

## DEPARTMENT OF FARM MACHINERY & POWER ENGINEERING

**Course No: FMPE 111**

**Title: Engineering Drawing**

**Credit: 2 (0+2)**

**Semester: I**

### **Practical**

Introduction of drawing scales; First and third angle methods of projection. Principles of orthographic projections; Reference planes; Points and lines in space and traces of lines and planes; Auxiliary planes and true shapes of oblique plain surface; True length and inclination of lines; Projections of solids (Change of position method, alteration of ground lines); Section of solids and Interpenetration of solid surfaces; Development of surfaces of geometrical solids; Isometric projection of geometrical solids. Preparation of working drawing from models and isometric views. Drawing of missing views. Different methods of dimensioning. Concept of sectioning. Revolved and oblique sections. Sectional drawing of simple machine parts. Types of rivet heads and riveted joints. Processes for producing leak proof joints. Symbols for different types of welded joints. Nomenclature, thread profiles, multi start threads, left and right hand threads. Square headed and hexagonal nuts and bolts. Conventional representation of threads. Different types of lock nuts, studs, machine screws, cap screws and wood screws. Foundation bolts. Forms of screw threads, representation of threads, Bolts- headed centre, stud screws, set screws, butt, hexagonal and square; keys-types, taper, rank taper, hollow saddle etc.

### **Practical Exercises**

<b>Practical No.</b>	<b>Title of Sheet</b>
1-2	<b>Introduction to Drawing Instruments , Sheet Layout ,Name plate ,Types of lines</b>
3-6	<b>Planes</b> Principles of orthographic projections; Reference planes; Points and lines in space and traces of lines and planes
7-8 9-10 11-12 13-17	<b>Solids and Solid Surfaces</b> Projections of solids. Section of solids and Interpenetration of solid surfaces; Development of surfaces of geometrical solids; Isometric projection of geometrical solids

18-20	<b>Exercises</b> Preparation of working drawing from models and isometric views. Sectional drawing of simple machine parts.
21-22	<b>Rivets and Riveted Joints</b> Types of rivet heads and riveted joints. Processes for producing leak proof joints
23	<b>Weld Joints</b> Symbols for different types of welded joints.
24	<b>Threads</b> Nomenclature, thread profiles, multi start threads, left and right hand threads. Forms of screw threads, representation of threads,
25-27	<b>Nuts and Bolts</b> Square headed and hexagonal nuts and bolts Different types of lock nuts Foundation bolts
26	<b>Screws</b> cap screws and wood screws, stud screws, set screws,
27	<b>Keys</b> Types of Keys. taper, rank taper, hollow saddle etc.
28-32	<b>Exercise</b> on detail drawings of agricultural machinery assembly and equipment

#### **Text /Reference Books**

1. Bhat N D. 2010. Elementary Engineering Drawing. Charotar Publishing House Pvt. Ltd., Anand.
2. Bhatt N D and Panchal V M. 2013. Machine Drawing. Charotar Publishing House Pvt. Ltd., Anand.
3. Narayana K L and Kannaiah P. 2010. Machine Drawing. Scitech Publications (India) Pvt. Ltd., Chennai.

**Course No: FMPE 112**  
**Semester: I**

**Title: Workshop Practice**  
**Credit: 1(0+1)**

## **Syllabus**

### **Practical**

Preparation of simple joint (wood working); Cross half Lap joint and T-Halving joint; Preparation of Dove tail joint. Mortise and tenon joint; Introduction to Smithy tools and operations; Jobs on Bending. Shaping etc; Jobs on drawing, punching. Reverting; Introduction to welding equipment; process tools ,jobs on Arc welding- lap joint ,butt joint ,Tee joint ;Introduction to tools and measuring instruments for fitting; Jobs on sawing, filing and right angle fitting of MS Flat; Practical in more complex fitting job Operations of drilling, reaming, and threading with tap and dies; Practical test; Introduction to tools and operations in sheet metal work; Making different types of sheet metal joints using G.I. sheets.

### **Practical Exercises**

<b>Exercises No.</b>	<b>Title</b>
1	Study of carpentry tools, sawing and planing practice
2-3	To make (a) Butt joint (b) Tee joint by using carpentry tools
4	Introduction to hot and cold smithy tools
5-6	To make (a)Screw driver (b) Ring by using hot and cold smithy tools
7-8	Study of different welding method and their tools.
9-10	To make (a)Lap joint (b) Butt joint by using an arc welding method
11	Study of fitting tools and their uses
12-13	To make (a)Square flat (b) Triangle cut by using fitting tools
14	Study of sheet metal working tools
15-16	To make (a) Funnel (b) Cylinder

### **Suggested readings**

**Course No: FMPE 123**

**Course Title: Workshop Technology**

**Credit: 1+1=2**

**Semester- II**

### **Syllabus**

#### **Theory**

Iron carbon phase diagram, lattice type, ferrous and non-ferrous metals and their alloys, Heat treatment: Introduction, purpose, method, Annealing, Normalizing, Hardening, case hardening, carburizing, nitriding, cyaniding, flame hardening, quenching. Introduction to welding, types of welding, Oxyacetylene gas welding, types of flames, welding techniques and equipment. Principle of arc welding, equipment and tools. Casting processes; Classification, constructional details of center lathe, Main accessories and attachments. Main operations and tools used on center lathes. Types of shapers, Constructional details of standard shaper. Work holding devices, shaper tools and main operations. 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. Constructional details and principles of operation of column and knee type universal milling machines. Plain milling cutter. Main operations on milling machine.

#### **Practical**

Preparation of simple joints: Cross half Lap joint and T-Halving joint; Preparation of Dovetail joint, Mortise and tenon joint; Jobs on Bending, shaping etc.; Jobs on Drawing, Punching, Rivetting. Introduction to tools and measuring instruments for fitting; Jobs on sawing, filing and right angle fitting of MS Flat; Practical in more complex fitting job; Operations of drilling, reaming, and threading with tap and dies; Introduction to tools and operations in sheet metal work; Making different types of sheet metal joints using G.I. sheets. Introduction to welding equipment, processes tools, their use and precautions; Jobs on ARC welding – Lap joint, butt joint; T-Joint and corner joint in Arc welding; Gas welding Practice – Lab, butt and T-Joints; Introduction to metal casting equipment, tools and their use; Mould making using one-piece pattern and two pieces pattern; Demonstration of mould making using sweep pattern, and match plate patterns; Introduction to machine shop machines and tools; Demonstration on Processes in machining and use of measuring instruments;

Practical jobs on simple turning, step turning; Practical job on taper turning, drilling and threading; Operations on shaper and planer, changing a round MS rod into square section on a shaper; Demonstration of important operations on a milling machine, making a plot, gear tooth forming and indexing; Any additional job.

### Lesson Plan

Lec. No.	Topic	Book	Chapter	Article no.	Page no
1	Types of lattice, Iron carbon equilibrium diagram	A	2	2.3 2.12- 2.13	23-24 36-39
2-3	Ferrous metal and alloys	A	4	4-2, 4.4- 4.6	61-63, 64-74
4	Nonferrous, metal and alloys	A	5	5-2-5.10	103- 112
5-6	Heat treatment: Introduction, purpose, method, Annealing, Normalizing, Hardening, case hardening, carburizing, nitriding, cyaniding, flame hardening, quenching.	A	6	6.5 - 6.18	125 - 149
7-8	Foundry: Pattern making tools, types of pattern, pattern making. Allowances, types of molding sand, making of greensand mould, defects in casting	A	11	11.3- 11.5 11.13, 11.21, 11.36	311- 322 341 357- 359 419- 422
9	Welding: Arc welding methods. Defects in welding and precautions	A C	9 9	9.10 9.54	223- 241
10-11	Lathe machine: Types and classification	B	3	3.1-3.4	83-88
12-13	Shaper: types and classification shaper operation	B	7	7.1-7.2, 7.7	297- 299, 315- 319
14-15	Milling machine- types and classification, operation	B	11	11.1- 11.2	399- 400
16	Drilling machine and classification operation	B	5	5.1-5.10	227- 233

### Teaching schedule- Theory with weightages (%)

Unit No.	Lectures No.	Topic	Weightages (%)
I	1	Types of lattice, Iron carbon equilibrium diagram	20
	2-3	Ferrous metal and alloys	
	4	Nonferrous, metal and alloys	
II	5-6	Heat treatment: Introduction, purpose, method, Annealing, Normalizing, Hardening, case hardening, carburizing, nitriding, cyaniding, flame hardening, quenching.	30
	7-8	Foundry: Pattern making tools, types of pattern, pattern making. Allowances, types of molding sand, making of greensand mould, defects in casting	
III	9-10	Welding: Arc welding methods. Defects in welding and precautions	10
IV	11-12	Lathe machine: Types and classification	40
	13-14	Shaper: types and classification shaper operation	
	15	Milling machine- types and classification, operation	
	16	Drilling machine and classification operation	

### Practical

Sr. No.	Practical No.	Title of practical
<b>Jobs on Lathe Machine</b>		
1.	1-2	Study of facing operations on the given job.
2.	3	Study of step turning operation on the given job.
3.	4	Study of taper turning operation on the given job.
4.	5	Study of knurling operation on the given job.
5.	6-7	Study of internal and external threading operation on the given job.
6.	8	Introduction and demonstration to CNC machine.
<b>Jobs on Shaping Machine</b>		
7.	9	Study of surface planning operation on shaping machine.
8.	10-11	Study of slotting operation for making key slot on the given job.
<b>Jobs on Milling Machine</b>		
10.	12-13	To make hexagonal head on given job with the milling machine.
<b>Jobs on Drilling Machine</b>		
11.	14-15	Jobs on drilling, reaming, internal threading and countersunk operations.
12.	16	Visit to manufacturing industry.

