X. Suggested Reading

- Bernacki C, Haman J and Kanafajski Cz 1972. *Agricultural Machines Theory and Construction.* Vol-I. U.S. Department of Commerce, National Technical Information Service, Springfield, Virginia22151.
- Bindra, OS and Singh H. 1971. *Pesticides Application Equipments.* Oxford & IBH Publishing Co., New Delhi.
- Bosoi ES, Verniaev OV, Smirnov II and Sultan-Shakh EG. 1987. C*onstruction and Calculations of Agricultural Machinery - Vol.II.* Oxonian Press Pvt. Ltd. New Delhi.
- Miu P. 2016. *Combine Harvesters Modeling and Design.* CRC Press, Boca Raton, USA ISBN 13:978-1-4822-8237-5
- Thornhill EW and Matthews GA. 1995. *Pesticide Application Equipment for Use in Agriculture* Vol II. Mechanically powered equipment FAO Rome.

I. Course Title : Management of Farm Power and Machinery System

II. Course Code : FMPE 507

III. Credit Hours : 2+1

IV. Aim of the course

To understand how principles of management are applied to farm machinery systems to make them more effective and profitable.

V. Theory

Unit I

Importance and objectives of farm mechanization in Indian agriculture, its impact, strategies, myths and future needs. Estimation of operating cost of tractors and farm machinery. Management and performance of power, operator, labour. Economic performance of machinery, field capacity, field efficiency and factors affecting field efficiency.

Unit II

Tractor power performance in terms of PTO, drawbar and fuel consumption. Power requirement problems to PTO, DBHP.

Unit III

Selection of farm machinery, size selection, timeliness of operation, optimum width and problem related to its power selection. Reliability of agricultural machinery. Replacement of farm machinery and inventory control of spare parts.

Unit IV

Systems approach to farm machinery management and application of programming techniques to farm machinery selection and scheduling. Network Analysis: Transportation, CPM and PERT, dynamic programming, Markov chain.

VI. Practical

Study of latest development of different agricultural equipment and implements in India and other developing countries. Size selection of agricultural machinery. Experimental determination of field capacity of different farm machines. Study of farm mechanization in relation to crop yield. Determination of optimum machinery system for field crop and machine constraints. To develop computer program for the selection of power and machinery.

VII. Learning outcome

The student will be able to understand how farm machinery is selected and operated to make them economically viable.

VIII. Lecture Schedule

S.No.	Topic	No of Lectures
1.	Importance and scope of farm mechanization in Indian Agriculture	1
2.	Cost analysis of Farm Machinery and tractor, Breakdown analysis, Inflation.	2
3.	Measurement of power performance (PTO power, drawbar power and fuel consumption) of tractor and power tiller	3
4.	Study of field capacity and field efficiency of different farm machinery and factor affecting them	1
5.	Selection of Farm Machinery size wrt to power source and timeliness of operation	4
6.	Application of programming technique to problem of farm power and machinery selection.	4
7.	Replacement models, spare parts and inventory control	2
8.	Maintenance and scheduling of operations.	2
9.	Network analysis – transportation	2
10.	Network analysis – critical path method, PERT	2
11.	Network analysis – dynamic programming	3
12.	Network analysis – markov chain	3
13.	Linear programming, multivariable system, simplex algorithm. Theory of network.	3
	Total	**32**

IX. List of Practicals

S.No.	Topic	No of Practicals
1.	Introduction to latest development of advanced agricultural equipment's in India	3
2.	Experimental determination of field capacity of different farm machines	3
3.	Case studies on optimum size selection of agricultural machinery	3
4.	Determination of inventory of different farm machines for a farm of size 50 ha as per regional crop rotations	3
5.	To develop computer program regarding selection of farm machinery size and power requirement for a 10, 50 and 100 ha farm size	3
	Total	**15**

X. Suggested Reading

- Carveille LA. 1980. *Selecting Farm Machinery*. Louisiana Cooperative Extn. Services Publication.
- Culpin C. 1996. *Profitable Farm Mechanization*. Lock Wood and Sons, London.
- FAO. 1990. *Agricultural Engineering in Development: Selection of Mechanization Inputs*. FAO, Agri service Bulletin.
- Hunt D. 1979. *Farm Power and Machinery Management*. Iowa State University Press, USA.
- Kapoor VK. 2012. *Operation Research: Concepts, Problems and Solutions*. Sultan Chand and Sons, India.

• Singh S and Verma SR. *Farm Machinery Maintenance and Management*. DIPA, ICAR, KAB-I, New Delhi.

I. Course Title : Principles of Automation and Control

II. Course Code : FMPE 511

III. Credit Hours : 2+1

IV. Aim of the course

To learn the principles behind systems for industrial automation and control especially with respect to electronically implemented systems.

V. Theory

Unit I

Introduction to industrial automation and control: Architecture of industrial automation systems, review of sensors and measurement systems. Introduction to process control: PID control, controller tuning, implementation of PID controllers, special control structures, feed forward and ratio control, predictive control, control of systems with inverse response, cascade control, overriding control, selective control and split range control.

Unit II

Introduction to sequence control: PLCs and relay ladder logic, sequence control, scan cycle, RLL syntax, sequence control structured design approach, advanced RLL programming, the hardware environment, Introduction to CNC machines.

Unit III

Control of machine tools: Analysis of a control loop, introduction to actuators. Flow control valves, hydraulic actuator systems, principles, components and symbols, pumps and motors. Proportional and servo valves. Pneumatic control systems, system components, controllers and integrated control.

Unit IV

Control systems: Electric drives, introduction, energy saving with adjustable speed drives stepper motors, principles, construction and drives. DC motor drives: Introduction to DC-DC converters, adjustable speed drives. Induction motor drives: Introduction, characteristics, adjustable speed drives. Synchronous motor drive-motor principles, adjustable speed and servo drives.

Unit V

Networking of sensors, actuators and controllers, the fieldbus, the fieldbus communication protocol, introduction to production control systems.

VI. Practical

Control system practical: Characteristics of DC servomotor, AC/DC position control system. ON/OFF temperature control system. Step response of second order system, temperature control system using PID level control system. Automation: Introduction to ladder logic, writing logic and implementation in ladder. PLC programming, water level controller using programmable logic controller. Batch process reactor using programmable logic controller. Speed control of AC servo motor using programmable logic controller.