Practical Manual

Farm Machinery & Power

AAE 234 2(1+1)

B.Sc. (Hons.) Agriculture III semester

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Syllabus

Study of different components of I.C. engine. To study air cleaning and cooling system of engine, Familiarization with clutch, transmission, differential and final drive of a tractor, Familiarization with lubrication and fuel supply system of engine, Familiarization with brake, steering, hydraulic control system of engine, Learning of tractor driving, Familiarization with operation of power tiller, Implements for hill agriculture, Familiarization with different types of primary and secondary tillage implements: mould plough, disc plough and disc harrow . Familiarization with seed-cum-fertilizer drills their seed metering mechanism and calibration, planters and transplanter Familiarization with different types of sprayers and dusters Familiarization with different inter-cultivation equipment, Familiarization with harvesting and threshing machinery.

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CONTENTS

Experiment No. 1

Objective: To study about the various components of an Internal Combustion (I.C.) Engine.

Identify the different components of an I. C. engine and describe them:

1. **Cylinder**: ----------

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i. Cylinder Block: ----------

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ii. **Cylinder Head**: ----------

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iii. Cylinder Liner or Sleeve: ----------

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2. Piston: ----------

---

i. Piston Head: ----------

---

ii. Skirt: ----------

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iii. Piston Ring: ----------

Functions: ----------

Types of piston rings:----------

---

iv. Piston Pin: ----------

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3. Connecting Rod: : ----------

-

4. Crankshaft: : ----------

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5. Flywheel: ----------

---

6. Crankcase: ----------

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7. Camshaft: ----------

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8. Timing Gear: : ----------

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9. Inlet Manifold: ----------

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10. Exhaust Manifold: ----------

Experiment No. 2

Objective: To study about principle and working of four-stroke I.C. engine.

Principle of operation of Internal Combustion Engine:

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i. ---

---

ii. ---

Working of Four Stroke Cycle Engine: ---

Describe the different strokes of an I.C. engine:

1. Suction Stroke: ---

-

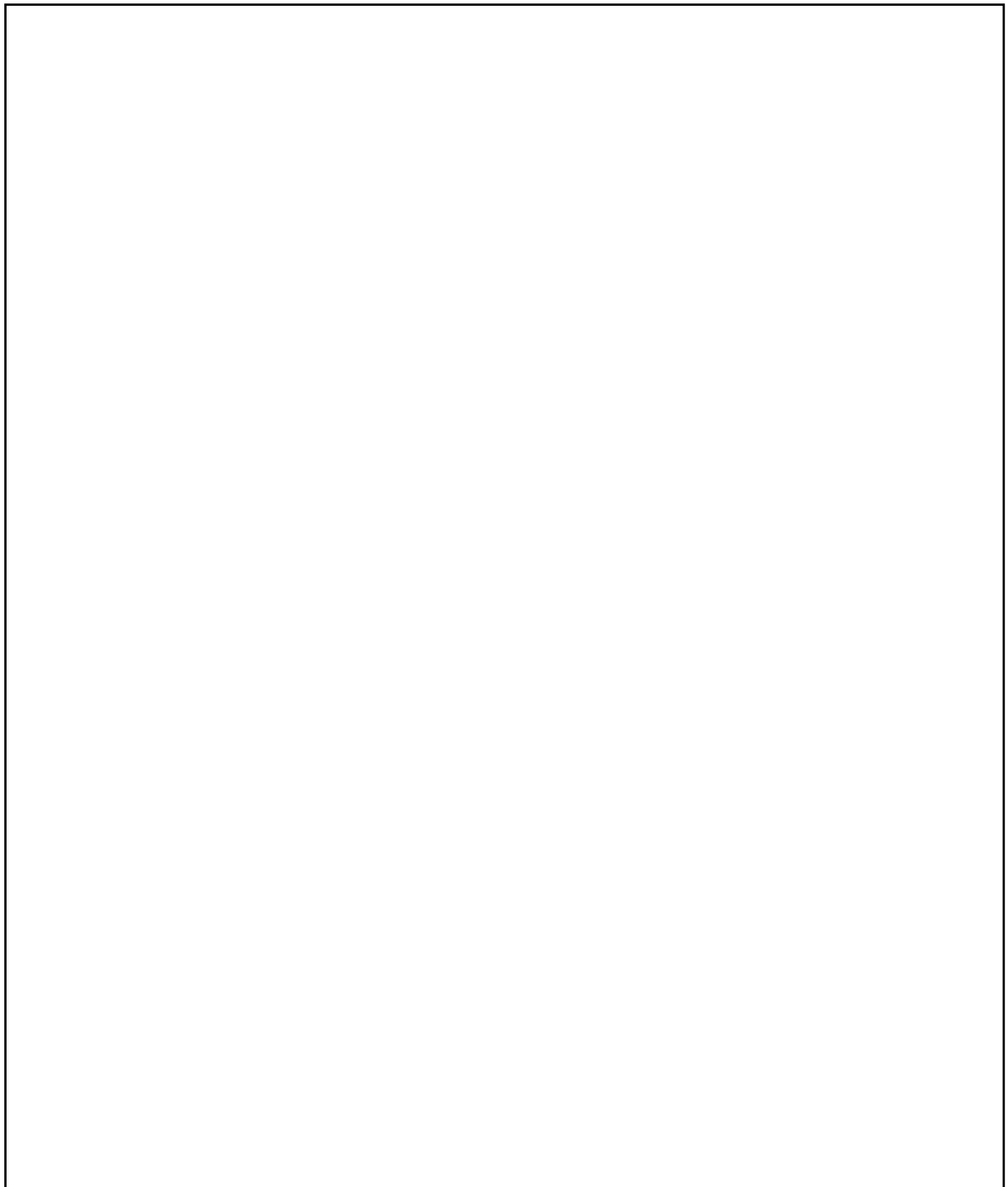
2. Compression Stroke: ---

-

3. Power Stroke: ---

-

4. Exhaust Stroke: ----------



Schematic representation of 4-S cycle engine

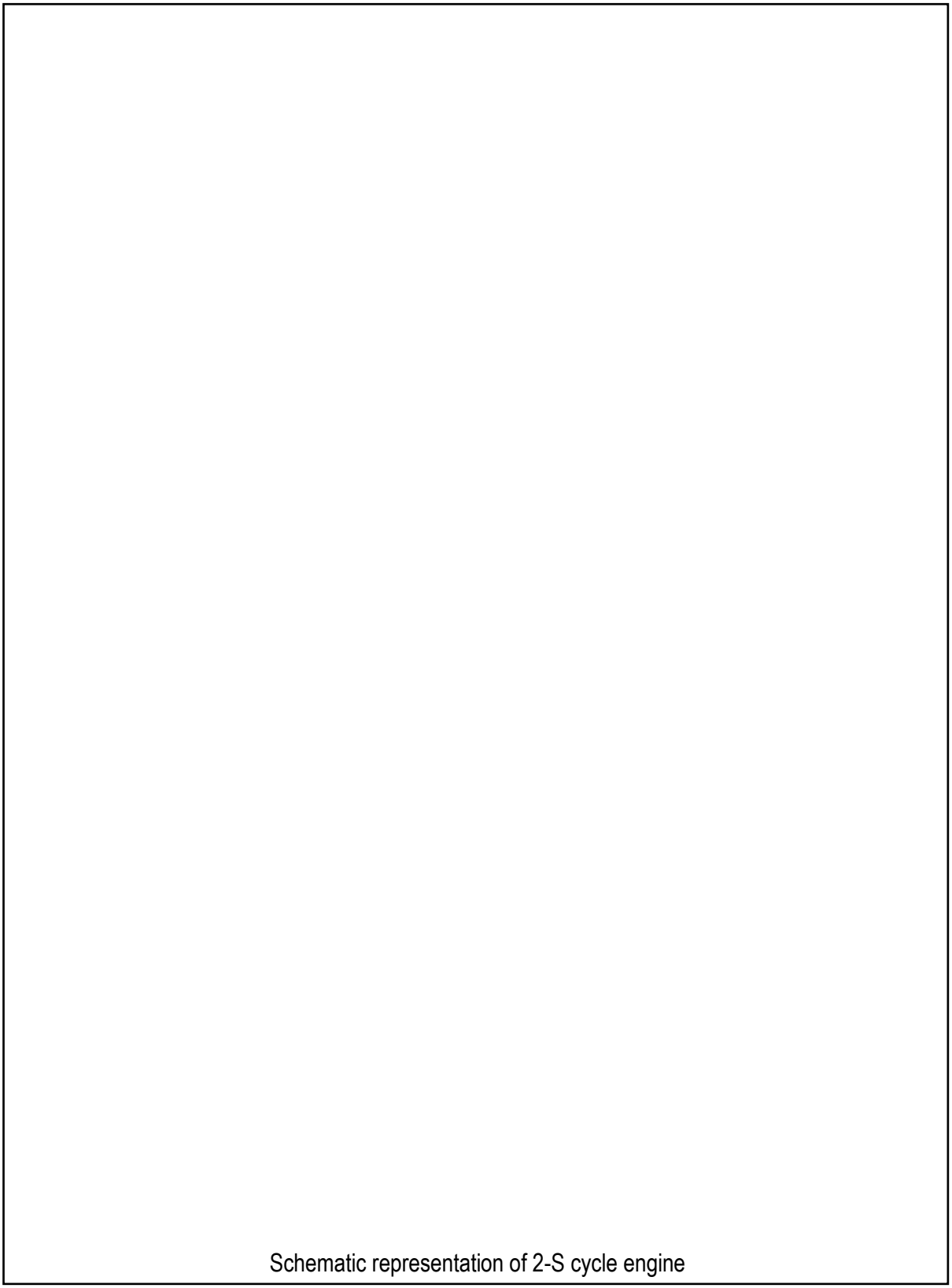
Experiment No. 3

Objective: To study about principle and working of two-stroke I.C. engine.

Working: ----------

First Stroke (Suction + Compression): ----------

Second Stroke (Power + Exhaust): ----------



Schematic representation of 2-S cycle engine

Experiment No. 4

Objective: To study about the fuel supply system in an engine.

Fuel supply systems in S. I. engines:

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Fuel supply system of C.I. Engine

Components of the fuel system in diesel engine are:

1. ---
2. ---
3. ---

4. ---

5. ---

6. ---

7. ---

Fuel Lift Pump (Feed Pump or Transfer Pump):

Fuel Injection Pump:

Experiment No. 5

Objective: To study about the cooling and air cleaning system of an engine.

Cooling System: ----------

-

Necessity of Cooling: ----------

Methods of Cooling:

Air Cooling: ----------

Principle of Air Cooling: ----------

-

Advantages of Air-Cooled Engine: ----------

Disadvantages:----------

Water Cooling: ----------

-

Name three common methods of water-cooling:

1. ----------
2. ----------
3. ----------

Explain the working of different methods of water-cooling:

Air cleaner: ----------

---

1. Dry type air cleaner: ----------

-

2. Oil bath type air cleaner: ----------

-

Experiment No. 6

Objective: To study about the need and importance of lubrication system in an engine.

Need of Lubrication System: ----------

Types of Lubricants: ----------

Purpose of Lubrication: ----------

Name the engine parts which requires lubrication:

1. ----------
2. ----------
3. ----------
4. ----------

5. ----------
6. ----------
7. ----------
8. ----------
9. ----------
10. ----------

Explain the following systems of lubrication:

1. Splash System: ----------

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2. Forced feed system: ----------

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3. Combination of Splash and Forced Feed System: ----------

Care and Maintenance of Lubrication System: ----------

-

Experiment No. 7

Objective: To study about the power transmission system of a tractor.

Power Transmission System of Tractor

Explain various components of power transmission system: ----------

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Types of Clutch: ----------

Gear:

Differential and final drive of a tractor: ---

Experiment No. 8

Objective: Familiarization with Steering and brake system.

Steering System: ----------

Components of the Steering system:

i. ----------

ii. ----------

iii. ----------

iv. ----------

v. ----------

vi. ----------

vii. ----------

Working: ----------

Brake System: ----------

Principle of operation: ----------

Classification of brake: ----------

-

Experiment No. 9

Objective: Familiarization with hydraulic control system of a tractor.