### Suggested readings

- A. Elements of workshop technology, VOI I: manufacturing process by S.K. Hajra Choudhary, A.K.Hajra Choudhary, Nirjhar Ray, In collaboration with Prof. D.C, Bhattacharya (Fifteenth Edition) Media Promotors and Publishers Pvt. Ltd.
- B. Elements of workshop technology, VOI II: Machine Tools by S.K. Hajra Choudhary, A.K.Hajra Choudhary, Nirjhar Ray, In collaboration with Prof. D.C, Bhattacharya (Fifteenth Edition) Media Promotors and Publishers Pvt. Ltd.
- C. Production technology by R.K. Jain, Khanna Publishers Delhi. (Fifteenth Edition).

**Course No: FMPE- 234**

**Titles: Farm Power and Automotive Engines**

**Sem: III (New)**

**Credit: 2 (1+1)**

**Theory:**

Sources of farm power -conventional & non-conventional energy sources. Classification of tractors and IC engines. Review of thermodynamic principles of IC (CI & SI) engines and deviation from ideal cycle. Indicator diagram. Study of engine components their construction, operating principles and functions. Study of engine stroke and comparison of 2 stroke and 4 stroke engine cycle and CI and SI engines. Study of engine valve systems, valve mechanism, valve timing diagram and valve clearance adjustment. Study of importance of air cleaning system. Study of types of air cleaners. Study of fuel supply system. Study of Fuel, properties of fuels, calculation of air fuel ration. Study of tests on fuel for SI and CI engines. Study of detonation and knocking in IC engine. Study of carburetion system, carburetors and their main components. Study of fuel injection system-injection pump, their types, working principles. Fuel injector nozzles, their types and working principles. Engine governing- need of governor, governor types. Study of lubrication system- need, types, functional components. Study of lubricants- Physical properties, additives and their application. Engine cooling system- need, cooling methods and main functional components Additives in the coolant and properties. Study of ignition system of SI engines. Study of electrical system including battery, starting motor, battery charging, cut-out etc.

**Practical:**

Introduction to different systems of IC engine; Engine parts and functions, working principles etc; Valve system – study, construction and adjustments;

Air cleaning system; Fuel supply system of SI engine; Diesel injection system & timing; Cooling system, governor; Lubricating system & adjustments; Ignition system; electrical system; Calculation on diff. horse power and cylinder pressure , specific fuel consumption and power requirement & efficiencies, air fuel ratio etc.

**Lesson Plan**

Lecture, No.	Topic	Book/Art.No./Page No.
1	Sources of Farm power,	M: 1.1-1.7
	Conventional & non Conventional energy	S:2.1-2.6
2-3	Classification of tractors, Otto cycle & diesel cycle, their efficiencies Causes for deviation from Ideal & PV diagram, & their problems, Air cycles.	L:1-8 L:37:45 M-2.1, J-1.1
4	Principle & working of four stroke & two-stroke cycle engine	J-1.3
5	IC engine components, operating principle, their function and	J-1.2



	their construction	
6	Valve and valve mechanism, Valve arrangement, Firing order, firing interval, power balance and firing order of engines, valve timing diagram	S: 3.9 J: 4.2-4.5 J: 5.11.5
7	Intake & exhaust system, types of air cleaners	J:9.1-9.8
8-9	Fuel system : Fuel supply in petrol engine- Carburetor & it's working principle	M: 88-90 S:5.3
	Fuel supply system of diesel engine, fuel filter, injector nozzles, their types and working principles.	J-6.3 to 6.4 (75-83), 6.51-6.53
	Fuel injection system, Combustion chamber,	S:5.5-5.6
10	Cooling system: Cooling methods and main functional components	J-8.1-8.3
11	Lubrication system- needs, types, functional components. Splash & forced feed system. Combination of both, oil filters & other accessories.	J: 7.6-7.8
12	Ignition systems: Battery ignition & its components Magneto ignition, other methods of ignition	S: 8.1-8.6
13	Engine principles of governor Introductions of Principles of governor Classifications of governing system, hit & miss & throttle leave system. (Centrifugal governor, pneumatic & hydraulic governor) Governor regulations & governor hunting.	S: 6.1-6.5 M: Fig 3.20
14	Electrical system including battery chemical activity, battery charging, starting motor, cut-out etc. (in brief)	J:20.1.1-20.1.07 20.2.1- 20.2.2.1,20.2.2.2; 2.2.3-2.2.4 2.3.2-2.3.4
15	Fuel properties & qualities of fuel, tests on fuel for SI and CI engine, Detonation of IC engine	L-Pg 54-75 S-5.1
16	Properties of coolants, anti freeze material, anti corrosion materials,	L: Pg.175-178
	Types of lubricants, Oil tests Physical properties, additives and their application.	S:Pg.111-112 J-7.4-7.5

#### Teaching shedule theory with weightages (%)

Unit	Lecture, No.	Topic	Weightage %
I	1	Sources of Farm power, Conventional & non Conventional energy	15
	2-3	Otto cycle & diesel cycle, their efficiencies Causes for	

		deviation from Ideal & PV diagram, & their problems, Air cycles.	
II	4	Principle & working of four stroke & two-stroke cycle engine	30
	5	IC engine components, operating principle, their function and their construction	
	6	Valve and valve mechanism, Valve arrangement, Firing order, firing interval, power balance and firing order of engines, valve timing diagram	
III	7	Intake & exhaust system, types of air cleaners	20
	8-10	Fuel properties & qualities of fuel, tests on fuel for SI and CI engine, Detonation of IC engine	
		Fuel system :Fuel supply in petrol engine- Carburetor & it's working principle	
		Fuel supply system of diesel engine, fuel filter, injector nozzles, their types and working principles. Fuel injection system, Combustion chamber,	
11	Engine principles of governor Introductions of Principles of governor Classifications of governing system, hit & miss & throttle leave system. (Centrifugal governor, pneumatic & hydraulic governor) Governor regulations & governor hunting.		
IV	12	Properties of coolants, anti freeze material, anti corrosion materials,	20
		Cooling system: Cooling methods and main functional components	
	13-14	Types of lubricants, Oil tests Physical properties, additives and their application.	
Lubrication system- needs, types, functional components. Splash & forced feed system. Combination of both, oil filters & other accessories.			
V	15-16	Ignition systems: Battery ignition & its components Magneto ignition, other methods of ignition Electrical system including battery chemical activity, battery charging, starting motor, cut-out etc. (in brief)	15

### Practical Exercises

Ex. no	Title
1	To study working principle of two and four stroke engines
2-4	Dismantling and assembling of diesel engine

5	To study valve operating system, FI & FO valve timing diagram, valve clearance adjustment.
6	To study intake and exhaust of IC engine
7	To study fuel system of Spark Ignition engine
8	To study fuel system of Compression Ignition engine
9	To study cooling system of tractor
10	To study lubrication system of tractor engine
11	To study ignition system of IC engine
12	To study diff. types of governors and methods of governing
13	To study electrical system of tractor.
14-15	To study engine terminology, Calculation on diff. horse power and cylinder pressure specific fuel consumption and power requirement & efficiencies, air fuel ratio
16	To study the physical properties of oil, fuel

### **Suggested reading**

#### **Text Book:**

1. Elements of Agril. Engineering by Dr. Jagdiswar Sahay-(S) fourth edition 2004
2. Farm tractor maintenance & repair by SC. Jain & C R.Rai (J) second Reprint, 1999
3. Principles of Agril. Engineering Vol-I By AM Michael and TP Ojha (M)-2<sup>nd</sup> Edn.
4. Tractor and their power unit by JB Liljedahl & et al. (L) (4 authors books 1<sup>st</sup> Edn.1997)

#### **Reference Book :**

1. Farm machines and Equipment by C. P. Nakra,  
Dhankpat Rai & Sons (N) Edition 1990.
2. Fundamentals of IC Engines by Paul W. Gill,  
James H. Smith Eugene Ziury-(G) (revised 4<sup>th</sup>Edn)

<b>Course no: FMP-235</b>	<b>Title : Theory of Machines</b>
<b>Sem : III (New)</b>	<b>Credit : 2 (1+1)</b>

## Syllabus

### Theory:

Elements, links, pairs, kinematics chain, and mechanisms. Classification of pairs and mechanisms. Lower and higher pairs. Four bar chain, slider crank chain and their inversions. Types of gears. Law of gearing, velocity of sliding between two teeth in mesh. interference and undercutting. Introduction to helical, spiral, bevel and worm gear. Simple, compound, reverted and epicyclic trains. Determining velocity ratio by tabular method. Turning moment diagrams, co-efficient of fluctuation of speed and energy, weight of flywheel, flywheel applications. Types of governors, constructional details and analysis of Watt. Porter, Pronell governors, Balancing of rotating masses in one and different planes. Partial primary balancing of reciprocating masses.

