

**Diploma (Agril. Engineering)****(2022-23)****SEMESTER- III**

<b>Sr. No.</b>	<b>Sub. Code</b>	<b>SUBJECT</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>Credit</b>
<b>1.</b>	29AE301	Crop Production Technology	4	0	0	4
<b>2.</b>	29AE302	Irrigation Engineering	3	0	0	3
<b>3.</b>	29ME303	Thermodynamics and Heat Engine	3	0	0	3
<b>4.</b>	29AE304	Farm Power	2	0	0	2
<b>5.</b>	29EE305	Basics of Electrical and Electronics Engineering.	3	0	0	3
<b>6.</b>	29CE306	Surveying & Levelling	2	0	0	2
<b>7</b>	29ME307	Workshop Technology	2	0	0	2
<b>1</b>	29AE351	Crop Production Technology-Lab	0	0	2	1
<b>2</b>	29AE352	Irrigation Engineering-Lab	0	0	4	2
<b>3</b>	29ME353	Thermodynamics and Heat Engine-Lab	0	0	2	1
<b>4</b>	29AE354	Farm Power-Lab	0	0	2	1
<b>5</b>	29EE355	Basics of Electrical and Electronics Engineering -Lab	0	0	2	1
<b>6</b>	29CE356	Surveying & Levelling -Lab	0	0	2	1
<b>Total</b>			<b>17</b>	<b>0</b>	<b>14</b>	<b>24</b>

## Diploma (Agrill. Engineering)

### SEMESTER- IV

<b>Sr. No.</b>	<b>Sub. Code</b>	<b>SUBJECT</b>	<b>Group</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>Credit</b>
1.	29AE401	Farm Machinery and Implements	Ag Engg.	3	1	0	4
2.	29AE402	Farm Tractor : Systems and Controls	Ag Engg.	2	0	0	3
3.	29AE403	Renewable Sources of Energy	Ag Engg.	2	0	0	2
4.	29AE404	Post Harvest Technology	Ag Engg.	2	1	0	3
5.	29AE405	Soil and Water Conservation	Ag Engg.	2	1	0	3
6.	29AE406	Agricultural Structure and Rural Engineering	Ag Engg.	2	0	0	2
7.	29AE451	Farm Machinery and Implements-Lab	Ag Engg.	0	0	2	2
8.	29AE452	Farm Tractor : Systems and Controls - Lab	Ag Engg.	0	0	1	1
9.	29AE453	Renewable Sources of Energy-Lab	Ag Engg.	0	0	1	1
10.	29AE454	Post Harvest Technology-Lab	Ag Engg.	0	0	1	1
11.	29AE455	Soil and Water Conservation-Lab	Ag Engg.	0	0	1	1
12.	29AE456	Agricultural Structure and Rural Engineering -Lab	Ag Engg.	0	0	1	1
<b>Total</b>				<b>13</b>	<b>3</b>	<b>7</b>	<b>24</b>

**Diploma (Agril. Engineering)****SEMESTER- V**

<b>Sr. No.</b>	<b>Sub. Code</b>	<b>SUBJECT</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>Credit</b>
1.	29AE501	Operation and Maintenance of Tractors and Farm Machineries	1	1	0	2
2.	29AE502	Agricultural Industrial Finance & Rural Entrepreneurship	3	1	0	4
3.	29AE503	Computer Aided Drafting	2	0	0	2
4.	29AE504	Agricultural Process Engineering	3	1	0	4
5.	29AE505	Watershed Management	2	1	0	3
6.	29AE551	Operation and Maintenance of Tractors and Farm Machineries-Lab	0	0	4	2
7.	29AE552	Computer Aided Drafting-Lab	0	0	4	2
8.	29AE553	Agricultural Process Engineering-Lab	0	0	4	2
9.	29AE554	Watershed Management-Lab	0	0	2	1
<b>Total</b>			<b>11</b>	<b>4</b>	<b>14</b>	<b>22</b>

**Diploma (Agrill. Engineering)****SEMESTER- VI**

<b>Sr. No.</b>	<b>Sub. Code</b>	<b>SUBJECT</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>Credit</b>
1.	29AE651	Internship cum Industrial Training	0	0	18	10
2.	29AE652	Project	0	0	6	6
<b>Total</b>			<b>0</b>	<b>0</b>	<b>24</b>	<b>24</b>

## **Crop Production Technology 5(3+1+1)**

**Objective-** A diploma holder in Agricultural Technology needs to learn about package of practices for various seasonal crops besides becoming familiar with the preparation of cost estimates for production of these crops. After studying the subject of crop production, the diploma holders should acquire adequate knowledge and skills of crop production and cropping system, soil fertility and weed management besides plant protection and crop harvesting.

### **Unit-I**

Introduction to Agriculture, importance of agriculture, Crop production Art, Science and business, Factors affecting crop production viz. Internal and external factors. Classification of crops based on their utility and seasons of growing. Major and principal crops of the country and Madhya Pradesh state. Introduction to major fruits, vegetables and flower crops of country with specific emphasis on the crops of state of Madhya Pradesh. Introduction to various specialization of agriculture.

### **Unit-II**

**Soil Science :** Nature and origin of soil; soil forming rocks and minerals, their classification and composition, soil forming processes, classification of soils soil taxonomy orders; important soil physical properties; and their importance; soil particle distribution; soil inorganic colloids their composition, properties and origin of charge; ion exchange in soil and nutrient availability; soil organic matter its composition and decomposition, effect on soil fertility; soil reaction acid, saline and sodic soils; quality or irrigation water; essential plants nutrients their functions and deficiency symptoms in plants; important inorganic fertilizers and their reactions in soils.

### **Unit-III**

**Agronomy:** Definition and scope of agronomy. Classification of crops, Effect of different weather parameters on crop growth and development. Principles of tillage, tith and its characteristics. Soil water plant relationship and water requirement of crops, weeds and their control, crop rotation, cropping systems, Relay cropping and mixed cropping.

### **Unit- IV**

**Horticulture:** Scope of horticultural and vegetable crops. Soil and climatic requirements for fruits, vegetables and floriculture crops, improved varieties, Criteria for site selection, layout and planting methods, nursery raising, macro and micro propagation methods, plant growing structures, pruning and training, fertilizer application, fertigation, irrigation methods, harvesting, grading and packaging, post harvest practices, Garden tools, management of orchard, Extraction and storage of vegetables seeds.

#### **LIST OF PRACTICALS**

- Identification of crops and their seeds.
- Identification of different types of fertilizers.
- Identification of different crop weeds and methods of weed control.
- Practices of fertilizer application.
- Methods of seed bed preparation.
- Methods of sowing/planting.

- Visits to the mechanized/modernized farms of agricultural universities farms for the study of growth phases in various crops and to get the exposure of modern techniques being used for raising different crops.
- Study of Vermicomposting and visits to agriculture farms.
- Estimation of different entities required for crop production and estimation of yield of crops.
- Identification of different diseases and insect-pests of major field crops.

### **RECOMMENDED BOOKS**

1. A text book of Soil Engineering; New India Publishing House Delhi.
2. Cropping System Theory Practice by Chatterjee; Oxford IBH Publication Co.
3. Crop Production & Management by Y.B. Morachan; Oxford IBH Publication Co.
4. Principles Practices of Agronomy by S.S. Singh; Kalyani Publishers, New Delhi.
5. Manual of Irrigation Agronomy by Mishra and Ahmad Mall; Oxford IBH Publication Co.