Hydraulic System: ----------

Working principle: ----------

Basic Components of Hydraulic System:

(i) ----------

(ii) ----------

(iii) ----------

(iv) ----------

(v) ----------

(vi) ----------

(vii) ----------

Operation: ----------

Hydraulic pump: ----------

Hydraulic cylinder: ----------

Hydraulic tank: ---

Control valve: ---

Oil filter: ---

TYPES OF HYDRAULIC SYSTEM

(i) ---

(ii) ---

(iii) ---

Explain the various hydraulic systems: ---

HITCH AND CONTROL BOARD OF TRACTOR HITCH

Implements can be hitched in two ways:

(a) ----------

(b) ----------

Drawbar hitch: ----------

Three-point linkage: ----------

Experiment No. 10

Objective: Familiarization with the primary tillage implements: Indigenous plough, MB plough and Disc plough.

Indigenous plough: ----------

Indigenous plough

Components:

S. No.	Particulars	Materials used for construction	Function
1.	Share		
2.	Body		
3.	Shoe		
4.	Handle		
5.	Beam		

Observations to be recorded:

S. No.	Particulars	M.B. Plough
1.	No. of Bottom	
2.	Length of beam (cm)	
3.	Length of handle (cm)	
4.	Type of Share	
5.	Size of share	
6.	Weight (Kg)	
7.	Field Efficiency (%)	
8.	Field Capacity (ha/hr)	
9.	Depth of furrow (cm)	
10.	Width of furrow (cm)	
11.	Operated by	
12.	Operating speed (km/hr)	

M.B. plough: ----------

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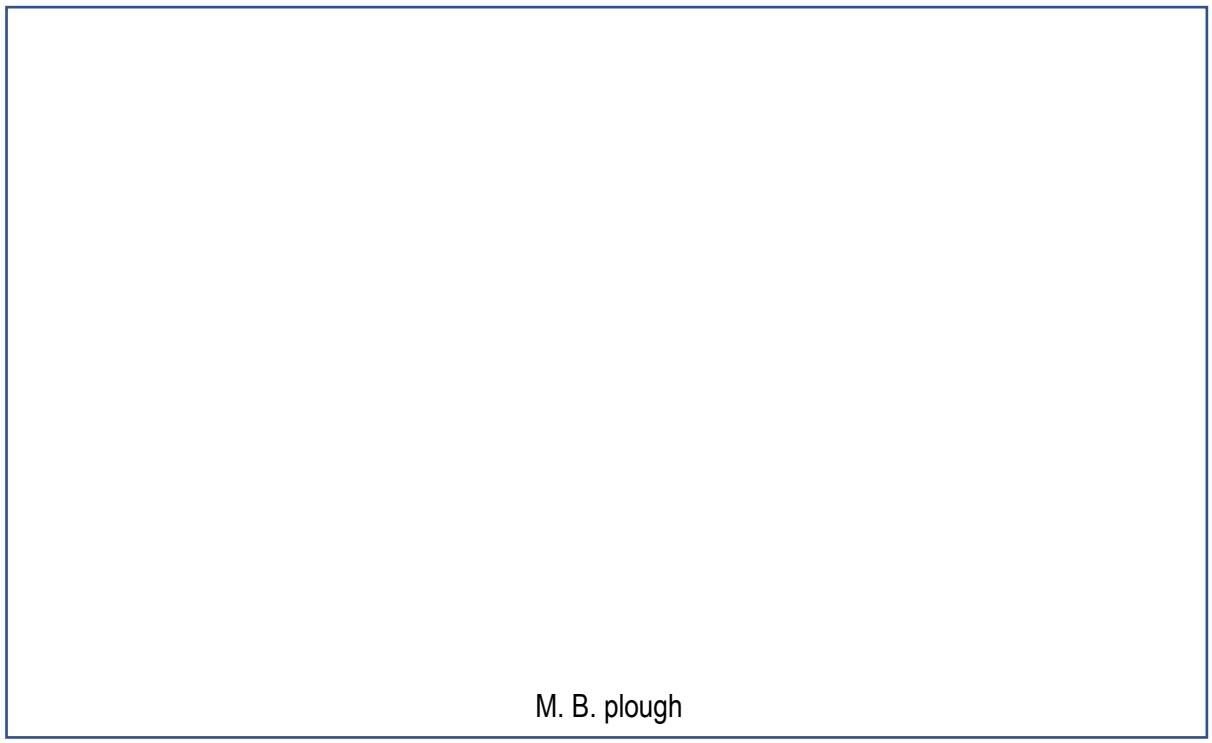

