GROUND WATER DEVELOPMENT AND TUBEWELL TECHNOLOGY
AE …

Lecture : 3 **Year : IV**
Tutorial : 1 **Part : I**
Practical : 1.5

Course Objective:
To acquaint and familiarize the students with the concept, technological development and problem solving in the area of groundwater, tube well technology and water lifting devices.

1. Occurrence and Movement of Ground Water [4 hours]
- 1.1. Occurrence of Ground Water
- 1.2. Types of Water Bearing Formation and their Characteristics
- 1.3. Ground Water Movement and Darcy's Law
- 1.4. Acquifer Characteristics Influencing Ground Water Yield
- 1.5. Permeability and Factors Affecting Permeability
- 1.6. Measurement of Permeability

2. Well Hydraulics [5 hours]
- 2.1. Classification of Wells
- 2.2. Steady State Flow in Fully Penetrating Wells
- 2.3. Unsteady State Flow in Fully penetrating Wells
- 2.4. Steady and Transient State Flow in Partially penetrating Wells
- 2.5. Interference of Wells
- 2.6. Pumping Test and Determination of Acquifer Parameters by: Theis Method, Copper-Jacob Method, Chow's Method

3. Ground Water Exploration [3 hours]
- 3.1. Objectives of Ground Water Exploration
- 3.2. Methods of Ground Water Exploration:
  - 3.2.1. Geological Method
  - 3.2.2. Geophysical Method
  - 3.2.3. Electrical Resistivity Method
  - 3.2.4. Seismic Refraction Method
  - 3.2.5. Water Winching

4. Well Classification and Design [5 hours]
- 4.1. Classification of Wells and Tubewells
- 4.2. Classification and Selection of Strainers
- 4.3. Design Considerations in Open Wells
- 4.4. Test Drilling
- 4.5. Design Consideration in Tubewells:
  - 4.5.1. Preparation of Bore Log
  - 4.5.2. Grain Size Distribution of Water Bearing Strata
  - 4.5.3. Determination of Safe Yield
  - 4.5.4. Diameter and Depth of Casing Pipe
  - 4.5.5. Diameter and Depth of Strainer
  - 4.5.6. Design of Gravel Packing
- 4.6. Well Development
- 4.7. Multiple Well System

5. Tube-well Construction [4 hours]
- 5.1. Methods of Drilling
  - 5.1.1. Percussion Drilling
  - 5.1.2. Hydraulic Rotary
  - 5.1.3. Reverse Rotary
  - 5.1.4. Bamboo shallow wells
- 5.2. Choice of Well Drilling Method
- 5.3. Installation of Well Casing and Screens

6. Operation and Maintenance of Tube wells [1 hour]

7. Environmental impacts on groundwater: groundwater pollution, [2hrs]
- 7.1. Temporal variation of groundwater, stream flows groundwater levels,
- 7.2. evapotranspirative and tidal fluctuations, urbanization, earthquakes,
- 7.3. external loads, land subsidence

8. Water Lifting Devices and Pumps [17 hours]
- 8.1. Classification of pumps and traditional water lifting devices
- 8.2. Reciprocating Pumps
  - 8.2.1. Working Principle and Classification
  - 8.2.2. Design Considerations
  - 8.2.3. Operating Characteristic Curves
  - 8.2.4. Selection and Installation
  - 8.2.5. Maintenance and Trouble-Shooting
- 8.3. Centrifugal Pumps
  - 8.3.1. Working Principle and Classification
  - 8.3.2. Components
  - 8.3.3. Design Considerations
  - 8.3.4. Performance Characteristics
  - 8.3.5. Selection and Installation
  - 8.3.6. Maintenance and Trouble-Shooting

8.4. Turbine and Submersible Pumps
  8.4.1. Working Principle
  8.4.2. Components
  8.4.3. Performance Characteristics
  8.4.4. Selection and Installation
  8.4.5. Maintenance and Trouble Shooting
8.5. Propeller Pump
  8.5.1. Working Principle
  8.5.2. Components
  8.5.3. Performance Characteristics
  8.5.4. Selection and Installation
  8.5.5. Maintenance and Trouble-Shooting
8.6. Other Types of Pumps
  8.6.1. Jet Pump
  8.6.2. Gear Pump
  8.6.3. Screw Pump
  8.6.4. Hydraulic Ram
  8.6.5. Treadle Pump

9. Design Considerations in Pumping Plant [2 hours]

10. Economics of Pumping and Ground Water Utilization [2 hours]

Practical

1. Use of Resistivity Meter for Exploration of Water Bearing Formation [2 hours]
2. Measurement of Ground Water Level and Preparation of Water Table Contour Maps [2 hours]
3. Well Log Assessment [2 hours]
4. Analysis of Acquifer Material and Design of Gravel Pack [2 hours]
5. Evaluation of Discharge-Drawdown Relationship of Wells and Determination of Recuperation Rate [2 hours]
6. Evaluation of Acquifer Parameters by Pumping Tests [2 hours]
7. Testing of Well Screen [2 hours]
8. Performance Evaluation of Reciprocating Pumps [2 hours]
9. Performance Evaluation of Centrifugal Pumps [2 hours]

Visit to a Tube well Drilling Site and Study of Different Drilling Equipments.

Reference:

1. D.K. Todd. Ground Water Hydrology. John Wiley & Sons. (latest edition-Indian/Low Cost Edition Preferred)
2. H.M. Raghunath. 1990. Ground Water. Wiley Eastern Ltd., New Delhi.
3. Karanth K.R. Ground Water Assessment, Development and Management. Tata McGraw Hill Book Co., New Delhi.
4. Michael A.M. and Khepar S.D. Water Wells and Pump Engineering. Tata McGraw Hill Publishing Co., New Delhi.
5. Jagdish Lal. Hydraulic Machines. Metropolitan Book Co., New Delhi.

Evaluation Scheme:

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

<table>
<tr><th>Chapter</th><th>Hours</th><th>Marks Distribution*</th></tr>
<tr><td>1</td><td>4</td><td>4</td></tr>
<tr><td>2</td><td>6</td><td rowspan="2">16</td></tr>
<tr><td>3</td><td>3</td></tr>
<tr><td>4</td><td>5</td><td rowspan="2">16</td></tr>
<tr><td>5</td><td>4</td></tr>
<tr><td>6</td><td rowspan="2">3</td><td rowspan="2">6</td></tr>
<tr><td>7</td></tr>
<tr><td>8</td><td>17</td><td>32</td></tr>
<tr><td>9</td><td rowspan="2">4</td><td rowspan="2">6</td></tr>
<tr><td>10</td></tr>
<tr><td>Total</td><td>45</td><td>80</td></tr>
</table>

*There may be minor variation in marks distribution

DAIRY AND FOOD ENGINEERING
AE ..

Lectures : 3 **Year : IV**
Tutorials : 1 **Part : I**
Practical : 2

Course Objectives:

- To acquaint and equip the students with different unit operations of Dairy industries.
- To acquaint and equip the students with different forms of moisture, water activity and its relation with food safety.
- To acquaint and equip the students with different preservation techniques employed in Dairy and Food industries.

1. **Dairy Development in Nepal:** **[5 hours]**
   - 1.1. Engineering, thermal and chemical properties of milk and milk products
   - 1.2. Unit operation of various dairy and food processing systems in Nepal
   - 1.3. Process flow charts for product manufacture
   - 1.4. Working principles of equipment for receiving, pasteurization, sterilization, homogenization, filling & packaging

2. Heat Processing: **[5 hours]**
   - 2.1. Methods of applying heat to food Sterilisation
   - 2.2. Batch and continuous retorts, their working principle
   - 2.3. Thermal bacteriology: TDR and TDT curve, D-value, z-value and F-value
   - 2.4. Heat penetration curve
   - 2.5. Processing time by formula and graphical method

3. Deterioration in Products and their Controls: **[5 hours]**
   - 3.1. Physical, chemical and biological methods of food preservation
   - 3.2. Changes undergone by the food components during processing
   - 3.3. Butter manufacturing
   - 3.4. Dairy plant design and layout
   - 3.5. Composition and proximate analysis of food products

4. Evaporation: **[7 hours]**
   - 4.1. Basic concepts of evaporation
   - 4.2. Types of heat exchangers
   - 4.3. Working principle of a single effect evaporation system
   - 4.4. Heat and mass transfer in evaporator
   - 4.5. Evaporator capacity, overall heat transfer co-efficient
   - 4.6. Evaporator economy and capacity
   - 4.7. Multiple effect evaporation system, it's working principle and economy
   - 4.8. Different arrangements of triple effect system and their principle

5. Dehydration and Drying: **[7 hours]**
   - 5.1. Free moisture, bond moisture
   - 5.2. Equilibrium moisture content
   - 5.3. BET equation, Water activity and its estimation
   - 5.4. Classification of driers: hot air, heated surface, microwave etc.
   - 5.5. Tray, drum and spray, foam mat drier for liquids and pastes,
   - 5.6. Vacuum, fluidized bed, osmotic drying: mechanism & working principles

6. Freezing: **[7 hours]**
   - 6.1. Low temperature preservation
   - 6.2. Theory of freezing
   - 6.3. Nucleation and ice crystal growth
   - 6.4. Freezing plateau
   - 6.5. Calculation of freezing time by Plank's equation
   - 6.6. IQF, Effect of freezing on product
   - 6.7. Frozen products
   - 6.8. Effect of frozen storage
   - 6.9. Commercial freezers and cryogens: CO_2, liquid N_2

7. Freeze drying: **[5 hours]**
   - 7.1. Theory of Lyophilization
   - 7.2. Phase diagram of water
   - 7.3. Heat and mass transfer in freeze drying
   - 7.4. Calculation of freeze drying time
   - 7.5. Freeze dried foods

8. Concentration: **[2 hours]**
   - 8.1. Theory of Concentration
   - 8.2. Freeze Concentration
   - 8.3. Membrane Concentration: reverse osmosis and ultra filtration

9. Irradiation: **[2 hours]**
   - 9.1. Theory of irradiation, effect on foods
   - 9.2. Microwave heating
   - 9.3. Dielectric heating of foods

Tutorial: – 12 tutorials from relevant chapters/topics.

Practicals:

1. Study of a composite pilot milk processing plant & equipments [3 hours]
2. Study of pasteurizers [2 hours]
3. Study of sterilizers [2 hours]
4. Study of homogenizers [2 hours]
5. Study of separators [3 hours]
6. Study of butter churners [3 hours]
7. Study of evaporators: PHE [2 hours]
8. Study of milk dryers [3 hours]
9. Study of freezers [3 hours]
10. Estimation of refrigeration requirements in dairy & food plant [3 hours]

Visit:

Visit to nearby multiproduct dairy or food industry and submit a detail report including working principle, equipment drawing and procedure and efficiency of the available equipments if moderate dairy or food factory is available in the vicinity.

Reference:

1. Sukumar De, *Outlines of Dairy Technology,* Oxford University press, Delhi.
2. Tufail Ahmad. Dairy Plant Engineering and Management, (latest edition), Kitab Mahal,
3. Brennan JG, Butters JR, Cowell ND & Lilly AEI. 1990. *Food Engineering Operations*. Elsevier.
4. Earle RL. 1985. *Unit Operations in Food Processing*. Pergamon Press.
5. Fellows P. 1988. *Food Processing Technology: Principle and Practice*. VCH Publ.
6. Geankoplis J Christie. 1999. *Transport Process and Unit Operations*. Allyn & Bacon.
7. Henderson S & Perry SM. 1976. *Agricultural Process Engineering*. 5th Ed. AVI Publ.
8. McCabe WL & Smith JC. 1999. *Unit Operations of Chemical Engineering*. McGraw Hill.
9. Verma R. C. & Sanjay Kr jain. *Fundamentals of Food Engineering*. Himanshu publications Udaipur.
10. Coulson JM & Richardson JF. 1999. *Chemical Engineering*. VolS. II, IV. The Pergamon Press.

Evaluation Scheme:

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

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

*There may be minor variation in marks distribution.

RENEWABLE ENERGY AND ENERGY CONVERSION DEVICES
AE …

Lecture : 3 **Year : IV**
Tutorial : 1 **Part : I**
Practical : 2

Course Objective:
The main objective of this course is to provide fundamental knowledge to detect potential renewable energy sources near to firm and development of skills on their conversion devices. After completion of this course the students will be able to use locally available energy sources to fulfill the requirement of farm power devices using appropriate tools and methodology.

1. Introduction: **[2** hours**]**
- 1.1. Energy Sources and Their Classification
- 1.2. Earth Energy Cycle and Human Interference
- 1.3. Concept of Energy Audit and Tools of Energy Analysis
- 1.4. Energy Requirement in Agricultural Production System
- 1.5. Agricultural and Rural Energy Consumption Pattern in Nepal

2. Solar Energy **[22 hours]**
- 2.1. Availability and Distribution of Solar Radiation:
  - 2.1.1. Spatial and Temporal Distribution
  - 2.1.2. Measurement of Solar Radiation
  - 2.1.3. Solar Angle, Angle of Incidence and Solar Time
  - 2.1.4. Incidence of Solar Radiation on Horizontal and Inclined Surfaces
- 2.2. Application of Solar Energy
  - 2.2.1. Solar electricity
  - 2.2.2. Solar thermal energy application
- 2.3. Flat Plate Collectors:
  - 2.3.1. Principle
  - 2.3.2. Types and Material of Construction
  - 2.3.3. Design Considerations
- 2.4. Concentrating Collectors:
  - 2.4.1. Types
  - 2.4.2. Thermodynamics and Limits of Concentration
  - 2.4.3. Stationary Concentrators
  - 2.4.4. Compound Parabolic Concentrators
  - 2.4.5. Multi-Step Asymmetric Concentrators
- 2.5. Solar Air Heaters:
  - 2.5.1. Types and Use
  - 2.5.2. Design Considerations
  - 2.5.3. Selection, Installation and Maintenance
- 2.6. Solar Water Heaters:
  - 2.6.1. Types and Use
  - 2.6.2. Design Considerations
  - 2.6.3. Selection, Installation and Maintenance
- 2.7. Solar Passive Heating Devices:
  - 2.7.1. Types and Use
  - 2.7.2. Thermal Storage Walls and Attached Green Houses
  - 2.7.3. Thermal Storage Roof
- 2.8. Solar Cooker and Oven:
  - 2.8.1. Types and Working Principle
  - 2.8.2. Design Considerations
  - 2.8.3. Performance Evaluation Parameters
- 2.9. Photovoltaic Conversion
  - 2.9.1. Fundamentals of Photovoltaic Cell
  - 2.9.2. Materials, Manufacturing Process and Performance
  - 2.9.3. SPV Applications – Solar Lantern, Home/Street Lighting,
    - 2.9.3.1. Water Pumping, Refrigeration & Cold Storage
  - 2.9.4. Installation and Maintenance
- 2.10. Solar Crop Dryers
  - 2.10.1. Types of Solar Crop Dryers
  - 2.10.2. Natural Convection Solar Dryers
  - 2.10.3. Forced Convection Solar Dryers
  - 2.10.4. Mixed Mode Solar Dryers
  - 2.10.5. Design Considerations
  - 2.10.6. Performance Evaluation