## **Irrigation Engineering 5(3+0+2)**

**Objective-** A diploma holder in agricultural technology needs to learn the principles pertaining to the optimum use of water for maximum agricultural yield besides understanding engineering principles related to surface and ground water resources. After studying this subject, the students shall acquire adequate knowledge and skills about water requirement of crops and water lifting devices.

### **Unit-I Introduction**

Irrigation, necessity of irrigation and advantages and disadvantages of irrigation. Types of irrigation viz. artificial(flow, lift etc.) and natural. Sources of irrigation water. Quality of irrigation water. Evaporation, measurement of evaporation by pan evaporimeter. Transpiration and transpiration ratio. Evapotranspiration or consumptive use, seasonal consumptive use, peak period consumptive use.

### **Unit-II Water Requirement of Crops**

Measurement of evapotranspiration by direct methods viz. Lysimeter experiment, Field experimental plots. Estimation of evapotranspiration from evaporation data and climatological data(introduction only). Water infiltration and determination of infiltration rate. Water requirement, net and gross irrigation requirement of crops. Irrigation frequency and irrigation period. Estimation of irrigation depth and irrigation scheduling, irrigation intensity Duty and Delta; factors affecting duty and methods of improving duty.

Irrigation efficiencies- water conveyance, application, storage, distribution, water use, project, operational and economic efficiency. Uniformity coefficient.

### **Unit-III Water Application Methods**

Introduction to surface, subsurface, sprinkler and drip irrigation systems. Surface methods of irrigation viz. border, check basin and furrow irrigation, their basic details, characteristics, types and their adaptability. Concept of subsurface irrigation method, its importance and adaptability. Sprinkler irrigation-its adaptability and limitations, types ,components, operation and maintenance of sprinkler systems. Layout and various design parameters of sprinkler irrigation system. Drip irrigation- its adaptability and limitations, types ,components, operation and maintenance of sprinkler systems. Layout and various design parameters of drip irrigation system.

### **Unit-IV Water Lifting Devices**

Introduction to various water lifting devices viz. manual, animal and power operated. Classification of pumps-positive displacement (reciprocating and rotary), variable displacement. Terms related to pumps. Principle of operation of centrifugal pumps (volute and diffuser type, single stage and multistage type), Types of impellers of centrifugal pump ;Installation, operation and maintenance of centrifugal pumps, submersible pump and vertical turbine pumps; their common troubles and remedies. Principles of operation of propeller and jet pumps, their adaptability and limitations. Criteria and procedures for selection of irrigation pumps, power requirements, efficiency and economics of irrigation pumping plants.

### **Unit-V Conveyance of irrigation water**

Canals and their classification (brief description only), seepage from canals and field channels. Canal lining-various types. Their advantages and disadvantages. Introduction to various water conveyance structures and their functions e.g. flumes, tunnels, inverted siphons, flexible tubing and gated pipes. Open channels, their types, layout and design parameters. Subsurface systems of water conveyance, their components, hydraulics and layout.

## **LIST OF PRACTICALS**

- Installation, operation and maintenance of sprinkler irrigation system.
- Installation and operation of centrifugal pump.
- Dismantling of centrifugal pump, study of constructional feature of its component and its assembly.
- Installation, operation maintenance of submersible pump. Identifying/locating the faults/troubles and remedies.
- Determination of infiltration rate of soil.
- To survey market and field for the availability, adaptability and selection of various types of pumps and irrigation systems in the region.
- Measurement of irrigation water in the field channels with the use of Parshall flumes and weir.
- Study tours to watershed management, irrigation and drainage projects.

## **LIST OF BOOKS**

Ground Water and Well Drilling by Parveen Kumar; CBS Publishers and Distributors, Delhi

Text Book of Irrigation Engineering (Vol. 2,3) by Sharma Sharma; Oxford IBH Publication Co.

Irrigation Theory and Practice by Dr. A.M. Michael; Vikas Publishing House, New Delhi.

Sprinkler Irrigation by Sivanappan; Oxford IBH Publication Co.

Irrigation Engineering by Sharma Bari; Satya Parkashan Publishers.

Irrigation Engineering (Vol. 1, 2, 3) by Sharma & Sharma; Oxford ffiH Publication Co.

## **Thermodynamics and Heat Engine 4(3+0+1)**

### **Unit I**

Fundamentals and Definitions, System (closed and open system), Control Volume, properties, state, state change, and diagram, Dimensions and units. Thermodynamics properties, flow and non-flow processes, gas laws, Laws of thermodynamics.

### **Unit II**

Application of first law in heating and expansion of gases in non-flow processes. First law applied to steady flow processes. Kelvin-Planck and Clausius statements. Reversible processes, Carnot cycle, Carnot theorem. Entropy, physical concept of entropy, change of entropy of gases in thermodynamics processes. Difference between gas and vapour, change of phase during constant pressure process.

### **Unit III**

Generation of steam, triple point and critical point. Internal energy and entropy of steam. Use of steam tables and Mollier chart, heating and expansion of vapour in non-flow processes, measurement of dryness fraction. Classification of steam boilers, Cochran, Lancashire, locomotive and Babcock-Wilcox boilers. Boiler mountings and accessories.

### **Unit IV**

Desirable properties of working fluid used for power plants. Rankine cycle. Expansive and non-expansive working. Saturation curve and missing quantity, governing. Calculations of cylinder dimensions.

### **Unit V**

Air Standard efficiency, other engine efficiencies and terms. Otto, diesel and dual cycles. Calculation of efficiency, mean effective pressure and their comparison. Measurement of IP, BP and heat balance calculations (not involving combustion). Engine efficiencies and performance.

### **LIST OF PRACTICALS**

- Comparison of different temperature measuring methods;
- Study of boilers; Study of various mountings and accessories of boilers; Study of steam engine;
- To measure dryness fraction of steam Performance test of steam engine;
- Study of I.C. engines;
- Study of valve timing diagram of 2-stroke engines;
- Study of valve timing diagram of 4-stroke engines;
- Study the performance test on 2- cylinder diesel engines;
- Study the performance test and heat balance test on a four cylinder horizontal diesel engine;

### **Suggested Text Books References**

- Thermal engineering ( R.K. Rajput) Laxmi Publication.
- Engineering Thermodynamics by T. P. Roy Choudhary
- Thermal engineering ( Domkundwar, Kothandaraman and Khajuria) Dhanatrai Publication
- Van Wylen, G. J. and Sonntag, R.E., Fundamentals of Classical Thermodynamics,

## **Farm Power 4(2+1+1)**

### **UNIT-I**

Sources of farm power - conventional non-conventional energy sources. Classification of IC engines and tractors.

### **UNIT-II**

Review of thermodynamic principles of IC (CI SI) engines and deviation from ideal cycle.

### **UNIT-III**

Study of engine components their construction, operating principles and functions. Engine systems valves valve mechanism.

### **UNIT-IV**

Fuel air supply, cooling, lubricating, ignition, starting and electrical systems. Study of constructional details, adjustments operating principles of these systems.

### **UNIT-V**

IC engine fuels - their properties combustion of fuels, gasoline tests and their significance, diesel fuel tests and their significance, detonation and knocking in IC engines, study of properties of coolants, anti-freeze and anti-corrosion materials, lubricant types study of their properties. Engine governing systems.