### Practical:

Demonstration in mechanisms study using models; Analysis of 4-bar mechanism, slides crank mechanism and their inversions; Determination of velocity and acceleration using graphical (relative velocity and acceleration) method with examples. Study of gears and gear trains and motion analysis of some practical complex compound gear train; Motion analysis Epicyclic gear trains using tabular and formula methods; To design a compound gear train and epicyclic gear train for a desired speed ratio; Practical test; To study the flywheel and governor action in laboratory; To graphically synthesize the cam profile for a desired standard follower motion; Study on the cam follower demonstration machine for follower displacement as a function of cam rotation angle and phenomenon of follower jump; Demonstration of static and dynamic balancing in the laboratory.

### Lesson Plan

Sr. No.	Lecture No.	Topic	Art.No.	Page No.
1	1 to 3	Element, link, pairs, Kinematics and mechanism, classification of pairs and mechanisms, lower and higher pairs, four bar chain, slider crank chain and their inversion (related problems)	5.2-5.8 5.11 5.15-5.22	94-97, 101-102 105-115
2	4 and 6	Types of gears, law of gearing, velocity of sliding between two teeth in mesh, involutes and cycloid profile for gear teeth, nomenclature, interference and under cutting. Introduction to spiral, bevel and worm gear. (related problems.)	12.4-12.11 12.17 -12.19	384-393 396-397 405-406
3	7 and 8	Simple, compound, reverted and epicyclic gear trains. Determination of velocity ratio by tubular method. (related problems.)	13.2-13.11	428-463
4	9 and 10	Turning moment diagram, coefficient of	16.3,	567

		fluctuations of speed and energy, weight of flywheel, flywheel application. (related problems)	16.5 to 16.10	568-573
5	11 and 13	Types of governor, constructional details and analysis of watt, Proter and Proell governor (related problems.)	18.2 - 18.7	653-678
6	14 and 15	Balancing of rotating masses (related problems)	21.2 - 21.5	833-839
7	16	Balancing of reciprocating masses (related problems)	22.2 t-22.3	859-861

### Practical

Sr. No.	Practical No.	Name of practical
1	1- 2	Study of four bar and slider crank mechanism and their inversion
2	3-6	Determination of velocity and acceleration in mechanism (relative velocity method). Determination of velocity in mechanism (instantaneous centre method).
3	7 - 9	Determination of train values of different types of gear trains
4	10 -12	Study of governor and flywheel in laboratory
5	13 - 15	Construction of cam profile for different motions of follower
6	16	Problem on balancing of rotating and reciprocating masses

### Teaching schedule- Theory with weightages (%)

Unit No..	Lecture No.	Topic	Weightages
1	1 to 3	Element, link, pairs, Kinematics and mechanism, classification of pairs and mechanisms, lower and higher pairs, four bar chain, slider crank chain and their inversion (related problems)	15
2	4 and 6	Types of gears, law of gearing, velocity of sliding between two teeth in mesh, involutes and cycloid profile for gear teeth, nomenclature, interference and under cutting. Introduction to spiral, bevel and worm gear. (related problems.)	40
	7 and 8	Simple, compound, reverted and epicyclic gear trains. Determination of velocity ratio by tubular method. (related problems.)	
3	9 and 10	Turning moment diagram, coefficient of fluctuations of speed and energy, weight of flywheel, flywheel application. (related problems)	15
4	11 and 13	Types of governor, constructional details and analysis of	15

		watt, Proter and Proell governor (related problems.)	
5	14 and 15	Balancing of rotating masses (related problems)	15
	16	Balancing of reciprocating masses (related problems)	

Note: The theory paper is to be set on the basis of 60 % theory and 40 % numeric (problems)

### **Suggested readings**

#### **Text Book:**

1. Theory of Machines – R.S. Khurmi and J.K. Gupta (14<sup>th</sup> Edition, 2010)

#### **Reference books:**

1. Theory of Machines – Thomas Beven
2. Theory of Machines – Balaney P L
3. Theory of Mechanism and Machines – JagdishLal
4. Theory of Machine – Rattan S B
5. Mechanism and Machine Theory- Rao J S and Dukkippatti R V

**Course No: FMPE-246**

**Title: Tractor Systems and Controls**

**Sem: IV**

**Credit: 2 (1+1)**

**Theory:**

Classification of tractors. Study of transmission systems, clutch- need, gear box, differential and final drive mechanism Familiarization of brake mechanism. Steering system, types, steering gear box, Ackerman and hydraulic steering and hydraulic systems. Tractor power outlets: P.T.O., belt pulley, drawbar, etc. Tractor chassis mechanics and design for tractor stability. Introduction to tractor testing Ergonomic considerations and operational safety.

**Practical:** Introduction to transmission systems and components; Study of clutch functioning, parts , Study of different types of gear box, calculation of speed ratios, design problems on gear box; Study on differential and final drive and planetary gears; Study of brake systems and some design problems; Steering systems, types, steering gear box, principles of operations, Steering geometry and adjustments; Study of hydraulic systems in a tractor, hydraulic trailer; Traction performance of a tractor wheel; Finding C.G. of a tractor by weighing technique; Finding CG of a tractor using suspension/balancing techniques; Finding moment of Inertia of a tractor; Ergonomic considerations and operational safety.

**Lesson Plan**

<b>Sr. No.</b>	<b>Lecture No.</b>	<b>Topic</b>	<b>Art. No./Page</b>
1.	1 - 2	Classification of tractors. Study of transmission system-Clutch: Function, principle of operation, clutch system, working of single plate system, detail of components, working of dual clutch plate & clutch adjustment Types of clutch system, multiple plate clutch, cone clutch, dog clutch, fluid coupling	J-11.1 to 11.7 S-141to 143
2.	3	Gear Box : Introduction, principle of gearing, types of gar box.	J-12.1 to 12.3
3.	4	Differential : Need, function, principle of operation, operational details and differential lock, Final Drive	J-13.1 to 13.4, 13.6
4.	5-6	Brake : General classification of brake, mechanical, hydraulic brake	J-15.1 to 15.3.2
5.	7-8	Steering systems- requirement, qualities of steering system, types, main parts of steering system, types of steering boxes, steering geometry, Toe in, Ackerman steering, Toe out on turns, Toe out negative camber, king pin inclination, spindle bearing	N- 18-23 N- 27-33

		load, caster angle.	
		Types: Single drop, double drop, Power Steering	J-173, J-14.1.5
6.	9-11	Hydraulic system of tractor, principle, main components, functions, working, implement control-draft and position	J-17.1 to 17.5
7.	12	Tractor power outlet- P.T.O., Tractor pulley, drawbar	O-4.6-4.7, 4.8
		Tyres, tubes, construction, specification and wheel ballasting	J- 16.1- 16.7
8.	13-14	Introduction to traction, terminologies, forces acting on pneumatic tyre	S-169- 173
		Tractor chassis mechanism, stability, weight transfer methods CG determination	B-307-315
10	15	Introduction to tractor testing	J-21.1-21.7
11.	16	Ergonomic and safety in tractor design. Spatial, visual and control requirement of the tractor operator	SM-12.1, 12.2, 12.4, 12.5



**Course No: FMPE-247**  
**Sem: IV**

**Title: Machine Design**  
**Credit: 2 (1+1)**

## Syllabus

### Theory:

Meaning of design, Phases of design, design considerations, mechanical properties. Types of loads and stresses, theories of failure, factor of safety, selection of allowable stress. Stress concentration. Elementary fatigue and creep aspects. Cotter joints, knuckle joint, turnbuckle. Design of welded joints subjected to static loads. Design of shafts under torsion, bending and combined bending and torsion. Design of keys. Design of muff, sleeve, and rigid flange couplings. Design of helical and leaf springs. Belt: Introduction, selection of belt, types of belt drive, types of belt, material used for belt, types of flat belt drive. Design of flat belt and V-belt drives. Chain drive: Chain drives, Advantages and disadvantages over belt drive, terms used in chain drives, relation between pitch and pitch circle diameter, classification of chains, hoisting chain, conveyor chain, power transmitting chain. (related problems). Selection of anti-friction bearings.

