4.1 FARM MACHINERY AND IMPLEMENTS - I

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 Enterprise related with Farm Machinery and employment in Farm Mechanization sectors. In view of its importance and lengthy curriculum this course will be taught partly in two semesters Farm Machinery-I & II

DETAILED CONTENTS

1. Mechanical Principles (30 hrs)

1.1 Simple Mechanisms
Introduction to Mechanism, Machine, Structure, Element & Link. Clasification of Links, Kinematic Pair, Classification of Kinematic Pair, Kinematic Chain, Types of Kinematic Chain(Introduction only), Brief description of Four Bar chain.

1.2 Power Transmission in Farm Machinery
Flat and V-Belt Drive, Length of belt, Ratio of tensions for belt drives, Chain & Sprocket Drive, Gear Drive, Effect of Centrifugal Tension, Horse Power transmitted, Conditions for maximum power transmission. Introduction to Belt dynamometer (No derivation)

1.3 Balancing & Vibration
Concept of Balancing, Static & Dynamic Balancing,Concept of Vibration, Types of Vibrations- Longitudinal, Transverse & Torsional, Causes of vibration in machines, their harmful effects & remedies.

1.4 Shaft Couplings, Bearings & Pipe Joints
Couplings, their functions and use (Oldham and Universal Coupling), Bearings their functions and use (Bush Bearing & Plummer Block), Pipe Joints & their use in Agricultural machinery(Flanged, Socket & Union joint)

1.5 Hydraulic Control System
Working Principle of hydraulic system, Basic components of hydraulic system. Types of Hydraulic system- Position Control, Draft control & Mixed Control, Repair & Maintenance of hydraulic system, Precautions for hydraulic system.

2. Introduction (8 hrs)

Introduction and brief history of the traditional tools and equipments used in farming operations. Farm Mechanization-Scope & Limitation, Classification of Farm Machinery according to operation (seed bed preparation, sowing, harvesting, threshing etc.). Classification of Farm Machinery/ Implements according to hitching (Trailed, Semi mounted & mounted type Drawbar, 2-point & 3-point linkag

3. Tillage Implements (22 hrs)

3.1 Tillage & its Objectives. Types of Tillage.
Introduction to different types of tillage implements and their classification.

3.2 Primary Tillage Implements
Mould Board Plough- Constructional details & Components & its different types, Adjustments of M. B. Plough (Horizontal suction, Vertical suction etc.) Plough accessories(Jointer, Coulter etc.),

3.3 Mechanics of Ploughs, Size, capacity and power requirements of plough.

Disc Plough- Constructional details & Components , different typesof disc plough- Standard disc plough and Vertical disc plough, Adjustments of Disc Plough (Disc angle, Tilt angle)

3.4 Adaptability of Mould Board Plough & Disc Plough & their Comparison.

3.4 Methods of Ploughing- Continuous & Round and Round Ploughing

3.5 Constructional details, functions, uses and working of Indigenous Plough, Chisel Plough, Subsoiler and Rotary Plough

3.6 Secondary Tillage Implements
Introduction to various types of Harrow- Constructional details & components and Working of Disc Harrow, Spike tooth harrow, Spring tooth harrow, Triangular harrow, Blade harrow, Zigzag Harrow, Rolling harrow, Reciprocating harrow, Cage Harrow

3.7 Introduction to different types of cultivators, their functions and constructional details.

3.8 Rotavator- Constructional details, Principle of operation & functions, Advantages over other tillage implements

3.9 Routine maintenance of Ploughs and other tillage machinery.

3.10 No tillage/ Zero tillage machinery – Zero till drill, Strip till drill etc.

4. Seeding & Planting Machines & Equipments (20 hrs)

4.1 Introduction to different types of Seeding/ Planting Methods & machines used for sowing/ planting different crops.

4.2 Seed drills and Seed cum fertilizers drills, their functions, Constructional details, Components & working. Different types of seed metering mechanisms and furrow openers used in seed drills.