3. Biomass Energy Technologies: **[12 hours]**
- 3.1. Biomass:
  - 3.1.1. Definition and Potential
  - 3.1.2. Characteristics of Biomass
  - 3.1.3. Collection and Preconditioning of Biomass- Cutting, Grinding, Bailing,
    - 3.1.3.1. Briquetting
- 3.2. Biomass Gasification
  - 3.2.1. Basic Principles
  - 3.2.2. Process Description
  - 3.2.3. Types of Gasifiers
  - 3.2.4. Operating Parameters and Performance of Gasifiers

3.2.5. Conditioning of Producer Gas
3.2.6. Application of Producer Gas – Thermal, Engine

3.3. Biogas
3.3.1. Introduction to Biogas
3.3.2. Basics of Anaerobic Digestion
3.3.3. Microbial and Biochemical Process in Anaerobic Digestion
3.3.4. Types of Bioreactors and their Characteristics
3.3.5. Parameters for Selection of Reactor Types for Anaerobic Digestion
3.3.6. Factors Controlling Rates of Anaerobic Digestion
3.3.7. Design of Anaerobic Reactor for Utilizing Cattle Dung
3.3.8. Construction, Start-up, Operation and Maintenance of Bioreactors
3.3.9. Application of Biogas – Thermal, Lighting, Engine
3.3.10. Slurry Utilization as Fertilizer
3.3.11. Biogas Production in Cold Climate

3.4. Bio-diesel
3.4.1. Introduction of bio- diesel
3.4.2. Source of bio- diesel
3.4.3. Bio- diesel production technology
3.4.4. Application of bio- diesel

4. Wind Energy [4 hours]
4.1. Basic Wind Data- Speed and Direction
4.2. Diurnal and Seasonal Variation in Wind Speed and Direction
4.3. Types of Wind Energy Converters
4.4. Performance and Efficiency of Wind Mill

5. Micro and Small Hydroelectric Systems [5 hours]
5.1. Classification of Water Wheels and Turbines
5.2. Components of Water Wheels and Turbines
5.3. Design Considerations
5.4. Power Output and Efficiency
5.5. Popular Micro-Hydroelectric Systems in Nepal
5.6. Installation and Operation Management
5.7. Applications in Agricultural and Rural Development

Tutorials from chapters/topics: 1.4, 2.1, 2.3, 2.4, 2.5, 2.6, 2.7, 2.8, 2.9.3, 2.10, 3.2, 3.3, 4.4, & 5.4

References:

1. S. P. Sukahtme. Solar Energy: Principle of Thermal Collection and Storage. Tata McGraw Hill Publishing Co., New Delhi (latest edition)
2. H. P. Garg and J. Prakash. Solar Energy Fundamentals and Applications. Tata McGraw Hill Publishing Co., New Delhi (latest edition)
3. John A. Duffie and W. A. Beckman. Solar Engineering of Thermal Process. John Wiley & Sons. (latest edition)
4. R. C. Fluck and C. D. Baird. Agricultural Energetics. AVI Publishing Co. Inc. Connecticut. (latest edition - Indian/Low Cost Edition Preferred)
5. K. M. Mittal. Biomass Systems: Principle and Applications. New Age International Pvt. Ltd., New Delhi
6. B. T. Nijaguna. Biogas Technology. New Age International Pvt. Ltd., New Delhi
7. W. J. Kennedy Jr. and Wayne C. Turner. Energy Management. Prentice Hall Inc.
8. Journals of American Society of Agricultural and Biological Engineers (ASABE)
9. FAO Journals on Biomass Combustion Technologies.
10. FAO Journals on Energy Conversion and Renewable Energy for Greenhouse Heating

Practical:

1. Analysis of Solar Energy Applications [3 hrs]
2. Study on Solar Collectors and Photovoltaic Energy Conversions [3 hrs]
3. Study on Solar Crop Dryers [2 hrs]
4. Determination of Total Solid and Volatile Solid in Biomass [2 hrs]
5. Determination of Calorific Value of Different Fuels [3 hrs]
6. Study on Working of Gasifiers [3 hrs]
7. Study on Anaerobic Bioreactors for Methane Generation [2 hrs]
8. Design of Anaerobic Bioreactors [3 hrs]
9. Study on Operation of IC Engines on Biogas and Producer Gas [3 hrs]
10. Study on Water Lifting System by Windmill [3 hrs]
11. Study on Performance of Micro-Hydroelectric Power Generation [3 hrs]

Visit:

1. One day visit to nearby micro or small hydro power station.
2. One day visit to nearby wind mill or water pumping station.

Evaluation Scheme:

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

Chapter	Hours	Marks Distribution*
1	2	4
2		
2.1	2	16
2.2	2	
2.3	2	
2.4	2	
2.5	2	8
2.6	2	
2.7	1	4
2.8	2	8
2.9	4	
2.10	3	8
3.0		
3.1	2	16
3.2	3	
3.3	4	
3.4	2	
4.0	4	8
5.0	5	8
Total	45	80

*There may be minor variation in marks distribution.

Estimating and Costing
CE 706

Lecture : 3 **Year : IV**
Tutorial : 2 **Part : I**
Practical : 0

Course objective:
To provide the knowledge of basic tools and methodology of estimating and costing of a construction work. After completion of this course, the students can prepare detailed estimate of Building, Agricultural Roads & Farm Buildings and can prepare BOQ. They can also write specification of building materials and building works.

1. **Introduction** **(2 hours)**
   - 1.1 General
   - 1.2 System of Units
   - 1.3 Units of Measurement and Payments for different items of Works and Materials
   - 1.4 Requirements of Estimating and Costing

2. **Methods of Estimating** **(4 hours)**
   - 2.1 Methods of Measurement of Building and Agricultural Engineering Works
   - 2.2 Subheads of item of works
   - 2.3 Methods of Taking out Quantities:
     - 2.3.1 Center Line Method
     - 2.3.2 Long Wall and Short Wall Method
     - 2.3.3 Crossing Method
   - 2.4 Abstracting Bill of Quantities

3. **Preparation of Detail Estimate** **(3 hours)**
   - 3.1 Cost of Item
   - 3.2 Transportation cost, other expenses and overheads
   - 3.3 Contingency

4. **Types of Estimates** **(4 hours)**
   - 4.1 Approximate Estimate
   - 4.2 Detailed Estimate
   - 4.3 Revised Estimate
   - 4.4 Supplementary Estimate
   - 4.5 Annual Repair & Maintenance Estimate
   - 4.6 Extension and Improvement Estimate
   - 4.7 Complete Estimate
   - 4.8 Split of Costs of Building Works

5. **Analysis of Rates** **(**6 hours)
   - 5.1 Introduction
   - 5.2 Purpose of Rate Analysis
   - 5.3 Importance of Rate Analysis
   - 5.4 Requirements of Rate analysis
   - 5.5 Factors affecting Rate Analysis
   - 5.6 Procedure of Rate Analysis for
     - 5.6.1 Building works
     - 5.6.2 Water supply Works
     - 5.6.3 Rural Road Works
     - 5.6.4 Irrigation Works

6. **Detailed Estimate** **(18 hours)**
   - 6.1 Estimate for Walls
   - 6.2 Estimate for a single room building
   - 6.3 Estimate for a two room building
   - 6.4 Estimate for Earthwork in road
   - 6.5 Estimate for RCC slab culvert
   - 6.6 Estimate for Septic Tank and Soak pits

7. **Specification:** **(5 hours)**
   - 7.1 Purpose of Specification
   - 7.2 Types of Specification – General Specification and Detailed specification
   - 7.3 Importance of Specification
   - 7.4 Specification writing – Techniques, Use of International and Local Standards, Code of Practice.

Tutorial:
Six Estimation Assignments on following Projects:
1. A single storied residential building
2. Dairy Cattle Housing
3. Rural Roads
4. A canal fall
5. A Biogas Plant
6. Writing Specification of - Brickwork, RCC work, Cement, Sand, Aggregate, Steel reinforcement and Earth work.

References:

1. Estimating and costing by BN Dutta – latest edition.
2. A text book of Estimating and Costing by G.S. Birdie – latest edition.
3. Estimating and Project Management for Small Construction Firms by Seymour Berger and Jules B. Godel - latest edition.
4. Civil Estimation, Quantity Surveying and Valuation by Amarjeet Agrawal - latest edition.
5. BSP Publications.

Evaluation Scheme:

Chapter	Hours	Marks Distribution*
1	2	4
2	4	6
3	3	4
4	4	6
5	6	12
6	18	32
7	5	16
Total	42	80

* Minor deviation on mark distribution can be made.

PROJECT ENGINEERING
CE …

Lecture : 3 **Year : IV**
Tutorial : 1 **Part : I**
Practical : 0

Course Objective:

- To introduce the basic knowledge on project and project environment
- To make the students able to prepare feasibility study report and project proposal.
- To provide the sound knowledge of project planning, implementation and controlling.
- To provide knowledge on risk associated with the project
- To provide the knowledge of project finance and
- To provide the concept of modern trends and techniques of project management.

1. Introduction of Project and Project Management [6 hours]

1.1. Definition of Project, its characteristics, and example of project.
1.2. Classification of Project.
1.3. Project Objective and Goal.
1.4. Project Life Cycle Phases.
1.5. Project Environment.
1.6. Introduction to Project Management.

2. Project Appraisal and Project Formulation [8 hours]

2.1. Concept of Project Appraisal
2.2. Project Proposal (technical and financial)
2.3. Procedure for Developing Project Proposal
2.4. Techniques of Project Formulation
- Feasibility analysis,
- Cost Benefit analysis,
- Input analysis,
- Environmental analysis

3. Project Planning and Scheduling [12 hours]

3.1. Concept of Project Planning and its Importance.
3.2. Project Planning Process.
3.3. Work Breakdown Structure (WBS)
3.4. Project Scheduling with Bar Chart, CPM & PERT
3.5. Project Scheduling with Limited Resources (Resource Leveling and Smoothing).
3.6. Introduction to Planning Soft ware - MS Project

4. Project Implementation and Controlling. [7 hours]

4.1. Introduction to Monitoring, Evaluation and Controlling
4.2. Project Control.
4.3. Project Control Cycle
4.4. Elements of Project Control (time, cost and quality).
4.5. Project Schedule Control
4.6. Project Cost Control: Methods and procedure (Earned value analysis)
4.7. Project Quality Control
4.8. Introduction to Project Management Information System (PMIS)

5. Project Risk Analysis and Management [7 hours]

5.1. Introduction to Project Risk.
5.2. Types of Project Risk.
5.3. Analysis of Major Sources of Risk
5.4. Effective Management of Project Risk.
- Risk Management planning
- Risk Identification
- Qualitative and Quantitative Risk Analysis
- Risk Response Planning
- Risk Monitoring and Controlling

6. Introduction to Project Financing [5 hours]

6.1. Project finance
6.2. Capital Structure Planning
6.3. Capital Budgeting Decision.

Tutorials:

1.	Writing project Proposal	[2 hours]
2.	Scheduling Using Bar chart & CPM	[4 hours]
3.	Scheduling Using Planning Software	[4 hours]
4.	Project Control Method (EVA)	[1 hour]
5.	Capital Structure Planning Exercise	[2 hours]
6.	Capital Budgeting Exercise	[2 hours]

References:

1 Ishwar Adhikari and Santosh Kr. Shrestha, “A text of Project Engineering” 2011, Chandeshwori Publication, First Edition.
2 Dhurba P.Rizal, “Project Management” 2001, Ratna pustak bhandar, First Edition.
3 E.R. Yescombe, “Principles of Project Finance” 2002, Yescombe-Consulting Limited.
4 K. Nagarajan, “Project Management”, ISBN: 81-224-1340-4, New Age International (P) Limited, New Delhi, India, 2001.
5 Dr. Govinda Ram Agrawal, “Project Management in Nepal” Edition: 2006, M.K. Publishers and Distributors, Kathmandu, Nepal.

Evaluation Scheme:

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

Chapters	Hours	Marks Distribution*
1	6	10
2	8	12
3	12	24
4	7	12
5	7	12
6	5	10
Total	45	80

* There may be minor deviation in marks distribution.

AGRICULTURAL ENGINEERING PROJECT (PART I)
AE …

Lecture : 0 **Year : IV**
Tutorial : 0 **Part : I**
Practical : 3

Course Objective:
The objective of Agricultural Engineering Project work is to provide the students opportunity of hands-on skill development and practical learning involving design, development, fabrication, testing and evaluation and its exploitation on Agricultural Engineering problems pertaining to any one specializing areas. At least 4 students shall be in a group for one project and each group will be under the guidance of a team of specialized faculty member/s designated by the Agricultural Engineering Department. A task at the beginning of fourth year shall be assigned to the group. It will be completed within the due date. A project report, in prescribed format, requires to submit on due date to the department.

The basic work of Agricultural Engineering Project (Part A) is to expose the students to preparation and presentation of technical papers and reports on a technical forum, on the issues pertaining to Agricultural Engineering Project (Part B) that shall be completed in fourth year part II. In first part of Project Work each group of students shall prepare a project proposal. The project proposal shall be presented by the group of students in the technical forum or department. After presentation of the seminar they will be required to prepare and submit a final project proposal to the department.
Faculty and guest speakers shall be invited to present seminar on topics/issues relevant to Agricultural Engineering to enhance the project work.

Evaluation Scheme:
The evaluation of the project work shall be done as under:

S. N.	Particulars	Marks Distribution
1	Project proposal preparation and submission	10
2	Seminar Presentation	15
3	Preparation and submission of project report up to methodology etc.	25
Total		50

Elective I

PLANNING AND DESIGN OF SURFACE IRRIGATION SYSTEM
AE ...

Lecture : 3 **Year : IV**
Tutorial : 1 **Part : I**
Practical : 1.5

Course Objective:
To familiarize and orient the students in theory, planning, technological development and management in engineering problem solving in the area of surface irrigation system.