### Lesson Plan

Lec. No.	Topic to be covered	Book. No.	Art. No.	Page No.
1	Meaning of design, Phases of design, design considerations, mechanical properties.	1	1.1-1.4, 2.1-2.5	1-3 16-20
2	Types of loads and stresses, theories of failure, factor of safety	1	4.1-4.14	87-102
3-4	Cotter joints and knuckle joint	1	12.1-12.4 12.12-12.15	431-439 455-462
5-6	Design of welded joints subjected to static loads	1	10.1 to 10.11, 10.16-10.17, 10.19	341-345, 349-350, 353
7-8	Design of shafts under torsion, bending and combined bending and torsion.	1	14.1 to 14.11	509-517
9-10	Design of helical spring	1	23.1 to 23.9	819-831
11	Design of keys.	1	13.1-13.10	470-478

12-13	Design of muff, and flange couplings	1	13.11-13.17	478-498
14	Design of levers	1	15.1 to 15.5	558-568
15-16	Belt drives and Chain drive  Design of flat belt and V-belt drives	1	11.1-11.6 11.29 -11.32, 11.35 - 11.38  18.1to 18.4 18.6 to 18.9 18.13-18.14, 18.18 20.1, 20.4-20.5	325-330 369-371 373-375  677-679 680 686-687692-693 727-728 730-731

### Lesson Plan with weightages

Unit No.	Topic to be covered	Weightage, %
I	Meaning of design, Phases of design, design considerations, mechanical properties.	10
	Types of loads and stresses, theories of failure, factor of safety	
II	Cotter joints and knuckle joint	20
	Design of welded joints subjected to static loads	
III	Design of shafts under torsion, bending and combined bending and torsion.	30
	Design of keys.	
	Design of muff, and flange couplings	
IV	Design of helical spring	20
	Design of levers	
V	Belt drives and Chain drive Design of flat belt and V-belt drives	20

Note: The theory paper is to be set on the basis of 60 % theory and 40 % numeric (problems)

### Practical:

Numerical Problems based on above topics

### Suggested readings

#### Text Books

- 1) Khurmi R S and Gupta J K. 2014. A Text Book of Machine Design. S. Chand & Company Ltd., New Delhi.
- 2) Jain R K. 2013. Machine Design. Khanna Publishers, 2-B Nath Market, NaiSarak, New Delhi.

- 3) Element of workshop technology vol.1 by S.K. Hajara Chaudhary and A.K. HajaraChaudhari

**Course No : FMPE-358**

**Course Title: Farm Machinery and Equipment-I**

**Credits: 2(1+1)**

**Semester:- V**

### **Theory**

Introduction to farm mechanization. Classification of farm machines. Unit operations in crop production. Identification and selection of machines for various operations on the farm. Introduction to machines used for primary tillage, secondary tillage, rotary tillage, deep tillage and minimum tillage. Measurement of draft of tillage tools and calculations for power requirement for the tillage machines. Introduction to tillage machines like mould-board plough, disc plough, chisel plough, sub-soiler, harrows, cultivators, Identification of major functional components. Attachments with tillage machinery. Hitching systems and controls of farm machinery. Calculation of field capacities and field efficiency. Calculations for economics of machinery usage, comparison of ownership with hiring of machines. Introduction to seed-bed preparation and its classification. Introduction to sowing, planting & transplanting equipment. Introduction to seed drills, no-till drills, and strip-till drills. Introduction to planters, bed-planters and other planting equipment. Study of types of furrow openers and metering systems in drills and planters. Calibration of seed-drills/ planters. Adjustments during operation. Fertilizer application equipment. Weed control machineries. Familiarization with land reclamation and earth moving equipment.

### **Practical**

Familiarization with different farm implements and tools. Study of hitching systems, Problems on machinery management. Study of primary and secondary tillage machinery – construction, operation, adjustments and calculations of power and draft requirements. Study of sowing and planting equipment – construction, types, calculation for calibration and adjustments. Study of transplanters – paddy, vegetable, etc. Study of weeding equipments manual wheel hoe, bullock drawn and power operated inter-row cultivator and their use. Study of earth moving equipment.

### **Lesson Plan**

<b>Lecture No.</b>	<b>Topic</b>	<b>Book No.</b>	<b>Chapter, Art. No.</b>	<b>Page No.</b>
1, 2	Objectives of farm mechanizations. Classifications of farm machines.	1	1.5	6-9
3	Principles of operation and selection of machines used for production of crops.	2	24	7-15
4, 5, 6, 7	Primary and secondary tillage equipment, Problems	3	3.1-3.6	59-81
8, 9	Forces acting on tillage tools, Hitching systems and controls. Draft measurement of tillage equipments. Field capacities & economics	1 7	13.14 3.3.3	235- 236 6-7

10, 11, 12	Sowing planting and transplanting equipment, their calibration and adjustments. Problems	5	3	36-70
13	Fertilizer application equipment	2	14	270-284
14	Weed control	6	11	81-91
15, 16	Earth moving equipment, their construction & working principles viz. Bulldozer, Trencher, Elevators	4	22	313-318, 320-321
Total				

**Lesson plan with weightages (%)**

Unit No.	Topic	Weightages,%
I	Objectives of farm mechanizations. Classifications of farm machines.	15
	Principles of operation and selection of machines used for production of crops.	
II	Primary and secondary tillage equipment, Problems	40
	Forces acting on tillage tools, Hitching systems and controls. Draft measurement of tillage equipments. Field capacities & economics	
III	Sowing planting and transplanting equipment, their calibration and adjustments. Problems	35
	Fertilizer application equipment	
	Weed control	
IV	Earth moving equipment, their construction & working principles viz. Bulldozer, Trencher, Elevators	10
Total		100

**Course Code: FMPE – 359**  
**Credits: 1(0+1)**

**Course Title : CAD Applications**  
**Semester:- V**

## **Syllabus**

### **Practical**

Application of computers for design. CAD- Overview of CAD window – Explanation of various options on drawing screen. Study of draw and dimension tool bar. Practice on draw and dimension tool bar. Study of OSNAP, line thickness and format tool bar. Practice on OSNAP, line thickness and format tool bar. Practice on mirror, offset and array commands. Practice on trim, extend, chamfer and fillet commands. Practice on copy, move, scale and rotate commands. Drawing of 2 D- drawing using draw tool bar. Practice on creating boundary, region, hatch and gradient commands. Practice on Editing polyline- PEDIT and Explode commands. Setting of view ports for sketched drawings. Printing of selected view ports in various paper sizes. 2D- drawing of machine parts with all dimensions and allowances- Foot step bearing and knuckle joint. Sectioning of foot step bearing and stuffing box. Drawing of hexagonal, nut and bolt and other machine parts. Practice on 3-D commands- Extrusion and loft. Practice on 3-D commands-on sweep and press pull. Practice on 3-D Commands- revolving and joining.

### **Practical Exercises**

<b>Exercises No.</b>	<b>Title of practical</b>
1	Introduction to basic structure of CAD software. Study of draw and dimension tool bar.Practice on draw and dimension toolbar.
2	Practice on trim, extend, chamfer and fillet commands.
3	Practice on copy, move, scale and rotate commands.Practice of OSNAP, line thickness and format tool bar.
4	Practice on mirror, offset and array commands.
5	Drawing of 2 D- drawing using draw tool bar.
6	Practice on creating boundary, region, hatch and gradient commands.
7	Practice on Editing polyline- PEDIT and Explode commands.
8	Setting of view ports for sketched drawings

9	Printing of selected view ports in various paper sizes.
10-11	2D drawing of machine parts with all dimensions and allowances- 1. Foot step bearing and printing 2. knuckle joint and printing
12	Sectioning of foot step bearing and stuffing box.
13-14	Drawing of hexagonal, nut and bolt and other machine parts and printing
15-16	Practice on 3-D commands