4.3 Planter- Introduction to planters for different crops. Main Components and functions of a planter. Different types of seed metering mechanisms used in planters.

4.4 Study of Potato Planter, Sugarcane planter, Corn Planter

4.5 Adjustments of seed drills and planters for depth of sowing and sowing rate and Calibration of seed drills and planters.

4.6 Transplanter- Functions, working, components & constructional details of Paddy transplanter. Routine/ Preventive maintenance of Seed Drills and Planters.

INSTRUCTIONAL STRATEGY

Drawing of various machines may be used to illustrate the constructional details of Machinery & Equipments. Besides this live demonstration of the machines & visits to the local units manufacturing these implements/ machines be arranged so that students are able to understand in a clear and better way.

LIST OF PRACTICALS

1. Study of constructional features, working and adjustments of Mould Board Plough.
2. Study of constructional features, working and adjustments of Disc Plough.
3. Study of constructional features and working of Disc Harrow.
4. Study of constructional features and working of Subsoiler.
5. Study of constructional features, working and adjustments of Seed cum fertilizer Drill.
6. Study of constructional features, working and adjustments of Zero till Drill.
7. Study of constructional features, working and adjustments of Potato planter.
8. Study of constructional features, working and adjustments of Sugarcane Planter.
9. Study of constructional features, working and adjustments of Paddy Transplanter.
10. Tractor driving practice.
11. Hitching and de hitching of different implements with the tractor.
12. Preventive/ Routine maintenance of tillage & sowing machines.

LIST OF BOOKS

1. Elements of Agricultural Engineering by Dr. Jagdishwar Sahay; Standard Publisher Distributors, Nai Sarak, Delhi-110006.
2. Principle of Farm Machinery by R.A.Kepner, Roy Bainer and E.H. Barger,CBS Publishers and Distributors, Delhi.
3. Farm Power Machinery & Surveying by Irshad Ali; Kitab Mahal, Allahabad, Surjit Book Depot P.B.No. 1425,4074-75, Nai Sarak, Delhi.
4. Principle of Agricultural Engineering Volume-I by A.M. Michael &T.P.Ojha; Jain brothers.
5. Farm Machines & Equipments by C.P.Nakra; Dhanpat Rai & Sons ,Nai Sarak New Delhi.
6. Elements Of Agricultural Engineering Part 1 & 2 by Dr. O.P. Singhal and Naresh Chandra Aggarwal; Mumfordganj, Allahabad.
7. Basic Farm Machinery by Shiphen & Ellen; Jain brothers.
8. Farm Machinery and Equipments by Smith , Tata McGraw Hill Publishing Company Ltd., New Delhi

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allotted (%)
1	30	40
2	8	10
3	22	25
4	20	25
Total	**80**	**100**

4.2 RENEWABLE SOURCES OF ENERGY

L	P
4	-

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 (6 hrs)

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

2. Biogas (20 hrs)

   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.

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 (10 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 (7 hrs)

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

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

7. Govt incentives/promotional schemes for promotion of use of renewable sources of energy and departments/ agencies engaged in this work. (3 hrs)

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.

INSTRUCTIONAL STRAGEGY

The students may be given instructions through demonstration on the various systems, using models and video films besides field visits. Students may be given demonstration in the following:

- 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
- Visit to biogas plants, domestic community/institution for study and demonstration of biogas plants
- Demonstration/study of the working of a windmill
- Study of energy saving appliances and their applications

RECOMMENDED 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.

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allotted (%)
1	6	10
2	20	30
3	6	10
4	12	18
5	10	17
6	7	10
7	3	5
Total	**64**	**100**

4.3 POST HARVEST TECHNOLOGY

L	T	P
5	-	3

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 (8 hrs)

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

   .

   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 (10 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 (20 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, thin layer dryers, continuous flow dryers, L.S.U. dryers, fluidized bed dryers, rotary dryer, tray and tunnel dryers .