1. Introduction [2 hours]
- 1.1. Classification of Irrigation System
- 1.2. Comparison of Irrigation System and Their Relative Merits
- 1.3. Selection of Irrigation System

2. Surface Irrigation System [5 hours]
- 2.1. Estimation of Water Requirement of Selected Command Area
- 2.2. Delta, Base Period, Duty and Their Relationship
- 2.3. Factors Affecting Canal Duty
- 2.4. Classification of Canals and Canal Network
- 2.5. Nomenclature and Terminology Used in Canal Distribution System

3. Planning Canal Irrigation System [3 hours]
- 3.1. Considerations in Canal Alignment
- 3.2. Curves in Canals
- 3.3. Optimal Layout of Canal Network
- 3.4. L-Section in Canal Network

4. Design of Irrigation Channels [7 hours]
- 4.1. Design Based on Maximum Permissible Velocity
- 4.2. Kennedy's Silt Theory and Kennedy's Method of Channel Design
- 4.3. Silt Carrying Capacity by Kennedy's Theory
- 4.4. Limitations of Kennedy's Theory
- 4.5. Lacey's Regime Theory and Shock Concept
- 4.6. Lacey's Theory Applied to Channel Design
- 4.7. Comparison of Lacey's and Kennedy's Theory
- 4.8. Garret's and Lacey's Diagram Applied to Channel Design
  - 4.8.1. Components of Canal Cross-Section: Side Slope, Berm,
    - 4.8.1.1. Free Board, Bank Width, Barrow Pit, Spoil Bank
- 4.9. Lining of Irrigation Channels, Types of Lining,
  - 4.9.1. Comparison of Different Lining Materials
- 4.10. Design of Lined Canals
- 4.11. Maintenance of Irrigation Channels

5. Underground Pipe Line Conveyance [7 hours]
- 5.1. Purpose and Advantage
- 5.2. Materials of Underground Pipe Line and their Properties
- 5.3. Design of Underground Pipeline:
  - 5.3.1. Design Velocities
  - 5.3.2. Pipe Diameter
  - 5.3.3. Frictional Head Loss
  - 5.3.4. Design of Pump Stand
  - 5.3.5. Surge and Water Hammer Protection
  - 5.3.6. Air Vents
- 5.4. Ancillary Structures and Devices in Underground Pipeline
- 5.5. Installation of Underground Pipeline

6. Hydraulic Structures in Surface Irrigation System [12 hours]
- 6.1. Headworks:
  - 6.1.1. Components of Headworks
  - 6.1.2. Types of Diversion Works
  - 6.1.3. Types of Weirs and their Location
  - 6.1.4. Consideration in Weir Design
- 6.2. Head and Cross Regulators:
  - 6.2.1. Purpose and Location of Head and Cross Regulators
  - 6.2.2. Design Considerations
- 6.3. Sediment Control and Exclusion Devices:
  - 6.3.1. Sediment Control and Exclusion at Headworks
  - 6.3.2. Design Criteria for Sediment Excluders
- 6.4. Canal Drops and Drop Structures:
  - 6.4.1. Types of Drops and Their Selection
  - 6.4.2. Design Principle of Drop Structures
- 6.5. Cross-Drainage Works:
  - 6.5.1. Purpose and Types of Cross-Drainage Works
  - 6.5.2. Selection of Cross Drainage Works
  - 6.5.3. Design Considerations
- 6.6. Canal Outlets:
  - 6.6.1. Types- Modular, Semi-Modular and Non-Modular with their Salient Features
  - 6.6.2. Parameters Governing Behaviour of outlets
  - 6.6.3. Design Consideration in Canal Outlet

7. Land Development [7 hours]

7.1. Purpose and Importance of Land Development in Command Area
7.2. Land Grading and Farm Layout
7.3. Consolidation of Land Holding and Its Importance
7.4. Conjunctive Use- Concept and Scope
7.5. Integrated Development of Command Area

8. Preparation of Project Plan for Command Area [2 hours]

Practical:

1. Selection of Optimal Cropping Pattern Based on Soil and Climatic Condition [1.5 hours.]
2. Estimation of Water Requirement of Selected Cropping Pattern for Given Command Area [1.5 hours.]
3. Use of CROPWAT model by FAO for irrigation scheduling [3 hours.]
4. Delineation of Optimal Canal Alignment on Topographical Map of Given Command Area [3 hours.]
5. Design of Canal Conveyance System for given Command Area [3 hours.]
6. Design of Underground Pipe Line for Given Command Area [3 hours.]
7. Design of Canal Outlet [1.5 hpurs.]
8. Preparation of Rotational Schedule for Given Canal Outlet [1.5 hours.]
9. Design Problems on Land Grading and Farm Layout [2 hours.]

References:

1. Michael, A.M. Irrigation Theory and Practice. Vikash Publishing House, New Delhi.
2. Irrigation Principles and Practices by O.W. Israelson and V.E. Hensen. John Wiley & Sons.
3. L.G. James Farm Irrigation System Design. John Wiley & Sons, New York (latest edition
4. Reddi, T. Yellamanda & Reddi, G.H. Sankara. Efficient Use of Irrigation Water (1995)
5. R. Lal. Irrigation Hydraulics
6. S.K. Garg. Irrigation Engineering and Hydraulic Structures. Khanna Publishers, New Delhi (8 copies)
7. J.N. Luthin. Drainage Engineering. Wiley Eastern Pvt. Ltd. New Delhi.
8. International Course on Land Drainage. Drainage Principles and Applications, Vol. I to IV. International Land Reclamation Institute (ILRI), Wakhningen, the Netherlands.
9. Walker, W.R. and G.V. Skogerboe. Surface Irrigation: Theory and Practice. Prentice-Hall Inc. USA
10. Irrigation Engineering. R. K. Sharma and T. K. Sharma. S. Chand & Co., New Delhi.
11. Bruce Withers and Stanley Vipond, B T Batsford limited, London, WiHoAH, Irrigation: Design and Practice.
12. Herman J Finkel, CRC Press Inc, Florida, CRC Handbook of Irrigation Technology.
13. Larry G James, John Wiley and Sons, Principals of farm irrigation system design.

Evaluation Scheme:

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

Chapters	Hour	Marks Distribution*
1	2	4
2	5	8
3	3	4
4	7	12
5	7	12
6	12	24
7	7	12
8	2	4
Total	45	80

*****There may be minor variation in marks distribution

WATERSHED MANAGEMENT AND PLANNING
AE …

Lecture : 3 **Year : IV**
Tutorial : 1 **Part : I**
Practical : 1.5

Course Objective:
To familiarize and orient the students in planning, management and development of engineering problem solving technology related to the watershed management.

1. Introduction and Concept of Watershed Management [7 hours]
- 1.1. Definition and Classification of Watershed
- 1.2. Delineation of Watershed Boundary
- 1.3. Geomorphological Characteristics of Watershed
- 1.4. Coding of Watershed
- 1.5. Analysis of Watershed: Shape, Size, Drainage Network and Relief
- 1.6. Watershed as a Planning and Management Unit

2. Land Capability Classification [5 hours]
- 2.1. Importance and Application of Land Capability Classification
- 2.2. Land capability classification scheme
- 2.3. Land capability Sub-classes and units
- 2.4. Interpretation and use of land capability maps
- 2.5. Identification of land capability classes in the field

3. Runoff and Water Yield of Watershed [6 hours]
- 3.1. Runoff process
- 3.2. Runoff measurement- velocity, area and slope area methods
- 3.3. Runoff measuring devices- notch, orifice, flume
- 3.4. Empirical methods in runoff estimation:
  - 3.4.1. Rational method
  - 3.4.2. Cook's method
  - 3.4.3. SCS curve number method
- 3.5. Stage discharge relationship
- 3.6. Estimation of watershed yield

4. Sedimentation [6 hours]
- 4.1. Sediments
- 4.2. Sediment transport in stream flow
- 4.3. Types of sediment load
- 4.4. Assessment of sediments load:
  - 4.4.1. Types of sediment samplers
  - 4.4.2. Location and frequency of sampling
  - 4.4.3. Sediment observation posts- location and observation
  - 4.4.4. Analysis of sediment samples
- 4.5. Estimation of sediment yield of watershed

5. Reservoir Sedimentation [4 hours]
- 5.1. Distribution of sediments in reservoir
- 5.2. Prediction of sediment distribution
- 5.3. Factors affecting silting of reservoir
- 5.4. Rates of reservoir sedimentation
- 5.5. Reservoir sedimentation control

6. Evaluation of Land Degradation and Trends [5 hours]
- 6.1. Definition of land degradation
- 6.2. Causes of land degradation:
  - 6.2.1. Natural causes
  - 6.2.2. Man made causes
  - 6.2.3. Socio - economic factors
- 6.3. Forms of land degradation
  - 6.3.1. Physical degradation
  - 6.3.2. Chemical degradation
  - 6.3.3. Productivity loss
  - 6.3.4. Vegetation degradation
- 6.4. Assessment of Land Degradation
- 6.5. Visual methods for identifying signs of soil erosion and productivity loss

7. Watershed Management Planning [7 hours]
- 7.1. Sub-watershed and micro-watershed prioritization
- 7.2. Concept of Integrated Watershed Management planning
- 7.3. Data needs for Watershed Management plan:
  - 7.3.1. Hydro-meteorological data
  - 7.3.2. Geological and Geomorphological data
  - 7.3.3. Agricultural Data
  - 7.3.4. Socio-economic data
- 7.4. Synthesizing watershed information into a coherent plan
- 7.5. Formulation of project proposal

8. Watershed management works [5 hours]
- 8.1. Factors affecting watershed management
- 8.2. Watershed management Practices

8.3. Steps in watershed management
8.4. Monitoring and evaluation of watershed management works

Practical

1. Delineation of watershed boundary using topographical maps and aerial photographs and determination of geographical characteristics of watershed [1.5 hours]
2. Preparation of slope map [1.5 hours]
3. Identification of data needs and hydro- meteorological gauging of watershed [1.5 hours]
4. Runoff gauging and Estimation of water yield [3 hours]
5. Sediment Gauging and Analysis [3 hours]
6. Compilation of geological, hydrological, meteorological, land system, land use, soil, agricultural and socio- economic information of a watershed [3 hours]
7. Socio- economic questionnaire design and survey [3 hours]
8. Prioritization of watershed for conservation and protection [3 hours]

References

1. Suresh R. Soil and Water Conservation Engineering.2002. Standard Publishers and Distributors, New Delhi
2. V.V Dhruvanarayana, G. Shastri and U.S. Patnaik. Watershed management. Indian Council of Agricultural Research(ICAR)
3. G. Singh, C. Venkataraman. G. Shastri and B.P. joshi. Manual of soil and water Conservation practices. Oxford and IBH publishing Co. Ltd. New Delhi
4. Tideman E.M. 1999.Watershed Management (Guideline for Indian Conditions). Omega publishing house, New Delhi.
5. Singh Rajir. 2000. Watershed planning and management. Yash publishing House, Bikaner.
6. Lal, R. 1996. Methods and guidelines for assessing sustainable use of soil and water resources in the tropics. Jagmander book agency, Karol bagh, New Delhi.
7. Dhaliwla G.S., Hansa, B.S. and ladhar S.S. 1993. Wetlands their conservation and management. Punjab agricultural university, Ludhiana.
8. Murty V.V.N and takeuchi, D.K. 1997. land and water development for agriculture in Asia- pacific region. Oxford and IBH publishing co. New Delhi.
9. Wasshiullah, gupta S.K. and dalal S.S. Hydrological measurements for watershed research. Jugal kishore and co. Dehradun.
10. Bruce J.P. and Clark R.H. (latest edition). Introduction to hydrometeorology, pergamon press, London.
11. Chow V.T. (ed) 1988. Handbook of applied hydrology McGraw Hill Book Co.

Evaluation Scheme:

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

Chapter	Hours	Marks distribution*
1	7	12
2	5	8
3	6	12
4	6	12
5	4	8
6	5	8
7	7	12
8	5	8
1	**45**	**80**

*There may be minor variations in marks distribution

FARM MACHINERY DESIGN
AE …

Lecture : 3 **Year : IV**
Tutorial : 1 **Part : I**
Practical : 1.5

Course Objective:
To familiarize and orient the students in theory, planning, designing, technological development, modification and exploitation of small and medium scale farm machinery.

1. Introduction to Design Parameters and Procedure [3 hours]
- 1.1. Principles of Agricultural Machine Design
- 1.2. Design Parameters: Force, Stress, Reliability, Factor of Safety, Limit, Fit and Tolerances
- 1.3. Farm Machinery Design Procedure:
  - 1.3.1. Recognition and Identification of Need
  - 1.3.2. Definition of Problem
  - 1.3.3. Information on Functional Requirements
  - 1.3.4. Modeling and Simulation
  - 1.3.5. Prototype and Its Performance

2. Material of Construction for Agricultural Machinery, their Composition and Heat Treatment Process [2 hours]
- 2.1. General Properties of Critical Components of Farm Machinery
- 2.2. Material Selection Criteria

3. Force Analysis on Tillage Tools and Hitching System [6 hours]
- 3.1. Introduction
- 3.2. Forces Acting on Tillage Implement
- 3.3. Measurement of Soil Resistance
- 3.4. Vertical Effects of Hitching
- 3.5. Horizontal Effects of Hitching
- 3.6. Design Considerations of Hitches
- 3.7. Hitch System Design

4. Design and Selection of Power Transmission Components in Agricultural Machines [4 hours]
- 4.1. Introduction
- 4.2. V-belt, Chain, Rope, Gear, Shaft, Hydraulic Drives and Joints
- 4.3. Capacities of Agricultural V-belts and Chain Drives
- 4.4. PTO Drives
- 4.5. Telescopic Shaft

5. Safety Aspects in the Design of Agricultural Machines [2 hours]
- 5.1. Introduction
- 5.2. Safety Factors- Concept and Application
- 5.3. Overload Safety Devices

6. Design Methods of Mould Board Plough [5 hours]
- 6.1. Types of Mould Board Plough
- 6.2. Design of Frontal Plan
- 6.3. Design of Cylindrical, Cylindroidal, and Semi-Helical Type Mould Board
- 6.4. Standard Dimension of Plogh Share and Landside

7. Design Methods of Disk Implements [4 hours]
- 7.1. Introduction to Disk Tools and Their Design Considrations
- 7.2. Design of Disk Tools for Disk Harrow and Disk Plough
- 7.3. Spacing in Multi Disk Implements
- 7.4. Determination of Loads for Design of Standard
- 7.5. Selection of Bearings

8. Design Methods of Cultivators [3 hours]
- 8.1. Types of Cultivators and Their Applications
- 8.2. Design of Soil Engaging Tools in Cultivators- Shovel, Sweep
- 8.3. Design of Shank

9. Design Methods of Rotary Tillage Machines [4 hours]
- 9.1. Action of Rotary Tillage Machines
- 9.2. Soil Reactions in Rotary Tillage Tools
- 9.3. Design Considerations for Rotavator Blades
- 9.4. Rotavator Blade Arrangement and Configuration

10. Design Methods of Sowing and Planting Implements [4 hours]
- 10.1. Design Parameters of Sowing and Planting Implements
- 10.2. Design of Seed Metering Mechanism
- 10.3. Types of Furrow Openers and Covering Devices
- 10.4. Design Considerations for Furrow Openers
- 10.5. Design Considerations for Seed and Fertilizer Box and Frame

11. Design Methods of Reaper [3 hours]
- 11.1. Types of Reaper and their Functional Requirements
- 11.2. Components of a Vertical Conveyor Reaper
- 11.3. Design and Selection of Different Components of a Vertical Conveyor Reaper

11.4. Design Considerations and Selection of Conveyors in Harvesting Machines

12. Design Methods of Threshers [5 hours]

12.1. Types of Threshers and Their Components
12.2. Bond between Grain and Spike
12.3. Parameters of Thresher drum- length, diameter, speed, teeth arrangement
12.4. Selection of Drum
12.5. Drum-Concave Clearance
12.6. Design of Feeding Chute
12.7. Cleaning Sieves and their Design Considerations
12.8. Thresher Adjustments

Tutorials and Practicals:

1. Design Problem on Force Analysis of Tillage Tools and Hitching System
2. Design Problems on Mould Board Plough
3. Design Problems on Disk Implements
4. Design Problems on Cultivators
5. Design Problems on Rotary Tillage Implements
6. Design Problems on Sowing and Planting Equipments
7. Design Problems on Vertical Conveyor Reaper
8. Design Problems on Rice and Wheat Threshers

References:

1. D. N. Sharma and S. Mukesh. 2008. Farm Machinery design: Principles and Problems. Jain Brothers, New Delhi (Latest Edition).