### **LIST OF PRACTICALS**

- Engine parts and functions, working principles etc.
- Valve system study, construction and adjustments.
- Oil Fuel - determination of physical properties.
- Air cleaning system; Fuel supply system of SI engine.
- Diesel injection system timing; Cooling system, and fan performance, thermostat and radiator performance evaluation.
- Part load efficiencies governing.
- Lubricating system adjustments.
- Starting and electrical system; Ignition system.
- Tractor engine performance curves.

### **Text Book:**

- S.C. Jain, and C.R. Rai; Farm Tractor Maintenance. Granada Publishing Ltd., London.
- Ojha, T.P. and Michael, A.M. 2001. Principals of Agricultural Engineering, Vol.- I, Jain Brothers, New Delhi.
- Sahay, J. 2001. Elements of Agricultural Engineering, Jain Brothers, New Delhi.
- Smith, H.P. and Wilkes, L.H. 1979. Farm Machinery and Equipment. Tata McGraw-Hill Publishing Co. Ltd., New Delhi.

## Basics of Electrical and Electronics Engineering 4(2+1+1)

**Objective-** The objective of this subject is to impart fundamental knowledge and skills regarding basic electrical and electronics engineering, which diploma holders will come across in their professional life. This course will provide the students to understand the basic concepts and principles of D.C. and A.C. fundamentals, electromagnetic induction, transformers, motors distribution system, domestic installation, electrical safety etc. The students will also learn basic electronics including diodes and transistors and their applications.

**UNIT-I Fundamentals of Electrical Engineering** Concept of electric current, potential and potential difference (Voltage). Sources of D.C. and A.C. Electric energy. Methods of voltage generation and standard voltages used in generation transmission and distribution. Electrical Power, energy and their units.

**D.C. Circuits** - Ohms Law, Concept of resistance, conductance, resistivity, conductivity and their units. Effect of temp. on resistance. Temperature coefficient of resistance ( Definition only) Connections of resistances. Series, Parallel connections and their combinations. ( Simple Numerical ) Kirchoff's Voltage Law, Kirchoff's Current Law ( Simple Numerical)

**A.C. Circuits** - Generation of single phase and three phase sinusoidal voltage. Vector representation. Concept of Cycle, Frequency, time period, amplitude, phase and phase difference. Define instantaneous value, average value, RMS value and peak value of sinusoidal electrical quantities. Derive relationship between them . Form factor and peak factor ( Definition only). Current voltage and power in pure resistive, inductive and capacitive circuit. Concept of Reactance , impedance and power factor in R.L., R. C. and RLC Series circuit. ( Simple Numerical). Causes and effect of poor power factor. Methods of improving power factor. 3 phase AC supply- three phase three wire and three phase four wire system. Relationship between VL and VPH, IL and IPH and three phase power in star and delta connected load.( Simple Numerical)

**UNIT-II A.C. MACHINES** - Single Phase Transformer Construction, working principle. EMF Equation (Derivation with simple numerical), Turn ratio, Step up and step down transformers and their application. Losses , efficiency and regulation ( No derivation). Three Phase Induction Motor Construction, types , principle of operation. Concept of Slip ( Simple Numerical), Applications, Starters DOL and Star Delta. Single Phase Induction Motor Methods of making a single phase motor self start. Types of single phase induction motor- capacitor start, capacitor run and shaded pole and their applications. Synchronous Machines Synchronous motor- construction, principle of operation, comparison with three phase induction motor. Synchronous generator( alternator) Construction, principle of operation, speed and frequency, synchronous speed.

**UNIT-III Measuring Instruments** - Classification of Measuring Instruments, absolute and secondary instruments. Indicating, Integrating and Recording instruments, their examples. Elementary idea about working principles and construction of MI and MC type Ammeter and voltmeter. Electrodynamometer type watt meter. Induction type energy meter , electronic energy meter. Application of Megger and earth tester. Multimeter,

**UNIT-IV Electric Wiring** - Types of Wiring and their Applications in brief. Size of conductor , S.W. gauge. Accessories like switches, fuses, holders, sockets and MCBs. Staircase Wiring , Fluorescent tube light wiring .

**Electric Safety** - Electric shock and its prevention , effect of electrical current on human body, shock treatment, need of earthing.

**UNIT-V Electronic Devices And Circuits** - Semiconductor PN Junction Diode, Zener

Diode, PNP and NPN transistor , UJT, FET, MOSFET and SCR. Their layer diagram, symbol, V-I characteristics and applications. Electronic Circuits Concept of biasing of diode and transistor. Single Phase Half wave and Full wave rectifier( I/O waveform), Concept of ripple, filter circuit ( shunt capacitor and series inductor) . Transistor as an amplifier, concept of gain, Zener regulator, regulated power supply ( Block diagram only).

### **LIST OF EXPERIMENTS**

- Verification of Kirchoff's Law
- To Measure Voltage Current and power in single phase AC circuit.
- To calculate Impedance, power and power factor by measuring voltage across each element
- Study of different parts of DC machine . Study of three point starter for DC motor.
- Study of different parts of Induction Motor (Single Phase/ Three Phase)
- To determine transformation ratio of a given single phase transformer.
- Study and operation of DOL and Star Delta Starter.
- To measure slip for a given three phase induction motor.
- To measure insulation resistance by Megger.
- To measure earth resistance by earth tester.
- To make connection for fluorescent tube light circuit.

### **REFERENCES**

Fundamental of Electrical Engineering and Electronics B.L. Thareja , S. CHAND Publication

Basic Electrical Engineering V.K. Mehta , S. CHAND Publication

Principles of Electronics V.K. Mehta , S. CHAND Publication

Basic Electrical Engineering V. N. Mittle, TMH

Electrical Machines Vol I & II S.K.Bhattacharya, TTTI, Chandigarh

A Curse book in Electrical Electronic Measurement and Instrumentation , A.K Sawhney.

Principles of Electrical Engg. and Electronics V.K. Mehta , S. CHAND Publication

Electrical Technology S.L.Uppal, Khanna Publication

Electrical Measurement J.B. Gupta, Dhanpat Rai Sons.

## **Workshop Technology 4(2+0+2)**

**UNIT-I** Introduction to welding, types of welding, Oxyacetylene gas welding, types of flames, welding techniques and equipment. Principle of arc welding, equipment and tools. Introduction Casting processes.

**UNIT-II** Classification, constructional details of center lathe, Main accessories and attachments. Main operations and tools used on center lathes.

**UNIT-III** Types of shapers, Constructional details of standard shaper. Work holding devices, shaper tools and main operations.

**UNIT-IV** Types of drilling machines. Constructional details of pillar types and radial drilling machines. Work holding and tool holding devices. Main operations. Twist drills, drill angles and sizes. Types and classification.

**UNIT-V** Constructional details and principles of operation of column and knee type universal milling machines. Plain milling cutter. Main operations on milling machine.

### **LIST OF EXPERIMENTS**

- Study of shop lay-out fitting shop, carpentry shop, black smithy shop.
- To prepare a single piece pattern by wood working operation
- To prepare half lap joint by wood working operation
- To prepare Dove-tail joint by wood working operation
- To prepare Mortised joint by wood working operation
- To prepare Tennon joint by wood working operation
- To prepare square bar out of cylindrical bar by cold working process
- To prepare hexagonal chisel by hot working process
- To prepare chipping hammer by hot working process
- To prepare khurpi by hot working process
- To prepare I hook by hot working process
- To prepare a lap joint of galvanized/ M.S. sheet by punching , drilling, and riveting operation
- To prepare m.s. square plates by filing, cutting, with hacksaw, drilling, ramming, threading with tap and die and assembly processes
- To prepare male and female (C T ) parts by different fitting operations

## Farm Machinery and Implements 6 (3+1+2)

**Rationale :** The topics covered in the subject will enable the students to understand the basic principles, construction and working of farm machinery for different crops. This will also enable them to select appropriate machinery, use, repair and maintain the same. This knowledge will be highly useful in running an Enterprise related with Farm Machinery and employment in Farm Mechanization sectors.