4. Storage of Cereals and Pulses (20 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 and temperature etc. on stored product.

4.2. 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. Comparison of bag and bulk storage. Losses during storage and their control, space requirement of bag storage structure.

5. Post Harvest Technology of Fruits and Vegetables (22 hrs)

5.1. 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.

5.2. 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.

INSTRUCTIONAL STRAGEGY

Arrange visits to storage and drying facility. Invited guest lecture may be arranged from technical persons of FCI/State Warehousing Corporation.

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

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allotted (%)
1	08	08
2	10	14
3	20	24
4	20	24
5	22	30
Total	**80**	**100**

4.4 MANUFACTURING TECHNOLOGY - II

L	T	P
4	-	4

RATIONALE

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

DETAILED CONTENTS

1. Drilling and Boring (10 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 (16 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 (6 hrs)

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

4. Gear Production (6 hrs)

   Gear cutting and gear shaving machines, gear cutters and coolants

5. CNC Machines (6 hrs)

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

6. Bending and Forming (6 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 (4 hrs)

INSTRUCTIONAL STRAGEGY

Teacher should take the help of models, charts and non-print instructional resources e.g. CDs etc. so that the students are able to understand the topics effectively.

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.

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allotted (%)
1	10	15
2	16	25
3	6	10
4	6	10
5	6	10
6	6	10
7	10	15
8	4	5
Total	**64**	**100**

4.5 I.C. ENGINES

L	P
4	3

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 (12 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 (6 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 (10 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 (10 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 (10 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. Introduction to latest Standards for emission instituted by Govt. of India from time to time.

7. Preventive Maintenance, repair and overhaul of engines (9 hrs)

INSTRUCTIONAL STRAGEGY

Cut section/models may be used for explaining different components of engine. Visits may be arranged to nearest tractor/engine repair workshop.

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. Visits to I.C. Engine repair shops.

RECOMMENDED 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.

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allotted (%)
1	12	20
2	7	10
3	6	10
4	10	15
5	10	15
6	10	15
7	9	15
Total	**64**	**100**

INDUSTRIAL TRAINING OF STUDENTS

(during summer vacation after IV Semester)

It is needless to emphasize further the importance of Industrial Training of students during their 3 years of studies at Polytechnics. It is industrial training, which provides an opportunity to students to experience the environment and culture of industrial production units and commercial activities undertaken in field organizations. It prepares student for their future role as diploma engineers in the world of work and enables them to integrate theory with practice. Polytechnics have been arranging industrial training of students of various durations to meet the above objectives.

This document includes guided and supervised industrial training of a minimum of 6 weeks duration to be organised during the semester break starting after second year i.e. after IV Semester examinations. The concerned HODs along with other teachers will guide and help students in arranging appropriate training places relevant to their specific branch. It is suggested that a training schedule may be drawn for each student before starting of the training in consultation with the training providers. Students should also be briefed in advance about the organizational setup, product range, manufacturing process, important machines and materials used in the training organization.

Equally important with the guidance is supervision of students training in the industry/organization by the teachers. A minimum of one visit per week by the teacher is recommended. Students should be encouraged to write daily report in their diary to enable them to write final report and its presentation later on.

An internal assessment of 50 and external assessment of 50 marks have been provided in the study and evaluation scheme of V Semester. Evaluation of professional industrial training report through viva-voce/presentation aims at assessing students understanding of materials, industrial process, practices in industry/field organization and their ability to engage in activities related to problem solving in industrial setup as well as understanding of application of knowledge and skills learnt in real life situations. The formative and summative evaluation may comprise of weightage to performance in testing, general behaviour, quality of report and presentation during viva-voce examination. It is recommended that such evaluations may be carried out by a team comprising of concerned HOD, teachers and representative from industry.

Teachers and students are requested to see the footnote below the study and evaluation scheme of IV Semester for further details.