### Teaching Schedule – Theory with weightages (%)

Unit	Practical No.	Title of practical	Weightages (%)
1	1	Study of overview of CAD window and various options on drawing screen. Study of draw and dimension tool bar. Practice on draw and dimension toolbar.	10
	2	Practice on trim, extend, chamfer and fillet commands.	
2	3	Practice on copy, move, scale and rotate commands. Practice of OSNAP, line thickness and format tool bar.	10
	4	Practice on mirror, offset and array commands.	
3	5	Drawing of 2 D- drawing using draw tool bar.	10
4	6	Practice on creating boundary, region, hatch and gradient commands.	10
	7	Practice on Editing polyline- PEDIT and Explode commands.	
5	8	Setting of view ports for sketched drawings	10
	9	Printing of selected view ports in various paper sizes.	
6	10	2D drawing of machine parts with all dimensions and allowances- Foot step bearing and printing	10
	11	2D- drawing of machine parts with all dimensions and allowances- knuckle joint and printing	
7	12	Sectioning of foot step bearing and stuffing box.	10
8	13	Drawing of hexagonal, nut and bolt and other machine parts and printing	10
9	14	Practice on 3-D commands	10
	15	Practice on 3-D commands	
10	16	Working of CNC machine. Demonstration of simple problems on it.	10

## **Suggested readings**

### **Reference Books:**

- 1 Rao P.N..2002. CAD/CAM Principles and Applications. McGraw-Hill Education Pvt. Ltd., New Delhi.
- 2 SareenKuldeep and Chandan Deep Grewal. 2010. CAD/CAM Theory and Practice. S.Chand& Company Ltd., New Delhi.
- 3 Zeid Ibrahim. 2011. Mastering CAD/CAM with Engineering. McGraw-Hill Education Pvt. Ltd., New Delhi.



**Course Code: FMPE-3510**

**Course Title : Field operation and Maintenance of  
Tractor and Farm Machinery**

**Credits: 1(0+1)**

**Semester:- V**

**Syllabus**

<b>Unit</b>	<b>Practical No.</b>	<b>Title</b>
1	1-2	Familiarization with different make and models of tractors Study of different tools required for repair and maintenance of tractor
2	3	Identification of functional system of tractor, Familiarization with different controls on tractor
3	4	Driving practice of tractor, safety rules and precautions, trolley forwarding and reversing, fuel saving tips
4	5	Hitching and De-hitching of mounted and trailed type implements
5	6-7	Tractor maintenance schedule -precautionary and break down maintenance. Tractor starting with low battery charge.
6	8-9	Field operation with M.B. plough, Disc plough, Rotavator, cultivator etc.
7	10-11	Field operation with self-propelled machine viz. reaper, mower
8	12-13	Familiarization with different controls of power tiller and driving practice
9	14-15	Repair and maintenance of different agricultural equipments and machinery
10	16	Replacement criteria for parts of machine

**Reference Books :**

1. Farm Tractor Maintenance and Repair. By S.C. Jain and C.R. Rai. Tata Mc Graw Hill Pub. Co. Ltd., 12/4 Asaf Ali Road, New Delhi.
2. Farm Machinery Equipment By C.P. Nakra, Dhanpat Rai & Sons, 1962, Nai Sarak Delhi.

3. Elements of Farm Machinery By A.C. Srivastava Oxford & IBH Publishing Co. Pvt. Ltd. New Delhi, Bombay.
4. Farm Power Machinery Management by Donel Hunt. Iowa state Univ. Press. Ames Low. The operation care and repairs of Farm machinery, Deere and Company.

A Workbook of Practical Farm Machinery, Volume I and Volume 2 by Dr. T.K. Bhattacharya, Saroj Prakashan, 646 Katra, Allahabad

**Course No. : FMPE-  
3611**

**Title: Farm Machinery and  
Equipment-II**

**Sem:-VI**

**Credits: 2(1+1)**

## **Syllabus:**

### **Theory**

Introduction to plant protection equipment – sprayers and dusters. Classification of sprayers and sprays. Types of nozzles. Calculations for calibration of sprayers and chemical application rates. Introduction to interculture equipment. Use of weeders – manual and powered. Study of functional requirements of weeders and main components. Familiarization of fertilizer application equipment. Study of harvesting operation – harvesting methods, harvesting terminology. Study of mowers – types, constructional details, working and adjustments. Study of shear type harvesting devices – cutter bar, inertial forces, counter balancing, terminology, cutting pattern. Study of reapers, binders and windrowers – principle of operation and constructional details. Importance of hay conditioning, methods of hay conditioning, and calculation of moisture content of hay. Introduction to threshing systems – manual and mechanical systems. Types of threshing drums and their applications. Types of threshers- tangential and axial, their constructional details and cleaning systems. Study of factors affecting thresher performance. Study of grain combines, combine terminology, classification of grain combines, study of material flow in combines. Computation of combine losses, study of combine troubles and troubleshooting. Study of chaff cutters and capacity calculations. Study of straw combines – working principle and constructional details. Study of root crop diggers – principle of operation, blade adjustment and approach angle, and calculation of material handled. Study of potato and groundnut diggers. Study of Cotton harvesting – Cotton harvesting mechanisms, study of cotton pickers and strippers, functional components. Study of maize harvesting combines. Introduction to vegetables and fruit harvesting equipment and tools.

### **Practical:**

Familiarization with various Farm machines related to harvesting, threshing, root harvesting, combine etc; Study of various types of mowers, constructional details, materials and working; Study of various types of reaper, constructional details, materials and working & performance; Study of various types of reaper binder, constructional details, materials and working; Study of various types of potato harvesters, constructional details, materials and working; Study of various types of groundnut harvesters, constructional details, materials and working & performance; Study of various types of forage harvester, constructional details, materials and working; Study of various types of sugarcane harvester, constructional details, materials and working; Study of various types of maize sheller, constructional details, materials and working & performance; Study of various types of threshers, constructional details, materials and working & performance; Study of various types of cotton pickers and strippers, constructional details, materials and working; Study of various types of harvester tools, constructional details, materials and working; Study

of various types of combine harvester, constructional details, materials and working; Study of various types of straw combines, constructional details, materials and working; Study of various types of fruit harvester equipment, constructional details, materials and working.

**Teaching schedule- Theory with weightages (%)**

Lecture No	Topic	Book No.	Chapter , Art. No.	Page No.
1 . 2	Plant protection equipment- Sprayers and duster their calibration selection. Constructional features of different components and adjustments.	5	6.1-6.5	114-135
3	Principle and types of cutting mechanisms	7	14.3- 14.10	315-321
4 - 9	Crop harvesting machinery: Harvesting and threshing equipments Threshing mechanics.  Combine harvester: components, functions and flow chart, grain losses  Sugarcane harvester: components, functions and flow chart	5 7 4 4	4.1,4.2 , 17 17.9- 17.14, 33  6.13  33	71-85  400-409 438-450 453-454  460-461
10 - 11	Forage chopping and handling equipment  Chaff cutter	7  1	16.1- 16.7  16.15- 16.16 18.1	368-374 383-384 371-376
12	Root crop harvesting equipment: components, functions and flow chart of Potato harvester and Peanut harvester.	4 2	33	462-463 372-376
13,14	Cotton harvesting machinery: components, functions and flow chart	7	19.1- 19.10	446-455
15	Testing of farm machines test code procedures, interpretation of test results	8	1	2-15
16	Selection of tractor and matching implements	5	Annex -I	219-228

**Teaching schedule- Theory with weightages (%)**

Lecture No	Topic	Weightages %
I	Plant protection equipment- Sprayers and duster their calibration selection. Constructional features of different	20

	components and adjustments.	
II	Principle and types of cutting mechanisms	35
	Crop harvesting machinery: Harvesting and threshing equipments Threshing mechanics.	
III	Combine harvester, grain losses Sugarcane harvester	35
	Forage chopping and handling equipment Chaff cutter	
	Root crop harvesting equipment Potato harvesting Peanut harvesting	
	Cotton harvesting machinery	
IV	Testing of farm machines test code procedures	10
	Selection of tractor and matching implements	

### Practical Exercises

Exercises No.	Topics
1	To study different types of pesticides application equipments
2	To study different types of spray nozzles
3	To study different types of dusters
4	Study of various types of movers, constructional details, materials and working
5	Study of various types of repairs, constructional details, materials and working
6	Study of grain crop combine harvesters constructional details, materials and working
7-8	To study different types of threshers constructional details, materials and working and performance
9	Study of maize sheller
10	Study of sugarcane harvester
11	Study of chaff cutter
12	Study of Potato harvester
13	Study of Peanut harvester
14	Study of cotton harvesting machinery
15	Study of various types of fruits harvesting equipments, constructional details, materials and working
16	Study of various types of forage harvesters, constructional details, materials and working

### Suggested readings

#### Text Books

- 01 Elements of Agril. Engineering by Dr. Jagdiswar sahay.
- 02 Farm machinery and Equipment by Smith and Wikes, TMH Publ.(1984 edition )
- 03 Elements of Farm Machinery by A.C. Shrivastav (1990 edition )
- 04 Farm Machinery & Equipment by CP Nakra, Dhankpat Rai & Sons Edition 1990
- 05 Farm machinery and approach by S. C. Jain, Grace Philip
- 06 Practical Farm Machinery Vol.2 By Bhattacharya, Saroj Prakashan, 1999 Ed.
- 07 Principles of Farm Machinery by Kepner, Bainer and Barger, CBS Publishers and Distributer, Delhi (1987) Indian Edition.
- 08 RNAM Test Codes and Procedures for Farm Machinery.