M. B. plough

Components:

S. No.	Particulars	Material used in construction	Function
1.	Share		
2.	Mould board		
3.	Land side		
4.	Frog		
5.	Tail piece		

Observations to be recorded:

S. No.	Particulars	M.B. Plough
1.	No. of Bottom	
2.	Length (mm)	
3.	Width (mm)	
4.	Height (mm)	
5.	Weight (Kg)	
6.	Type of Share	
7.	Field Capacity (ha/hr)	
8.	Type of Hitching	

9.	Rear furrow wheel	
10.	Depth of furrow (cm)	
11.	Width of furrow (cm)	
12.	Power required to operate (in hp)	
13.	Draft (kg)	
14.	Vertical Suction	
15.	Throat Clearance	

Disc Plough: ----------

Disc plough

Advantages of Disc Plough:----------

Limitations: ----------

-

Terminology related to Disc Plough:

1. Disc: ----------

-

2. Disc Angle: ----------

---

3. Tilt Angle: ----------

---

4. Concavity: ----------

A. Standard Disc Plough: ----------

-

B. Vertical Disc Plough: ----------

Plough Adjustments: ----------

-

Components:

S. No.	Particulars	Materials used for construction	Function
1.	Frame		
2.	Disc		
3.	Land wheel		
4.	Shaft		
5.	Scraper		
6.	Spool		

Observations to be recorded:

S. No.	Particulars	Disc Plough
1.	No. of Bottom	
2.	Length (mm)	
3.	Width (mm)	
4.	Height (mm)	
5.	Disc	
	Number	
	Diameter (cm)	
	Spacing	
	Concavity	
	Thickness (mm)	
6.	Weight (Kg)	
7.	Disc angle	
8.	Tilt angle	
9.	Field Efficiency (%)	
10.	Field Capacity (ha/hr)	
11.	Type of Hitching	
12.	Rear furrow wheel	
13.	Depth of ploughing	
14.	Width of ploughing	

15.	Power required to operate (in hp)	
16.	Scraper	
	Numbers	
	Types	
17.	Draft (kg)	

Experiment No. 11

Objective: Familiarization with the secondary tillage implements: Disc harrow and Cultivator.

Harrow: ----------

Disc Harrow: ----------

Tractor Drawn Disc Harrow: ----------

Explain the components of disc harrow

1. Disc: .....

   ---
2. Gang: .....

   ---
3. Gang bolt or Arbor bolt: .....

   ---
4. Gang control lever: ----------

   ---
5. Spool or spacer: ----------

   ---
6. Bearing: ----------

   ---
7. Transport wheel: ----------

   ---
8. Scraper: ----------

   ---
9. Weight box: ----------

Observations to be recorded:

S. No.	Particulars	Disc Harrow
1.	Type of harrow	
2.	Gangs	
3.	Gang angle (degree)	
4.	Disc	
	Number of discs in each gang	
	Diameter (cm)	
	Spacing (cm)	
	Concavity (cm)	
	Thickness (cm)	
	Type (notched/plane/cone)	
5.	Maximum width of front gang and rear gang (cm)	
6.	Operating width (cm)	
7.	Weight (Kg)	
8.	Length of spool (cm)	
9.	Length of scraper (cm)	
10.	Field Efficiency (%)	
11.	Field Capacity (ha/hr)	
12.	Type of Hitching	
13.	Depth of ploughing (cm)	
14.	Power required to operate (in hp)	
15.	No. of Scrapers	
16.	Overall dimension	
17.	Draft per meter of width (kg)	

Cultivator:----------

Types of cultivator: ----------

Cultivators based on power availability:

Explain the components of a cultivator:

1. Frame: ----------

   ---

2. Seeding attachment: ----------

   ---

3. Shovel: ----------

   ---

4. Tyne: ----------

   ---

5. Handle: ----------

   ---

6. Beam: ----------

Observations to be recorded:

S. No.	Particulars	Cultivator
1.	Type of cultivator	
2.	Type of shovel	
3.	No. of tynes	
4.	Spacing of tynes (cm)	
5.	Type of bolt	
6.	Shank	
7.	Shank angle	
8.	Type of hitching	
9.	Field Efficiency (%)	
10.	Depth of ploughing (cm)	

11.	Width of furrow (cm)	
12.	Weight (Kg)	
13.	Power required to operate (in hp)	
14.	Overall dimension (mm)	
15.	Draft (kg)	

Experiment No. 12

Objective: To study about the seed-cum-fertilizer drill and its calibration.

