing and structural details of trench, pit and tower silo

8. Green house and poly house [2 hours]
8.1. Purpose of green house and poly house
8.2. Types, functional requirement and constructional detail

Total Lecture = 45 hours

Tutorials

The Drawing/Tutorial shall be used for problem solving and students shall be given assignments and final examination on:

1. Planning and layout of building/Farm house.
2. Detailed drawing of a small building from measurement.
3. Making plans of alternative courses of different thickness of brick wall in
(a) English bond - one brick, 1½ brick and two bricks, and
(b) Flemish bond - single Flemish and double Flemish bond.
4. Structural drawings of various types of roofs.
5. Structural design of various types of floors.
6. Structural drawing of various types of foundations.
7. Planning and layout of dairy cattle, poultry and swine housing.
8. Drawing of a small Farm house.
9. Drawing and design of simple fish pond.
10. Preparation of site plan.

Practical

The practical should be used for problem solving and class should be taken of two periods per week on:

i. Planning and layout of building
ii. Detail drawing of a small building from measurement
iii. Structural drawing of various types of roof
iv. Structural drawing of various types of floors
v. Structural drawing of various types of foundations
vi. Planning and layout of dairy cattle, poultry, swine and goat and sheep housing
vii. Layout of Fish pond
viii. Layout of Silo
ix. Planning and layout of farm shed with various farm machinery and equipments
x. Planning and layout of greenhouse shed
xi. Planning and lay out of electrical fixtures on existing drawing
xii. Preparation of master plan of Agricultural Farm.

Reference

1. Building Construction; by B.C. Punmia, Laxmi publication
2. Building Construction; by Shusil Kumar, Laxmi publication
3. Building Construction; by Rangawala, Laxmi publication
4. Farm structures, by Barre, H.J. and Sammet L.L. John Wiley & sons Inc.
5. Farm Building Design by Neubaur L.W. Prentice Hall Inc
6. Farm Building in Punjab by A.P. Bhatnagar, Punjab Agricultural University, Publication
7 CIGR handbook of Agricultural Engineering, vol. 2, animal production and aquaculture Engineering, published by American Society of Agricultural Engineers
8 Farm building design by Neubaur L.W. Prentice- Hall Inc.
9 Farm structures by Barre, H.J. and Sammet L.L., John Wiley and Sons Inc.
10 Farm building in Panjab by A.P. Bhatnagar, Punjab Agricultural University Publications.
11 Time Saver for Architecture Data

Evaluation Scheme

The questions will cover the entire chapter of the syllabus. The evaluation scheme will be as indicated in the table below:

Chapter	Hours	Marks distribution*
Part A		
1	2	10
2	4	
3	2	10
4	2	
5	2	
6	3	10
7	2	
8	2	10
9	2	
10	2	
11	2	10
12	2	
13	2	
Part B		
1	2	10
2	2	
3	2	
4	2	10
5	2	
6	2	
7	2	10
8	2	
Total	45	80

* Minor deviation on mark distribution can be made.

- The questions setting should be in the multiplication of either 8 or 10.

FIELD OPERATION AND MAINTENANCE OF TRACTOR AND FARM MACHINES
AE 651

Lecture : 0 Year : III
Tutorial : 0 Part : II
Practical : 3

Course Objective:
After completion of this course the students will be able to:

- Operate the Tractor with farm implements in agricultural field
- Understand the essential safety and maintenance of the farm implements and Tractor

Course Detail

1. Familiarization with different make and models of 4 - wheeled farm Tractors, starting and safety checks.
2. Forward and reverse driving practice on farm Tractors, selection of right combination of speed and gear.
3. Tractor driving practice in serpentine and circuitous form and with two wheeled Tractor trailer.
4. Practicing on hitching and de-hitching of mounted; semi mounted and trailed type implements.
5. Field operation and adjustments on Tractor drawn mould board and disc plough.
6. Field operation and adjustments on Tractor drawn mould board and disc harrow and cultivators.
7. Field operation and adjustments on seed drill and planting machines.
8. Field operation and adjustments on harvesting machines.
9. Field operation and adjustments on threshing machine.
10. Driving practice on two-wheeled tractor (power tiller).
11. Hitching and de-hitching of power tiller driven farm machines.
12. Maintenance and servicing of tractor after 10 hours and 50 hours of operations.
13. Maintenance and servicing of tractor after 100 hours and 250 hours of operations.
14. Maintenance and servicing of tractor after 500 hours and 1000 hours of operations.
15. Adjustment of tractor wheel track.