**Unit-I Introduction :** Importance of farm mechanization. Classification of machinery & implements used in the farm. **Basics of Machines:** Kinetic energy of rotating masses, friction force in a moving body, collars, pivots. **Transmission of power in farm machinery :** Flat and V -belt drives, length of belt, ratio of tensions. Horse power transmitted, effect of centrifugal tension, condition for maximum power transmission, belt dynamometer. (No derivation), Simple problems. **Balancing :** Concept of balancing, difference between static and dynamic balancing, balancing of single and several masses in a plane, balancing of several rotating masses in different parallel planes.

**Unit-II Primary Tillage Equipment :** Introduction to various primary tillage implements used on the farm. Functions, constructional details, adjustments and study of different plough viz. mould board plough, disc plough, rotary plough (rotator) and chisel plough. **Secondary Tillage Implements :** Introduction to the various secondary tillage implements. Study of cultivators & harrows, their types, functions & constructional details.

**Unit-III Seeding and Planting Equipment :** Introduction to various seeding and planting machinery used for various crops. Study of components & functions of seed drills & planters; Concept of minimum tillage technology (Zero till, strip till drill, bed planters). Calibration of seed drills and planters. **Interculture Tools/Weeding Tools :** Introduction to various tools used for interculture, study of their functions and constructional details.

**Unit-IV Fertilizer/Manure Application Equipment :** Familiarization with the manure spreaders & granular fertilizer spreading equipment, study of their functions and importance. Study of various types of the nozzles used in the sprayers. **Harvesting and Threshing Machinery :** Familiarization with the harvesting machines for various crops e. g. hay harvesters, forage harvesters, vertical conveyer reapers, cotton pickers, corn harvester, potato diggers, ground nut diggers.

**Unit-V Constructional details & principles of working :** Study of power thresher including axial flow thresher - main components, function and constructional details. Safety requirements in threshing operations. **Introduction to combine harvesters** and straw combines and study of their operation. Losses during harvesting and threshing operations and their management.

**Land Development Machinery :** Familiarization with various land development implements e.g. leveler, planer, scraper, ridger. Study of their functions and adaptability.

### LIST OF PRACTICALS

To study the constructional features and different components of the following agricultural implements/ farm machines.

- Primary tillage implements Mould board plough /Disc plough.
- Secondary tillage implements Harrow/Cultivators, Rotavators.
- Sowing Machines Seed Drill/Planter/Transplanter, no-till, strip-till drill, bed planter, sugarcane planters, potato planter.
- Intercultural equipment/tools Wheel hand hoe/Cultivators.
- Harvesting Machines Vertical Conveyer Reaper/Mower/Potato digger/ Groundnut Digger.
- Threshing Machines Wheat/paddy thresher, axial flow thresher, High capacity multicrop thresher.

- Seed treater, different types of sprayers and dusters.

#### **LIST OF BOOKS**

Elements of Agricultural Engineering by Dr. Jagdishwar Sahay; Standard Publisher Distributors, Farm Power Machinery Surveying by Irshad Ali; Kitab Mahal, Allahabad, Principle of Agricultural Engineering Volume-I by A.M. Michael &T.P.Ojha; Jain brothers.

## **Farm Tractor : Systems and Controls 4 (2+0+2)**

**UNIT-I Introduction** Sources of farm power and scope of mechanization. Tractor - classification and different type of tractors and systems. Main assemblies of the tractors (Names only)

**Power Transmission System of Tractors** : Functions and various components of power train. Clutch; functions of clutch, type of clutch(single plate, dual plate and multi plate clutch) . Gear box; function and working of gear box, types of gear boxes (sliding, constant mesh and synchromesh gears). Differential and differential lock; function and constructional details. Final drive; reduction gear and rear axle. Power take off shaft and drive to the PTO shaft.

**UNIT-II Braking System** : Importance and function of brakes, various types of brakes viz. mechanical and hydraulic and their working.

**Wheels and Tyres of Tractors** : Types of wheels rim and tyres used in tractors. Function of tyres. Causes of tyre wear. Need for changing the rear wheel, spacing of wheels and arrangement for the change. Wheel ballasting and methods of ballasting.

**UNIT-III Hydraulic System** : Principles and working of hydraulic system.

**Steering System of Tractors** ; Functions and components of steering systems.

**Electrical System of Tractors** :Components of electrical systems viz. battery, starter switch, self starter, motor, dynamo and its construction, functions, operation; maintenance and care of the battery.

**UNIT- IV Economics, Selection and Safety of Tractors** : Various factors affecting the right selection of a tractor. Safety measures in the operation of tractor, cost analysis of use of tractors.

Periodical Maintenance, Repair and Overhauling of Tractor; Daily, weekly and monthly maintenance, repair and overhauling of tractor.

**UNIT- IV Tractor Testing** : Traction, Terms related to traction- Traction efficiency, coefficient of traction, rolling resistance, slip, rim pull. Tractor testing stations, test conditions, general requirements for testing a tractor. Type of tests.

### **LIST OF PRACTICALS**

- Familiarization with tractors available in India.
- Familiarization with various tools used for dismantling and assembling of tractors and implements.
- Study of clutch and its components and assembly.
- Study of gear box, differential and final drive.
- Study of Brake and steering.
- Wheel equipment-care and maintenance, fitting of wheels and adjustment of track width.
- Operation of hydraulics system, draft position and mix control systems.
- Periodical maintenance and service of tractors.
- Repair and overhaul of tractors.
- To prepare the cost estimate for repair work.

### **LIST OF BOOKS**

Elements of Agricultural Engineering by Dr. Jagdishwar Sahay; Standard Publisher

Distributors.

Farm Power Machinery Surveying by Irshad Ali; Kitab Mahal, Allahabad,

Principle of Agricultural Engineering Volume-I by A.M. Michael &T.P.Ojha; Jain brothers.

### **Renewable Sources of Energy 3 (2+0+1)**

**Rationale :** Conventional energy sources are depleting day by day. Before we face the alarming deterioration, non-conventional energy sources should be harnessed. Non-conventional energy sources like solar, wind, bio-gas etc. should be used to the extent possible. A diploma holder in Agricultural Technology must know various types of non-conventional energy sources gadgets and their use and maintenance. Hence this subject.

**UNIT-I Introduction :**Energy; Different forms and types of energy, classification resources of energy, Conventional and Non conventional sources of energy. Need, importance and scope of non conventional and alternate energy resources/renewable sources of energy.

**UNIT-II Biogas :** Bio-gas, Benefits of bio-gas. Principles of biogas. Technology for biogas production. Feedstock, types and design of biogas plants, comparison of designs. Main parts of biogas plants, digester, gas holder, pressure gauge, gas controlling cocks and meter. Selection of biogas model and size. Site selection of biogas plants. Appliances of biogas plant - burner, heating plate, lamps. Operation, trouble shooting and maintenance of biogas plant. Safety measures in biogas plant. Introduction to biomass and farm residue, management and gasification.

