4.1 FARM MACHINERY AND IMPLEMENTS

L	P
5	3

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 Agro Service Centre for Farm Machinery.

DETAILED CONTENTS

1. Introduction (2 hrs)

   Importance of farm mechanization. Classification of machinery & implements used in the farm for raising crops.

2. Basics of Machines (5hrs)

   Kinetic energy of rotating masses, friction force in a moving body, collars, pivots

3. Transmission of power in farm machinery (7 hrs)

   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.

4. Balancing (6 hrs)

   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.

5. Vibration (6 hrs)

   Concept and analysis of various types of vibrations – longitudinal, transverse and torsional vibrations, Causes of vibration in machines, their harmful effects and remedies.

6. Primary Tillage Equipment (5 hrs)

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.

7. Secondary Tillage Implements (5 hrs)

Introduction to the various secondary tillage implements. Study of cultivators & harrows, their types, functions & constructional details.

8. Seeding and Planting Equipment (4 hrs)

Introduction to various seeding and planting machinery used for various crops. Study of components & functions of seed drills & planters; Concept of minimum tillage technology (Zerotill, striptill drill, bed planters).

Calibration of seed drills and planters.

9. Interculture Tools/Weeding Tools (3 hrs)

Introduction to various tools used for interculture, study of their functions and constructional details.

10. Fertilizer/Manure Application Equipment (3 hrs)

Familiarization with the manure spreaders & granular fertilizer spreading equipment, study of their functions and importance.

11. Plant Protection Machinery (4 hrs)

Familiarization with the various type of dusters and sprayers used for the plant protection. Study of their constructional details, function & principle of operation.

Study of various types of the nozzles used in the sprayers.

12. Harvesting and Threshing Machinery (12 hrs)

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.

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.

13. Land Development Machinery (4 hrs)

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

14. Miscellaneous Equipment (10 hrs)

Introduction to different equipments used for special operation e.g. puddlers, cage wheels, power tiller , straw chopper, sub soiler

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Introduction to various horticultural tools.

15. Economics of Equipment (4 hrs)

Field capacities, field efficiency, cost analysis and selection of farm machinery, Indian Standards of Farm Machinery and Specifications

LIST OF PRACTICALS

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

1. Primary tillage implements: Mould board plough /Disc plough.
2. Secondary tillage implements: Harrow/Cultivators, Rotavators.
3. Sowing Machines: Seed Drill/Planter/Transplanter, no-till, strip-till drill, bed planter, sugarcane planters, potato planter.
4. Interculture equipment/tools : Wheel hand hoe/Cultivators.
5. Harvesting Machines: Vertical Conveyer Reaper/Mower/Potato digger/ Groundnut Digger.
6. Threshing Machines: Wheat/paddy thresher, axial flow thresher, High capacity multicrop thresher.
7. Seed treater, different types of sprayers and dusters.

Note: Emphasis should be laid on operation, maintenance, repair, safety and trouble shooting of farm machines and calibration of seeding machinery.

LIST OF BOOKS

1. Element of Farm Machinery by A.C.srivastava and Raju Primlari; Oxford &IBH Publishing Co. Pvt Ltd, New Delhi
2. Principle of Farm Machinery by R.A.Kepner , Roy Bainer, and E.H. Barger; CBS Publishers and Distributors, Delhi
3. Elements Of Agricultural Engineering Part 1 & 2 by Dr. O.P. Singhal and Naresh Chandra Aggarwal ; Mumfordganj, Allahabad
4. Principle of Agricultural Engineering Volume-I by A.M. Michael & T.P.Ojha; Jain brothers.
5. Principle of Agricultural Engineering Volume-II by A.M. Michael & T.P.Ojha ; Jain brothers.
6. Farm Power Machinery Volume-I by ISAE ; Jain brothers
7. Farm Power Machinery & Surveying by Irshad Ali ; Kitab Mahal, Nai Sarak, Delhi
8. Farm Machinery by Smith
9. Tillage System in the Tropics by FAO; Oxford and IBH Publication Co.

4.2 NON-CONVENTIONAL ENERGY SOURCES

L	P
3	2

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.