References:

1 Operator's manuals of farm tractors supplied by different manufacturers.

2 Farm tractor tune-up and service guide. American Association for Ag. Engg. and vocational Agriculture. Ag. Engg. center, Athens, Georgia.

3 Tractor maintenance principle and procedure. American Association for Ag. Engg. and vocational Agriculture. Ag. Engg. center, Athens, Georgia.

4 Repair of farm machinery by S. Peterev and Bisnovaty.

Evaluation Scheme:

- Continue assessment system
- Viva-voce and practical test at the end of the semester

ENGINEERING ECONOMICS
AE 656

Lectures : 3 Year : III
Tutorials : 1 Part : II
Practical : 0

Course Objective:
After completion of this course the students will be able to:

- Understand the basic terms, concepts and principles of economics required for management decisions.
- Prepare simple farm planning and budgeting to modify existing tools and equipment for better crop production or repair and maintenance work of them.
- Carryout the simple economic and financial analysis in the field of agricultural engineering.

1. Basic Terms and Concepts in Economics [10 hours]

1.1 Definition and Scope
1.2 Basic Concepts of Goods, Utility, Value, Wealth, Equilibrium and Margin
1.3 Consumption and Indifference Curve- Meaning, Types and Properties and Price Effects and Income Effects
1.4 Law of Diminishing Marginal Utility- Meaning, Assumption, Limitations and Exceptions
1.5 Law of Demand and Elasticity of Demand
1.6 Law of Supply and Elasticity of Supply
1.7 Concept of Cost Curve
1.8 Types of Cost- Real, Opportunity, Implicit, Explicit, Social, Fixed, Variable and Marginal
1.9 Short Run and Long Run Cost Analysis
1.10 Market and Price Determination:
- Market Forms
- Characteristics of Perfect Competition Market
- Characteristics of Monopoly Market
- Characteristics of Monopolistic Market

2. Production Economics Related to Management Decision [10 hours]

2.1 Production Economics and its objectives
2.2 Production Relationships:
- Factor- Product Relationships
- Factor-Factor Relationships
- Product-Product Relationships

2.3 Principles Involved in Management Decisions
- Principle of Diminishing Return
- Cost Principle
- Principle of Substitution
- Principle of Combining Enterprises
- Principle of Equi-marginal Returns
- Principle of Comparative Advantage
- Principle of Time Comparison

3. Tools of Farm Management [9 hours]

3.1 Farm Planning
3.2 Farm Budgeting:
- Partial Budgeting
- Complete Budgeting

3.3 Farm Business Analysis:
- Farm Records and Accounts
- Farm Inventory
- Measuring Financial Condition
- Measuring Farm Profits
- Farm Prices and Production Efficiency
- Factors Affecting Farm Costs and Income

4. Economic and Financial Analysis [8 hours]

4.1 Definition of Cash Flow
4.2 Interest and Time Value of Money:
- Simple Interest
- Compound Interest
- Interest Tables and Charts

4.3 Compounding Factors
4.4 Methods of Economic Analysis:
- Present Value Method
- Future Value Method
- Internal Rate of Return Method
- Benefit/Cost Ratio Method
- Breakeven Analysis
- Payback Period Method

4.5 Financial Analysis
4.6 Risk and Sensitivity Analysis

5. Investment Decisions [8 hours]

5.1 Comparison of Alternatives having same useful life
5.2 Comparison of Alternatives having different useful life
5.3 Comparison of Alternatives including and excluding the time value of money
5.4 Comparison of Alternatives using Capitalized Worth Method
5.5 Comparison of Mutually Exclusive Alternatives

Tutorials

Tutorial shall be used in problem solving on such farm management decisions as- profit maximization, optimal input decision, least cost combination and on farm inventory and farm budgeting. In addition case studies on economic analysis of such projects relating to the areas of Agricultural Engineering as- Agricultural Mechanization, Soil Conservation and Watershed Management, Irrigation and Water Management, shall be discussed as case studies. Students shall be given assignments based on these case studies.