Seed Drill: ----------

Function of Seed Drill: Seed drill performs the following functions:

(i) ----------

(ii) ----------

(iii) ----------

(iv) ----------

(v) ----------

Seed-cum-fertilizer Drill: ----------

Explain the components of seed drill

1. Frame: ----------

   ---

2. Seed box: ----------

   ---

3. Seed metering mechanism: ----------

---

4. Furrow openers: ----------

---

5. Covering device: ----------

---

6. Transport wheels: ----------

Observations to be recorded:

S. No.	Particulars	Seed drill
1.	Type of seed drill	
2.	Type of seed to be sown	
3.	Seed box	
	Shape	
	Length (cm)	
	Top width (cm)	
	Bottom width (cm)	
4.	Type of agitator	
5.	Type of seed metering mechanism	
6.	Diameter of seed metering device (cm)	
7.	Width of circumference of seed metering device (cm)	
8.	Type of hitching	
9.	Number of furrow opener	
10.	Type of furrow openers	
11.	Type of covering device	
12.	Field Efficiency (%)	
13.	Depth of sowing (cm)	
14.	Diameter of ground wheel	
15.	Weight (Kg)	
16.	Power required to operate (in hp)	
17.	Type of power transmission	

18.	Type of chain	
19.	Distance covered in one revolution of ground wheel (cm)	
20.	Width of sowing (cm)	
21.	Area covered/hr	

Calibration of seed drill and seed-cum fertilizer drill:

Steps involved in calibration of seed drill or seed-cum fertilizer drill

---

Problems:

1. Calculate the seed rate per hectare of a 7 x 17 cm seed drill, whose main drive wheel is 124 cm diameter and total weight of grain collected in 20 revolutions is 0.423 kg.

---

2. The following results were obtained by calibration of a seed drill: No. of furrows = 10, spacing between furrows = 20 cm, diameter of drive wheel = 1.5 metre, speed = 500 rev/min. and seed collected = 20 kg. Calculate the seed rate per hectare.

Experiment No. 13

Objective: To study about the different components and working of power tiller.

Power Tiller: ----------

-

Explain the components of power tiller:

1. Engine: ----------

   ---

2. Clutch: ----------

   ---

3. Transmission gears: ----------

---

4. Brakes: ----------

---

5. Rotary Unit: ----------

Identification of parts of power tiller:

S . No.	Name of Part	S . No.	Name of Part
1.		2.	
3.		4.	
5.		6.	
7.		8.	
9.		10.	
11.		12.	
13.		14.	
15.		16.	
17.		18.	
19.		20.	

Experiment No. 14

Objective: To study about the tractor drawn planter.

Planter: ----------

Functions of a planter:

(i) ----------

(ii) ----------

(iii) ----------

(iv) ----------

Components of a planter:

S. No.	Particulars	Function
1.	Hopper	
2.	Feed metering device	
3.	Knock out mechanism	
4.	Cut-out mechanism	
5.	Furrow opener	
6.	Furrow closer	
7.	Drive mechanism	
8.	Seed tube	
9.	Seed boot	

Observations to be recorded:

S. No.	Particulars	Tractor drawn planter
1.	Type of planter	
2.	Type of seed to be sown	
3.	Seed box	
	Shape	
	Length (cm)	
	Top width (cm)	
	Bottom width (cm)	
4.	Type of agitator	
5.	Type of seed metering mechanism	
6.	Diameter of seed metering device (cm)	
7.	Width of circumference of seed metering device (cm)	
8.	Type of hitching	
9.	Number of furrow opener	
10.	Type of furrow openers	
11.	Type of covering device	
12.	Field Efficiency (%)	
13.	Row maker	
14.	Depth of sowing (cm)	
15.	Diameter of ground wheel	
16.	Weight (Kg)	
17.	Power required to operate (in hp)	
18.	Type of power transmission	
19.	Type of chain	
20.	Distance covered in one revolution of ground wheel (cm)	
21.	Width of sowing (cm)	
22.	Area covered/hr	

Experiment No. 15

Objective: To study about the power operated sprayer.