2. H. Bernacki, J. Haman and Cz Kanafojski. 1985. Agricultural Machines: Theory and Construction. Vol. I & II. US Department of Commerce. National Technical Information Service.

3. Bainer R., Kepner, R.A. and Barger E. L. Principles of Farm Machinery. John Wiley & Sons Publications (latest edition-Indian/Low Cost Edition Preferred)

4. Agricultural Machinery Design and Data Hand Book (Seeders and Planters). 1991. Regional Network of Agricultural Mechanization (RNAM), Philippines.

5. Wilkinson, Robert H. and Braunbeck, Oscar A. 1997. Elements of Agricultural Machinery (Vol. I). FAO, Rome

6. Crossley, P. and Kilgour J. 1983. Small Farm Mechanization for Developing Countries. John Wiley & Sons, New York (latest edition- Indian/Low Cost Edition Preferred)

7. Krutz, G., Thomson L. and Claar P. 1984. Design of Agricultural Machinery. John Wiley & Sons, New York (latest edition- Indian/Low Cost Edition Preferred)

8. Klenin, N.I., Popov I. F. and Sakun V.A. 1985. Agricultural Machines. Amerind Publishing Co. Pvt. Ltd.(latest edition- Indian/Low Cost Edition Preferred)

9. Sineokov. G.N. Design of Soil Tillage Machines. Indian National Scientific Documentation Center, New Delhi.

10. FAO Bulletin on Agricultural Engineering Development: Selection of Mechanization Inputs. FAO Agricultural Service, Rome.

Evaluation Scheme:

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

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

*****There may be minor variation in marks distribution

BIO-ENERGY TECHNOLOGIES
AE …

Lecture : 3 **Year : IV**
Tutorial : 1 **Part : I**
Practical : 1.5

Course Objective:
The primary objective of this course is to introduce bio-energy sources and their conversion methods used for the fulfillment of requirement of energy in Agricultural Engineering activities in rural areas. Secondly the course emphasizes in design and development of such rural technologies that converts rural bio-energy sources into usable form and supply it to operate tools, equipments and machineries used in agricultural works.

1. Bio-mass Energy [4 hours]
- 1.1. Introduction to bio-mass energy
- **1.2.** Characteristics of Bio-energy Resource
- 1.3. Classification of Bio-energy Resource
  - 1.3.1. Woody Biomass, Noon-woody, Solid bio-mass
  - 1.3.2. Animal and Human Bio-Wastes, Bio-Degradable Materials, Animal and Human Energy
- 1.4. Bio-energy Availability and Estimation:
  - 1.4.1. Estimation of Wood fuel Availability
  - 1.4.2. Estimation of Agricultural residues
  - 1.4.3. Estimation of Animal and human Bio-wastes
  - 1.4.4. Estimation and Availability of Animal and Human Energy

2. Bio-mass Energy Conversion [5 hours]
- 2.1. Physical Conversion- Drying, Pulverization, densification
- 2.2. Chemical Conversion- Acid Hydrolysis, fermentation, Distillation
- 2.3. Bio-chemical Conversion- Anaerobic Digestion, Ethanol-Fermentation,
  - 2.3.1. Vermin-composting
- 2.4. Thermo-chemical Conversion - Combustion, Pyrolysis, Gasification, Liquefaction

3. Wood Energy Technology [8 hours]
- 3.1. Properties of fuel Wood
  - 3.1.1. Physical Properties
  - 3.1.2. Chemical Properties
  - 3.1.3. Thermal Properties and Thermal behavior of fuel wood
- 3.2. Wood Energy Conversion Process:
  - 3.2.1. Thermo- chemical conversion pathways
  - 3.2.2. Thermal behavior of fuel wood-heat release and moisture content
  - 3.2.3. Heat release rate and air flow, heat releases rate and feed rate
- 3.3. Wood stove
  - 3.3.1. Parameters controlling performance of wood stove
  - 3.3.2. Design consideration for fuel electric cook stoves
  - 3.3.3. Performance of improve cook stove program in Nepal

4. Bio- gas Technology [8 hours]
- 4.1. Anaerobic digestion process
  - 4.1.1. Bio- chemical process in anaerobic digestion
  - 4.1.2. Stage of anaerobic digestion process
  - 4.1.3. Factors affecting microbial activities
  - 4.1.4. Optimal environment or anaerobic digestion
- 4.2. Consideration in bio-gas plant design
  - 4.2.1. Types of anaerobic digestion
  - 4.2.2. Site selection
  - 4.2.3. Size of bio-gas plant
  - 4.2.4. Construction of bio-gas plant.
- 4.3. Bio-gas plants for cold climate
  - 4.3.1. Treatment of bio-gas plants for cold climate
  - 4.3.2. High altitude bio-gas reactor
  - 4.3.3. Integrated bio-gas systems

5. Bio-mass Gasification Technology [8 hours]
- 5.1. Principle of Bio-mass gasification
  - 5.1.1. Process and pathway
  - 5.1.2. Operating parameters
  - 5.1.3. Effects of feedstock on gasification process
  - 5.1.4. Constituents of producer gas
- 5.2. Types of bio-mass gasification
  - 5.2.1. Updraft gas producer
  - 5.2.2. Downdraft gas producer
  - 5.2.3. Cross flow gas producer
  - 5.2.4. Twin fire gas producer
  - 5.2.5. Comparison of performance of gasifiers
- 5.3. Producer gas drive engine
  - 5.3.1. Conditioning gas producer
  - 5.3.2. Conversion of gasoline and diesel engine to produce gas
  - 5.3.3. Performance of gasifiers engine system

6. Bio-diesel [8 hours]

6.1. Oil producing plant of Nepal
6.2. Chemical properties of vegetable oils
6.3. Oil extraction and processing technology
  6.3.1. Mechanical extraction
  6.3.2. Moisture removal
  6.3.3. Solvent extraction
  6.3.4. Oil refinement techniques
6.4. Application of bio-diesel
  6.4.1. Forms of bio-diesels
  6.4.2. Problem due to thermal instability
  6.4.3. Application of IC engines
  6.4.4. Power speed relationship of IC engines with bio-diesel

7. Animals and Human Energy [4 hours]

7.1. Characteristics of animal and human energy
  7.1.1. Contribution of animal and human energy
  7.1.2. Estimation of animal and human energy
7.2. Bio-mechanics of animal and human energy conversion
  7.2.1. Bio-mechanics of animal power harnessing system
  7.2.2. Bio-mechanics of human power harnessing

Practical:

1. Evaluation of energy value of wood fuel for different plant species
2. Comparison of energy values of fuel wood, agriculture residues, bio-briquettes and other bio-fuels
3. Comparison of performance of different types of fuel stoves
4. Vegetable oil extraction by solvent distillation process
5. Evaluation of physic-chemical properties of bio-diesel
6. Design calculation for cattle dung based bio-gas reactor
7. Biomass gasification design calculation

References:

1. K. M. Mittal. Biomass Systems: Principle and Applications. New Age International Pvt. Ltd., New Delhi (Latest Edition)
2. B. T. Nijaguna. Biogas Technology. New Age International Pvt. Ltd., New Delhi (Latest Edition)
3. Journals and Publications of American Society of Agricultural and Biological Engineers (ASABE) on Biogas Technology
4. FAO Journals on Biomass Combustion Technologies.
5. FAO Journals on Energy Conversion and Renewable Energy for Greenhouse Heating
6. ASTM and ISI Standards

Evaluation Scheme:

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

Chapter	Hour	Marks Distribution*
1	4	15
2	5	
3	8	15
4	8	15
5	8	15
6	8	15
7	4	5
Total	45	80

*There may be minor variation in marks distribution.

RURAL ENGINEERING AND INFRASTRUCTURE
AE …

Lecture : 3 **Year : IV**
Tutorial : 2 **Part : II**
Practical : 0

Course objective:
This course provides students a basic knowledge about rural road, rural water supply and sanitation. The first & second topics of this course are aimed to provide the students a basic concept about road planning, with special emphasis on green road, cross drainage structures & retaining structures, basic concept on geometric design, bio-engineering techniques and highway maintenance. The third topic is about suspended bridge. The fourth and fifth topics deal with rural water supply, and the sixth topic deals with solid waste management and septic tank design.

1. Introduction [1hour]
- 1.1. Definition and Scope of the Subject
- 1.2. Transportation System Classification
- 1.3. Advantage and Disadvantages of Road Transportation System

2. Rural Roads with Green Road Concepts in Nepal [16 hours]
- 2.1. Rural Road Planning:
  - 2.1.1. Road Classification: Types of roads: Rural road, National highway, Feeder road, District road, Village road
  - 2.1.2. Approach to rural road planning
  - 2.1.3. Existing policies and strategies on rural roads in Nepal.
  - 2.1.4. Problems at different stage for road planning in Nepal
- 2.2. Green Road Concepts:
  - 2.2.1. Introduction
  - 2.2.2. Core Principals and Basic Principles
  - 2.2.3. Planning
  - 2.2.4. Implementation Arrangements
  - 2.2.5. Construction Technology
  - 2.2.6. Maintenance and Rehabilitation
- 2.3. Geometric Design:
  - 2.3.1. Importance of geometric design, Basic design criteria
  - 2.3.2. Parameters and Standards
  - 2.3.3. Introduction to Design speed, Camber, Superelevation, & Extra widening.
  - 2.3.4. Pavement- types and difference between Flexible & Rigid pavement.
  - 2.3.5. Traffic lane capacity
  - 2.3.6. Curves: Simple circular and Transition curves
  - 2.3.7. Axle loads
  - 2.3.8. Horizontal and Vertical alignments
  - 2.3.9. Cut and fill including mass balance
  - 2.3.10. Flexible pavement design using GI and CBR methods
  - 2.3.11. Numerical on Geometric Design
- 2.4. Cross Drainage Structures
  - 2.4.1. Introduction
  - 2.4.2. Water management of dispersed and concentrated flows
  - 2.4.3. Pipe culvert
  - 2.4.4. Slab culvert
  - 2.4.5. Arch culvert
  - 2.4.6. Box culvert
  - 2.4.7. Scoopers
  - 2.4.8. Flood Crossways
  - 2.4.9. Road side drainage
  - 2.4.10. Dry Stone Masonry, Crossways and Fords
- 2.5. Road side Retaining Structures
  - 2.5.1. Introduction
  - 2.5.2. Rip-rap Protection (stone pitching)
  - 2.5.3. Dry Stone Masonry
  - 2.5.4. Gravity Walls and Composite Masonry Walls
  - 2.5.5. Gabion Walls
  - 2.5.6. Simple RCC Walls
  - 2.5.7. Revetment Walls
- 2.6. Bio-Engineering Measures:
  - 2.6.1. Introduction
  - 2.6.2. Bio-Engineering Functions
  - 2.6.3. Stabilizing Slopes with Bio-Engineering
  - 2.6.4. Bio-Engineering Techniques
  - 2.6.5. Use of Bio-Engineering Techniques for slope stabilization
- 2.7. Highway Maintenance:
  - 2.7.1. Failure of Pavement
  - 2.7.2. Classification of maintenance
  - 2.7.3. Maintenance of Earth road, Gravel road, Water-bound macadam
  - 2.7.4. road, and Bituminous Pavement.