References:

i. Small Business Management: An Entrepreneur's Guidebook by Megginson, I.C., Byrd M.J. and Meginson W.I. McGraw Hill Book Co.
ii. Walter J. Wills. An Introduction to Agricultural Business Management
iii. Economic Analysis for Engineering and Managerial Decision Making by N.N. Borish and S. Kaplan. McGraw Hill Book Co.

Evaluation scheme:

The questions will cover the entire chapter of the syllabus. The evaluation scheme will be as indicated in the table below:

Chapter	Hours	Marks Distribution*
1	10	15
2	10	20
3	9	15
4	8	15
5	8	15
Total	**45 hrs**	**80**

*There may be mirror deviation in marks distribution.

- The questions setting should be in the multiplication of either 8 or 10.

SOIL AND WATER CONSERVATION ENGINEERING
AE 652

Lecture : 3 Year : III
Tutorial : 0 Part : II
Practical : 2

1. Introduction **[2 hours]**
- 1.1. Importance of Soil and Its Conservation
- 1.2. On-site and Off-site Consequences of Soil Erosion
- 1.3. Socio-Economic Effects of Soil Erosion in Nepal
- 1.4. Role of Agricultural Engineering in Soil Conservation and Watershed Management

2. Mechanics of Soil Erosion by Water **[5 hours]**
- 2.1. Water Erosion Types and Factors Affecting
- 2.2. Characteristics of Raindrop and Rainfall Erosivity
- 2.3. Mechanism and Assessment of Raindrop Splash
- 2.4. Mechanics of Sheet and Rill Erosion
- 2.5. Gully Erosion Mechanism, Types and Stages
- 2.6. Stream-Bank Erosion

3. Wind Erosion **[2 hours]**
- 3.1. Factors Causing Wind Erosion
- 3.2. Mechanics of Soil Movement due to Wind
- 3.3. Estimation and Prediction of Wind Erosion Rates
- 3.4. Wind Erosion Control

4. Landslide, Landslip and Mass Wasting **[2 hours]**

5. Soil Loss Estimation and Monitoring **[3 hours]**
- 5.1. Simple Visual Methods for Identifying Signs of Erosion
- 5.2. Universal Soil Loss Equation (USLE):
  - 5.2.1. Parameters of USLE
  - 5.2.2. Limitations of USLE and its Applicability in Nepal
  - 5.2.3. Modified USLE
- 5.3. Soil Erosion Monitoring:
  - 5.3.1. Sedimentation Survey
  - 5.3.2. Paired Catchment Studies
  - 5.3.3. Run-Off and Erosion Plots