Sprayers: ----------

The main functions of sprayer are: ----------

Explain Basic Components of Sprayer:

S. No.	Particulars	Function
1.	Nozzle body	
2.	Swirl plate	
3.	Filter	
4.	Over-flow pipe	
5.	Relief valve	
6.	Pressure regulator	
7.	Cut-off valve	
8.	Spray boom	
9.	Nozzle boss	

10.	Nozzle disc	
11.	Nozzle cap	
12.	Nozzle tip	
13.	Spray lance	
14.	Spray gun	

Power Sprayer: ----------

A power sprayer essentially consists of:

(i) ----------

(ii) ----------

(iii) ----------

(iv) ----------

(v) ----------

(vi) ----------

Tractor mounter power sprayer

Observations to be recorded:

S. No.	Particulars	Power operated sprayer
1.	Prime mover	
2.	Pressure gauges	
3.	Air chamber	
4.	Strainer	
5.	Pressure regulator	
6.	Type of nozzle	
7.	Tank capacity (litres)	
8.	Volumetric Efficiency (%)	
9.	Cut-off valve	
10.	Relief valve	
11.	Swirl plate	
12.	Operating pressure (kPa or kg/cm^2)	
13.	Overflow pipe	
14.	Type of pump	

Experiment No. 16

Objective: Familiarization with different inter-cultivation equipment.

Need of Intercultural Operation: ----------

-

Classification of weeding tools on the Basis of Source of Power:

1. Manual or Traditional hand tools.
2. Animal drawn weeders.
3. Power or Tractor operated weeders.

1. Manual or Traditional hand tools:

Khurpi: ----------

Kodali: ----------

-

Spades or Chopping hoes: ----------

-

Long handle tools: ----------

Wheel hoe type weeders: ----------

---

a) Star type weeder: ----------

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b) Peg type weeder: ----------

Dryland weeder

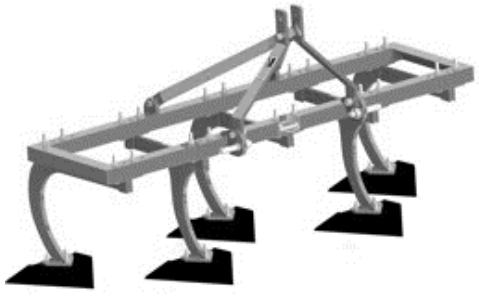
2. Animal drawn weeder: ----------

-

Sweep: ----------

Junior hoe: ----------

Duck foot cultivator: ----------



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3. Power or Tractor operated weeders

(i) Engine operated weeder: ----------

(ii) Engine operated rotary tiller: ----------

(iii) Tractor operated spring tyne cultivator: ----------

(iv) Rotary hoe: ----------

Experiment No. 17

Objective: To study about the power operated reaper.

Harvesting: ----------

Explain components of reaper

S. No.	Particulars	Function
1.	Frame	
2.	Power transmitting unit	
3.	Cutter bar	
(i)	Guard point	
(ii)	Knife guard	
(iii)	Reciprocating knife	
(iv)	Knife bar	

(v)	Main bar	
(vi)	Ledger plate	
4.	Star wheel	

Observations to be recorded:

S. No.	Particulars	Power operated reaper
1.	Type of reaper	
2.	Prime mover	
3.	Cutter bar length (m)	
4.	Width of cutter bar (m)	
5.	Type of cutter bar	
6.	Operating speed (km/hr)	
7.	Height of cutting (cm)	
8.	Theoretical field capacity (ha/hr)	
9.	Actual field capacity (ha/hr)	
10.	Weight (kg)	
11.	Suitability	
12.	Total grain losses (%)	
13.	Harvesting losses (%)	
14.	Fuel consumption (litres/hr)	
15.	Field Efficiency (%)	

Experiment No. 18

Objective: To study about the power operated thresher.