3. Suspended Bridge [4 hours]
- 3.1. Introduction to Bridge and Culvert
- 3.2. Types of Bridge: Suspension and Suspended Bridge,

3.2.1. Deck and Slab Bridge, Truss Bridge, Wooden Log Bridge
3.3. Site selection criterion for Suspended Bridge
3.4. Introduction to Trail Road

4. Rural Water Supply [16 hours]

4.1. Introduction:
4.1.1. Objectives of Water Supply
4.1.2. Impacts of Water Supply Scheme
4.1.3. Water Right Problems
4.1.4. Major Works in a Water Supply Scheme
4.2. Sources of water supply: Surface, Ground, Precipitation & Water Reclamation
4.3. Brief Introduction to different sources of water - spring, Stream, River, Well (Dug well, Tube well and Artesian well) and Lake.
4.3.1. Numerical on reservoir capacity
4.4. Selection of source
4.5. Estimation of quantities of Rural Water Supply
4.5.1. Water Demand
4.5.2. Types of Demand
4.5.3. Variation in Water Demand
4.5.4. Factors affecting Water Demand
4.5.5. Population Forecast (Arithmetical Increase Method, Geometrical Increase Method and Incremental Increase Method)
4.5.6. Numerical on water demand and population forecast
4.6. Quality consideration in Rural Water supply:
4.6.1. Types of Impurities and their Remedial Measures
4.6.2. WHO Guide Line for Drinking Water Quality
4.7. Water Treatment Methods:
4.7.1. Analysis of water
4.7.2. Purpose of water analysis
4.7.3. Introduction to different treatment methods:
4.7.3.1. Screening – Coarse screen and Fine screen
4.7.3.2. Sedimentation – Plain sedimentation and Sedimentation with coagulation
4.7.3.3. Filtration: Slow Sand Filter, Rapid Sand Filter (Introduction only)
4.7.3.4. Disinfection – Methods, Chlorination, Breakpoint Chlorination, Disinfectant Residuals
4.7.3.5. Miscellaneous Treatments – Aeration and Softening (Introduction only)
4.7.4. Numerical on Plain Sedimentation and Chlorine Dose
4.8. Intake Works:
4.8.1. Definition
4.8.2. Site selection for an intake
4.8.3. Types of Intake - Brief description to River, Reservoir and Spring Intake.
4.9. Reservoir and Distribution system:
4.9.1. System of Supply and Method of Supply
4.9.2. Types of reservoir
4.9.3. Numerical on Balancing Reservoir
4.10. Pipes and Pipe-fittings in distribution system

5. Introduction on water tanks [4 hours]

5.1. Ferro-cement tank
5.2. Masonry and RCC tanks

6. Waste disposal and Management [4 hours]

6.1. Rural Sanitation
6.1.1. Introduction
6.1.2. Collection and disposal of dry refuse and sullage
6.1.3. Disposal of night soil
6.1.4. Design of Simple Pit Latrine, VIP Latrine, Pour-flush Latrine, Septic Tank and Soak pits.
6.1.5. Numerical on septic tank & soak pit
6.2. Solid waste Generation and Collection
6.2.1. Introduction
6.2.2. Classification of solid waste
6.2.3. Composition and quality of solid waste
6.2.4. Solid Waste disposal by Landfill and Composting

Tutorials:

1. Design of Rural Roads with the help of contour maps
2. Design of Rural Water Supply scheme
3. Design of Septic Tank and Soak-pit
4. Design and layout of pipe line for domestic water supply system

Visit:

1. One day visit to nearby water supply source and office.
2. One day visit to nearby hill road.

References:

1. Transportation Engineering by VN Vazrani and SP Chandola
2. Green Road Manuals by GTZ, Nepal
3. Suspended and Suspension Bridge Manuals by HELVETAS & DOR, Nepal
4. Road side bio-engineering hand book, DOR, Nepal Government.
5. Water supply Engineering by Dr. P.N. Modi
6. Water Supply and Sanitation by B.C. Punmia
7. Highway Engineering by S.K. Khanna & C.E.G. Justo
8. NRS (Nepal Road Standards)
9. Principals and practices of Highway Engineering by L. R. Kadyali & N. B. Lal
10. Gravity Flow Water Supply System - GTZ, and UNICEF Publications.

Evaluation Scheme:

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

Chapter	Hours	Marks Distribution*
1	1	32
2	16	
3	4	8
4	16	24
5	4	8
6	4	8
Total	45	80

* Minor deviation on mark distribution can be made.

FIELD/INDUSTRIAL TRAINING
AE …

Lecture : 0 **Year : IV**
Tutorial : 0 **Part : II**
Practical : 4 week

Course Objective:
The Purpose of Field/Industrial Training is to expose the students to the real life and field based works in the areas relevant to Agricultural Engineering and Technology.
A group of students shall be attached to appropriate industry/s and institute/s where they shall be required to accomplish tasks decided mutually by faculty members in Agricultural Engineering at IOE and personnel from collaborating industry/institutions. As far as practicable students shall be given option to select the industries or agencies depending upon their choice for elective subjects.

The field/industrial training shall be scheduled during winter/summer vacation and the total duration of the field/industrial training shall be 4 weeks.

Evaluation Scheme:
The evaluation scheme shall be as under:

S. N.	Hours	Marks Distribution
1	Attendance, participation and completion of training (to be evaluated by personnel from collaborating industry/institutions and guide teacher nominated by IOE)	20 (as assessment)
2	Preparation and Submission of Field/Industrial Training Report to the Department	10
3	Viva –Voce/Seminar Presentation	20
	Total	50

AGRICULTURAL EXTENSION EDUCATION & RURAL DEVELOPMENT

AE …

Lecture : 3 **Year : IV**
Tutorial : 1 **Part : II**
Practical : 1.5

Course Objective:

- To familiarize students with agricultural extension education, learning principle, leadership development, extension delivery system for the dissemination of agricultural engineering technologies.
- To acquaint the students on the concept of rural development, it's planning, monitoring and evaluation tools.

Part – A

1. **Education and its approaches** **[2 hours]**
   Meaning, concept and types of education and its objective in national context: Formal, non formal and informal education.
2. **Extension education** **[2 hours]**
   Definition, concept, history, philosophy, principle of extension education and objective of extension education.
3. **Basic learning principle and adult learning** **[4 hours]**
   Meaning of teaching and learning, concepts and laws of learning, basic learning theories and learning process, principles of adult learning and learner's characteristics, factors affecting adult learning and elements of effective learning.
4. **Rural leadership development** **[3 hours]**
   Meaning, types of leader and leadership, characteristics of good leader, methods of identifying leader, selection and development of local leaders.
5. **Extension delivery system and its components** **[2 hours]**
   present organization, approach of extension delivery system in Nepal.
6. **Extension teaching methods** **[2 hours]**
   Individual method, group method and mass media methods.
7. **Communication** **[4 hours]**
   Concept, definition, meaning and importance of communication in extension work, function of communication with its models, communication channel/media; organizational communication in agricultural development, audio aids, visual aids, audio-visual aids and other teaching aids.

Part – B

8. **Nature and scope of rural development** **[3 hours]**
   concept of rural development, subject matter of rural development, importance of rural development, problems of rural development and indicators of rural development.
9. **Determinants of rural developments** **[3 hours]**
   Natural resources, human resources, financial resources, technology, rural industries, rural governance and regional dimensions and socio-cultural dimensions.
10. **Basic issues of rural development** **[3 hours]**
    Leadership in rural development, rural poverty and right based approach to development, empowerment, gender issues, globalization, social inclusion and exclusion.
11. **Rural economic structure of Nepal** **[4 hours]**
    Agrarian structure, land tenure system, agrarian movement, and rural industries: small and cottage industries; infrastructure: roads, communications, irrigation and electrification; rural market-types and channel, rural indebtedness and institutional finance, entrepreneurship and informal sector, village tourism.
12. **Institutions for rural development in Nepal** **[3 hours]**
    Government institution: ministry of local development and ministry of women development (functions and programmes), private sector: corporate social responsibility, private voluntary organizations (PVOs) - their objectives and features, social organizations, self- help groups, civil societies, NGOs, CBOs - their objectives and features.
13. **Rural development planning** **[1hour]**
    Concept, need for micro planning, elements of micro planning
14. **Approaches of rural development** **[2 hours]**
    The modernization theory or market: led approach dependency theory, participatory theory
15. **Planning tools and techniques for rural development** **[4 hours]**
    Process for local level plan formulation, data collection for project formulation- primary and secondary, tools and techniques: participatory rural appraisal (PRA), rapid rural appraisal (RRA), participatory learning and action (PLA) and focus group discussion (FGD)
16. **Implementation, monitoring and evaluation of rural development** **[3 hours]**
    Project implementation - process and basic elements of implementation plan, project monitoring - purpose and process; project evaluation - objectives and methods (before and after, with and without)

Practical

1. Visit the different agricultural extension organization (ADO, DLDO, NGOS Corporative) to study their organization structure, working procedure, program development and implementation, achievements and linkages
2. Study the extension/ teaching methods adopted by district agriculture development office and NGOS
3. Design of audio- visual material such as poster, booklets, leaflets, flip chart, folder, wallpaper.
4. Operation of audio visual equipments such as overhead projector, multimedia projector, still and movie camera
5. Visit agriculture information and communication centre (AICC) OR its satellite station to observe communication resource and activities at its vicinity.
6. Practical on tools and techniques used in data collection: participatory rural appraisal (PRA) and focus group discussion (FGD)
7. visit the rural development projects run by women development section, WDS, district development committee, DDC, rural energy development program, REDP, micro Enterprise development program, MEDP, world food program, WFP, etc.

References

1. SV Supe, An introduction to extension education
2. OP Dahama and OP Bhatnagar, Education and communication for development
3. GL Ray, Extension, Communication and Management
4. Uttam Kumar Singh and AK Nayak, Extension Education
5. Katar Singh, Rural development: Principles, Policies and Management, Vistar Publication, New Delhi
6. Vivek Saurath, Rural Development: Planning Strategies and Policy Imperatives, ominant publishers and distributors, New Delhi
7. Vivel Saurath, Rural Development: Major Issues in Agricultural Management, (first edition 2002), Dominant Publishers and Distributors, New Delhi
8. K. Rastogi, Rural Development Strategy, Wide Vision Publications.
9. Madan Kumar Dahal and Dev Raj Dahal (Ed), Environment and Sustainable Development in Nepalese Perspective, Nepal foundation for advanced studies (NEFAS)
10. Shyam Prasad Adhikari, Rural Development in Nepal: Problems and Prospects, Sajha Prakashan, Nepal
11. Santosh Kumar Bista, Rural Development in Nepal: An Alternative Strategy, (first edition 2000), Krishna Kumar Shrestha
12. Ram Kumar Dahal, Rajya ra gramin bikas. New hira books enterprises
13. H.D. lekhak and binod lekhak, natural resource conservation and sustainable development in Nepal, kshitz publication
14. Chakrapani Luitel, rural development, theories, techniques and approaches, pradhan book house, Kathmandu.
15. United nations, guidelines for rural centre planning, economic and social commission for Asia and the pacific.
16. Kanhaiya R.B. matherma, strategies of rural development in Nepal: some observations some thoughts, sitadevi mathema
17. Y. P. Panta, planning and rural development, Mohan Primlani for Oxford and IBH Publishing Co, Pvt. Ltd.

Evaluation Scheme:

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

Chapter	Hours	Marks Distribution*
1	2	12
2	2	
3	4	
4	3	12
5	2	
6	2	
7	4	8
8	3	12
9	3	
10	3	6
11	4	8
12	3	8
13	1	
14	2	
15	4	8
16	3	6
Total	45	80

* Minor deviation on mark distribution can be made.

CLIMATE CHANGE AND ADAPTATION MEASURES
AE …

Lecture : 3 **Year : IV**
Tutorial : 1 **Part : II**
Practical : 0

Course Objective:

- To familiarize students with global warming, climate change and causes of climate change, and its impact on agriculture.
- To acquaint and equip the students with adaptation and mitigation options in the context of climate change and global warming activities.

1. Climate and climate change science overview [2 hours]

2. Climate and weather, their parameters and global warming [3 hours]
Definition, present scenario of global warming in global and Nepalese context, causes of global warming

3. Climate system [2 hours]
Earth's energy balance, green house effect, hydrological cycle, carbon cycle, nitrogen cycle, atmosphere-layer of atmosphere, atmospheric composition, green house gases, aerosols, atmospheric circulation, air pollution, local and regional air pollution effects on ocean and glaciers

4. Causes of climate changes: [4 hours]
4.1. **Natural causes** - changes in composition of earth's atmosphere, changes in topography, land-sea geography, changes in solar luminosity, changes in earth's orbit, volcanic activity and internal variability
4.2. **Human causes** - chemically and radioactively important gases (carbondiooxide, methane, nitrous oxide, Montréal protocol gases, ozone, and stratospheric water vapor) green house gas emissions, changes in aerosol concentrations, land - use change, deforestation

5. Climate change implications [8 hours]
5.1. Changes in surface temperature - long temperature records, changes in large- scale precipitation, changes in evapotranspiration, changes in soil moisture, drought, runoff and river discharge, changes in the troposphere and stratosphere, changes in water vapor, changes in clouds, changes in radiation, changes in atmospheric circulation, pattern of atmospheric circulation variability, changes in extreme events, changes in alpine glaciers.
5.2. Changes in snow, ice and frozen land - changes in seasonal snow cover changes in river and lake ice changes in sea ice, changes in glaciers, ice caps ice sheets and ice shelves, changes in frozen ground, changes in the length of the north American growing season, changes in the distribution of plants and animals trends in precipitation storminess, and La nino.
5.3. Oceanic climate change and sea level - changes in global scale temperature and salinity, regional, changes in ocean circulation and water masses, ocean biogeochemical changes in sea level.

6. Global climate projections [4 hours]
6.1. Overview projected changes in emissions concentration and radioactive forcing projected changes in the physical climate system changes associated with biogeochemical feedbacks and ocean acidification.
6.2. Quantifying the range of climate change projections, sea level change in the line 21st century, regional climate projection of Asia climate projection of Nepal

7. Climate change mitigation: [4 hours]
7.1. Energy sector, Transport and infrastructure sector, industrial sector, Agriculture sector (Status of agricultural emissions, mitigating technologies and strategies, global and regional estimates of agricultural greenhouse gas mitigating potential, bioenergy feedstocks, Renewable sources of energy, implications of mitigation for sustainable development)
7.2. Forestry sector; Waste management; cross-sectoral perspectives.

8. Impact and adaptation to climate change: [12hours]
8.1. **Historical climate trend of Nepal**
Historical extreme events of Nepal, Evidences of climate change on agriculture in Nepal, impact of climate change in major crops, impact of climate change on water resource, socio economic impact in climate change
8.2. Adaptation practices, options, constrains and capacity
Elements of adaptive capacity; vulnerability and adaptive capacity; Limits and barriers to adaptation inter-relationships between adaptive and mitigation.
8.3. Key vulnerabilities and risks from climate change
Global social systems; Regional vulnerabilities; Ecosystems and biodiversity; geophysical systems; Extreme events.
8.4. Climate change and sustainability

Impacts and adaptation in the context of multiple stresses; Global and aggregate impacts; Regional, Sub-regional, local and sectoral development.

8.5. Adaptation measures in agricultural sector

Genotypes address climate change, agronomic practices for climate change adaptation, conservation agriculture, technologies for efficient utilization of irrigation water in irrigated agriculture, technologies for conservation and utilization of land and soil moisture in rain fed agriculture, community based adaptation, preparedness in agriculture for climate change-crop modeling.

9. Global and national initiatives in climate change: [6 hours]

9.1. Intergovernmental panel on climate change(IPCC)
9.2. Kyoto Protocol
9.3. United Nations Framework Convention on climate change
9.4. United Nations Human Development Programme UNDP Human Development Report 2007/2008 fighting climate change: Human solidarity in a dividend world.
9.5. Clean Development Mechanism(CDM)
9.6. National Adaptation Programme of Action(NAPA)
9.7. National projects related to climate change.