<b>Course No:- FMPE 3612</b>	<b>Title :-Tractor and farm machinery design</b>
<b>Semester:-VI</b>	<b>Credit- 3 (2 + 1)</b>

## Syllabus

### Theory:-

Design of power transmission components and system in agril. Machines, Design paramaters of agril. Implements, Force analysis of primary tillage tools and their hitching systems. Considerations of Reapers, Mowers, Harvesters and threshing equipments. Application of design method to the system of selected farm machinery, cost estimation of designed machinery. Procedure for design and development of agricultural tractor. Design of Ackerman Steering and tractor hydraulic systems. Study of special design features of tractor engines and Design of seat and controls of an agricultural tractor.

### Practical:

Problems on Power transmission, Design consideration of seed drills/planters, inter culture tools, reaper/mower/harvester and thresher. Application of computer aided design methods of the selected farm machinery. Design problems of tractor engine & power transmission.

### Lesson Plan- Theory with weightages (%)

Sr. No.	Lect. No.	Topic	Book No.	Chapter No.
1.	1-4	Procedure for design of tractor engine parts: cylinder, cylinder head, piston, ring, Crank shaft, valve, connecting rod etc.	6	1.3 (complete)
2.	5-7	Lubrication system and cooling system of tractor	6	5.1-5.5 6.1- 6.6
3.	8-10	Design of tractor hydraulic systems: hydraulic cylinder, pump	6	9.1-9.5
4.	11-12	Design of seat and controls of an agricultural tractor	6	12.4.3-12.4.5
5.	13-17	Study of parameters for balanced design of tractor for stability & weight distribution	2	Chapter-11
6.	18-19	Theoretical Design of power transmission components in Agril. Machinery- Clutches	3	24 (24.9 to 24.11)

7.	20	Design considerations of Agricultural Implements	6	1
8.	21-24	Design of tillage tool	5	4.1-4.5
9.	25-27	Design of sowing and planting machines	5	5.1 to 5.2
10.	28	Design of intercultural tools and implements	5	6.1
11.	29-30	Design of sprayers	4	Chapter 17 complete
12.	31-32	Design of harvester & Threshing machines	5	7.1 to 7.2 8.1 to 8.2

#### Lesson Plan- with weightages (%)

Unit No.	Lect. No.	Topic	Weightage, %
I	1-4	Procedure for design of tractor engine parts: cylinder, cylinder head, piston, ring, Crank shaft, valve, connecting rod etc.	20
	18-19	Theoretical Design of power transmission components in Agril. Machinery- Clutches	
II	5-7	Lubrication system and cooling system of tractor	20
	8-10	Design of tractor hydraulic systems: hydraulic cylinder, pump	
III	11-12	Design of seat and controls of an agricultural tractor	20
	13-17	Study of parameters for balanced design of tractor for stability & weight distribution	
IV	20	Design considerations of Agricultural Implements	20
	21-24	Design of tillage tool	
	25-27	Design of sowing and planting machines	
V	28	Design of intercultural tools and implements	20
	29-30	Design of sprayers	
	31-32	Design of harvester & Threshing machines	

#### Practical Exercises

1 to 16 : Numerical on design of tractor and farm machinery as per theory lesson plan.

#### Text Books:

1. Engineering material science By-Cedric W. Rechards, Prentice- Hall of INDIA (PVT) Ltd (1965)



2. Design of agricultural Machinery By- Gary Krutzs&others,Johnwiley& sons
3. A text Book of Machine Design By-R.S. Khurmi& J.K. Gupta
4. Agricultural machines by klenin&popov
5. Farm Machinery Design : principal & problem ,Sharma D.N. &Mukesh S.  
Published by Jain Brothers
6. Design of Agril. Tractor principles & problems- D.N.Sharma, S.Mukesh-Jain  
Publication
7. Theroy ,construction and calculations of Agril.MachinesVol.I by  
E.S.Bosaietloxoninan press pvt.ltd new delhi

**Ref. Books:**

- 1) The Mechanics of Tractor- Implement Performance *Theory and Worked Examples* R.H. Macmillan
- 2) ASAE Distiguished lecture series on Tractor Design
- 3) Machine Design- Pandya& Shah, R.S. Khurmi

**Module-I** : **Farm Mechanization**  
**Course No.** : **GAE-477-1**  
**Course Title** : **Farm Mechanization**  
**Credit** : **10 (0+10)**

**Objectives :**

1. To acquaint the students in the field of farm implements and machinery.
2. To acquaint the students for different field operations.
3. To estimate the cost operations of different field operations.
4. Economic analysis of different farm implements and equipments.

**Outline of the Course:**

- The students will be trained to drive tractor and attach implements to the tractor. Hitching and unhitching of the tractor and trolley reversing.
- Different implements like M.B. Plough (Fixed and reversible), Standard Disc Plough, Disc harrow, Cultivator, ridger, leveler, Rotavator, Seed cum fertilizer drill, planter, power weeder, Reaper, Mower, Combine harvester and Threshers will be operated in the field and practically students will do field operations for different crops.
- The field operations like Transplanting, Weeding and Harvesting of paddy and Transplanting of vegetables will be taught through video clippings if wet fields/ facilities are not available.
- The different equipments/machines like pulverizer cum grinder, chaff cutter, leaf shredder, Post hold digger, cotton gin and Urea briquetting machine will also be demonstrated and evaluated for their performance.

**INDEX**

Sr. No.	Name of Exercise	Number of Practicals
1	Orientation to Farm Mechanization : <ul style="list-style-type: none"> <li>• Scope, Importance, Limiting Factors, Suggestions and Status of farm mechanization</li> <li>• Different type of tractors and farm implements</li> <li>• Different systems of tractor</li> </ul>	01-02
2	Hand Tools used in the Farm Workshop <ul style="list-style-type: none"> <li>• List of tools, equipment for repairs, Precision measuring tools, cleaning and washing equipments/tools and equipment's for auto electrical repair.</li> </ul>	02-4
3	Tractor Operation : <ul style="list-style-type: none"> <li>• Pre and after starting checks, Importance of gauges, controls and safety precautions while driving a tractor.</li> </ul>	4-10

4	Tractor Driving Practice : <ul style="list-style-type: none"> <li>To obtain learning license of tractor to the students from the RTO office</li> <li>Actual driving practice in forward and reverse gears</li> </ul>	11-15
5	Hitching and Un-Hitching of Different Implements to the Tractor Including Trailer Reversing	16-20
6	Mould Board Plough (Fixed and reversible plough) : <ul style="list-style-type: none"> <li>Use, function, construction, types attachments, extension, adjustments and demonstrations on M.B.Plough adjustments, Measurement of Horizontal and vertical suction and its importance, ploughing methods and field operation. Calculation of power requirement and field efficiency.</li> <li>Dismantling and assembling of M.B.Plough.</li> </ul>	21-25
7	Disc Plough (standard ) : <ul style="list-style-type: none"> <li>Use, function, construction, types attachments, extension, adjustments and demonstrations on disc Plough adjustments, Adjustment of disc and tilt angle and its importance and field operation. Calculation of power requirement and field efficiency.</li> <li>Dismantling and assembling of disc Plough.</li> </ul>	26-30
8	Harrows : <ul style="list-style-type: none"> <li>Use , function, type, adjustment and their field operation, Difference between disc harrow and disc plough.</li> <li>Dismantling and assembling of disc harrows.</li> </ul>	31-35
9	Cultivators : <ul style="list-style-type: none"> <li>Use, function, type, adjustment and their field operation.</li> <li>Dismantling and assembling of disc cultivation.</li> </ul>	36-40
10	Rotavator and its Field Operation.	41-50
11	Seed drill and Planter : <ul style="list-style-type: none"> <li>Use, function, type, construction, importance, special features, difference, adjustment and demonstration on seed drill and planter.</li> </ul>	51-60
12	<ul style="list-style-type: none"> <li>Calibration of Seed drill for different crops and checking of seed rate in the field.</li> </ul>	
13	Intercultural Equipments (Hand and Power Operated) : <ul style="list-style-type: none"> <li>Operation of wheel hand hoe, hand hoe, peg tooth weeder power weeder etc.</li> </ul>	61-65
14	Harvesting and Threshing Equipments : <ul style="list-style-type: none"> <li>Introduction, use improved sickles, construction of reaper, mower and reaper binder, operation of Maize Sheller, groundnut decorticator and sunflower thresher.</li> <li>Different types of threshers, their construction, Adjustments and Installation.</li> <li>Safely Precautions of Harvesting and Threshing equipments while their operation.</li> </ul>	66-70
15	To study of combine Harvester	71-75
16	Periodical maintenance of Tractor and Agricultural implements : Maintenance of Tractor and implements after 10, 50, 250, 500 and 1000 working hrs, and filling of log books, history sheet etc. Demonstration on Wheel track adjustment and Ballasting of tractor	76-80