6. Soil Erosion Control and Control Measures **[3 hours]**
- 6.1. Principle of Soil Erosion Control
- 6.2. Land Classification and Evaluation of Erosion Sensitivity
- 6.3. Biological and Cultural Measures: **[3 hours]**
  - 6.3.1. Tillage and Crop Rotation
  - 6.3.2. Contouring
  - 6.3.3. Strip Cropping
  - 6.3.4. Mulching
  - 6.3.5. Plantation and Seeding: Wattling, Bolstors, Jute Netting
  - 6.3.6. Controlled Grazing
  - 6.3.7. Manuring and Fertilization
  - 6.3.8. Sloping Land Agricultural Technology (SALT)
- 6.4. Mechanical Measures: **[6 hours]**
  - **6.4.1.** Terracing:
    - 6.4.1.1. Types of Terraces
    - 6.4.1.2. Design of Broad Base and Bench Terraces
    - 6.4.1.3. Maintenance of Terrace System
  - 6.4.2. Bunding:
    - 6.4.2.1. Types of Bunds for Soil Conservation
    - 6.4.2.2. Design of Contour Bunds
  - 6.4.3. Waterways:
    - 6.4.3.1. Purpose of Waterways
    - 6.4.3.2. Design of Vegetated Waterways
- 6.5. Structural Measures: **[10 hours]**
  - 6.5.1. Check Dams:
    - 6.5.1.1. Purpose and Types of Check Dams
    - 6.5.1.2. Design and Construction of Check Dams
    - 6.5.1.3. Stability Analysis of Check Dams
  - 6.5.2. Gully Control Structures:
    - 6.5.2.1. Processes, Stages and Growth of Gully
    - 6.5.2.2. Gully Plugging
    - 6.5.2.3. Design and Construction of Drop Spillway
    - 6.5.2.4. Design and Construction of Chute Spillway
    - 6.5.2.5. Design and Construction of Drop-Inlet Spillway
  - 6.5.3. Stream-Bank Erosion Control Structures:
    - 6.5.3.1. Types of Embankment
    - 6.5.3.2. Design and Construction of Embankments
    - 6.5.3.3. Types of Spurs, Jetties and Groyens
    - 6.5.3.4. Design of Spurs and Groyens
  - 6.5.4. Roadside Erosion Control Structures:
- 6.6. Soil Conservation in Hilly Areas **[2 hours]**

7. Water Conservation and Management in Arid and Semi-Arid Areas[3 hours]

7.1. Problems of Soil and Water Management in Arid and Semi-Arid Areas
7.2. Methods of Soil Moisture Management
7.3. Systems of Water Harvesting and Recycling
7.4. Design of Farm Ponds and Conservation Ponds

8. Watershed Management [2 hours]

8.1. Concept of Watershed Management
8.2. Watershed Management Planning
8.3. Objectives of Integrated Watershed Management
8.4. Sub-Watershed and Micro-Watershed Prioritization

9. Institutional Arrangement for Soil Conservation and [2 hours]

9.1. Watershed Management in Nepal:
9.2. Organizational Structure
9.3. Legislation and Legal Provisions:
  9.3.1. Land Tenure
  9.3.2. Water Laws in Nepal
  9.3.3. Soil and Watershed Conservation Act, 1982
  9.3.4. Soil and Watershed Conservation Regulation, 1985
  9.3.5. Regulations Related to Protected Areas
9.4. Programs and Strategies

S.N.	Practicals	Periods
1	Calculation of Rainfall Erosivity Index	2
2	Use of Weismeir's Nomograph for Soil Erodibility Estimation	2
3	Use of USLE for Calculation of Soil Loss	2
4	Design of Vegetated Waterways	3
5	Design Problem Solving on Bench and Broad Base Terraces	3
6	Design Problem Solving on Contour and Graded Bunds	3
7	Design Problem Solving on Check Dams	3
8	Design of Farm Ponds	2
9	Field Observation of Check Dams and Other Soil Conservation Structures	2
10	Field Observation on Bio-Engineering Practices of Soil Conservation	2
	Total	**24**

Field Visit to a Watershed Management Site

References:

i. Soil and Water Conservation Engineering by G.O. Schwab, K.K. Barnes, R.K. Frevert and T.W. Edminster. John Wiley & Sons Inc., New York.
ii. Soil and Water Conservation by Norman Hudson, B.T. Batsford Limited, London.
iii. Land and Water Management Engineering by V.V.N. Murty. Kalyani Publishers Pvt. Ltd., New Delhi.
iv. Introduction to Soil and Water Conservation Engineering by B.C. Mal. Kalyani Publishers, Pvt. Ltd., New Delhi.
v. Manual on Soil and Water Conservation Practice in India by G. Singh. Central Soil and Water Conservation, Research and Training Institute, Dehradun.
vi. Design of Small Dams. Oxford and IBH Publishing Co., New Delhi
vii. Guidelines for Watershed Management. FAO Watershed Management Field Manual No. FAO, Rome.
viii. Vegetated and Soil Treatment Measures. FAO Watershed Management Field Manual No. 13/1. FAO, Rome.
ix. Laboratory manual of soil and water conservation. AK shukla, TB khatri, KM Pandit, IAAS, Rampur.