**UNIT-III Wind Energy Technology :** Introduction, scope and significance. Type and constructional details of windmill - vertical and horizontal axis. Data required for windmill installation such as meteorological data, geo-hydrological, agricultural and socio- economic data. Site selection of windmill. Maintenance and performance of windmill.

**UNIT-IV Solar Energy Technology:** Introduction, significance of solar energy, solar spectral and green house effect. Principles of thermal collection and storage. Comparison of flat type collector and concentration or focussing type collectors. Introduction to SPV module, its principle and applications.

#### **LIST OF PRACTICALS**

- Visit to biogas plants, domestic community/institution for study and demonstration of biogas plants.
- Demonstration/study of the working of a windmill.
- Demonstration/study of solar cooker.
- Demonstration/study of solar water distillation.
- Demonstration/study of solar water heater.
- Demonstration/study of solar photovoltaic lighting system.
- Demonstration/study of water pumping system.
- Study of energy saving appliances and their applications.

#### **LIST OF BOOKS**

Non Conventional Energy Sources by G.D.Rai; Khanna Publishers, New Delhi.

Renewable & Conventional Energy by S. Rao.

Bio Gas Technology by K.C. Khandelwal & S.S. Mahdi; Tata McGraw-hill Publishing Co. Ltd., New Delhi.

Wind Energy For water Pumping by Srivastava; Oxford & IBH Publication Co.

Cook Stoves For Masses by N.S.Grewal; PAU Ludhiana.

Energy in Agricultural Engineering by ISAE; Jain Brothers, Delhi.

## Post Harvest Technology 4 (2+1+1)

**RATIONALE:** Agricultural produce e.g. cereal, pulses and oil seeds are not consumed as such. They are processed before consumption. Knowledge of unit operation such as drying, storage and processing of fruits and vegetables is of great importance for value addition of these food products.

**UNIT- I Introduction :** Introduction to post harvest technology of agricultural produce, its need, scope and importance. Brief description and introduction to various post harvest operation such as cleaning, grading, sorting, drying, storage, milling, size reduction, expelling, extraction, blending, heat treatment, separation, material handling (transportation, conveying, elevating), washing; their functions and use in the post harvest processing

**UNIT- II Engineering Properties of Agricultural Materials :** Introduction to the engineering properties of agricultural materials affecting post harvest operations. Physical properties such as shape, size, density and specific gravity . Aero and hydro dynamic properties such as drag coefficient and terminal velocity. Frictional properties e.g. static friction, kinetic friction, rolling resistance, elasticity and angle of repose. Mechanical properties such as hardness, compressive strength, impact and shear resistance and thermal properties like specific heat, thermal conductivity and thermal diffusivity etc.

**UNIT- III Drying:** Drying of Cereals and Pulses Introduction, importance of drying, principles of drying and factors affecting drying, types of drying methods i.e. sun drying artificial drying by mechanical means. Moisture content representation, equilibrium moisture content, determination of moisture content by direct and indirect methods. Introduction to various grain drying systems - solar drying system, batch drying system, continuous flow drying system. Safe temperatures during drying. Principles of operation of different types of dryers viz. Deep bed dryers, thin layer dryers, continuous flow dryers, L.S.U. dryers, fluidized bed dryers, rotary dryer, tray and tunnel dryers .

**UNIT- IV Storage:** Storage of Cereals and Pulses (2hrs) Introduction, need and importance, general principles of storage, temperature and moisture changes during storage i.e. influence of moisture content, relative humidity and temperature etc. on stored product. Insect and other organism associated with stored grains. Familiarization with the various types of storage structures. Deep and shallow bins. Traditional and modern storage structures. Management of storage structures. Comparison of bag and bulk storage. Losses during storage and their control, space requirement of bag storage structure.

**UNIT- V Post Harvest Technology of Fruits and Vegetables :** Post harvest losses and introduction to factors affecting storage of fruits and vegetables. Need and importance of storage. Principle of storage of fruits and vegetables i.e. cold storage, controlled and modified atmosphere storage. Recommended storage conditions for important fruits and vegetables. Introduction to packaging of fruits and vegetables and types of packaging. Concept of modified atmosphere packaging. Post harvest treatment to increase shelf life i.e. freezing, chilling and canning. Introduction to cool-chain for handling, storage and marketing of fresh fruits and vegetables.

### LIST OF PRACTICALS

1. Determination of physical properties of agricultural materials e.g. size, shape, density and angle of repose.
2. Determination of moisture content of grains by direct/oven method and by digital moisture meter.
3. Study of different types of dryers.
4. Study of domestic grain storage structures.
5. Visit to warehouses (bag storage and bulk storage structures).
6. Visit to cold-storage.
7. Study of different packaging materials.

8. Study of material conveying equipments.
9. Visit to canning industry( Milk Plant etc.)

**RECOMMENDED BOOKS**

1. Post Harvest Technology of Cereal, Pulses, Oil seeds by A. Chakraverty; Oxford IBH Publication Co.
2. Unit operation of Agro Processing Engineering by Dr.K.M. Sahay & K.K Singh; Vikas Publications.
3. Post Harvest Technology of fruits Vegetables by Thompson; CBS Publishers and Distributors,

## **Soil and Water Conservation 4 (2+1+1)**

**RATIONALE** : A diploma holder in Agricultural Technology needs to learn about the soil erosion, the factors affecting the erosion besides the soil erosion control practices and drainage. A course on soil conservation shall equip the students with the knowledge of the properties of soil, agents of erosion, methods of erosion control, water harvesting and drainage problems.

**UNIT- I Soil and its properties** : Introduction to the soil as a natural body, definitions and functions of soil. Various constituents of soil and their importance. Soil as a medium of plant growth. Properties of Soil in relation to plant growth Soil separates and classifications (I. S. S. S. U. S. D. A.). Soil texture and classification of soil (U. S. D. A.). Soil structure; definition, types and factors affecting soil structure. Bulk density and particle density of soils. Soil consistency. Porosity void ratio. Degree of saturation. Soil moisture content (dry basis wet basis ). Method of soil moisture determination viz. gravimetric method. Retention of soil moisture; maximum retentive capacity, field capacity, permanent wilting percentage, hygroscopic coefficient. Soil moisture classifications. Available water holding capacity of soil. Soil permeability; definition and importance. Darcy's law, Coefficient of permeability. Soil air and aeration.

**UNIT- II Soil Erosion** : Introduction, Classification of erosion viz. Geological and accelerated. Mechanics of Water Erosion, Raindrop erosion, Sheet erosion, Rill erosion, Gully erosion and principle of gully erosion and Classification of gullies. Stream channel erosion. Effects of water erosion, Factors affecting erosion by water. Mechanics of Wind Erosion Processes of saltation, suspension, surface creep. Factors affecting erosion by wind.

**Erosion Control Measures** : Principles of erosion control Agronomical measures Agronomic and field practices to control erosion by wind and water i.e. Contour farming, strip cropping, tillage etc. Mechanical measures Terracing to control erosion by water. Types of terraces. Terrace design parameters and planning a terrace system. Bench terraces, types and design parameters. Use of bunds to control erosion and design parameters of bunds. Contour bunding. Vegetated water ways for the control of erosion. Temporary structures for the control of gully erosion, their types and adaptability. Permanent soil conservation structures viz. Drop spillway, Chute spillway, Drop inlet spillway for the control of erosion; their principles, adaptability, constructional features and material of construction. Introduction to the farm ponds, earthen embankments and water harvesting in relation to soil and water conservation, soil conservation through tree and grass cultivation, ground water recharge, watershed management

**UNIT- III Water Harvesting and Storage** : Need, Importance and scope of water harvesting, Types and Methods of water harvesting. Brief description of the different systems of water harvesting and storage. Salt affected soils and their reclamation. Saline, alkaline and acid soils, Reasons and factors of their formation. Chemical Properties, Soil reaction (pH), Electrical Conductivity (EC), Cation Exchange Capacity (CEC), Sodium Adsorption Ratio (SAR), Exchangeable Sodium Percentage (ESP), salt concentration in the soils. Effect of salinity, alkalinity and acidity on plant growth. Reclamation of these soils and their management.