References:

1. Clean Development Mechanism (CDM). http://www.cdm.unfcc.int
2. Intergovernmental panel on climate change (IPCC).http://www.ipcc.ch
3. ISO 14064-1:2006. Specification with guidance at the organization level for quantification and reporting of greenhouse gas emission reductions or removal enhancements.http://www.iso.org
4. ISO 14064-2:2006. Specification with guidance at the organization level for quantification, monitoring and reporting greenhouse gas emission reductions or removal enhancements.http://www.iso.org
5. ISO 14065:2007. Requirements for greenhouse gas validation and verification bodies for use in accreditation or other forms of recognition. http://www.iso.org
6. PAS 2050. Assessing the life cycle greenhouse gas emissions of goods and services.http://bsigroup.com
7. VCS (Voluntary Carbon Standard) Guidance for Agriculture, Forestry and other Land Use Projects. http://www.v-c-s.org
8. Voluntary Carbon Standard Proposed Methodology Adoption for sustainable agricultural land management (SALM).http://www.v-c-s.org
9. Climate change adaptation in developing countries: issues and perspectives for economic analysis Practical Action, Promoting adaptation to climate change in Nepal
10. IPCC (Intergovernmental panel on climate change) 1996. Technologies, policies and measures for mitigating.
11. Climate change. IPCC technical paper no.1.Geneva http://ipcc.ch/pub/IPCCTP.I(E).pdf.
12. IPCC (Intergovernmental panel on climate change) 2001. Summary for policymakers and Technical Summary of the Working group III report: Climate Change2001: mitigation. Part of the contribution of Working Group III to the Third Assessment Report. Geneva.
13. Sathaye, J & Meyers, S 1995. Greenhouse gas mitigation assessment: a guidebook. Dordretcht, kluwer.
14. UNEP 1998. Mitigation and adaptation cost assessment: Concepts, methods and appropriate use. Roskilde.
15. Denmark, United Nations Environment Programme collaborating centre on energy and Environment, RISO National Laboratory.
16. UNFCCC (United Nations Framework Convection on Climate Change) 2001. Climate Change Information Kit. Paris.http://unfcc.int/resource/convkp.html.
17. World Bank 1998. Greenhouse gas assessment handbook: a practical guidance document for the assessment of project-level greenhouse gas emissions. Washington, D.C., World Bank Global Environment Division. September.
18. Gyanendra Karki, a discussion paper on NAPA Way Forward: Climate Change Adaptation project Prioritization in Nepal.
19. Clean Energy Nepal, Climate Change Fact Sheet Issue No.7, 8, 2008.
20. Dr. Juergen Kropp, Michael Scholoze, Climate Change Information for Effective Adaptation 2009, www.gtz.de/climate.
21. Climate Change Network Nepal, 2010, Climate change Training manual An Easy guide for Teachers.
22. Maggie L. Walser (Lead Author); Stephen C. Nodvin (Topic Editor) "Climate change outline of topics". In: Encyclopedia of Earths. Eds Cutler J. Cleveland (Washington D.C): [first published in the Encyclopedia of Earth January 24, 2010; last revised date January 24, 2010;Retrieved September 18, 2011] < http://www.eoearth.org/article/Climate_change_outline_of_topics>
23. ADB and ICIMOD, 2006. Environmental Assessment of Nepal-Emerging Issues and Challenges; Asian Development bank and the International Centre for mountain development, Kathmandu

24. Nepal bureau of standards and metrology (NBSM) 1999.nepal Country Program for Phase out of ozone Depleting substance. Kathmandu, His Majesty Government of Nepal, NBSM/UNDP

25. Lyangara san, M.L Tinachi and S Shrestha, 1002. The natural resources Hazards, Desertification and implication of Climate Change. http://www.mtnforum.org/resources/library/iyingx02p.htm

26. Sustainable Development Agenda For Nepal (SDAN) 2002. http://www.scdp.org.np/sdan/

27. OECD: Development and Climate Change in Nepal: Focus on Water resources and hydropower http://nepaldisaster.org/download/development.pdf

Evaluation Scheme:

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

Chapter	Hours	Marks Distribution*
1	2	8
2	3	
3	2	16
4	4	
5	8	16
6	4	16
7	4	
8	12	16
9	6	8
Total	45	80

* Minor deviation on mark distribution can be made.

ENGINEERING PROFESSIONAL PRACTICE
CE ……

Lecture : 2 **Year : IV**
Tutorial : 0 **Part : II**
Practical : 0

Course Objective:
To familiarize the students with their roles in the society, ethical and legal environment in which engineering is practiced, contract administration, regulatory environment and contemporary issues in Engineering.

1. **History of Engineering Practices** [3 **hours]**
   - 1.1. Man and Society
   - 1.2. Technology and Society
   - 1.3. History of Engineering Practice in Eastern Society
   - 1.4. History of Engineering Practice in Western society
   - 1.5. Engineering Practices in Nepal

2. **Profession and Ethics** **[6 hours]**
   - 2.1. Profession: Definition and Characteristics
   - 2.2. Professional Institutions
   - 2.3. Relation of an Engineer with Client, Contractor and Fellow Engineers
   - 2.4. Ethics, Code of Ethics and Engineering Ethics
   - 2.5. Moral Dilemma and Ethical Decision Making
   - 2.6. Detailed Duties of an Engineer and Architect
   - 2.7. Liability and Negligence

3. **Professional Practices in Nepal** **[3 hours]**
   - 3.1. Public Sector practices
   - 3.2. Private Sector Practices
   - 3.3. General Job Descriptions of Fresh Graduates in both Public and Private Sector

4. **Contract Management** **[6 hours]**
   - 4.1. Methods of work execution/contracting
   - 4.2. Types of Contracts
   - 4.3. Tendering Procedure
   - 4.4. Contract agreement

5. **Regulatory Environment** **[5 hours]**
   - 5.1. Nepal Engineering Council Act
   - 5.2. Labor Law
   - 5.3. Intellectual Property Right
   - 5.4. Building Codes and Bylaws
   - 5.5. Company Registration

6. **Contemporary Issues in Engineering** **[3 hours]**
   - 6.1. Globalization and Cross Cultural Issues
   - 6.2. Public Private Partnership
   - 6.3. Safety, Risk and Benefit Analysis
   - 6.4. Development and Environment
   - 6.5. Conflict and Dispute Management

7. **Case Studies based on Engineering Practices** **[4 hours]**

References:

1. Carson Morrison and Philip Hughes “Professional engineering Practice – Ethical Aspects”, McGraw-Hill Ryerson Ltd.’ Toronto 1982
2. Dr Rajendra Adhikari, “Engineering Professional Practice – Nepalese and international Perspectives” Pashupati Publishing House, Kathmandu Nepal 2010
3. M. Govindarajan; S Natarajan and V.S. Senthikumar., “ Engineering Ethics” – PHI Learning Pvt. Ltd. New Delhi 2009
4. Nepal Engineering Council Act
5. Contract Act
6. Labor Act
7. Company Act
8. Copyright Act
9. Public Procurement Act
10. Building By-Laws

Evaluation Scheme:

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

Chapter	Hours	Marks distribution*
1	3	4
2	6	8
3	3	4
4	6	8
5	5	6
6	3	4
7	4	6
Total	30	40

AGRICULTURAL ENGINEERING PROJECT (Part II)
AE …

Lecture : 0 **Year : IV**
Tutorial : 0 **Part : II**
Practical : 6

Course Objective:
This is the continuity of project work assigned to students in fourth year part A. The objective of Agricultural Engineering Project work is to provide the students opportunity of hands-on skill development and practical learning involving design, development, fabrication, testing and evaluation and experimentation on Agricultural Engineering problems pertaining to any one specializing areas–Water Management, Soil Conservation and Watershed Management, Farm Power and Machinery and Process and Food Engineering. The students shall work (at least 4 in a group) under the guidance of a team of specialized faculty member/s designated by the Agricultural Engineering Department.

The group of students assigned a task at the beginning of fourth year shall be required to complete the task within the due date of the second part of fourth year and submit a final project report in prescribed format. Viva-voce conduction and project work evaluation will be done at the end of the semester with the help of expert of related field.

Evaluation Scheme:
The evaluation of the project work shall be done as under:

S. N.	Particulars	Marks Distribution
1	Design, development, fabrication, testing and evaluation and exploitation of project (Internal)	25
2	Submission of Final Project Report (It will be evaluated by a panel of experts from IOE and outside)	25
3	Presentation	25
4	Viva-voce	25
	Total	**100**

Elective II

DESIGN OF PRESSURIZED AND MICRO IRRIGATION SYSTEM
AE …

Lecture : 3 **Year : IV**
Tutorial : 1 **Part : II**
Practical : 1.5

Course Objective:
To familiarize and orient students in theory, planning, technological development and management in engineering problem solving in the area of pressurized and micro- irrigation system.

1. Introduction [7 hours]
- 1.1. Concept and Importance of pressurized and micro irrigation
- 1.2. Types of pressurized and micro irrigation system
- 1.3. Suitability of Micro-irrigation in Nepal
- 1.4. Application depth and system capacity
- 1.5. Application of fertigation

2. Sprinkler Irrigation [15 hours]
- 2.1. Types of sprinkler irrigation system and their selection
- 2.2. Components of sprinkler irrigation
- 2.3. Pressure and water distribution profile
- 2.4. Uniformity of water distribution
- 2.5. Layout and planning of pipe network
- 2.6. Frictional head losses in pipes, fitting and fixtures
- 2.7. Design of sprinkler irrigation
  - 2.7.1. Hydraulic design
  - 2.7.2. Lateral design
  - 2.7.3. Design of sub-mains and mains
  - 2.7.4. Pumps and power unit
- 2.8. Maintenance and trouble-shooting
- 2.9. Economics of sprinkler

3. Drip Irrigation [15 hours]
- 3.1. Types of drip irrigations system and their selection
- 3.2. Components of drip irrigation system and layout
- 3.3. Pressure and water distribution profile
- 3.4. Uniformity of water distribution
- 3.5. Layout and planning of pipe network
- 3.6. Frictional head losses in pipes, fittings and fixtures
- 3.7. Design of drip irrigation system
  - 3.7.1. Hydraulic design
  - 3.7.2. Lateral design
    - 3.7.2.1. Design of sub–mains and mains
    - 3.7.2.2. Pumps and power units
- 3.8. Maintenance and trouble – shooting
- 3.9. Economics of drip irrigation

4. Automation of Irrigation System [8 hours]
- 4.1. Point, local and central automation
- 4.2. Control patterns
- 4.3. Computer based irrigation system controls

Practicals:
1. Evaluation of water application Uniformity in sprinkler irrigation [3 hours.]
2. Evaluation of pressure distribution in sprinkler irrigation [2 hours.]
3. Evaluation of water application uniformity in drip irrigation [2 hpurs.]
4. Evaluation of pressure distribution in drip irrigation [2 hours.]
5. Establishment of pressure- discharge relationship for different Emitters in drip irrigation system [3 hours.]
6. Evaluation of efficiency of fertigation [2 hours.]
7. Design exercise in sprinkler irrigation [2 hours.]
8. Design exercise in micro irrigation system [2 hours.]

References:

1. Sprinkler Irrigation by Sivanappan, R. K. Oxford and IBH Publishing Co., New Delhi, India.
2. Sprinkler Irrigation in India, ICID. Indian National Committee on Irrigation and Drainage.

Evaluation Scheme:
The questions will cover all the chapters in the Syllabus. The evaluation scheme will be as indicated in the table below.

Chapter	Hours	Marks Distribution*
1	7	16
2	15	24
3	15	24
4	8	16
Total	45	80

* Minor deviation on mark distribution can be made.

DESIGN OF SOIL & WATER CONSERVATION STRUCTURES
AE …

Lecture : 3 **Year : IV**
Tutorial : 1 **Part : II**
Practical : 1.5

Course Objective:
The primary objective of this course is to familiarize the students with the various soil and water conservation structures and their design that exercises in Agricultural Engineering. Secondly this course emphasizes in design and development of such simple and effective technologies and structures that conserve soil and water.

1. Introduction [3 hours]
- 1.1. Importance of structural means in soil and water Conservation
- 1.2. Functional requirements of soil and water conservation Structures
- 1.3. Classification of soil and water conservation structures

2. Vegetated Waterways [4 hours]
- 2.1. Types of waterways
- 2.2. Factors affecting shape of waterways
- 2.3. Design considerations in vegetated waterways
- 2.4. Layout, construction and maintenance of waterways

3. Design of Runoff Measuring Structures [4 hours]
- 3.1. Weirs and Noteches
- 3.2. Par shall flume
- 3.3. H- flume
- 3.4. Cut- throat flume

4. Design of Spillways [12 hours]
- 4.1. Drop Spillway:
  - 4.1.1. General description and function
  - 4.1.2. Components of drop Spillway
  - 4.1.3. Hydrologic and hydraulic design
  - 4.1.4. Freeboard and acration of weirs
  - 4.1.5. Structural design of drop Spillway:
    - 4.1.5.1. Loads on headwalls
    - 4.1.5.2. Variable affecting Equivalent Fluid Pressure
    - 4.1.5.3. Determination of saturation line
    - 4.1.5.4. Triangular load diagram for various flow conditions
    - 4.1.5.5. Uplift pressure estimation
    - 4.1.5.6. Safety against sliding, overturning, crushing and tension
- 4.2. Chute Spillway:
  - 4.2.1. General description and function
  - 4.2.2. Components of Chute Spillway
  - 4.2.3. Hydrologic and Hydraulic Design
  - 4.2.4. Energy Dissipators
  - 4.2.5. Structural design of chute Spillway:
    - 4.2.5.1. Load on headwalls
    - 4.2.5.2. Uplift pressure estimation
    - 4.2.5.3. Safety against sliding, overturning crushing and tension
  - 4.2.6. Design of SAF Stilling basin
- 4.3. Drop Inlet Spillway
  - 4.3.1. General description and function
  - 4.3.2. Components of drop inlet Spillway
  - 4.3.3. Hydrologic and hydraulic design
  - 4.3.4. Structural design

5. Stream Bank Erosion Control [6 hours]
- 5.1. Vegetative measures for stream bank stabilization
- 5.2. Slope protection:
  - 5.2.1. Soding and Turfing
  - 5.2.2. Stone revetment
  - 5.2.3. Gabion revetment
  - 5.2.4. Brushwood rollers
- 5.3. Indirect protection works
  - 5.3.1. Types and function of retards
  - 5.3.2. Classification and functions of spurs
  - 5.3.3. Design of spurs

6. Design of Landslide Controlling Structures [6 hours]
- 6.1. Mechanics of landslide
- 6.2. landslide control measures
  - 6.2.1. Slope treatment
  - 6.2.2. Surface and sub- surface drainage
  - 6.2.3. Retaining walls:
    - 6.2.3.1. Types of retaining walls
    - 6.2.3.2. Design of cantilever retaining walls
    - 6.2.3.3. Design of counter fort type retaining walls

7. Check Dams **[4 hours]**

7.1. General description and function
7.2. Types of check dams
7.3. Design of check dams
7.4. Stability analysis of check dams

8. Farm Ponds and Reservoirs **[6 hours]**

8.1. General description and function
8.2. Components of farm ponds and reservoirs
8.3. Site selection
8.4. Design of embankment: type, foundation condition, Cross-section, Free board and wave Protection
8.5. Seepage through embankment
8.6. Spillway and Spillway location

Practical:

1. Design of parshall flume [1.5 hours.]
2. Design of H- Flume [1.5 hours.]
3. Hydraulic design of straight drop Spillway [1.5 hours.]
4. Determination of uplift force and construction of uplift force diagram [3 hours]
5. Determination of loads on headwall and construction of triangular load diagram [1.5 hours.]
6. Stability analysis of straight drop Spillway [3 hours]
7. Hydraulic design of chute Spillway [3 hours]
8. Design of SAF energy dissipater [1.5 hours]
9. Design of small earth embankment [1.5 hours]

References:

1. Suresh R. 1993. Soil and Water Conservation Engineering. Standard publishers and Distributors, New Delhi.
2. Norman Hudson. 1985 Soil Conservation. Cornell University Press, Ithaca, New York.
3. Kirby, M.J. and Morgan P.P.C. (eds.) Soil Erosion John Wiley & sons, New York.
4. Schwab, G.O., Fangeir, D.D. Elliot, W.S. and Frevert R.K. 1993. Soil and Water Conservation Engineering John Wiley & sons.