DETAILED CONTENTS

1. Introduction (3 hrs)

   Conventional and Non conventional sources of energy. Need, importance and scope of non conventional and alternate energy resources.

2. Biogas and Bio-mass (15 hrs)

   Bio-gas, Benefits of bio-gas. Technology of biogas. Principles, 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 briquetting.

3. Wind Energy Technology (6 hrs)

   3.1. Introduction, scope and significance.

   3.2. Type and constructional details of windmill - vertical and horizontal axis. Data required for windmill installation such as meterological data, geohydrological, agricultural and socio- economic data. Site selection of windmill. Maintenance and performance of windmill.

4. Solar Energy Technology (12 hrs)

   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.

5. Solar Thermal Systems (6 hrs)

Operation, constructional details and maintenance of solar cooker, solar water heater, solar still, solar water pump, SPV system, solar crop dryer etc.

6. Energy Conservation (6 hrs)

6.1. Principles of energy conservation. Familiarization with the different energy conservation appliances and practices, improved cooking stoves, benefits of improved cooking stoves over the traditional cooking stoves.

6.2. Scope of energy conservation in the domestic, commercial and agricultural sector.

Visits

Visits should be made to following places:

- Solar energy appliances manufacturing units.
- Energy parks/ Schools of energy at Agricultural Universities.
- Community/ Institutional biogas plants.

LIST OF PRACTICALS

1. Demonstration/study of solar cooker
2. Demonstration/study of solar water distillation
3. Demonstration/study of solar water heater
4. Demonstration/study of solar photovoltic lighting system
5. Demonstration/study of water pumping system
6. Visit to biogas plants, domestic community/institution for study and demonstration of biogas plants
7. Demonstration/study of the working of a windmill
8. Study of energy saving appliances and their applications

LIST OF BOOKS

1. Advance in Biogas Technology by O.P.Chawla; Publications & Information Div. 1 CAR, New Delhi.
2. Solar Energy by S.P.Sukhatme; Tata McGraw-hill Publishing Co. Ltd., New Delhi.
3. Solar Energy Utilization by G.D.Rai; Khanna Publishers, New Delhi.

4. Bio Gas Technology by K.C.Khandelwal & S.S. Mahdi; Tata McGraw-hill Publishing Co. Ltd., New Delhi.
5. Biomass Energy by OECD; Oxford & IBH Publication Co.
6. Wind Energy For water Pumping by Srivastava; Oxford & IBH Publication Co.
7. Cook Stoves For Masses by N.S.Grewal; PAU Ludhiana.
8. Energy in Agricultural Engineering by ISAE; Jain Brothers, Delhi.
9. Non Conventional Energy Sources by G.D.Rai; Khanna Publishers,New Delhi.
10. Renewable & Conventional Energy by S. Rao.

4.3 POST HARVEST TECHNOLOGY

L	T	P
3	-	2

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.

DETAILED CONTENTS

1. Introduction (5 hrs)

   1.1 Introduction to post harvest technology of agricultural produce, its need, scope and importance

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   1.2 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

2. Engineering Properties of Agricultural Materials (5 hrs)

   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.

3. Drying of Cereals and Pulses (12 hrs)

   3.1. 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.

   3.2. Introduction to various grain drying systems - solar drying system, batch drying system, continuous flow drying system. Safe temperatures during drying.

3.3. Principles of operation of different types of dryers viz. Deep bed dryers, flat bed dryers, continuos flow dryers, L.S.U. dryers, fluidized bed dryers, rotary dryer, spouted beds, tray and tunnel dryers .

4. Storage of Cereals and Pulses (14 hrs)

4.1. Introduction, need and importance, general principles of storage, temperature and moisture changes during storage i.e. influence of moisture content, relative humidity, temperature, fungi etc. on stored product.

4.2. Fungi, insect and other organism associated with stored grains.

4.3. Familiarization with the various types of storage structures. Deep and shallow bins. Traditional and modern storage structures. Management of storage structures. Losses during storage and their control, space requirement of bag storage structure.

5. Post Harvest Technology of Fruits and Vegetables (12 hrs)

5.1. Post harvest losses of 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, dehydration, canning, thermal processing.