**UNIT- IV Waterlogged soils and their drainage** : Water logging, causes of water logging and its effects. Drainage. Types of drainage systems viz. surface and subsurface drainage. Introduction to drainage investigation. Benefits of drainage. Drainage properties of soil.

Drainage coefficient. Surface drainage-functional components, types (random drain, parallel field drain, parallel open ditch and bedding system used in flat areas and cross slope ditch system used in sloping areas). Benefits of subsurface drainage. Introduction to investigations for subsurface drainage, different method of subsurface drainage viz. tile drains, mole drains, drainage wells, deep open drains and combination of tile and opened drains. Environment Issues in waterlogged soils are health hazard, salt affected soils create impermeability and long term effects

### **LIST OF PRACTICALS**

- Study of Rain gauges, their operation & installation.
- Study and use of float & current meter to measure runoff.
- Demonstration of various types of soil erosion.
- Preparation of land use capability map for a given area.
- Survey and planning of soil conservation measures in a given area.
- Cost estimation of bunding.
- Cost estimation of levelling of a field with slope either lengthwise or breadth wise.
- Cost estimation of digging of farm ponds of definite dimensions.
- Study of layout and management of forest nurseries.
- Visit to various areas of soil-water conservation and land reclamation activities and structures.

### **RECOMMENDED BOOKS**

- Soil Water Conservation Engineering by Glenni O.Schwab, Richard K. Frevert, Talcott W. Edminster, Kenneth K.Barnes; John Wiley Sons New York
- Manual of Soil Water Conservation Practice by Gurmail Singh; Oxford IBH Publication co.
- Soil Water Conservation Engineering by Suresh R.; Standard Publication
- Principle of Agricultural Engineering Volume-II by A.M. Michael T.P. Ojha; Jain brothers.

## **Agricultural Structure and Rural Engineering 3 (2+0+1)**

**UNIT I :** Planning and layout of farm stead. Physiological reactions of livestock to solar radiation and other environmental factors, livestock production facilities, BIS. Standards for dairy, piggery, poultry and other farm structures.

**UNIT II :** Design, construction and cost estimation of farm structures; animal shelters, compost pit, fodder silo, fencing and implement sheds, barn for cows, buffalo, poultry, etc.

**UNIT III :** Design and construction of rural grain storage system; Engineering for rural living and development, rural roads, their construction cost and repair and maintenance.

**UNIT IV :** Sources of water supply, norms of water supply for human being and animals, drinking water standards and water treatment suitable to rural community. Site and orientation of building in regard to sanitation, community sanitation system; sewage system its design, cost and maintenance, design of septic tank for small family. source of power supply, use of alternate source of energy, electrification of rural housing.

### **LIST OF PRACTICALS**

- Design and layout of a dairy farm.
- Design and layout of a poultry house.
- Design and layout of a sheep/goat house.
- Design of a biogas plant.
- Design of a farm fencing system.
- Design of ventilation system for dairy and poultry house.
- Design of a feed/fodder storage structures.
- Familiarization with local grain storage structures.
- Design of grain storage structures.
- Cost estimation of a farm building.

### **RECOMMENDED BOOKS**

Farm Structures in tropical climates. FAO., By Bengtsson, L.P.

Agricultural buildings and structures. National Food Energy, By Whitaker, J.H

Farm buildings From planning to completion, By Phillips, R.E.

Practical farm buildings A textbook Handbook, By Boyd, J.S

## **Operation and Maintenance of Tractors and Farm Machineries 4 (1+1+2)**

**UNIT I** : Introduction to repair and maintenance , maintenance procedure and troubleshooting in tractors.

**UNIT II** : Scheduled maintenance after 10, 50, 100, 250, 50and 100hrs. of operation of tractor.

**UNIT III** : Top end overhauling. Safety hints, Fuel saving tips. Preparing the tractor for storage.

**UNIT IV** : Care and maintenance procedure of agricultural machinery during operation and off-season.

**UNIT V** : Repair and maintenance and workshop requirements for agricultural machineries.

### **LIST OF PRACTICALS**

- Familiarization with tools and equipment used for maintaining servicing of tractors farm machines.
- Doing the 10-hours service jobs Maintenance after 50- hours of operation;
- Maintenance after 10hours, 25hours, 50hours and 100hours of operation,
- Adjustment of tractor track;
- Dismantling and assembling of major engine parts;
- Visit to tractor/ engine repair workshop, injection pump injector repair shop;
- Doing minor repair of electric, mechanical and hydraulic system;
- Adjustment and maintenance of primary and secondary tillage equipment viz. m.b. plough, disc-plough and disc harrow etc.;
- Adjustment and maintenance of seeding planting and transplanting machines;
- Adjustment and maintenance of plant protection equipment;
- Adjustment and maintenance of reapers threshers;
- Adjustment maintenance of combine harvesters, straw combines, balers etc;
- Visit to small scale farm machinery manufacturers and their repair shops,
- Seasonal repair of farm machinery.

### **Reference Books**

Repair maintenance of tractors, By Jain & Rai

Farm Machines and equipment, ByC.P. Nakra, Dhanpat Rai Sons, New Delhi

Operators service manuals of each tractors, farm machinery

Farm machine, By Jagdishwar Sahay

## **Agricultural Industrial Finance & Rural Entrepreneurship 4 (3+1+0)**

**RATIONALE :** A diploma holder in Agricultural Engineering very often has to work with village folk. For this purpose he must have a good skills that he/she worded with the villagers. So a diploma holder in Agricultural Engg. should be able to apply the principles of rural sociology and social behaviour for rural people in his job and provide leadership in the development of rural areas. Therefore, the knowledge of development of rural area is very much needed to an agricultural engineering technician. The curriculum of diploma course in Agricultural Engineering is being developed keeping in view the job opportunities in the field. It has been experienced that students who opt for diploma course are fairly intelligent and enterprising. It has also been experienced that all students who pass out diploma do not go for jobs. Persons who posses entrepreneurial traits and attributes prefer setting up their own small scale industries/ business venture instead of seeking jobs. The percentage of students who like to set up their own industrial/ business venture could be increased by way of introducing entrepreneurship development in agricultural engineering curriculum.

**UNIT – I RURAL DEVELOPMENT:** Introduction Importance of rural development , need of development. Spheres of rural development: (a)Social (b) Education (c) Health (d) Housing (e) Sanitation and drainage (f) Industrial (g) Energy; Govt. Agencies involved in rural development: Block Development officer and its staff, Rural Engineering department. Financing Agencies and their working Development banks, regional rural bank, commercial banks, lead bank, cooperative banks. Govt. Schemes for rural development Trysem, IRDP, IRD, ACID (Agriculture credit intensive development scheme), DRI (Differential rate of Interest) scheme of banks, Insurance schemes.