Evaluation Scheme:

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

Chapter	Hours	Marks Distribution*
1	3	6
2	4	8
3	4	8
4	12	20
5	6	10
6	6	10
7	4	8
8	6	10
Total	45	80

*There may be minor variations in marks distribution

TESTING & EVALUATION OF AGRICULTURAL MACHINERY & TRACTOR

AE …

Lecture : 3 **Year : IV**
Tutorial : 1 **Part : II**
Practical : 1.5

Course Objective:

- To familiarize students with testing and evaluation of agricultural machinery and tractor.
- To acquaint and equip the students with tractor testing and tractor testing equipment with their constraints and evaluation techniques with procedure.

1. Objectives and Importance of Testing and Evaluation [2 hours]
- 1.1. Concept of testing and evaluation
- 1.2. Testing and evaluation procedures
- 1.3. Terminology used testing and evaluation of agricultural machine and tractors

2. Instruments used in Testing and Evaluation [3 hours]

Instruments for the measurement of:
- 2.1. Draft
- 2.2. Wheel slip
- 2.3. Shrinkage
- 2.4. Soil resistance
- 2.5. Sound
- 2.6. Vibration

3. Test Codes for Agricultural Machines and Tractors [6 hours]
- 3.1. Purpose of test codes
- 3.2. Types of test codes for agricultural machine
  - 3.2.1. RNAM Test Codes
  - 3.2.2. BIS Test Codes
  - 3.2.3. Nebraska Test Codes
- 3.3. Differences in the test codes for agricultural machine

4. Testing and Evaluation Procedures [8 hours]
- 4.1. Preparation for tests
- 4.2. Specification of implements
- 4.3. Test conditions
- 4.4. Laboratory tests
- 4.5. Performance test
- 4.6. Field test
- 4.7. Evaluation criteria
- 4.8. Test report format

5. Test Codes and Testing Procedures for Primary Tillage Implements [2 hours]
- 5.1. Test codes for Ploughs
- 5.2. Test procedures for Ploughs (M.B., Chisel, Disk)

6. Test Codes and Testing Procedures for Secondary Tillage Implements [4 hours]
- 6.1. Test code procedure for rotary tiller
- 6.2. Test code procedure for disc harrows

7. Test codes and testing Procedures for seeding and planting implement [5 hours]
- 7.1. Test code and procedure for seeding equipment with or without fertilizer attachment
- 7.2. Test code and procedure for rice transplanter
- 7.3. Test code and procedure for row- crop cultivators

8. Test Codes and Testing Procedures for Plant Protection Equipments [4 hours]
- 8.1. Test code and procedures for liquid (herbicide, fungicide, insecticides) applicators
- 8.2. Test code and procedure for duster application

9. Test Codes and Testing Procedures for Harvesting Implements [2 hours]
- 9.1. Test code for reaper
- 9.2. Test procedure for reaper

10. Test Codes and Testing Procedure for Threshers [2 hours]

11. Tractor Performance Criteria: [7 hours]
- 11.1. Power Measurement Methods:
  - 11.1.1. Absorption Dynamometer
  - 11.1.2. Transmission Dynamometer
  - 11.1.3. Hydraulic Dynamometer
  - 11.1.4. Electric- direct current Dynamometer
  - 11.1.5. Spring Dynamometer
  - 11.1.6. Strain gauge Dynamometer
- 11.2. Power Estimating
- 11.3. Engine Test Apparatus
  - 11.3.1. Air supply measurement
  - 11.3.2. Engine pressure indicators

11.3.3. Fuel flow meter
11.3.4. Torque sensor
11.4. Engine performance
11.5. Efficiency of tractor engine
11.6. Nebraska and ISI tractor test code

Tutorials:

1. Study and Comparison of Procedure and Test codes for farm Machines and Tractors-RNAM, BIS, Nebraska
2. Preparation of Tractor Engine Testing Parameters

Practical:

1. Visibility, noise and vibration test on farm tractors
2. Determination of turning radius of general purpose farm tractor
3. Measurement of basic dimensions of tillage tools
4. Field and performance testing of seeding and planting machines
5. Field and performance testing of sprayers and dusters
6. Field and performance testing of harvesting machines
7. Performance testing of threshers

References:

1. Mehta M. L., Mishra S. K., Verma S.R. And Sharma V.K. Testing and Evaluation of Agricultural Machines, National Agricultural Technical Information Center- 5 copies
2. OECD 1991. Standard code for the official testing of agricultural and forestry tractors. Organization for economic cooperation and development, Paris- 5 copies
3. Inns R. M. 1986. Selection, Testing and Evaluation of Agricultural Machines and Equipment. FAO service bulletin no. 115- 5 copies
4. Smith, D.W., Sims B.G. and O'Neil D. H. 1994 Testing and evaluation of agricultural machinery and equipment: principle and practices. FAO, Rome
5. Test codes for Bureau of Indian standards, New Delhi for agricultural implements, IC engines and tractors
6. RNAM test codes and procedures for farm machinery. Regional network for agricultural machinery Bangkok/ Philippines.

Evaluation Scheme:

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

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

* Minor deviation on mark distribution can be made.

SOLAR PHOTO-VOLTAIC SYSTEM AND APPLICATION
AE …

Lecture : 3 **Year : IV**
Tutorial : 1 **Part : II**
Practical : 1.5

Course Objective:
The primary objective of this course is to introduce solar photo-voltaic system and their conversion technology used to fulfil the requirement of energy in Agricultural Engineering activities in rural areas. Secondly this course emphasizes in design and development of such simple and effective technologies that converts solar energy into usable form and supply it to operate tools, equipments and machineries used in agricultural works.

1. Fundamentals of Solar Photo-Voltaic System [10 hours]
- 1.1. Principle of Photo-Voltaic Energy Conversion:
  - 1.1.1. Review of Electrical Power System
  - 1.1.2. Principle of photo-Voltaic effect
  - 1.1.3. Types of Solar cells
  - 1.1.4. Spectral response of Solar cell materials
  - 1.1.5. Electrical parameters of Solar cells
  - 1.1.6. Effect of environment on performance of Solar cells
- 1.2. Solar Modules and Arrays:
  - 1.2.1. Solar cells modules
  - 1.2.2. IV Curve for a module
  - 1.2.3. Blocking Diode and bypass Diode
  - 1.2.4. Solar arrays- role of installation Diode

2. Components of Solar Photo-Voltaic System [10 hours]
- 2.1. Batteries
  - 2.1.1. Types of batteries
  - 2.1.2. Battery terminology and performance characteristics
  - 2.1.3. Chemistry of lead acid battery
  - 2.1.4. Battery Test and Maintenance
- 2.2. Charge Regulators
  - 2.2.1. Principle of operation
  - 2.2.2. Parameters of charge regulator
  - 2.2.3. Methods of battery charging through charge regulator
- 2.3. DC-AC Inverters
  - 2.3.1. Basic principles of an inverter
  - 2.3.2. Parameters of an inverter
  - 2.3.3. Types of inverter
- 2.4. DC- DC Converter
  - 2.4.1. Principle of DC-DC converter
  - 2.4.2. Parameters of DC-DC converters
- 2.5. Lamps and Non-luminous Loads to Solar PV System
  - 2.5.1. Basic lamp types of Solar PV System
  - 2.5.2. Other loads to Solar PV system

3. Design of lighting with Solar PV system [10 hours]
- 3.1. Load Calculation
  - 3.1.1. Load characteristics-AC or DC, Apparent or Real,
  - 3.1.2. Critical and Non-critical
  - 3.1.3. Annual loading profile
  - 3.1.4. Maximum load and current
  - 3.1.5. Nominal system and array voltage
- 3.2. Module and Array Sizing
- 3.3. Battery Sizing
- 3.4. Sizing of Charge Regulator
- 3.5. Cable Sizing
- 3.6. Inverter Sizing
- 3.7. DC-AC Converter Sizing
- 3.8. Sizing of luminous and non-luminous loads

4. Design of Solar PV Water Pumping System [10 hours]
- **4.1. Solar PV water pumping system configurations**
  - 4.1.1. Appraisal of Solar PV water pumping for drinking
  - 4.1.2. water supply and Irrigation
  - 4.1.3. System components
  - 4.1.4. Selection of pumps
  - 4.1.5. Selections of motors
  - 4.1.6. Configuration of Solar arrays and panels
  - 4.1.7. Maximum power point tracking circuitry
- 4.2. Array wiring and mounting of water pumps
  - 4.2.1. Array wiring
  - 4.2.2. Array Mounting
  - 4.2.3. Considerations for tracking support structures
- 4.3. Water pumping system design
  - 4.3.1. Array sizing
  - 4.3.2. Selection of pump form manufacturer's data
  - 4.3.3. Installation diagram
  - 4.3.4. General algorithm for system design

5. Solar PV Technology in Nepal [5 hours]

5.1. Scope and potential of Solar PV system in Nepal
5.2. Agencies involved in development and promotion of Solar PV system
5.3. Policies and program for promotion of Solar PV system
5.4. Nepal PV quality assurance- conditions of NIPQA- 2000(2002)

Practical:

1. Measurement of electrical parameters of Solar Cells
2. Evaluation of effects of environmental parameters of output of Solar Module
   - Effect of Solar radiation intensity
   - Effect of temperature
   - Effect on shade
3. Studies on PV Solar lighting system
4. Evaluation of performance of solar lighting system
5. Study on Solar PV water pumping system
6. Evaluation of performance of Solar PV water pumping system

References:

7. S. P. Sukahtme. Solar Energy: Principle of Thermal Collection and Storage. Tata McGraw Hill Publishing Co., New Delhi (latest edition)
8. H. P. Garg and J. Prakash. Solar Energy Fundamentals and Applications. Tata McGraw Hill Publishing Co., New Delhi (latest edition)
9. John A. Duffie and W. A. Beckman. Solar Engineering of Thermal Process. John Wiley & Sons. (latest edition)
10. W. J. Kennedy Jr. and Wayne C. Turner. Energy Management. Prentice Hall Inc.
11. Journals of American Society of Agricultural and Biological Engineers on Solar Energy Application (ASABE)
12. FAO Journals on Solar Energy Conversion Technologies.
13. Vervaart, M.R. and Nieuwenhout F.D.J., 2001. Manual for design and modification of solar home system components. IBRD/ The World Bank.
14. Solar Water Pumping. ITDG Publications.
15. Wave sites: www.pvpower.com and www.pvresources.com

Evaluation Scheme:

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

Chapter	Hours	Marks Distribution*
1	10	10
2	10	20
3	10	20
4	10	20
5	5	10
Total	45	80

* Minor deviation on mark distribution can be made.

Elective III

SMALL DAMS & RESERVOIRS
AE …

Lecture : 3 **Year : IV**
Tutorial : 1 **Part : II**
Practical : 1.5

Course Objective:
To familiarize and orient the students in theory, planning, technological development and management in engineering problem solving in the area of small dams and reservoirs.

1. Introduction **[2 hours]**
- 1.1. Physical Characteristics of Reservoir
- 1.2. Types of reservoir
- 1.3. Dead Storage, Live Storage

2. Reservoir Capacity **[16 hours]**
- 2.1. Selection and Investigation of Sites
- 2.2. Area Elevation Curve
- 2.3. Estimation of Reservoir Capacity
- 2.4. Estimation of Sediment Flow and Reservoir Lift
- 2.5. Reservoir sediment Control
- 2.6. Water Losses from Reservoir and their Measurement
- 2.7. Determination of Reservoir Yield by Mass Curve Technique
- 2.8. Flood Routing

3. Earth Dam **[18 hours]**
- 3.1. Purpose and Types
- 3.2. Site Selection and Investigation for Earth Dam
- 3.3. Causes of Failure
- 3.4. Criteria for Safe Design of Earth Dams
- 3.5. Seepage Analysis
- 3.6. Stability Analysis
- 3.7. Stability of Foundation against Shear
- 3.8. Seepage Control Measures
- 3.9. Purpose and Location of Spillway
- 3.10. Design of Spillway
  - 3.10.1. Design of Straight Drop Spillway
  - 3.10.2. Design of Overflow/Emergency Spillway
  - 3.10.3. Energy Dissipation below Spillway

4. Water Harvesting **[3 hours]**
- 4.1. Importance and Principle of Water Harvesting
- 4.2. Water Harvesting Techniques
- 4.3. Flood Water Harvesting

5. Farm Ponds **[6 hours]**
- 5.1. Types and Components of Farm Ponds
- 5.2. Determination of Pond Capacity
- 5.3. Design of Embankment
- 5.4. Seepage through Embankment
- 5.5. Design of Mechanical and Emergency Spillway
- 5.6. Pond Protection, Maintenance and sanitation

Practical:
1. Preparation of depth-elevation curve and determination of optimum depth of storage [3 hours.]
2. Determination of Capacity of a Small Reservoir [3 hours.]
3. Estimation of Reservoir Yield [3 hours.]
4. Design problems on Small Reservoirs [3 hours.]
5. Design problems on Earth Dam [3 hours.]
6. Design of Farm Ponds [3 hours.]