	and its importance.	
17	Selection of Tractor and its matching implements	81-85
18	Tractor operated Ridger and Leveler : Use, function, construction and their field operation.	86-90
19	Study of Transplanting Equipments (Paddy and Vegetable Transplanted) Use, function, construction, demonstration and its important.	91-95
20	Self propelled weeders and its operation : Pre and after starting checks, importance of gauges, controls and safety precautions while driving power weeder . Field operation of power Tiller with different attachments.	96-100
	Operation with plant protection equipments 1.Human operated 2. Bullock operated 3.Tractor operated 4. preparation of solutions	101-110
21	Study of cropping pattern of the region ,agronomical consideration in various crops and adjustments accordingly	111-115
22	Estimation of maintenance cost of tractor, power tiller and other implements	116-120
23	Preparation of bank loan proposal for purchasing tractor, power tiller and other machineries	121-125
24	Record keeping of tractor, power tiller and machineries	126-130
25	Study of machineries and tools, practices in fruit and vegetable crops.	131-135
26	Visit to tractor and implement manufacturing industries and service centres.	136-160
27	Information regarding various government schemes related to farm mechanization.	161-165
28	Preparation of information for bulletins, leaflets, posters etc.	166-170
29	Demonstration of farm implements and machineries to the farmers	171-190
30	Report writing and Semester End Examination	191-200

**Module-II : Manufacturing of Agricultural Tools and Implements**  
**Course No. : GAE-475**  
**Course Title : Manufacturing of Agricultural Tools and Implements**  
**Credit : 10 (0+10)**

**Scope:**

Agricultural engineering education is the bridge between engineering and agricultural science. The application of the technological knowledge helps in enhancement of agricultural production and productivity in the country. Agricultural machinery are playing very important role in Indian agriculture by reducing drudgery, timeliness in agricultural operation, better quality work and reduction in cost of operation. Agricultural engineering graduates have to play a major role in improvement in country's agricultural picture by increasing productivity, production and economic returns to the farmers. The knowledge of Farm Machinery and Power is applicable to the entrepreneurship as well as to the end users. Hence the students offering agricultural engineering courses should be trained in such a way that their practical knowledge in the discipline of Farm Machinery and Power will be applied to the industry sector, entrepreneurship development, increasing job opportunities to the graduates and also in farming sector.

Agricultural Universities has been involved in developing the different tools and equipments for farmers. Most of the equipments are made available to the farmers of Maharashtra through Govt. subsidy program. Taking the advantages of infrastructural facilities of college workshop and strengthening them, the manufacturing activities of the equipments viz. toothed spade, hand operated coconut dehusker, stubble remover, Japanese weeder, dryland weeder will be taken as an experience learning if the students of B.Tech ( Agril.Engg) final year are given exposure to work on the floor of production unit. It will help to the students to build up their confidence, facilitate skill development through experiential learning and will be useful in becoming job provider rather than job seeker. With this view experience learning program for the students of the final year of B.Tech (Agril. Engg.) Students for six months are planned. The objectives of the same are as listed below.

**Objectives:**

1. To impart practical knowledge, aspect of design, production technology.

	2. To impart training and entrepreneurial skills in manufacturing of tools and equipments for self reliance.
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### Credit hours and syllabus

S.No	Contact Units	Particular of lecture practical
		<b>Basic of Production and manufacturing Technology</b>
1	02	Basic information about different tools, equipments raw material, their specifications
2	01	Metallurgical aspects of raw material
3	02	Manufacturing process in details
4	02	Drawing of different components, different view and assembly drawing with Auto Cad of Japanese weeder
5	02	Drawing of different components, different view and assembly drawing with Auto Cad of dryland weeder
6	02	Drawing of different components, different view and assembly drawing with Auto Cad of coconut dehusker
7	01	Drawing of different components, different view and assembly drawing with Auto Cad of stubble remover
8	01	Drawing of different components, different view and assembly drawing with Auto Cad of toothed spade
<b>A</b>		<b>Manufacturing of toothed spade</b>
1	02	Cutting of MS sheet for blade pipe for handle
2	03	Making of teeth and handle notch using press
3	02	Bending
4	02	Welding of handle to cutting blade
5	01	Quality inspection and lab testing
<b>B</b>		<b>Manufacturing of stubble remover</b>
1	01	Marking and cutting of M.S. flat for blade
2	01	Twisting and bending
3	01	Pipe cutting for handle
4	02	Welding of handle to blade
5	01	Quality inspection and lab testing
<b>C</b>		<b>Manufacturing of coconut dehusker</b>
1	05	Foot rest preparation
2	01	Fabrication of stand pipes
3	02	Fabrication of handle
4	02	Blade cutting
5	04	Fitting of handle to pipe
6	01	Quality inspection and lab testing
<b>D</b>		<b>Manufacturing of dryland weeder</b>
1	02	Fabrication of blade and tynes
2	02	Fabrication of handle
3	04	Fabrication of pipes frame with handle
4	02	Preparation of pegs
5	02	Preparation of shaft and bush pipe

6	04	Fabrication of peg wheel
7	02	Assembly of weeder
8	02	Quality inspection and lab testing
<b>E</b>		<b>Manufacturing of Hand rake /grubber</b>
1	02	Cutting of material
2	04	Sharpening of tynes
3	02	Preparation of handle
4	04	Fabrication of rake/grubber
5	03	Quality inspection and lab testing
<b>F</b>		<b>Manufacturing of Cono weeder</b>
1	06	Fabrication of cone, teeths, plates, central shaft
2	05	Fabrication of main frame
3	02	Fabrication of float
4	03	Fabrication of frame supporting to float and rear cone
5	02	Assembling of components
6	02	Quality inspection and lab testing
<b>G</b>		<b>Sales and Marketing of agril. tools and equipments</b>
1	02	Training and tips from experts
2	02	Trial sale demonstrations
3	02	Exhibitions and sale
4	10	Field sales and marketing
<b>H</b>		<b>Report preparation and Examinations</b>
1	04	Report preparation
2	01	Report preparation
Total	120	

\* contact unit : 1 unit =8 hrs

\*\* The equipments to be manufactured can be decided as per the local need.

**Course No: ELE- FMPE 481**  
**Semester:- VIII**

**Course Title: Testing of Agril. Equipment and Machinery**  
**Credit: 3 (1 + 2)**

## **Syllabus**

### **Theory**

Introduction of BIS and RNAM testing systems, their functions, activities, advantages of certification. General guidelines on use test code. Types of testing systems currently invoke in country. Testing and evaluation of tillage machinery, Testing and evaluation of seed drill and transplanter. Testing and evaluation of harvesting and threshing machinery, Testing and evaluation of plant protection equipment's, Testing and evaluation of Agril.Tractor.

### **Practical**

Testing of bullock/tractor drawn M.B.plough, disk harrow, tractor drawn cultivator, tractor drawn rotavator, bullock/tractor drawn seed drill/Planter, bullock/tractor drawn pudler, preparation of nursery for paddy transplanting. Testing of self propelled power tiller operated paddy transplanter, manually operated weeders, (dryland/ paddy), manually operated fruit harvesters, sickle, manually operated knapsack sprayer, portable engine operated sprayer, self propelled reaper, power thresher, stationary engine, visit to tractor testing centre.

### **Teaching schedule- Theory with weightages (%)**

<b>Unit No.</b>	<b>Lect. No</b>	<b>Topic/s</b>	<b>Weightages%</b>
I	1	Introduction of BIS and RNAM testing systems, General guidelines on use of test code	25
	2	Types of testing systems	
	13-16	Tractor testing general regulations, terminology, testing procedure, PTO performance, drawbar performance, hydraulic lift, safety test.	
II	3	Testing of tillage machinery. Introduction, testing procedure, laboratory test, and field test of plough and cultivator.	25
	4	Testing of rotavator and puddler, testing procedure. Laboratory test, and field test.	
III	5	Testing of sowing, planting machinery, types of test. General condition, testing procedure, laboratory test, and field test of tractor drawn planter.	25
	6	Testing of paddy transplanter. Scope, terminology.	
	7	Testing of manually operated weeders, general condition, testing procedure, laboratory test, and field test.	
IV	10-11	Testing of plant protection equipments: type of test for sprayer, testing methods, laboratory test, and field test.	25



	8-9	Testing of harvesting equipments, sickles and reapers, testing procedure, laboratory test, and field test.	
	12	Testing of power thresher, terminology, type of tests. Performance test.	