Evaluation Scheme

The questions will cover the entire chapter of the syllabus. The evaluation scheme will be as indicated in the table below:

Chapter	Period	Marks Distribution*
1	2	4
2	5	8
3	2	4
4	2	4
5	3	4
6		
6.1	1	8
6.2	2	
6.3	3	4
6.4	6	12
6.5	10	16
6.6	2	4
7	3	4
8	2	4
9	2	4
Total	**45**	**80**

*There may be minor variations in marks distribution.

- The questions setting should be in the multiplication of either 8 or 10.

DESIGN OF STRUCTURES
CE 661

Lectures : 4 Year : III
Tutorial : 2 Part : II
Practical : 0

Course Objective:
This course is aimed at teaching students the concept of design of structures and computational analysis for the design and management of agricultural projects. It gives a practical approach to the various facts of the subject and emphasizes the application of steel, timber and concrete structures to solve engineering problems in the agricultural engineering field.

Part-A: Design of Steel and Timber Structures

1. Introduction: [2 hours]
- 1.1. Types of loads on steel structures
- 1.2. Use of steel and timber in structures
- 1.3. Stress-strain behaviour and allowable stress in structural steel
- 1.4. Codes of practice for design of steel structures

2. Design Criteria for Steel Structures [3 hours]
- 2.1. Method of design
- 2.2. Design based on allowable stress
- 2.3. Principle of limit states design
- 2.4. Floor and truss system

3. Design of Riveted and Welded Connections [4 hours]
- 3.1. Types and failure of riveted joints
- 3.2. Rivet value and efficiency
- 3.3. Types and stresses in welded joints
- 3.4. Design of riveted joint under axial forces
- 3.5. Design of riveted joint under eccentric forces
- 3.6. Design of welded joints and axial forces
- 3.7. Design of welded joints under eccentric forces

4. Design of Tension Members [2 hours]
- 4.1. Types of tension members
- 4.2. Net sectional area
- 4.3. Design of angles, tee and tubular sections

5. Design of Compression Members [4 hours]
- 5.1. End conditions and effective length
- 5.2. Radius of gyration and slenderness ratio
- 5.3. Design of compressive members under axial loads
- 5.4. Design of bases for axially loaded columns

6. Design of Beams [4 hours]
- 6.1. Beams subjected to bending and axial forces
- 6.2. Bending and axial stress
- 6.3. Shear Stresses
- 6.4. Deflection limits
- 6.5. Design of laterally supported beams
- 6.6. Design of bearing plates

7. Design of Build-Up Compression Members [3 hours]
- 7.1. Types of build-up beams
- 7.2. Design of cover plates
- 7.3. Check for stresses

8. Design of Roof Trusses [4 hours]
- 8.1. Angular and tubular sections
- 8.2. Loads on roof trusses
- 8.3. Forces and deflections in trusses
- 8.4. Graphical method of finding forces in roof truss members
- 8.5. Design of purlins
- 8.6. Design of bearing and anchorage
- 8.7. Design of wind bracings

9. Design of Timber Structures [4 hours]
- 9.1. Types and properties of timber
- 9.2. Allowable stresses in timber
- 9.3. Use of Timber in construction
- 9.4. Codes of practice for the design of timber structures
- 9.5. Design of compression members
- 9.6. Design of beams
- 9.7. Types of joints and their connections

Part-B: Design of Reinforced Concrete Structures

1. Design Concepts of Reinforced Concrete Structures [4 hours]
- 1.1. Limitations of use of plain concrete
- 1.2. Purpose of steel reinforcement
- 1.3. Concept of reinforced concrete
- 1.4. Assumptions in elastic theory as applied to RCC
- 1.5. Loads, forces and stresses