Community Development Philosophy, principle and objectives, organizational set up of blocks, Panchayat samiti, Gram vikas samiti etc.

Rural Extension Rural Extension methods such Audio, Visual and Audio Visual. Use and role of information technology in rural development.

**UNIT – II ENTREPRENEURSHIP DEVELOPMENT:** Introduction Entrepreneur, entrepreneurship, its meaning & importance. Qualities of an entrepreneur. Entrepreneur Motivation Training (EMT). Ring toss, Achievement Planning, Tower Building. Industries Role and importance of small scale and other Industries. Classification of industries-village industry, tiny industry, small, medium and large scale industry. Ancillary industry. Identification of industry resources, demand and skill based industry.

Financing Agencies for - Land, Infra Structure, Machinery, raw material, import of raw material and machinery. Marketing. Role and function of Govt. department connected with the development of industries in the State. Component of project report - Land, Building, Electricity, water, Equipment and other utilities. Materials, its availability, cost, labour availability and wage rates. Price of finished product. Market Survey Project selection based on market survey, demand and supply estimation, fast moving brands etc.

**UNIT – III INDUSTRIAL MANAGEMENT:** Organization: Definition of good organization. Principle of good organization with merit demerits. Lay out: Site selection of factory, influence of location on plant layout, factors considering for plant building. Definition of plant layout, objectives & principles. Types of plant layout.

Industrial Management Production planning and control, marketing management and liaising, Basic concept of marketing and salesmanship, marketing mix, working capital management,

cash flow. Personnel management. Limiting cost ,budget and its control, book keeping, balance sheet, Break even analysis.

Industrial Legislation and Taxes : Industrial and Labour Laws, Production Tax. local tax, sales tax, excise duty, Income tax.

**UNIT - IV Material Management:** Importance and function of material handling. Engineering & economics consideration devices. Relation between plant layout and material handling. 4. Replacement of Machinery: Reason for machinery replacement. Depreciation, definition different method of calculation depreciation. 5. Purchase organization: Importance of good purchasing policy. Function of purchasing department. Duties of purchasing officer. Purchasing procedure.

Project Report Project report preparation and provisional registration. Preparation of detailed project report (D. P. R.) for financial assistance.

Human Resource Management: Human resource management, selection, performance appraisal, motivation and leadership and controlling.

#### **Reference Books**

Chitambar, J.B. (1977). Introductory Rural Sociology Wilcy Eastern Ltd., New Delhi.

Acharya, S.S., Agarwal, N.L.1987. Agricultural Marketing in India. Oxford and IBH, NewDelhi.

Acharya, S.S., Agarwal, N.L.1994. Agricultural Prices and Policy. Oxford and IBH, New Delhi.

Akhodri. N.M.P. etal. Trainers Manual on Developing entrepreneurial motivation. NIES Bud. New Delhi.

ED. Institute of India. Developing New entrepreneurs. EDII. Ahmedabad. NISIET. libraries . 338.93/EDI.

Rao. T.V. Development of an entrepreneur: A behavioural model IIM (A)

James S A.F and Freeman, R.E. (1994). Management. New Delhi. Prentice Hall of India. Pvt. Ltd.

## Computer Aided Drafting 4 (2+0+2)

**RATIONALE :** Computer aided drafting these days is extensively being used in the industry. This subject has been added to enable a diploma holder to make drawings using computer software and take prints/plots.

1. Introduction to AutoCAD Starting up, practice on how to create a new drawing file, setting drawing limits saving a file, drawing lines in different ways using absolute co-ordinates, user co-ordinates, WCS, UCS, drawing circles, drawing arcs, drawing ellipses. Drawing polygons, drawings splines. Drawing polylines, using window, zoom commands.
2. Practice on Edit commands such as erase, copy, mirror, array, offset, rotate, oops, undo, redo, scale, stretch, trim, break, extend, chamfer, fillet, O snap command
3. Practice on Text commands editing text, text size, text styles, change properties commands.
4. Practice on Layer Commands creating layer, freeze, layer on/off colour assigning, current layer, load line type, lock unlock layer, move from one layer to other.
5. Practice on Hatching, Hatch pattern selection.
6. Practice on Dimensioning, linear dimensioning, angular dimensioning radius/.diameter dimensioning O-snap command, aligned dimensioning, editing of dimensioning, tolerances in dimensioning.
7. Practice on print/plot commands. Export/import commands.
8. Practice on making complete drawings of components by doing following exercises:
  - a) Detail and assembly drawing of the following using AUTOCAD (2D) (4 sheets)
    - Plummer Block
    - Wall Bracket
    - Stepped pulley, V-belt pulley
    - Flanged coupling
    - Machine tool Holder (Three views)
    - Screw jack or knuckle joint
  - b) Isometric Drawing by CAD using Auto CAD (one sheet) Drawings of following on computer:
    - Cone
    - Cylinder
    - Isometric view of objects
9. Modeling (02 sheets) 3D modeling, Transformations, scaling, rotation, translation.
10. Creating Chamfer and Fillet Practice on surface modeling, create part file, practice on assembly of parts, creating assembly view, orthographic views, section view ( Practice on different views, practice on data transfer)
11. Introduction to Other Software; (Pro Engineer/CATIA / Inventor/Unigraphics/Solid Work Salient features.

### RECOMMENDED BOOKS

1. Engineering Drawing with AutoCAD 200by T. Jeyapooran; Vikas Publishing House, Delhi.

2. AutoCAD for Engineering Drawing Made Easy by P. Nageswara Rao; Tata McGraw Hill, New Delhi.
3. AutoCAD 200for you by Umesh Shettigar and Abdul Khader; Janatha Publishers, Udupi.
4. Auto CAD 200by Ajit Singh, TMH, New Delhi.

## **Agricultural Process Engineering 6 (3+1+2)**

**RATIONALE :** The agricultural material has to undergo different operations and processes before reaching the consumer as a final product. In this subject, processing techniques of different agricultural products e.g. paddy, wheat, oilseeds, pulses have been covered. These will enable the students to understand the basic principles, operation and maintenance of different processing machinery and also to set up their own processing unit.

**UNIT - I Seed Processing:** Introduction, principles of seed processing. Steps in processing and flow diagram showing various steps/operations in processing. Machine used in processing of seeds of cereals, pulses and cotton e.g. conveyors and elevators, different types of cleaners and graders viz. air screen cleaner-cum-grader, disc separators, indented cylinders, spiral separators, specific gravity separators, pneumatic separators, magnetic separator, inclined draper and belt type electrostatic separators. Process of mechanical and acid delinting of cotton seeds. Layout and plan of seed processing plant. Seed treaters, calibration of seed treater.

**UNIT - II Rice Milling :** Paddy grain structure, paddy cleaning, pre milling treatment. Parboiling ; basic concept and principles. Method of parboiling ; traditional method, single boiling, double boiling method. Modern methods :- CFTRI, Kisan continuous, pressure parboiling RPEC and sodium chromate method. Rice milling process flow chart of modern rice mill, dehulling operations of paddy. Under runner disc sheller, rubber roller sheller and hullers, whitening, polishing and grading. Construction and operation of rubber roll sheller, vertical cone rice whitener, horizontal rice whitener. Utilization of the by-products of rice mill.

**UNIT - III Pulse Milling :** Important unit operations of pulse milling, cleaning, conditioning, polishing and grading. Pulse milling process, domestic level process, commercial level process. Pulse milling method Wet milling and dry milling. Factors affecting pulse milling out turn a). grain parameter b) machine parameter.

