

**FMPE 506 : Design of Farm Machinery–II 2+1****Objectives:**

To learn the engineering principles behind application of pesticides and the systems that implements the same. To learn the concepts behind design of crop harvesting and threshing equipment.

**Unit-I**

Pesticide calculation examples. Multidisciplinary nature of pesticide application. Overview of chemical control integrated pest management. Targets for pesticide deposition. Formulation of pesticides.

**Unit-II**

Spray droplets. Hydraulic nozzles. Power operated hydraulic sprayer design principles. Air assisted hydraulic sprayer design principles. Controlled droplet application. Electrostatically charged sprayers. Spray drift and its mitigation. Aerial spraying systems. Use of drones for spraying: Design of spray generation and application issues.

**Unit-III**

Introduction to combine harvesters: Construction, equipment subsystems, power sub systems. Crop harvesting: Plant properties, physical and mechanical properties of plant stem, plant bending modelling. Properties of plant grain: Physical, mechanical, grain damage. Properties of MOG: Mechanical and aerodynamic.

**Unit-IV**

Design of grain header: Orienting and supporting reel. Plant cutting cutter bar: Working process, cutter bar drive. Knife cutting speed pattern area. Design of auger for plant collection. Corn header: Working elements, snapping roll design, stalk grasping and drawing process. Corn ear detachment: Stalk cutting and chopping.

**Unit-V**

Cereal threshing and separation: Design of tangential and axial threshing units. Performance indices of threshing units. Modelling material kinematics in different threshing units. Factors influencing the threshing process and power requirement. Separation process and design of straw walker. Cleaning Unit process and operation. Grain pan: Chaffer and bottom sieve. Blower design and flow orientation. Design of conveying system for grain. Straw choppers and shredders.

**Practical:**

Measurement of spray characters for different nozzles. Problems on sizing of sprayer components. Design of sprayer for special purpose: Orchard and tall trees. Harvesting machine. Problems on design of cutter bars, reels, platform auger, conveyors. Design of threshing drum: Radial and axial flow type. Design of cleaning and grading systems. Design of blowers.

**Course Outcome:**

The student will know the principles behind the design of crop spraying equipments and harvesting and threshing machinery.

**Teaching Schedule**

Sr No.	Topic	No of Lectures
1.	Overview of chemical control integrated pest management.	1
2.	Targets for pesticide deposition. Formulation of pesticides.	1
3.	Multidisciplinary nature of pesticide application.	1



4.	Pesticide calculation examples.	2
5.	Spray droplets. Hydraulic nozzles. Power operated hydraulic sprayer design principles.	2
6.	Controlled droplet application. Spray drift and its mitigation.	1
7.	Air assisted hydraulic sprayer design principles. Electrostatically charged sprayers.	2
8.	Aerial spraying systems. Use of drones for spraying:	1
9.	Design of spray generation and application issues.	1
10.	Introduction to combine harvesters: Construction, equipment subsystems, power sub systems.	1
11.	Crop harvesting: Plant properties, physical and mechanical properties of plant stem, plant bending modelling.	1
12.	Properties of plant grain: Physical, mechanical, grain damage.	2
13.	Properties of MOG: Mechanical and aerodynamic.	2
14.	Design of grain header: Orienting and supporting reel. Plant cutting cutter bar	2
15.	Working process, cutter bar drive. Knife cutting speed pattern area.	1
16.	Design of auger for plant collection.	1
17.	Corn header: Working elements, snapping roll design, stalk grasping and drawing process. Corn ear detachment: Stalk cutting and chopping.	2
18.	Cereal threshing and separation: Design of tangential and axial threshing units. Performance indices of threshing units.	2
19.	Modelling material kinematics in different threshing units. Factors influencing the threshing process and power requirement.	1
20.	Separation process and design of straw walker.	1
21.	Cleaning Unit process and operation. Grain pan: Chaffer and bottom sieve. Blower design and flow orientation.	2
22.	Design of conveying system for grain. Straw choppers and shredders.	2
	<b>Total</b>	<b>32</b>

#### List of Practicals

S. No.	Practical	No. of practicals
1.	Measurement of spray characters for different nozzles.	1



2.	Problems on sizing of sprayer components.	1
3.	Design of spraying units – manual	1
4.	Design of spraying units – powered	1
5.	Design of sprayer for special purpose: Orchard and tall trees.	1
6.	Design of agitation units – mechanical and hydraulic	1
7.	Harvesting machines: Problems on design of shear type cutting mechanism	1
8.	Harvesting machines: Problems on design of impact type harvesting mechanism	1
9.	Harvesting machines: Problems on design of platform auger and conveyors.	1
10.	Harvesting machines: Problems on design of reels	2
11.	Design of threshing drum: Radial flow type.	1
12.	Design of threshing drum: Axial flow type.	1
13.	Design of cleaning systems.	1
14.	Design of grading systems.	1
15.	Design of blowers.	1
	<b>Total</b>	<b>16</b>

**Suggested Reading:**

1. Thornhill E W and Matthews G A 1995. *Pesticide Application Equipment for Use in Agriculture* Vol II. Mechanically powered equipment FAO Rome.
2. Miu P 2016. *Combine Harvesters Modeling and Design*. CRC Press, Boca Raton, USA ISBN 13:978-1-4822-8237-5
3. Bosoi E S, Verniaev O V, Smirnov II and Sultan-Shakh E G 1987. *Construction and Calculations of Agricultural Machinery - Vol.II*. Oxonian Press Pvt. Ltd. New Delhi.
4. 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, Virginia 22151.
5. Bindra, O S and Singh H 1971. *Pesticides Application Equipments*. Oxford & IBH Publishing Co., New Delhi.