2. Working Stress Method [4 hours]

2.1. Single reinforced sections
2.2. Modular ratio
2.3. Neutral axis and stress and strain diagrams
2.4. Analysis of single reinforced sections
2.5. Shear stress and diagonal tension
2.6. Bond and torsion

3. Reinforcement Detailing [4 hours]

3.1. Spacing of reinforcement and concrete cover
3.2. Minimum and maximum reinforcement in beams, slabs and columns
3.3. Minimum and maximum sizes of reinforcing bars
3.4. Details of reinforcement in beams and columns

4. Limit State Method [6 hours]

4.1. Safety and serviceability requirements
4.2. Characteristic strength of materials and safety factors
4.3. Characteristic load and their partial safety factors
4.4. Limit state of collapse in compression
4.5. Limit state of collapse in shear
4.6. Limit state of collapse in torsion
4.7. Limit sate of serviceability in deflection
4.8. Limit state of serviceability in cracking

5. Design by Limit State Method [12 hours]

5.1. Design of singly reinforced beams
5.2. Design of doubly reinforced beams
5.3. Design of flanged beams
5.4. Design of one way slabs
5.5. Design of two way slabs
5.6. Design of columns
5.7. Design of footings

Tutorials

The tutorial classes shall be used for design problem solving and the students shall be required to submit following design assignment:

a) Steel Structures

i. Design problems on riveted and welded connections
ii. Design of continuous beam supported on columns
iii. Graphical method in the analysis of forces in a typical roof truss
iv. Design and drawing of a typical plane roof truss
v. Design and details of columns including base plate, foundation and anchorage

b) RCC Structures

i. Design and drawing of rectangular and flanged beams with single and double reinforcement
ii. Design and drawing of one way and two way slabs
iii. Design and drawing of axially loaded columns
iv. Design of footings

References:

i. Design of Steel Structures by V.M. Vazirani and M.H. Rativani. Khanna Publishers, New Delhi (Latest Edition)- 11 copies
ii. Design of Concrete Structures by V.M. Vazirani and M.H. Rativani. Khanna Publishers, New Delhi (Latest Edition)- 11 copies
iii. Design of Reinforced Concrete Structures by P. Dayaratnam. Oxford and IBH Publishing Co.- 6 copies
iv. Design of Steel Structures by Kazimi and Jindal. Prentice Hall of India Ltd. (Latest Edition)- 6 copies

Evaluation Scheme:

The questions will cover the entire chapter of the syllabus. The evaluation scheme will be as indicated in the table below:

Chapter	Hour	Marks distribution*
Part – A:		
1	2	8
2	3	
3	4	5
4	2	10
5	4	
6	4	5
7	3	8
8	4	
9	4	5
Part – B:		
1	4	5
2	4	5
3	4	5
4	6	8
5	12	16
Total	**60 hrs**	**80**

* There may be mirror deviation in marks distribution.

- The questions setting should be in the multiplication of either 8 or 10.

IRRIGATION AND DRAINAGE ENGINEERING
AE 655

Lectures : 3 Year : III
Tutorials : 1 Part : II
Practical : 2

Course Objective:
To orient and familiarize the students in theory, technological development and current practices in problems solving in the area of irrigation and drainage engineering that covers on-farm and off-farm irrigation and drainage system.

1. Introduction: [2 hours]
- 1.1 Definition, Need and Objectives of Irrigation
- 1.2 Advantages and disadvantages of irrigation
- 1.3 Significance of irrigation development in Nepal
- 1.4 Optimum utilization of irrigation water
- 1.5 Status of irrigation development in Nepal