### Practical Exercises

Exercises No.	Title
1-2	Testing of bullock/tractor drawn M.B. Plough
3-4	Testing of disc harrow
5-6	Testing of tractor drawn cultivator
7-8	Testing of tractor drawn rotavator
9-10	Testing of bullock/tractor drawn seed drill/Planter
11-12	Testing of bullock/tractor drawn puddler
13	Preparation of Nursery for paddy transplanter
14-15	Testing of self propelled power tiller operated paddy transplanter
16	Testing of manually operated weeders, (dryland/paddy)
17	Testing of manually operated fruit harvesters
18	Testing of sickle
19-20	Testing of manually operated knapsack sprayer
21-22	Testing of portable engine operated sprayer
23-24	Testing of self propelled reaper
25-26	Testing of power thresher
27-28	Testing of stationary engine
29-32	Visit to tractor testing centre

### Suggested readings

#### Text Books:

1. Testing and evaluation of Agril. Machinery by M.L.Mehta, S.R.Verma, S.K. Mishra and V.K.Sharma. Daya publishing house, Delhi-2005 edition.
2. RNAM Test Codes and Procedures for Farm Machinery, Technical Series No.12, 2<sup>nd</sup> Edition, 1995.
3. I.S. Specifications for Animal Drawn Puddler. UDC : 631. Manak Bhavan, 9, BahadurShahaZafar Marg. New Delhi-1, February 1966.

**Course No. : - ELE- FMPE 482**  
**Credit:-3 (2+1)**

**Course Title:-Human Engineering and Safety**  
**Semester:- VIII**

### **Syllabus**

**Theory:** Human factors in system development- Basic processes in system development, Separation of system function, Concept of systems, Performance reliability, Human performance, Information input process, Visual displays- major types & use of displays, Auditory & Tactual displays, Speech communications, Biomechanics of motion- types of movements, range of movements, strength & endurance, Speed & accuracy, Human control of systems, Human motor activities, Controls, tools & related devices, Anthropometry- arrangement & utilization of work space, Atmospheric conditions - heat exchange process & performance, Air pollution, Dangerous machine (Regulation) act. Rehabilitation and compensation to accident victims, Safety gadgets for spraying, threshing chaff cutting and tractor & trailer operation.

**Practical:** Collection of Anthropometric measurements of a selected group of farm workers and its statistical analysis, application of anthropometric and strength data in farm equipment design, Use of heart rate monitor. Study of computerized bicycle ergometer and calibration of the subject in laboratory using bi-cycle ergometer. Study and Calibration of the subject in laboratory using mechanical tread mill, Study of general fatigue of the subject using Blink ratio method, Familiarization with electro-myograph equipment, Familiarization with the noise & vibration equipment, Optimum work space layout and locations of controls for different tractors. Familiarization with safety gadgets for various farm machines.

**Teaching schedule- Theory with weightages (%)**

<b>Unit</b>	<b>Lecture No.</b>	<b>Topic</b>	<b>Weightage</b>
<b>1</b>	1 & 2	<b>Human factors in system development</b> Basic processes in system development	<b>10</b>
	3	<b>Separation of system function</b>	
	4	<b>Concept of systems</b>	
<b>2</b>	5	<b>Performance reliability</b> Human performance	<b>10</b>
	6	Information input process	
<b>3</b>	7	<b>Visual displays</b> major types & use of displays	<b>10</b>
	8 and 9	<b>Auditory &amp; Tactual displays</b>	
<b>4</b>	10& 11	<b>Speech communications</b>	<b>10</b>

<b>and 5</b>	12, 13 and 14	<b>Biomechanics of motion</b> types of movements range of movements strength & endurance	
	15	<b>Speed &amp; accuracy</b>	
<b>6</b>	16 and 17	<b>Human control of systems</b>	<b>10</b>
	18 and 19	<b>Human motor activities</b>	
<b>7</b>	20,21 and 22	<b>Controls, tools &amp; related devices</b>	<b>10</b>
<b>8</b>	23, 24 and 25	<b>Anthropometry</b> Arrangement & utilization of work space	<b>10</b>
<b>9</b>	26	<b>Atmospheric conditions</b> heat exchange process & performance	<b>10</b>
	27	<b>Air pollution</b>	
	28	<b>Dangerous machine (Regulation) act.</b>	
<b>10</b>	29	<b>Rehabilitation and compensation to accident victims</b>	<b>10</b>
	30,31,32	<b>Safety gadgets</b> for spraying, threshing chaff cutting and tractor & trailer operation	

### Teaching Shedule

Sr. No.	Lecture No.	Topic	Weight age of marks, %	Book No.	Chap . No.	Page No.
1.	1 & 2	Human factors in system development Basic processes in system development	10	1	2	17-29
2	3	Separation of system function		1	2	19-22
3	4	Concept of systems	5	1	1	5-6
4	5	Performance reliability	5	1	2	31-32
		Human performance		1	2	35-37
5	6	Information input process	5	1	4	83-87
6	7	Visual displays major types & use of displays	10	1	5	129 to133
7	8 and 9	Auditory & Tactual displays	5	1	6	185 to 194 195 to 199
8	10& 11	Speech communications	5	1	7	201 to 211
9	12, 13 and 14	Biomechanics of motion types of movements range of movements strength & endurance	10	1	10	300 to 301 303 to 310
10	15	Speed & accuracy		1	10	310 to

						313
11	16 and 17	Human control of systems	5	1	9	251 to 261
12	18 and 19	Human motor activities	5	1	10	283 to 290
13	20,21 and 22	Controls, tools & related devices	5	1	11	335 to 346 and 374 to 379
14	23, 24 and 25	Anthropometry Arrangement & utilization of work space	10	1	12	385 to 391 392 to 395
15	26	Atmospheric conditions heat exchange process & performance	5	1	15	479 to 487
16	27	Air pollution		1	15	500 to 510
17	28	Dangerous machine (Regulation) act.	5	3		1-14
18	29	Rehabilitation and compensation to accident victims	5	2	7	33 to 34
19	30,31,32	Safety gadgets for spraying, threshing chaff cutting and tractor & trailer operation	5	2	5	29 to 30

### Practical Exercises

Exercises No.	Topic
1 & 2	Collection of Anthropometric measurements of a selected group of farm workers and its statistical analysis.
3	Anthropometric considerations in Tool/Equipment design and the application of anthropometric and strength data in farm equipment design
4	Use of heart rate monitor.
5 & 6	Study of computerized bicycle ergometer and calibration of the subject in laboratory using bi-cycle ergometer as loading device and energy measurement device (k4b2)
6 & 7	Study of mechanical tread mill and Calibration of the subject in laboratory using mechanical tread mill as loading device and energy measurement device (k4b2)
8	Study of general fatigue of the subject using Blank ratio method.
9	Study of electromyography.
10 & 11	Study of noise and vibration and Familiarization of the noise & vibration equipment,
12 & 13	Study of optimum work space layout and locations of controls for different tractors.
14	Ergonomical consideration in workplace design
15 & 16	Assessment of postural discomfort by subject rating scales

### Suggested readings

**Text Books:**

<b>Sr. No.</b>	<b>Name of Book and Publisher</b>
1	Human Factors Engineering and Design by Ernest J. Mc. Cormick, 4 <sup>th</sup> Edition (1976) Tata McGraw-Hill Publishing Company Limited, New Delhi
2	Package of Farm Safety Measures in Madhya Pradesh (2012) AICRP on Ergonomics & Safety in Agriculture, CIAE, Bhopal
3	The Dangerous Machines (Regulation) Act, 1983 (35 of 1983), Ministry of Law, Justice and Company Affairs, Government of India.
4	Anthropometric and Strength Data of Indian Agricultural Workers for Farm Equipment Design By L.P.Gite, J Majumder, C.R.Mehta and AbhijitKhadatkar, AICRP on Ergonomics & Safety in Agriculture, CIAE, Bhopal

**Reference Books**

<b>Sr. No.</b>	<b>Name of Book and Publisher</b>
1	Fitting the task to the man- An Ergonomic Approach By E. Grandjean, Taylor & Francis Limited, London (Reprint-1982)
2	Ergonomics – Man in his working Environment By K.F.H. Murrell. Chapman & Hall Limited, London (1965)
3	Human Factors Engineering and Design by Mark S. Sanders & Ernest J. Mc. Cormick, (1993) Tata McGraw-Hill Publishing Company Limited, New Delhi
4	Textbook of Work Physiology. By Astrand P. & Rohahl K. (1997). Tata McGraw-Hill Publishing Company Limited, New Delhi