



S.No.	Topic	No. of Lectures
29.	Safety gadgets for tractors and trailers	1
30.	Standard/ codes for agricultural machinery safety	1
	<b>Total</b>	<b>32</b>

### IX. List of Practicals

S.No.	Topic	No of Practicals
1.	Identify role of ergonomics in our daily life	1
2.	Measurement of anthropometric dimensions of agriculture workers and establishing relation between them	2
3.	Measurement of strength parameters	1
4.	Determination of human requirements of field operation with manual operated equipment	2
5.	Assessment of psychological/ general load for agricultural operations	1
6.	Assessment of stress on eyes by specific agricultural operation	1
7.	Noise measurement in tractors	1
8.	Calibration of human subject on bicycle ergometer	1
9.	Calibration of human subject on treadmill	1
10.	Measurement of physiological parameter, viz. heart/ pulse rate	1
11.	Measurement of oxygen consumption under laboratory conditions	1
12.	Case study of accidents and safety on tractors and trailers	1
13.	Case study of accidents and safety on chaff cutters and threshers	1
14.	Practical examination	1
	<b>Total</b>	<b>16</b>

### X. Suggested Reading

- Bridger R S 2009. *Introduction to Ergonomics*. CRC Press, Boca Rotan, USA
- Sanders M S and McCormick E J 2000. *Human Factors in Engineering and Design*. McGraw Hill. 7<sup>th</sup> edition
- Astrand P, Rodahl K, Dahl H A and Stromme S B 2003. *Textbook of Work Physiology - Physiological Basis of Exercise*. McGraw Hill.
- Gite L P 2009. *Anthropometric and Strength Data of Indian Agricultural Workers for Farm Equipment Design*. Central Institute of Agricultural Engineering, Bhopal.
- Gite L P, Agrawal K N, Mehta C R, Potdar R R and Narwariya B S. 2019. *Handbook of Ergonomical Design of Agricultural Tools, Equipment and work Places*. Jain Brothers, New Delhi.

**I. Course Title : Design of Tractor Systems**

**II. Course Code : FMPE 504**

**III. Credit Hours : 2+1**

#### IV. Aim of the course

To introduce the student to the principles that direct the design of a tractor and its subsystems and enable the student to apply the concept of machine design in designing the subsystems and critical components.

#### V. Theory

##### Unit I

Design and types, research, development, design procedure, technical specifications



of tractors, modern trends in tractor design and development, special design features of tractors in relation to Indian agriculture.

### Unit II

Engine related terminology. Selection of stroke-bore ratio. Design of engine components; Piston, connecting rod, cylinder, cylinder head, crank shaft etc.

### Unit III

Design of tractor systems like clutch, gearbox, steering, steering geometry, turning force, hydraulic system & hitching, chassis, operator's seat, work-place area and controls. Tire selection, aspect ratio etc.

### Unit IV

Mechanics of tractor stability. Computer aided design and its application in farm tractors.

## VI. Practical

Engine design calculations, transmission component design calculations. Extensive practices on the computer aided design packages.

## VII. Learning outcome

The student will have an overview of the philosophy guiding the design of a tractor and also design tractor systems and components.

## VIII. Lecture Schedule

S.No.	Topic	No. of Lectures
	<b>Unit I</b>	
1.	Design and types, research, development, design procedure, technical specifications of tractors, modern trends in tractor design and development, special design features of tractors in relation to Indian agriculture.	3
	<b>Unit II</b>	
2.	Engine related terminology. Selection of stroke-bore ratio.	1
3.	Design of engine components: Piston, connecting rod, cylinder, cylinder head, crank shaft etc.	3
	<b>Unit III</b>	
4.	Design of tractor clutch	2
5.	Design of tractor gearbox	3
6.	Tractor steering system, functional requirements, steering geometry, turning force	2
7.	Steering system design parameters and design procedure	2
8.	Hydraulic system & hitching – principles of operation	2
9.	Hydraulic system - Design parameters and design procedures including design of pump, cylinder etc.	2
10.	Design of chassis	2
11.	Human factors in tractor design. Design of operator's seat	2
12.	Work-place area and controls	2
13.	Tire selection, aspect ratio etc.	1
	<b>Unit IV</b>	
14.	Mechanics of tractor stability. Dynamic and static analysis of forces acting on farm tractor, case studies.	3
15.	Computer aided design and its application in farm tractors	2
	<b>Total</b>	<b>32</b>

**IX. List of Practicals**

S.No.	Practical	No. of Practical
1.	Engine design calculations - Stroke-bore ratio determination - Design of radiator - Balancing of crankshaft	2
2.	Engine design calculations - Calculation of volumetric/thermal efficiencies	1
3.	Transmission component design calculations - Design of clutch	1
4.	Transmission component design calculations - Design of gear box and calculation of speed ratios	2
5.	Design of Ackerman steering. Calculation of turning radius.	1
6.	Design of brakes (mechanical and hydraulic)	2
7.	Design of hydraulic system	2
8.	Calculation for determination of centre of gravity of tractor, moment of inertia and stability	3
9.	Practice on the Computer Aided Design (CAD) packages for design of various components	2
	<b>Total</b>	<b>16</b>

**X. Suggested Reading**

- Barger EL Liljedahl JB and McKibben EC. 1967. *Tractors and their Power Units*. Wiley Eastern Pvt. Ltd.
- Macmillan RH. 2002. *The Mechanics of Tractor – Implement Performance and Worked Example*. University of Melbourne, Australia.
- Sharma PC and Agarwal DK. 2000. *Machine Design*. S K Kataria and Sons, Delhi.

**I. Course Title : Design of Farm Machinery I**

**II. Course Code : FMPE 505**

**III. Credit Hours : 2+1**

**IV. Aim of the course**

To understand the interaction of tillage tools with soil and design the components of the tillage tools based on their requirement and also to learn how the systems of planting machinery are designed.

**V. Theory****Unit I**

Farm machinery design: Modern trends, tasks and requirements, economic considerations of durability, reliability and rigidity. Physico-mechanical properties of soils. Technological process of ploughing. Wedge. Working process of mould board plough, determination of basic parameters. Design of coulters, shares, mould boards.

**Unit II**

Constructing of mould board working surface. Design of landside, frog, jointer. Forces acting on plough bottom and their effect on plough balance: Trailed, semi mounted and mounted plough. Draft on ploughs, resistance during ploughing. Design disk ploughs: Concave disk working tools, forces acting.

**Unit III**

Machines and implements for surface and inter row tillage; Peg toothed harrow,