5.2. Introduction to the storage of fruits and vegetables. Need and importance of storage. Principle of storage of fruits and vegetables. Concept of controlled and modified atmosphere storage. Recommended storage conditions for some important fruits and vegetables and their storage life.

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 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.

LIST OF 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, 485 Jain Bhavan, Shandara Delhi-110032.
4. Post Harvest (Introduction Physiology Handling fruits & Vegetables by Wills R.B.H. etal; Oxford & IBH Publication Co.

4.4 MANUFACTURING TECHNOLOGY - II

L	T	P
3	-	4

RATIONALE

Knowledge in various machining operations viz. drilling, boring, milling, planning and grindin processes, finishing operations, gear production, CNC machining, bending forming and welding processes is very essential for the diploma holders. Hence this subject.

DETAILED CONTENTS

1. Drilling and Boring (8 hrs)

   Introduction, Types of drills, types of drilling machines i.e. portable, bench type, piller and radial, drilling speeds and feeds, drill chucks and other accessories (jigs etc.) used in drilling machines, reaming, introduction to boring, types of boring machines – horizontal and vertical, specifications, boring bar and boring heads

2. Machining Processes (12 hrs)

   - Milling – Types of milling machines and their operations, speeds and feeds, indexing (simple and compound), types of milling cutters
   - Planing machines and their operation
   - Grinding – cylindrical, centreless and surface grinding machines, types of grinding wheels, specifications, grades and their selection, balancing of grinding wheels and their storage

3. Finishing Operations (4 hrs)

   Lapping, honing, superfinishing operations and their applications, types of abrasives used and their selection

4. Gear Production (4 hrs)

   Gear cutting and gear shaving machines, gear cutters and coolants

5. CNC Machines (4 hrs)

   Introduction to CNC control systems, advantages, productivity, accuracy and cost

6. Bending and Forming (4 hrs)

   Description of press brakes, bending dies, forming machines

7. Welding (10 hrs)

   - Introduction, types of welding (gauge welding, arc welding, resistance welding), butt welding, flash, projection, seam and spot welding. Selection of electrodes, filter metals, types of welding defects and their remedies, soldering and brazing – processes and applications
   - Special welding processes for stainless steel and aluminum

8. Types of Coolants and Lubricants for various machining processes (2 hrs)

LIST OF PRACTICALS

1. Introduction to drilling and boring machines, an exercise of simple drilling and boring operation, selection of speeds and feeds, use of jigs and fixtures and coolant.
2. Simple exercises on shaper
3. Practice on horizontal and vertical milling machines, work holding devices and types of milling cutters
4. Practice on cylindrical and centreless grinding machine, selection, dressing and storage of grinding machines. Use of lubricants
5. Practice on honing machines with selection of honing sticks, honing and finish pattern in the bore. Bore geometry measurement
6. Observe working of CNC machines including setting of cutting parameters and dimensions and loading of tools, repeatability of operation and adjustment for wear allowances
7. Visit to industry (sheet metal shoos) to observe bending and forming operation and use of dies
8. Use of appropriate coolant and lubricants for all machining operation in the workshop and during Industrial visits.

RECOMMENDED BOOKS

1. Workshop Technology by BS Raghuwanshi, Dhanpat Rai & Sons, Delhi.
2. Workshop Technology Vol. – I, II & III by Chapman, Standard Publishers Distributors, New Delhi.
3. Workshop Practice by RK Singhal, SK Kataria & Sons, New Delhi.
4. Production Technology by HMT, Tata McGraw Hill, New Delhi.
5. Elements of Workshop Technology by SK Chaudhary & Hazra, Asia Publishing House.

4.5 FARM I.C. ENGINES

L	P
3	2

RATIONALE

The IC engines are the primary source of mechanical power for tractors and all other allied purposes. This course will enable the students to understand the principle of working and construction of IC engines.

DETAILED CONTENTS

1. Principles of IC Engines (8 hrs)

   Introduction and classification of IC engines. Working principle of four stroke and two stroke cycle. Petrol and Diesel engines, their comparison location and function of various parts of IC engines and material used for them . Concept of IC engine terms , bore, stroke, dead centre, crank throw, compression ratio, clearance volume, piston displacement and piston speed . Working principle of rotary (wankle) engine.