**Wheat Milling :** Introduction to flour milling , steps in wheat milling, receiving ,drying and storage, cleaning, conditioning, milling into flour and by product, packaging and blending. Component, operation and performance of wheat mill.

**UNIT - IV Oil Mills :** Processes of oil milling, unit operations in oil mills. Oil expression and extraction. Mechanical expression devices such as Ghani, hydraulic press and screw press; Their principle of operations. Principle and concepts of solvent extraction.

**Animal Feed Processing :** Introduction to various animal feeds and sources of raw material. Machines used for grinding, blending, mixing, pelleting of feed ingredients. Lay out of animal feed plant.

**UNIT –V Milk & Milk Processing:** Importance of milk, Physical properties of Milk, . Factors affecting the quality of milk. Clean milk production. Processing of milk. Filtration, Clarification bacto-fugation pasteurization ultra high temperature treatment, homogenization, sterilization, cooling and chilling of milk, Definition, composition and method of manufacture of cream, butter, dahi, khoya, Chhenna, Ice cream, condensed milk, milk powder, cheddar and cottage cheese, common adulterants of Ghee and khoa and their detection, Cleaning and sanitization of dairy equipments.

### **LIST OF PRACTICALS**

1. Study of operation and adjustments of air screen cleaner-cum-grader.

2. Study of operation and adjustment of specific gravity separator.
3. Study of operation and adjustment of indented cylinder.
4. Visit to a seed processing plant.
5. Study of different materials handling equipments.
6. Visit to rice milling industry for the study of parboiling and rice milling equipment.
7. Visit to a Dall mill and study the operations.
8. Visit to flour mill and study of machinery and processes used in flour milling.
9. Visit to oil-mill and solvent extraction plant.
10. Visit to animal feed plant and study of machines used in feed mill.
11. Visit to Milk Processing Unit/Plant.

### **RECOMMENDED BOOKS**

Post harvest Technology of cereal, Pulses, oil seeds by Chakraverty; Oxford & IBH Publication Co.

Food Processing, by Potty Mulky; Oxford IBH Publication Co.

Unit operation of Agro Processing Engineering by Dr. K.M. Sahay; Vikas Publications.

Principles of Agro Process Engineering, by Dr.K.M. Sahay; Vikas Publications.

Rice Processing Technology by S. Bandyopadhyaya N.C. Roy; Oxford & IBH Publication Co.

Food Processing Industry in India by Desai; Oxford IBH Publication Co.

Fruits Vegetable Processing by Bhatti Suman; Oxford IBH Publication Co.

Food Process Engineering by Holdman; Oxford IBH Publication Co.

## **Watershed Management 4 (2+1+1)**

**UNIT - I Watershed management** - problems and prospects. Watershed based land use planning. Watershed characteristics physical and geomorphologic, factors affecting watershed management. Hydrologic data for watershed planning.

**UNIT - II Watershed delineation**, delineation of priority watershed. Water yield assessment and measurement from a watershed. Hydrologic and hydraulic design of earthen embankments and diversion structures. Sediment yield estimation and measurement from a watershed and sediment yield models.

**UNIT - III Rainwater conservation technologies** - in-situ and storage, design of water harvesting tanks and ponds. Water budgeting in a watershed. Effect of cropping system, land management and cultural practices on watershed hydrology.

**UNIT - IV Evaluation and monitoring of watershed programmes.** Peoples participation in watershed management programmes. Planning and formulation of project proposal; cost benefits analysis of watershed programmes.

### **LIST OF PRACTICALS**

- Study of watershed characteristic; analysis of hydrologic data for watershed management;
- Delineation of watershed and measurement of area under different vegetative and topographic conditions;
- Measurement of water and sediment yield from watershed;
- Study of different watershed management structures;
- Study of various water budget parameters; .
- Study of watershed management technologies;
- Preparation of a techno-economically effective project proposal

### **LIST OF BOOKS**

- Watershed Management(For Dryland Agriculture) , By Oswal M.C.
- Land Resources and Their Management for Sustainability in Arid Regions , By Kolarkar A.S.
- Land and Water Management Engineering , By V.V.N. Murthy
- Design of small canal structures , By Aisenbrey A.J., Hayes R.B., Warren H.J., Winsett D.L.
- Textbook of Irrigation Engineering and Hydraulic Structures , By R.K. Sharma
- River Basin Planning, Theory and Practices, By Saha S.K. Barrow C.J.
- Studies in Irrigation and Water Management B.D. Dhawan
- Watershed planning and management , By Rajvir Singh

**Internship cum Industrial Training**  
**(Project Oriented Professional Training)**

Project work aims at developing skills in the students whereby they apply the totality of knowledge and skills gained through the course in the solution of particular problem or undertaking a project. The students have various aptitudes and strengths. Project work, therefore, should match the strengths of students. For this purpose, students should be asked to identify the type of project work, they would like to execute. It is also essential that the faculty of the respective department may have a brainstorming session to identify suitable project assignments. The project assignment can be individual assignment or a group assignment. There should not be more than 3 students if the project work is given for a group. The students should identify or given project assignment at least two to three months in advance. The project work identified in collaboration with industry may be preferred.

Each teacher is expected to guide the project work of at least 5 students.

A suggestive criteria for assessing student performance by the external (personnel from industry) and internal (teacher) examiner is given in table below:

<b>Sr. No.</b>	<b>Performance criteria</b>	<b>Maximum Marks</b>	<b>Marks Obtain</b>
1	Selection of project assignment	10	
2	Planning and execution of considerations	10	
3	Quality of performance	20	
4	Providing solution of the problems or production of final product	20	
5	Sense of responsibility	10	
6	Self expression/ communication skills	5	
7	Interpersonal skills/human relations	5	
8	Report writing skills	10	
9	Viva voce	10	
<b>Total</b>		<b>100</b>	

The overall grading of the practical training shall be made as per following table

	Range of maximum marks			Overall grade
i)		More than	80	Excellent
ii)	79	<>	65	Very good
iii)	64	<>	50	Good
iv)	49	<>	40	Fair
v)		Less than	40	Poor

In order to qualify for the diploma, students must get “Overall Good grade” failing which the students may be given one more chance of undergoing 8 -10 weeks of project oriented professional training in the same industry and re-evaluated before being disqualified and declared “not eligible to receive diploma”. It is also important to note that the students must get more than six “goods” or above “good” grade in different performance criteria items in order to get “Overall Good” grade.

#### Important Notes

- ✓ This criteria must be followed by the internal and external examiner and they should see the daily, weekly and monthly reports while awarding marks as per the above criteria.
- ✓ The criteria for evaluation of the students have been worked out for 100 maximum marks. The internal and external examiners will evaluate students separately and give marks as per the study and evaluation scheme of examination.
- ✓ The external examiner, preferably, a person from industry/organization, who has been associated with the project-oriented professional training of the students, should evaluate the students performance as per the above criteria.
- ✓ It is also proposed that two students or two projects which are rated best be given merit certificate at the time of annual day of the institute. It would be better if specific nearby industries are approached for instituting such awards.

The teachers are free to evolve another criteria of assessment, depending upon the type of project work. It is proposed that the institute may organize an annual exhibition of the project work done by the students and invite leading Industrial organizations in such an exhibition. It is also proposed that two students or two projects which are rated best be given merit certificate at the time of annual day of the institute. It would be better if specific industries are approached for instituting such awards