References:

1. Design of Small Dams. USBR. Oxford and IBH Publishing Co., New Delhi, India.
2. Design and Construction of Small Earth Dams. Nelson, K. D. Scientific Publishers, Jodhpur, India.
3. Sahasrabudhe, S. R. Irrigation Engineering and Hydraulic Structures. S. K. Kataria and Sons, New Delhi, India.

Evaluation Scheme:

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

Chapter	Hours	Marks Distribution*
1	2	32
2	16	
3	18	32
4	3	16
5	6	
Total	45	80

* Minor deviation on mark distribution can be made.

REMOTE SENSING & GEOGRAPHIC INFORMATION SYSTEM
AE …

Lecture : 3 **Year : IV**
Tutorial : 1 **Part : II**
Practical : 1.5

Course Objective:
To aquant and provide the students the detailed information about the modern technologies of remote sensing and geographic information system for watershed management and planning.

1. Introduction **[2 hours]**
- 1.1. Necessity and importance
- 1.2. Application and scope
- 1.3. Basis of remote sensing

2. Remote Sensing Signatures **[4 hours]**
- **2.1.** Electromagnetic radiations
- 2.2. Interaction of electromagnetic radiation with matters
- 2.3. Basis for remote sensing signatures
- 2.4. Sensors used in remote sensing and their classification
- 2.5. Remote sensing platforms

3. Remote Sensing Data Products **[4 hours]**
- 3.1. Aerial photographs
- 3.2. Digital images
- 3.3. Satellite data products- FCC, CCT
- 3.4. LANDSAT, SPOT, and IRS images

4. Analysis and Interpretation Techniques **[5 hours]**
- 4.1. Visual Interpretation
  - 4.1.1. Basis for visual interpretation
  - 4.1.2. Elements of image interpretation
- 4.2. Image Processing
  - 4.2.1. Need for image processing
  - 4.2.2. Elements of image processing
- 4.3. Digital image Analysis

5. Aerial photograph Interpretation **[7 hours]**
- 5.1. Specifications of aerial photographs
- 5.2. Measurement of aerial photographs
- 5.3. Refinements of image co- ordinates
- 5.4. Measurement of scale, horizontal Distance, height, slope, Area & bearings
- 5.5. Stereoscopic views and depth perception
- 5.6. Preparation of aerial photos for interpretation
- 5.7. Elements of aerial photo interpretation
- 5.8. Methods of aerial photo interpretation
- 5.9. Photo- maps, mosaics and their use
- 5.10. Methods of map making and data transfer

6. Concept of GIS **[4 hours]**
- 6.1. Schematic representation of GIS
- 6.2. Relevance of GIS in Spatial analysis
- 6.3. Kinds of GIS models- vector and raster models
- 6.4. Software used in GIS and their capabilities
- 6.5. Terminology used in GIS

7. Raster Data Structure and Input **[5 hours]**
- 7.1. Data types – nominal, ordinal, interval and ratio
- 7.2. Methods of data input- manual, digitizing, scanning
- 7.3. Creating thematic data layers
- 7.4. Digitizing rules
- 7.5. Data management

8. Vector GIS and Data Management **[5 hours]**
- 8.1. Storing spatial data in vector GIS
- 8.2. Representing multiple features
- 8.3. Digitizing rules and steps
- 8.4. Digitizing errors and correcting spatial data
- 8.5. Tics and their use in vector GIS
- 8.6. Constructing topology

9. Database Management and Analysis **[7 hours]**
- 9.1. Coordinate system for multi- coverage database
- 9.2. Real-world coordinate system
- 9.3. Retrieval and classification of data
- 9.4. Measurements- Distance, Area, Perimeter and Slope
- 9.5. Overlay operations and creation of thematic layers
- 9.6. Neighborhood operations
- 9.7. Network functions
- 9.8. GIS outputs

10. Modeling with GIS **[2 hours]**

Practicals:

1. Familiarization with aerial photographs and satellite images [1.5 hours]
2. Establishments of photo coordinates and their measurements [1.5 hours]
3. Interpretation of aerial photographs [1.5 hours]
4. Use of stereoscope for measurement of elevation difference [1.5 hours]
5. Use of aerial photographs in delineation of watershed boundary and appraisal of natural resources [1.5 hours]
6. Introduction to GIS software and their use [1.5 hurs]
7. Digitizing thematic layers in raster GIS for Micro- watershed [1.5 hours]
8. Performing spatial analysis for micro- watershed in raster GIS [3 hours]
9. Digitizing tics and maps in vector GIS [3 hours]
10. Performing spatial analysis in vector GIS [3 hours]

References:

1. Sabin's J.R. (latest edition). Remote Sensing Principles and Interpretation. W.H. Freeman and Co.
2. Heywood, LAN. Cornelius Sarah and Carver Steve. 1999. An Introduction to Geographic Information System. Addison – Wesley – Longman
3. Chrisman Nicholas. 1997. Exploring Geographic Information System. John Wiley and Sons.
4. Shultz, G. A. and Engman E.T. 2000. Remote Sensing in Hydrology and Water Management. Springer, New York.
5. E.C. Barret and L. F. Curtis (latest edition). Introduction to Environmental Remote Sensing. John Wiley and Sons, New York.
6. H. S. Chem. (latest edition). Space Remote Sensing System: An Introduction. Academic Press, New York.
7. L. M. Lillesand and R.W. Keifer (latest edition). Remote Sensing and Image Interpretation. John Wiley and Sons.

Evaluation Scheme:

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

Chapter	Period	Marks Distribution*
1	2	16
2	4	
3	4	16
4	5	
5	7	16
6	4	
7	5	16
8	5	
9	7	16
10	2	
Total	45	80

*There may be minor variation in marks distributions.

TILLAGE, TRACTION & LAND DEVELOPMENT MACHINERY
AE …

Lecture : 3 **Year : IV**
Tutorial : 1 **Part : II**
Practical : 1.5

Course Objective:
The primary objective of this course is to introduce tillage, traction devices and land development machinery used in Agricultural Engineering activities in farms. Secondly this course introduces soil properties, soil-tillage-tool mechanics and traction theory associated with such technologies that used in agricultural works.

1. Introduction [4 hours]
- 1.1. Soil physical conditions required for plant growth
- 1.2. Role of cultivation in producing favorable tilth
- 1.3. Basic soil manipulations:
  - 1.3.1. Cutting and loosening
  - 1.3.2. Disintegration
  - 1.3.3. Inversion
  - 1.3.4. Mixing
  - 1.3.5. Compaction
  - 1.3.6. Smoothening

2. Dynamic Soil Properties and their Measurement [5 hours]
- 2.1. Cohesion
- 2.2. Shear and compressive strength
- 2.3. Stress – strain behavior
- 2.4. Theories of soil failure

3. Mechanics and Geometry of Soil Tool System [7 hours]
- 3.1. Determination of passive earth pressure
- 3.2. Application of passive earth pressure in design of soil engaging tools
- 3.3. Effects of rake angle of soil failure pattern
- 3.4. Shallow and deep tine concept
- 3.5. Soil compaction by agricultural machines

4. Mechanics of Rotatory Tillage Tools [4 hours]
- 4.1. Action of rotatory tillage tools
- 4.2. Design parameters of rotatory tillage tools:
  - 4.2.1. Length of cut
  - 4.2.2. Bite length
  - 4.2.3. Ratio of peripheral and forward speeds
- 4.3. Performance of rotatory tillage tools

5. Land Packers and Clod Crushers [4 hours]
- 5.1. Functions of land packers and clod crushers
- 5.2. Design parameters of land packers and clod crushers
- 5.3. Performance of land packers and clod crushers

6. Zero Tillage and Minimum Tillage Tools [4 hours]
- 6.1. Mechanics of zero tillage and minimum tillage
- 6.2. Design parameters and working principle
- 6.3. Performance of zero tillage and minimum tillage tools

7. Soil Wheel Interaction [8 hours]
- 7.1. Mechanics of traction device
- 7.2. Rolling resistance and tractive effort
- 7.3. Driven and steered wheels
- 7.4. Coefficient of traction
- 7.5. Drawbar pull and rim pull
- 7.6. Traction aids
- 7.7. Tyres- functions, size and selection
- 7.8. Crawlers mounted and wheel mounted machinery

8. Bulldozers [3 hours]
- 8.1. General information
- 8.2. Crawler mounted versus wheel mounted bulldozers
- 8.3. Earth moving with bulldozers
- 8.4. Output of bulldozers

9. Scrapers [3 hours]
- 9.1. General information
- 9.2. Types and sizes
- 9.3. Operating efficiency of scraper
- 9.4. Performance of wheel type scraper

10. Excavating Equipments [3 hours]
- 10.1. Power shovel- general information and basic components
- 10.2. Size and working principle of power shovel
- 10.3. Effect of depth of cut and job conditions on performance of power shovel
- 10.4. Dragline- general information and basic components
- 10.5. Types of draglines
- 10.6. Effect of depth of cut and angle of swing on output

Practicals:

1. Study on soil engaging components of agricultural machines
2. Determination of effect of moisture content on dynamic properties of soil
3. Determination of clod mean weight diameter
4. Calculation of passive earth pressure using different models
5. Familiarization with different land development machineries
6. Study on bulldozer with references to blade size and output
7. Study on different types of scrapers and levellers

References:

1. E. McKeys. 1985. Soil Cutting and Tillage. Elsevier, Tokyo
2. Soil Dynamics in Tillage and Traction. USDA Publication.
3. Sineokov, G. N. Design of Soil Tillage Machines. Indian National Scientific Documentation Center, Hillside Road, New Delhi.

Evaluation Scheme:

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

Chapter	Hours	Marks Distribution*
1	4	12
2	5	
3	7	12
4	4	8
5	4	8
6	4	8
7	8	16
8	3	16
9	3	
10	3	
Total	45	80

* Minor deviation on mark distribution can be made.

SMALL AND MICRO-HYDRO POWER SYSTEM
AG …

Lecture : 3 **Year : IV**
Tutorial : 1 **Part : II**
Practical : 1.5

Course Objective:
After the completion of this course students will be able to locate and predict the small and micro-hydro power sources for the fulfilment of requirement of energy in Agricultural Engineering activities in rural areas. This course also emphasizes in review, system design and development, commissioning and testing of such rural micro-hydro power station and supply electrical energy to operate tools, equipments and machineries used in agricultural works.

1. Review of Small and Micro-Hydropower Systems in Nepal: [2 hours]
- 1.1. Importance of small and Micro-hydropower Systems in Nepal
- 1.2. History of development of Small Hydropower Systems
- 1.3. Components of Small Hydropower Systems
- 1.4. Working Principle of Small and Micro-hydropower Systems

2. System Design for Small and Micro Hydropower: [6 hours]
- 2.1. Pre-Feasibility and Feasibility Survey
- 2.2. Hydrological Study
- 2.3. Assessment of Capacity and Demand
- 2.4. Design of Systems Components: Headwork, Headrace Cannel,
  - 2.4.1. Desilting Basin, fore-bay, Daily Pond age Basin, Spillways,
  - 2.4.2. Penstock and Power house

3. Mechanical Components in Small an Micro Hydropower System: [6 hours]
- 3.1. Turbines for Small and Micro Hydropower:
  - 3.1.1. Types of Turbines
  - 3.1.2. Specific Speed
  - 3.1.3. Suction Head
  - 3.1.4. Cavitations
  - 3.1.5. Turbine Governor
- 3.2. Selection of Turbine:
  - 3.2.1. Turbine Efficiency
  - 3.2.2. System Efficiency
  - 3.2.3. Performance Curve and Turbine Selection

4. Electrical Components in Small and Micro-hydropower System: [15 hours]
- 4.1. Driving and Control System:
  - 4.1.1. Transformers
  - 4.1.2. Load Controllers
  - 4.1.3. Voltage Regulators
  - 4.1.4. Protection System – Current Cutout and Metering
- 4.2. Transmission and Distribution System:
  - 4.2.1. Review of Electric Circuits
  - 4.2.2. Components of Transmission and Distribution System
  - 4.2.3. Generators
  - 4.2.4. Switchgears and Other Protective Measures
- 4.3. Performance of Small and Micro-hydro Power System:
  - 4.3.1. Quality of Generation and transmission Reliability

5. Commissioning and Testing: [3 hours]
- 5.1. Planning
- 5.2. Installations
- 5.3. Operation
- 5.4. Commissioning and Testing

6. Promotion of Small and Micro-hydro Power based Electrification: [2 hours]
- 6.1. Load Factor
- 6.2. Unit cost of electricity
- 6.3. Tariff Setting
- 6.4. Financial

7. Repair and Maintenance of Small and Micro-hydro Power System: [3 hours]
- 7.1. Maintenance check list
- 7.2. Repair and maintenance schedule for mechanical components
- 7.3. Repair and maintenance schedule for electrical components

8. Financial Evaluation: [6 hours]
- 8.1. Load factor
- 8.2. Unit cost of electricity
- 8.3. Tariff setting
- 8.4. Financial analysis of small and hydropower system

9. Promotion of Small and Micro-hydro Power System in Nepal: [2 hours]
- 9.1. Existing policies and strategies
- 9.2. Institutional arrangement for small and micro hydropower promotion
- 9.3. Manufactures of components of small and micro hydropower Nepal

Practical:

1. Evaluation of performance characteristics of turbine at low head high discharge and high head low discharge.
2. Evaluation of efficiency of cross flow turbines.
3. Design calculation for sizing of small and micro hydropower system.
4. Evaluation of performance of peltric set.
5. Financial evaluation of small and micro hydropower system.
6. Study visit: Study visit to operational small and micro hydropower system in adjoining areas/vicinity if available (Involving intensive study of hydraulic, mechanical and electrical components of the system. The students required to submit a mini- project report based on design, operation, management and financial aspects of the system).

References:

1. Hervey, Adam. 1993. Micro-hydro Design Manual. Intermediate Technology Publication, U.K.
2. ICIMOD. 1999. Manuals on Micro-hydropower for Installation. Commissioning Repair and Maintenance, ICIMOD, Kathmandu, Nepal.
3. Inver, Allen R. 1986. Micro-hydro Source Book. NRECA International Foundation, Washington D.C.

Evaluation Scheme:

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

Chapter	Hours	Marks Distribution*
1	2	16
2	6	
3	6	8
4	15	32
5	3	8
6	2	
7	3	16
8	6	
9	2	
Total	45	80

* Minor deviation on mark distribution can be made.