2. Soil-Water-Plant relationships to irrigation: [5 hours]
- 2.1 Soil composition
  - 2.1.1 Texture of mineral soils
  - 2.1.2 Structure of soil
  - 2.1.3 Behaviour of moisture in the soil
- 2.2 Classification of soil moisture
- 2.3 Characteristic behaviour of soil composition with moisture
- 2.4 Evaluation of water available to plant- How much to irrigate
- 2.5 Extraction pattern of soil-water by plant root
- 2.6 Critical crop growth stages
- 2.7 Reference Crop Water Requirement
  - 2.7.1 Consumptive use of crop and evapotranspiration
  - 2.7.2 Evapotranspiration estimates using empirical methods
  - 2.7.3 Experimental evaluation of evapotranspiration using Lysimeter
- 2.8 Field crop water requirement
- 2.9 Principle Crops in Nepal, their Calendar and gross Water Requirements

3. Farm Irrigation Practices [5 hours]
- 3.1 Methods of irrigation practice
- 3.2 Check basin irrigation
- 3.3 Hydraulic relationship of boarder-strip irrigation
- 3.4 Hydraulic relationship of furrow irrigation
- 3.5 Overhead irrigation and drip irrigation system-components
- 3.6 Sub Irrigation System
- 3.7 Performance of Farm Irrigation Methods-a comparison

4. Farm Irrigation Scheduling: [3 hours]
- 4.1 Objectives and Strategies- Full Vs. Deficit Irrigation
- 4.2 Method of scheduling- when and how much to irrigation
  - 4.2.1 Book-keeping/water budgeting
  - 4.2.2 Soil moisture
  - 4.2.3 Plant indicator
- 4.3 Types of water losses on farm
- 4.4 Farm irrigation requirement- depth of irrigation
  - 4.4.1 Paddy crop
  - 4.4.2 Dry foot crop
- 4.5 Frequency/Interval of irrigation
- 4.6 Determination of Stream Size
- 4.7 Planning Farm Irrigation Delivery based on- continuous, rotational, demand supply

5. Water Conveyance and Distribution System [3 hours]
- 5.1 Classification of Canals by Function and Types
- 5.2 Canal irrigation system and its components
- 5.3 Alignments of Canal
- 5.4 Seepage and Evaporation losses in Canal
- 5.5 Canal Command Area- GCA, CCA, NCA
- 5.6 Crop period, Base Perod, Kor Period and Kor Depth
- 5.7 Duty of water, Delta of crops and their relationships
- 5.8 Irrigation intensities

6. Design of Open Channels for irrigation [5 hours]
- 6.1 Manning's Uniform Flow Equation for Canal Design
- 6.2 Kennedy's and Lacy's Silt Theory
- 6.3 Design of Stable Canals in Alluvium
- 6.4 Lined Canals classification and Economics of Canal Lining
- 6.5 Design of Lined Canals
- 6.6 Design Considerations for Hilly Areas
- 6.7 Cross-Section of Canals- banks, berms, roadways and spoil banks

7. Irrigation Efficiencies [2 hours]
- 7.1 Farm Irrigation Efficiency and its components
- 7.2 Canal irrigation efficiency and its components
- 7.3 Project Efficiency

8. Measurement of Irrigation Water [3 hours]
- 8.1 Velocity Area Method

8.2 Direct Discharge Measurement:
Notches
Parshall Flume
H-Flume
Cut-throat Flume
8.3 Volumetric Flow Measurement

9. Control and regulatory Structures [4 hours]

9.1 Types, functions and components of gravity Headwork
9.2 Bed Sediment Control at Headwork- types of silt excluder and silt ejector
9.3 Cross-Drainage Structures- types, conditions of suitability and design
9.4 Drop Structures- conditions of suitability and design
9.5 Flow Regulation and Head Control Structures- types, conditions of suitability and design
9.6 Canal Outlet and Distribution Structures

10. Drainage Theory and Methods of Agricultural Drainage [3 hours]

10.1 Sources and Causes of Water logging
10.2 Damage to Crops by High Moisture
10.3 Drainage Requirement of Crops
10.4 Drainage Investigation
10.5 Hydraulic Conductivity and Drainage Coefficient
10.6 Drainage Methods and Suitability- Surface, Sub-Surface and Bio-Drainage