2. Thermodynamics Cycles (7 hrs)

   Concepts of reversibility cycle, perpetual motion machine, thermal efficiency and air standard efficiency, carnot cycle efficiency and its implications, Otto , Diesel and dual combustion cycles - ideal and actual effect of compression ratio, relative efficiency. Simple problems of their cycles.

3. Air Intake System (5 hrs)

   Components of air intake system viz. pre-air cleaner, inlet manifold, exhaust manifold, types of air cleaners: wet, dry

4. Fuel System in Diesel Engine (6 hrs)

   Components of fuel system, description and working of fuel feed pump, types working of fuel injection pump, injector, fuel filters, complete detail and working of micro fuel injection system for a multi cylinder engine, use of alternate fuels in IC engines i.e. biogas, gasoline, biomass fuel (wood).

5. Cooling and Lubrication (6 hrs)

   Necessity of engine cooling, cooling system, their main features , thermostat, defects in cooling system and their rectification, functions of lubrication, types and properties of engine lubricants, additives for improving the properties ,

lubrication system of IC engine, oil pumps, oil filters, pressure relief valve , positive crank case ventilation.

6. IC Engine Testing (8 hrs)

Engine power, indicated and brake power, efficiency – mechanical, thermal, relative and volumetric efficiencies, methods of finding indicated and brake horse power, Morse test and heat balance sheet performance and endurance tests of IC engine specification (according To ISI). Exhaust smoke analysis and pollution control.

7. Maintenance, repair and overhaul of engines (8 hrs)

LIST OF PRACTICALS

1. Identification of various types of diesel engines
2. Identification of various tools used for dismantling and assembling IC engines
3. Performing pre-starting checks on engine
4. Engine dismantling and inspection of various parts, measurements of clearances
5. Engine assembly and trouble shooting
6. Study of fuel injection equipments of multi cylinder engine, dismantling and reassembling
7. Study of cooling system, water pump, thermostat
8. Study of lubrication system, oil pump, oil filter
9. Determination of indicated power/brake power and specific fuel consumption
10. Testing diesel engine for pollution

LIST OF BOOKS

1. Farm Tractors by S.C. Jain and Rai; Tata Oxford Company.
2. IC Engine by S.S. Thethi.
3. IC Engine By A.S. Sarao.

4.6 FIELD PRACTICE

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RATIONALE

This is a practice-oriented subject, which will create the ability and develop the skill to carry out different operations for raising the crops on the farms. It will also enable the students to handle and operate the machines and implements used for crop production and carry out the minor repairs of machines.

LIST OF PRACTICALS

1. Preparation of lists of inputs/resources required for raising the crops of the seasons.
2. Availability and selection of inputs of crop production
3. Tractors driving practice (forward, reverse, with trolley, hitching implements, driving with implements)
4. Practice of seed bed preparation, operations and use of the different seed bed preparation machinery for the different crops of the season
5. Practice of sowing/planting of different crops of the season operation, adjustments and calibration of seed-cum-fertilizer drills/planters.
6. Practices of fertilizers and manure applications. Operation, use and maintenance of machinery used in this operation.
7. Practices of use of different tools and equipment used for interculture
8. Practices of plant protection methods and pest management. Operation, use and Maintenance of plant protection equipment
9. Practices of irrigating the crops by different methods (tube wells, drip and sprinkler)
10. Practices of harvesting different crops on vertical conveyer reaper, straw reaper, potato diggers and combine harvesters.
11. Practices of threshing of different crops. Operation of threshers; their maintenance and safety measure/adjustments for the threshers
12. Minor repair works of the machines/implements used for the above said agricultural/field operating. and maintenance of the machines.
13. Market survey for the availability of different inputs; their selection, prices and preparation of cost-estimate for the crop production
14. Visits to the mechanized/modernized farms of Agriculture Universities/State –farms agriculture fairs & exhibitions to get enough exposure about the modern techniques of raising the crops.
15. Practices of determination of moisture contents of soil and crops

Note: - (i) The students shall prepare the daily report regarding the activities practiced/performed by them.

(ii) The students will have to present a seminar at the end of the semester and their assessment will be awarded on the basis of the same.