Power thresher: ----------

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Types of Power threshers:

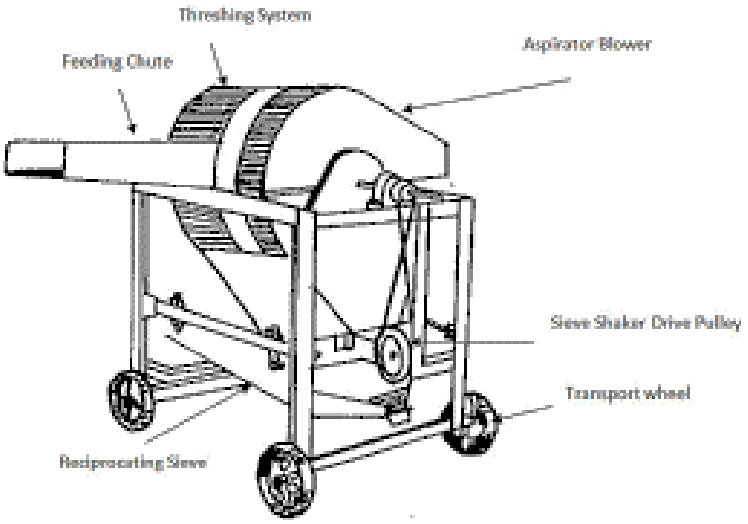
Hammer mill type: ----------

Rasp-bar-cylinder type: ----------

Spike-tooth cylinder type: ----------

Syndicator type: ----------

Drummy type: ----------



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Components of Power thresher

S. No.	Particular	Function
1.	Concave	
2.	Cylinder or drum	
	(i) Peg-tooth or spike tooth cylinder	
	(ii) Rasp-bar cylinder	

	(iii) Angle bar cylinder	
	(iv) Loop type cylinder	
	(v) Hammer-mill type cylinder	
3.	Cleaning unit	
	(i) Aspirator	
	(ii) Blower	
	(iii) Winnower	

Observations to be recorded:

S. No.	Particulars	Power operated thresher
1.	Type of thresher	
2.	Prime mover	
3.	Concave clearance (mm)	
4.	Diameter of flywheel (cm)	
5.	Diameter of flywheel shaft (mm)	
6.	Diameter of cylinder (cm)	
7.	Length of cylinder (cm)	
8.	Type of cylinder	
9.	Cleaning unit	
10.	Cylinder speed (rpm)	
11.	Number of beaters	
12.	Capacity (kg/hr)	
13.	Cleaning Efficiency (%)	
14.	Threshing Efficiency (%)	
15.	Length of straw (cm)	
16.	Suitability	

17.	Distance between thresher to straw dropped	

Appendix

Calibration Steps:

1. Determine the nominal width (W) of drill.

$$W = M \times S$$

where M- number of furrow openers

S- spacing between the openers (m)

W- Width (m)

2. Find the length of a strip (L) having nominal width (W) necessary to cover 1/25th of a hectare.

$$L = \frac{10000}{W} \; X \; \frac{1}{25} = \frac{400}{W} \quad \text{metres}$$

3. Determine the number of revolutions (N) the ground wheel has to make to cover the length of the strip (L).

$$\pi \; X \; D \; X \; N = \frac{400}{W}$$

where D -diameter of ground wheel in metre

$$N = \frac{400}{\pi \; X \; D \; X \; W} \quad \text{rev /min}$$

4. Jack up the drill so that the ground wheels turn freely. Make a mark on the drive wheel and a corresponding mark at a convenient place on the body of the drill to help in counting the revolutions of the drive wheel.
5. Put selected seed and fertilizer in the respective hoppers. Place a sack or a container under each boot for seeds and fertilizers.
6. Set the rate control adjustment for the seed and the fertilizer for maximum drilling. Mark this position on the control for reference.
7. Engage the clutch or on-off adjustment for the hoppers and rotate the drive wheel at the speed (N)
8. Weigh the quantity of seed and fertilizer, dropped from each opener and record on the data sheet.
9. Calculate the seed and fertilizer, dropped in kg/hectare and record on the data sheet.
10. Repeat the process by suitable adjusting the rate control till desired rate of seed and fertilizer drop is obtained.