11. Design of Agricultural Drainage System [4 hours]

11.1 Design Consideration for Surface Drainage Systems
11.2 Layout and Construction of Surface Drainage
11.3 Design Consideration for Sub-Surface Drainage
11.4 Unlined and Lined Sub-Surface Drainage
11.5 Mole Drains
11.6 Design of Filters for Sub-Surface Drainage
11.7 Vertical Drainage and Skimming Wells

12. Irrigation Water Quality [1 hours]

12.1 Water Quality Consideration in Irrigation
12.2 Appraising Irrigation Water Quality- using indicators

13. Planning and Management of Irrigation Systems [3 hours]

13.1 General Irrigation system planning
13.2 Management Functions in Irrigation Systems
13.3 Operation and Maintenance of Irrigation Systems
13.4 Organizational and Institutional Issues in Irrigation Management
13.5 Participatory Irrigation Management including FMIS

14. Irrigation Policy [1 hours]

14.1 Introduction to irrigation act and regulation
14.2 Water right- uphoff's matrix on irrigation management

Tutorials

Tutorial Classes for Design of Irrigation & drainage structure

Practical

S.N.	Laboratories	Perioeds
1	Estimation of Crop Evapotranspiration Using Empirical Methods	2
2	Field evaluation of Crop Evapotranspiration using Lysimeter	2
3	Measurement of Irrigation Water Using Flow Measuring Structures: Notches, Parshall Flume, H-Flume, Cut-throat Flume	3
4	Determination of Water Conveyance Efficiency in Unlined and Lined Channels	2
5	Field Evaluation of Check Basin Irrigation	2
6	Field Evaluation of Border-Strip Irrigation	3
7	Field Evaluation of Sprinkler Irrigation	2
8	Field Evaluation of Drip Irrigation	2
9	Design of Open Channels	2
10	Determination of Hydraulic Conductivity in the Field and Laboratory for Drainage Investigation	4
11	Determination of Drainage Coefficient from Daily Rainfall Data	2
Total		26

References

i. Michael, A.M. Irrigation Theory and Practice. Vikash Publishing House, New Delhi.
ii. Irrigation Principles and Practices by O.W. Israelson and V.E. Hensen. John Wiley & Sons.
iii. L.G. James Farm Irrigation System Design. John Wiley & Sons, New York
iv. Reddi, T. Yellamanda & Reddi, G.H. Sankara. Efficient Use of Irrigation Water (1995) – 8 copies
v. R. Lal. Irrigation Hydraulics**.**
vi. S.K. Garg. Irrigation Engineering and Hydraulic Structures. Khanna Publishers, New Delhi
vii. J.N. Luthin. Drainage Engineering. Wiley Eastern Pvt. Ltd. New Delhi.
viii. International Course on Land Drainage. Drainage Principles and Applications, Vol. I to IV. International Land Reclamation Institute (ILRI), Wakhningen, the Netherlands.
ix. Walker, W.R. and G.V. Skogerboe. Surface Irrigation: Theory and Practice. Prentice-Hall Inc. USA
x. Melvyn Kay, Cranfield Press, Surface Irrigation systems and practice
xi. D. Laat, UNESCO-IHE Institute for Water Education, Delft, The Netherlands, Crop-Water-Plant Relationships
xii. Bruce Withers and Stanley Vipond, B T Batsford Limited, London, WiHoAH, Irrigation: Design and Practice
xiii. Herman J Finkel, CRC Press Inc, Florida, CRC Handbook of Irrigation Technology Volume-I

Evaluation Scheme

The questions will cover the entire chapter of the syllabus. The evaluation scheme will be as indicated in the table below:

Chapter	Hours	Marks Distribution*
1	2	4
2	5	10
3	5	10
4	3	4
5	3	4
6	5	10
7	2	4
8	3	5
9	4	8
10	3	5
11	5	8
12	1	8
13	3	
14	1	
Total	45	80

*There may be minor variation in marks distribution.

- The questions setting should be in the multiplication of either 8 or 10.